

# End User Computing State of the Union 2021



Version 1.0 – April 2021

## Authors

Ruben Spruijt, Christiaan Brinkhoff and Mark Plettenberg

[www.vdilikeapro.com](http://www.vdilikeapro.com)

**WE LIKE AND ENCOURAGE IT WHEN PEOPLE USE AND  
PRESENT OUR DATA, BUT PLEASE LET US KNOW BEFORE  
YOU DO AT [TEAM@VDILIKEAPRO.COM](mailto:TEAM@VDILIKEAPRO.COM).**

**OR IN OTHER WORDS**

**IT IS NOT ALLOWED TO – PARTIALLY – PUBLISH OR DISTRIBUTE CONTENT FROM THIS PAPER WITHOUT  
PRIOR APPROVAL. WHEN YOU WANT TO USE CONTENT OF THIS WHITEPAPER CONTACT US  
[team@vdi-likeapro.com](mailto:team@vdi-likeapro.com)**

**THIS DOCUMENT IS PROVIDED "AS IS"  
WITHOUT WARRANTY OF ANY KIND  
FOR REFERENCE PURPOSES ONLY**

**COPYRIGHT 2021, #VDILIKEAPRO  
[www.vdi-likeapro.com](http://www.vdi-likeapro.com)**

## Table of Contents

Highlights .....	5
Introduction .....	7
About VDI Like a Pro .....	7
Made possible by: Login VSI .....	7
Teamwork .....	8
Team and contact .....	8
Leaderboard.....	8
The State of VDI survey is executed by:.....	8
Participant information.....	9
What is the most important business vertical to use your Virtual applications and desktops environment?.....	11
What is the total amount of users within your organization?.....	12
Operating Systems .....	13
What type of operating systems are you using? .....	13
What single-Session operating systems are you using? .....	15
What multi-session operating systems are you using? .....	16
Which virtual applications and desktop session broker solution is currently deployed on-premises? .....	17
What percentage of the single-user virtual machines are shared (pooled/stateless/non-persistent/personal?).....	19
Where are your workload machines, hosting your Virtual applications and desktops located? .....	20
What are today's biggest challenges with your on-premises virtual applications and desktops environment?.....	21
Infrastructure: Hypervisor, Servers, Storage, GPUs and more .....	22
What hypervisor is currently deployed for you virtual Applications and Desktops? .....	22
Which server hardware brand is used to host the Virtual Applications and Desktops environment? .....	24
Which storage technologies are used to host the workload VMs? .....	25
Which on-premises storage product is used to host the virtual applications and desktops?.....	26
Which remoting protocol configuration do you primary use for your Virtual Applications and Desktops solution?.....	28
Which GPUs do you use for your virtual applications and desktops? .....	29
Applications: Layering, imaging, updates, management, isolation, antivirus, workspace portal and more .....	30
Do you currently use an application layering solution in virtual applications and desktops? .....	30
How is the user environment managed?.....	31

How large are your Windows Profiles on average as part of your virtual apps and desktops environment?.....	32
Which image deployment and/or cloning solution is currently used?.....	33
Which solutions do you currently, or in the near future use for printing within your virtual applications and desktops environment? (multi-select) .....	35
Do you currently use unified communication solution?.....	36
Do the end-users use Desktops or remote/published applications? .....	37
How are Windows OS and applications installed, updated and managed on your main platform? .....	37
What % of applications in your environment are native Windows applications?.....	39
Which application isolation/virtualization solution is used within your environment?.....	40
What percentage of Windows applications are virtualized?.....	41
Various questions: Load testing, patching, devices, display config and more .....	42
Do you perform load tests in your virtual applications and desktops environment? .....	42
What type of business continuity / standby environment for your Virtual applications and desktops do you have? .....	43
Your opinion: My operating system preference in 3 years will be .....	43
Our Virtual applications or desktops solution upcoming years will: .....	44
How often do you patch your systems? .....	44
What products do you use to monitor your environment? .....	45
What anti-virus solution are you using? .....	46
What devices are being used to access your virtual applications or desktops?.....	48
What is the commonly used display configuration in your company and or home office (WFH)?..	49
Do you use or will you use a unified workspace portal solution? .....	50
What is the default browser within your virtual application and desktop environment? .....	50
Public Cloud: use-cases, challenges, products, strategy, GPUs,.....	51
Why are you using or (potentially) interested in Virtual applications or Desktop as a Service (DaaS)? .....	51
What are the biggest challenges in using or adopting public Cloud?.....	52
In which phase is your Desktop-as-a-Service (DaaS) public cloud deployment currently? .....	53
Which DaaS solution are you using, or will you introduce? .....	54
How much are you willing to pay for a Desktop in the cloud (control plane + IaaS) per user, per month?.....	55
Who delivers and operates the desktop virtualization 'control plane' (e.g. broker, gateway, orchestration, web interface etc.) .....	56
Who is responsible for the Infrastructure-as-a-Service of your cloud desktops (subscription, networking, security)? .....	56
Who is responsible for managing the Operating System updates, user environment in your cloud-desktop?.....	57
What is your cloud strategy with regards to workload VMs? .....	57

For what specific use case(s) in your environment did you choose Desktop-as-a-Service (DaaS)? .	58
Where's your application data in a DaaS scenario (location)? .....	59
On what Cloud storage platform service do you store your Windows Profiles?.....	60
What Cloud storage platform service do you prefer to store your Documents & Files (Enterprise file Synchronization and Sharing) within your Virtual apps and Desktop environment?.....	60
What ratio 'work from home' or 'work from the office' do you expect for the majority of your colleagues after Covid? Please allocate 100 points (%).....	61
Which GPUs do you use for your virtual applications and desktops in the cloud? .....	62
Workspace initiatives, feedback, comments .....	63
What are your most important End User Computing (EUC) initiatives for 2021+?.....	63
What's the most unnecessary/fun thing you bought or received during the COVID-19 pandemic?	64
Final comments from respondents.....	65

## Highlights

VDI Like a Pro conducted the eighth worldwide ‘End User Computing – State of the Union’ survey. Over the years, similar surveys were conducted in 2012, 2014, 2015, 2017, 2018, 2019 and 2020. The ‘End User Computing – State of the Union’ is truly unique because it’s unbiased, independent, powered by the community and the results are available for everyone—free of charge. The document provides valuable insights in trends, real-world deployments, configuration, and usage, both on-premises and public cloud environments, from more than 1647 people who supported the survey.

- **1647 people supported the survey** and on average, completed the survey in 10 minutes.
- **North America** has the largest response distribution and is the largest region by far. There is a relatively high number of participants from the Netherlands (11.60%), likely because VDI Like a Pro and their team members are well-connected with end-users, partners, and vendors in this region.
- In 2021 **47.37%** of the respondents are **using both a single user and multi-user operating system** to support their users with virtual applications and desktops.
- Microsoft **Windows Virtual Desktop (WVD)** is considered or **being used with 26.92%** which is similar compared to 2020. Citrix VADs at 14.93% and virtual applications and desktops via Citrix Cloud at 11.54%. The different Citrix solutions combined are being used or will be introduced at 30.77%. The different VMware solutions are being used or will be introduced at 9.27%. Nutanix Frame is used or will be introduced with 8.60% of the respondents followed by Amazon Workspaces at 6.79%.
- The **most important reason** for use of **Desktop as a Service** is the ability to support **Work from Home** with 23.76%.
- In the context of Desktop-as-a-Service the **IT department** is **responsible for managing the Infrastructure as a Service** at 67.05% of the respondents, followed by 11.14% where the System Integrator or Managed Service Provider is responsible for these tasks.
- **The use of unified communications** with voice and video support **has increased rapidly from** 13.4% in 2014, 30.6% in 2017, 38.72% in 2019, 47.92% in 2020 to 60.06% in 2021.
- The **total usage of Microsoft FSLogix Profile Container** is **32.48%** an increase of more than 11% compared to 2020.
- One of the new survey questions added in 2021 – what the size of the Windows user profile is. **A Windows Profile size between of 1-5GB is common** for **28.64%** of the respondents followed by a user profile of 5-10GB in size by 23.64% of the respondents.
- Where are the windows user profiles stored? **16.99% is using Azure Files Premium** for the windows user profiles, followed by 16.27% who is using Azure Files Standard.
- **Microsoft OneDrive is used the most within the virtual application and desktop deployments**, 51.62% of the respondents use OneDrive followed by Google Drive with 11.60%. Interesting is that **11.47% aren’t using Enterprise file synchronization** and sharing with virtual applications and desktops.
- A new question in the 2021 survey this year is around the Protocol being used in the context of on-premises and Desktop-as-a-Service. **Citrix HDX is the leading remoting protocol with 36.35%, followed by Microsoft RDP with 17.95%**. Citrix HDX w/ EDT is 3rd with 11.01% and 4th is VMware Blast Extreme with 9.20% of the deployments.
- The **majority of virtual desktop and application deployments in the cloud aren’t using GPUs**, 52.16% while NVIDIA GPU NV instance types on Azure are used at 15.38%. The AMD GPU based instances are used at 9.94%.
- **With 63.44% Windows 10 is used the most** with versions 1903/1909 and 2004/20H2 leading the usage, an increase of 6.44% compared to 2020.

- **Google Chrome is used the most within the virtual application and desktop deployments**, 46.61% of the respondents use Chrome, followed by the Chromium based Microsoft Edge with 31.97%.
- Another new question in the 2021 survey is the question which printing solutions is being used. **33.98% is using a regular Microsoft Windows print server**, Citrix Universal printing is 2nd with 18.07% followed by universal print solutions from Microsoft with 14.18%. 7.79% of the audience don't print anymore.
- We are surprised to see **that IT Admins are increasingly using manually installation and update of OS and applications within the master image**. 26.19% in 2021 which was 25.82% in 2020 which already was an increase of 6.59% compared to 2019.
- While **Citrix Provisioning Services (PVS) remains a popular choice** in many Citrix environments with 28.27% in 2020 and 23.69% in 2021 Citrix Machine Creation Services (MCS) usage has increased from 15.78% in 2017, 18.72% in 2018, 19.47% in 2019, 24.95% in 2020.
- **69.39% of all the applications in the organization are Windows based applications**, followed by 22.30% Web/SaaS applications and 8.31% of the applications are mobile.
- The **biggest competitor** for application isolation/virtualization solutions isn't Microsoft or VMware -- it's again **'NoAppVirt'**.
- A **Unified Workspace portal** brings Windows, Web/SaaS applications and data together. Most of the respondents, **43.61%, aren't using a unified workspace portal**.
- **Fewer participants are using application virtualization solutions**. We see that those who do virtualize their applications have a lower adoption rate as the 80-100% category dropped from 30.86% in 2019 to 26.83% in 2020 and 11.35% in 2021.
- **49.85% of the respondents have** an on-premises/multiple datacenter environment available for **business continuity** while 12.69% do not have a standby environment at all.
- **9.02% expect to switch** from a **multi-session operating system to a single session operating system** while 21.71% expect to switch from a single session operating system to a multi-session operating system.
- In upcoming years, how will the virtual application and desktop solution look? **38.78% expect it will look somewhat the same as today** while 27.94% expect it will shift more towards a combination of physical PCs and virtual applications and desktops. Close to **half of the respondents (48.70%) patch their systems once per month**, a small decrease compared to 2020.
- **With 50.80%, Windows laptops, desktops and workstations** are a **common solution** to access virtual applications and desktops.
- **Dual-display configurations remain the most popular setup** – as it combined totals of 63.92% in 2021 an increase of 2.18% compared to 2020. Dual display at Full HD is used the most with 41.90%.
- One of the new questions for this year's survey is the question what the ratio "work from home" or "work from office" will be. **Interesting is the result that it is a draw – 50% - 50%** which means Hybrid work scenario for many of us.

## Introduction

Welcome to the End User Computing – State of the Union 2021 edition.

We believe the results presented in this report provide valuable insights in trends real-world deployments, configuration, and usage of end-user computing (EUC) solutions such as Virtual Desktop and Applications – Virtual Desktop Infrastructure (VDI) and Desktop as a Service (DaaS) both on-premises and public clouds.

This document will also provide a great perspective on key end-user computing trends for the forthcoming years, which will help you with planning and creating your EUC roadmap.

The goal of the survey is to get a clear view on how the industry is changing and to support all involved with valuable, independent, and unbiased research results based on actual and objective customer data. 1647 people supported the survey and, with support from the EUC community, the results are freely available to everyone. This is truly a great achievement and community effort.

Topics in the survey will cover Virtual Desktop Infrastructure (VDI), Desktop as a Service (DaaS), public cloud, security, devices, single session and multi-session Operating Systems, storage, hypervisors, GPUs, manageability, tools and the key EUC initiatives for 2022 and beyond.

## About VDI Like a Pro

Independent research organization VDI Like a PRO started the State of the Union Survey back in 2013, with the goal to provide an annual insider view of the End User Computing (EUC) market. VDI Like a Pro ([www.vdilikeapro.com](http://www.vdilikeapro.com)) is an initiative by [Ruben Spruijt](#), Sr. Technologist at [Nutanix](#). [Mark Plettenberg](#), Senior Product manager at [Login VSI](#) and [Christiaan Brinkhoff](#) as Principal Program Manager at [Microsoft](#)

With many of the questions repeated annually, the survey not only gathers data about the current status of the industry but also discovers changes and trends. This year 1674 respondents participated in the survey, making this research initiative one of the largest on the EUC market currently. The survey closed on 22/03/2021.

The results of the survey are reported in this whitepaper which is available to all at [www.vdilikeapro.com](http://www.vdilikeapro.com). The content from this survey will also be presented at leading industry and events such as Microsoft Ignite, VMworld, ExpertsLive, Citrix Synergy, NVIDIA GTC, E2EVC, Nutanix .NEXT and various user groups.

If you want to use information from the survey feel free to **contact Christiaan, Mark or Ruben**.

## Made possible by: Login VSI

Login VSI has paid for the use of the survey tool (\$1200, per year). Login VSI ([www.loginvsi.com](http://www.loginvsi.com)) is the industry standard in synthetic load testing and active monitoring for virtual applications and desktops. The software of Login VSI is used by enterprises with centralized desktop environments and/or business-critical applications running in VDI, and by all major IT vendors that offer infrastructure solutions for VDI.



## Teamwork

A community project cannot be successful without inspiring individuals and dynamic companies. Here are some that made this possible this and past years!

- Lorna Crawford for making sure this document is presented in readable English
- Jack Madden, for announcing the survey at BrianMadden.com
- Login Consultants & PQR for running earlier surveys as ProjectVRC
- Login VSI, Atlantis Computing and FRAME for running earlier surveys as TeamVRC
- The Login VSI marketing team for their support
- Login VSI and Nutanix for support of this year's survey
- Actual Tech Media (ATM)
- Many other community friends on LinkedIn and Twitter

## Team and contact

All information about VDI Like a Pro can be found at [www.vdilikeapro.com](http://www.vdilikeapro.com).

We try to provide accurate, concise, and practical information. We appreciate any feedback.

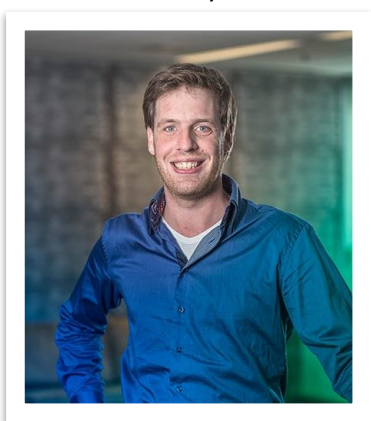
If you have any comments, corrections, or suggestions for improvements of this document, then we want to hear from you!

Please send an email to Mark Plettenberg ([m.plettenberg@loginvsi.com](mailto:m.plettenberg@loginvsi.com)), Christiaan Brinkhoff ([mail@christiaanbrinkhoff.com](mailto:mail@christiaanbrinkhoff.com)) or Ruben Spruijt ([ruben@rspruijt.com](mailto:ruben@rspruijt.com)) and include in your message: the title of the document, the version number, and the page that you refer to.

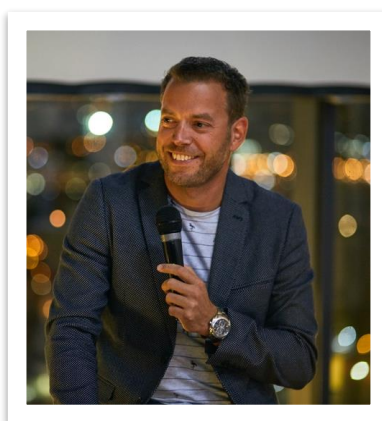
## Leaderboard

The State of VDI survey is executed

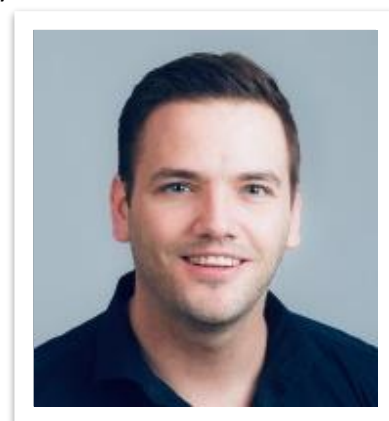
by:



**Mark Plettenberg**  
Sr. Product Manager  
Login VSI  
[@MarkPlettenberg](https://twitter.com/MarkPlettenberg)



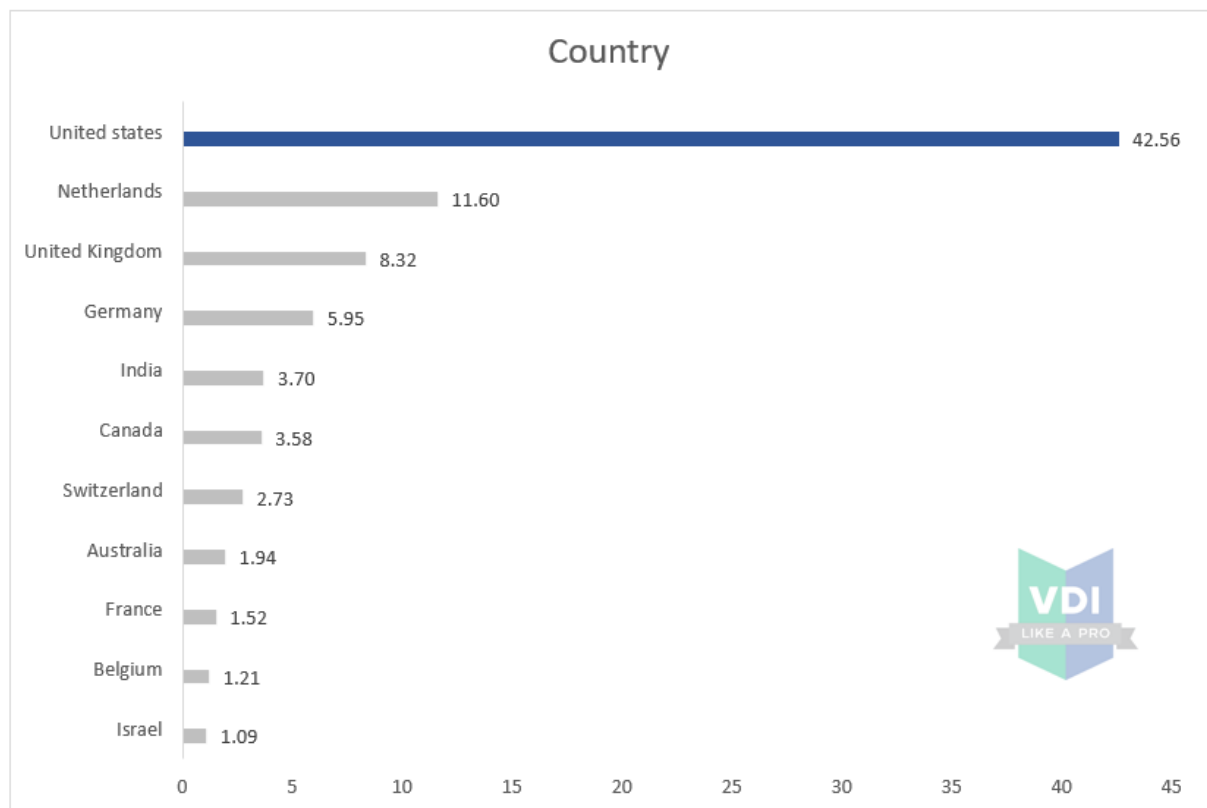
**Ruben Spruijt**  
Sr. Technologist  
Nutanix  
[@Rspruijt](https://twitter.com/Rspruijt)



**Christiaan Brinkhoff**  
Principal PM  
Microsoft  
[@Brinkhoff\\_C](https://twitter.com/Brinkhoff_C)

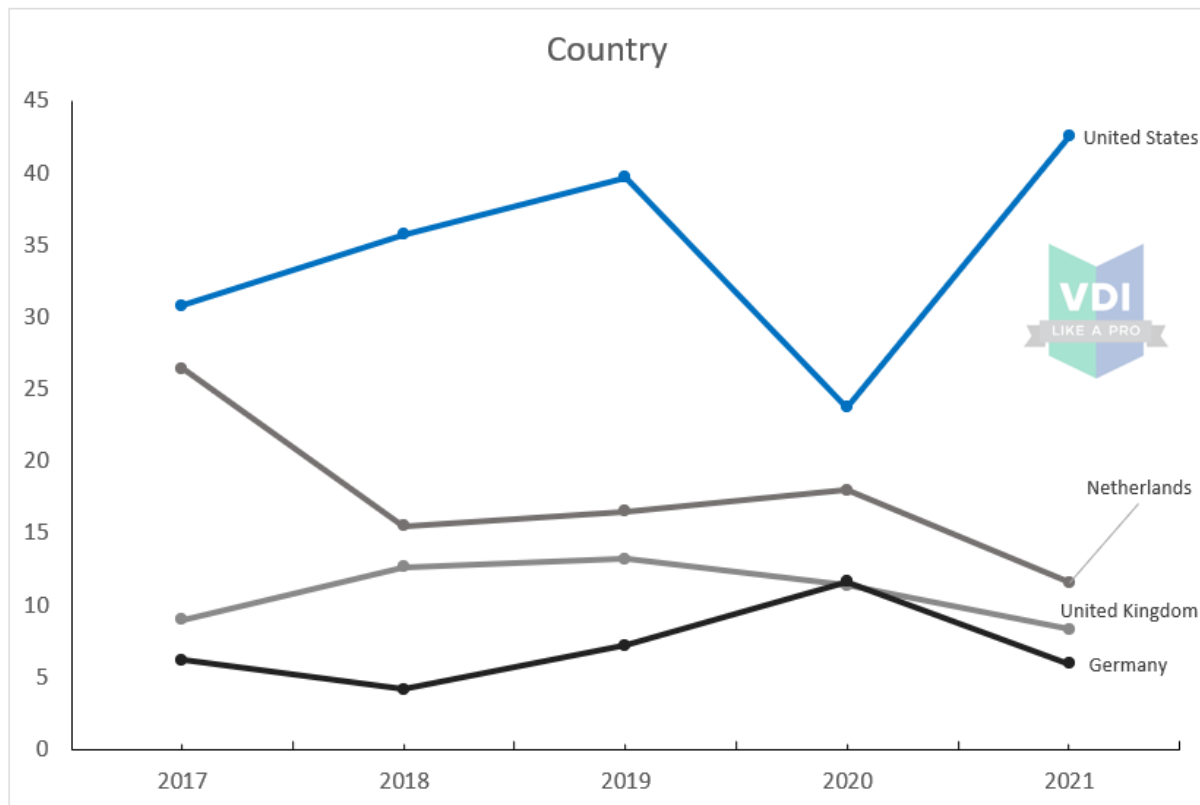
## Participant information

1647 people supported the survey and on average, completed the survey in 11 minutes. 10,654 did view the landing page. Participants from more than 60 different countries around the globe took part in the survey, with a majority of 42.56% in North America. 2<sup>nd</sup> is Netherlands with 11.60% followed by the United Kingdom with 8.32%. The response is measured based on client IP address.



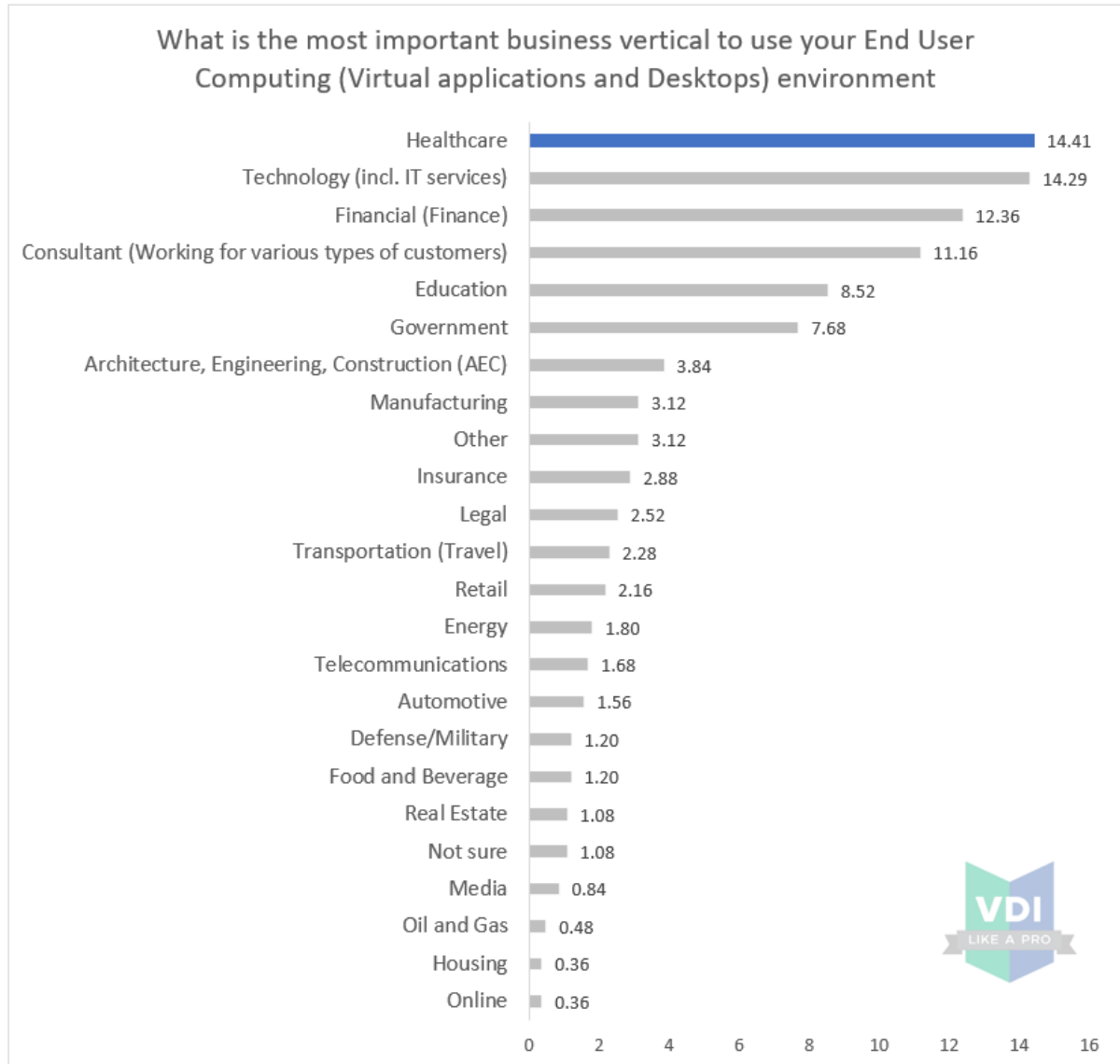
North America has the largest response distribution and is the largest region by far. There is a relatively high number of participants from the Netherlands (11.60%), likely because VDI Like a Pro and their team members are well-connected with end-users, partners, and vendors in this region.

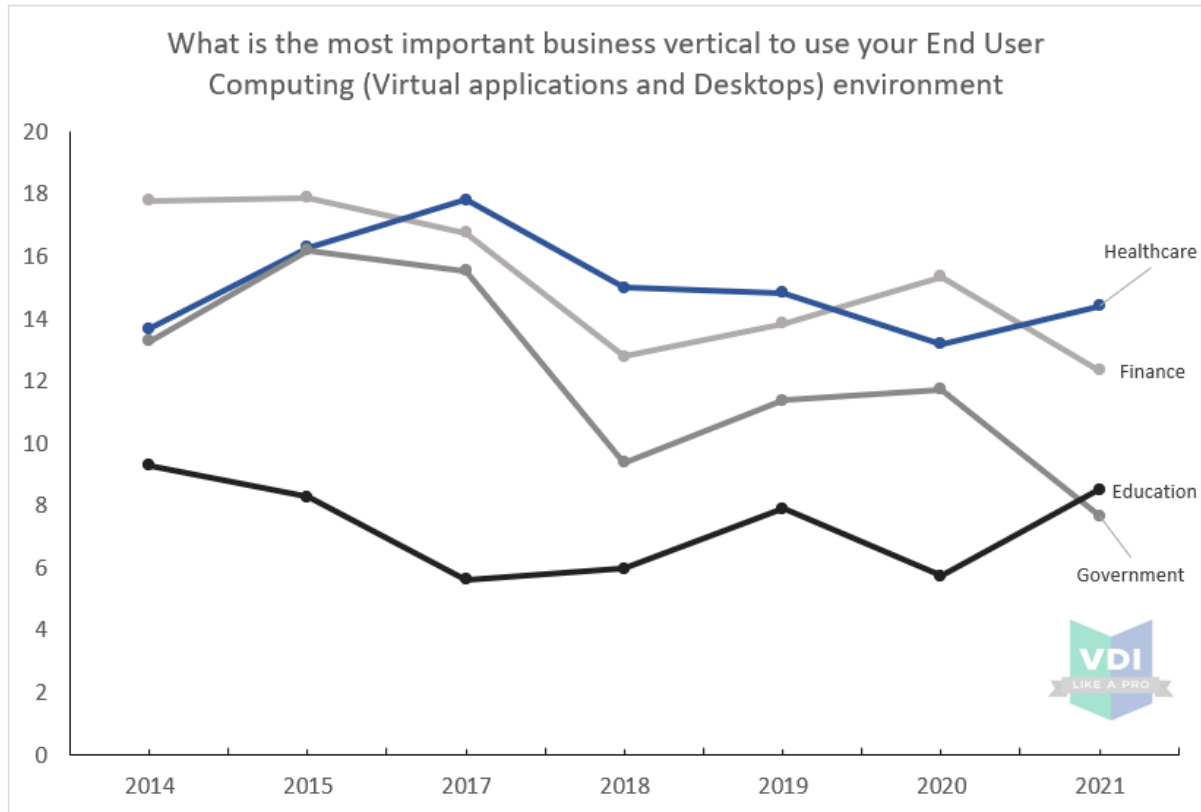
We could have said that **the Dutch are leading the way** in the EUC space with their high adoption rate, awesome customer deployments, and the deeply engaged community consisting of leading Microsoft MVPs, Citrix CTPs, Nutanix NTCs, and VMware vExperts -- but that's just bragging about the Dutch and isn't based on survey results.



## What is the most important business vertical to use your Virtual applications and desktops environment?

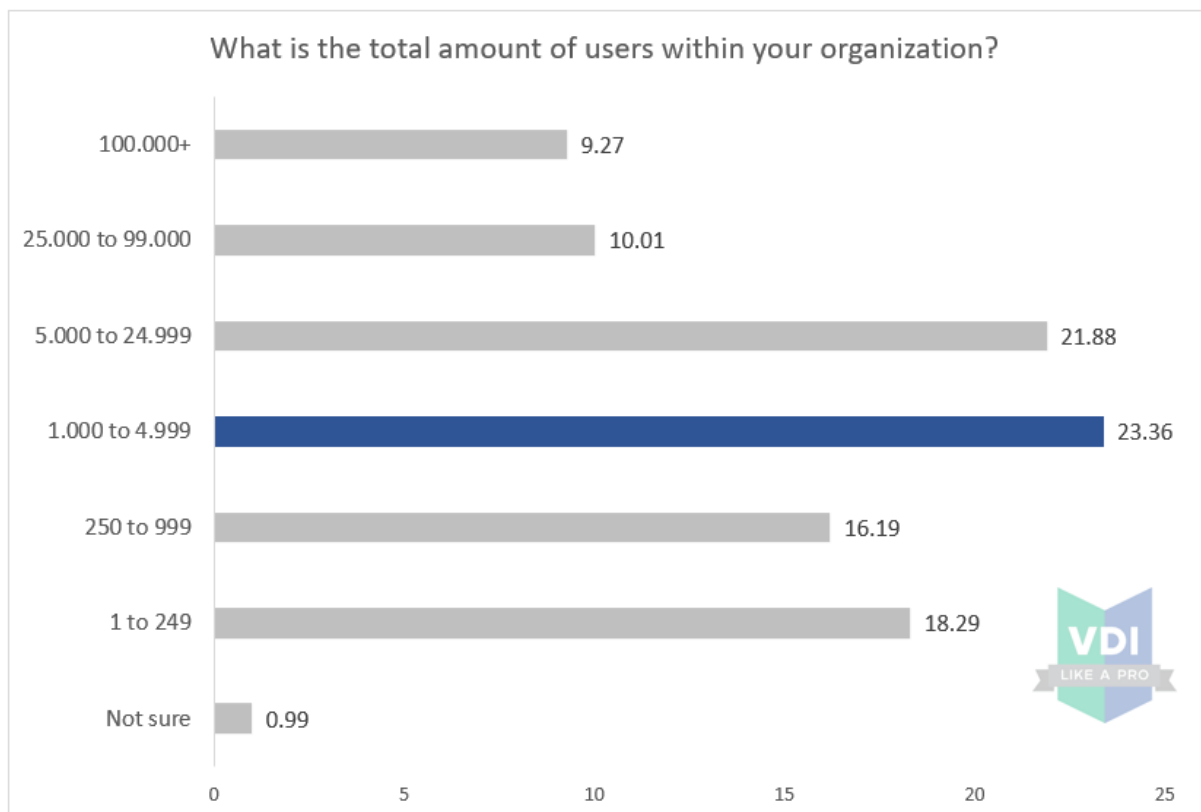
With 14.41% healthcare became the largest business vertical for virtual applications and desktop solutions. Closely followed by 'Technology' companies with 14.29% and Financial services with 12.36%. Compared to last year usage of from education and healthcare customers increased while finance and government declined.





### What is the total amount of users within your organization?

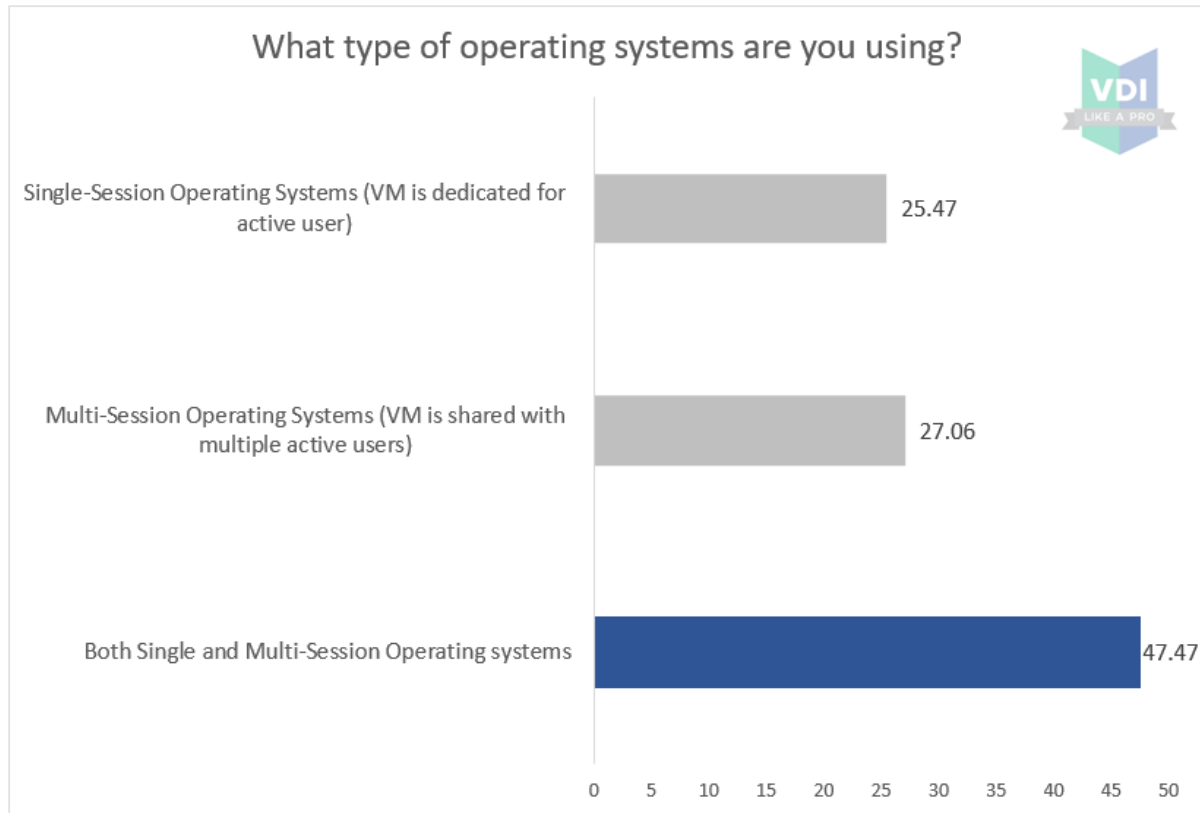
In 2020, the survey respondents working in an organization with 100,000+ users totaled 7.67%. This year, the percentage totals 9.27% an increase of 1.60%. The largest group of organizations using virtual applications and desktops, with 23.36% are between 1,000 and 4,999 users followed by 5,000-24,999 users with 21.88%.



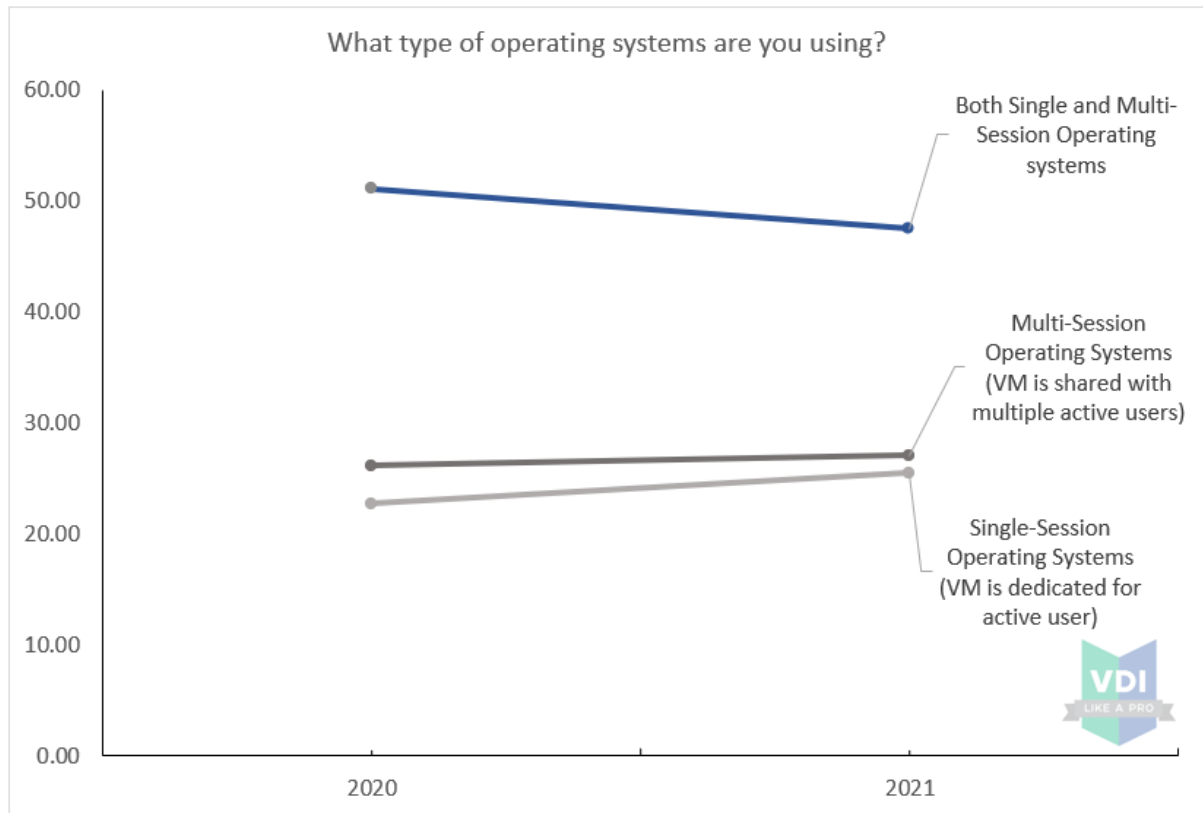
## Operating Systems

### What type of operating systems are you using?

In 2021 47.37% of the respondents are using both a single user and multi-user operating system to support their users with virtual applications and desktops, a decline of 3.62% compared to 2020. 27.06% is using a multi-user operating system (with multiple users actively sharing the VM) while 25.47% is using a single-user operating system which is an increase of 2.73% compared to 2020.

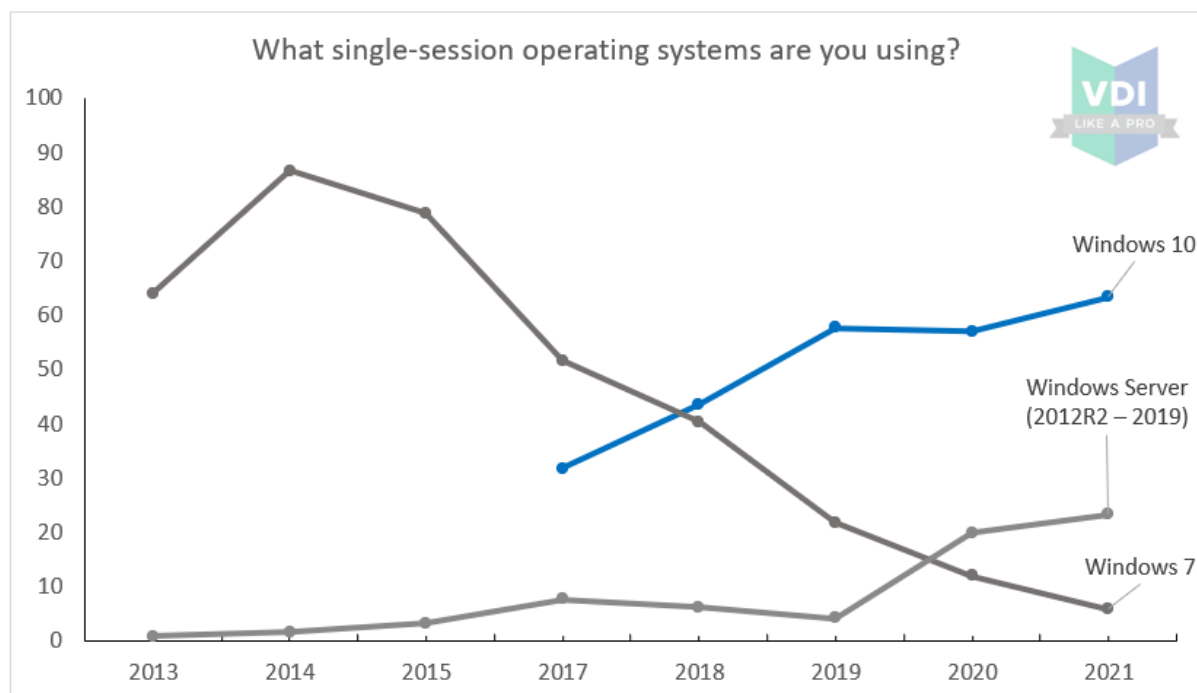
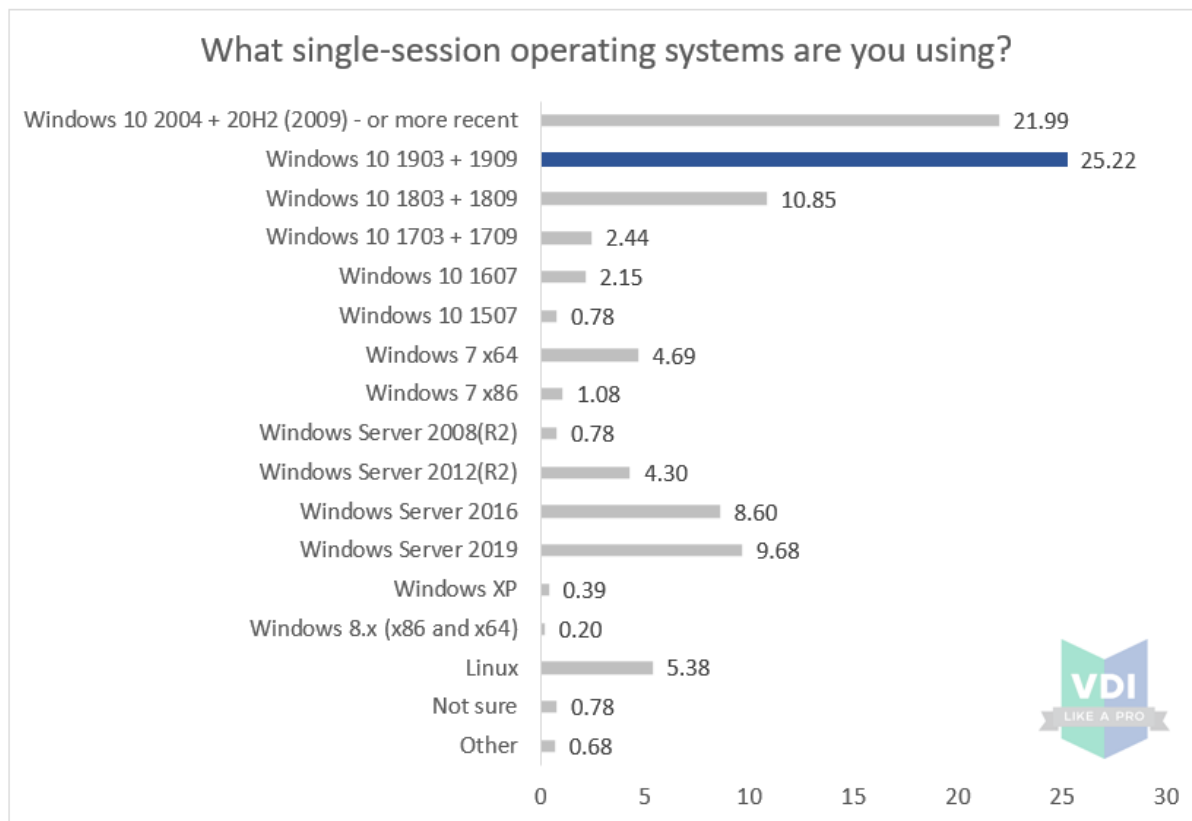


**Note from the authors;** The Windows Server Operating system and Windows 10 can support both single-user and multi-user scenarios. This is possible when the 'Session Host' role is enabled on Windows Server or Windows 10 Enterprise Multi-Session (EMS) as part of Microsoft Windows Virtual Desktop (WVD) is being used.



## What single-Session operating systems are you using?

With 63.44% Windows 10 is used the most with versions 1903/1909 and 2004/20H2 leading the usage, an increase of 6.44% compared to 2020. Windows 7 usage continued the decline from past years with 5.77% using Windows 7 as a guest operating system in 2021, which is a 6.23% decline compared to 2020. Windows Server 2012R2/2019 usage is 23.36% in 2021, an increase of 3.36% compared to 2020. Usage of Linux as Guest OS for virtual desktops and applications has declined a little but from 6% in 2020 to 5.38% in 2021.



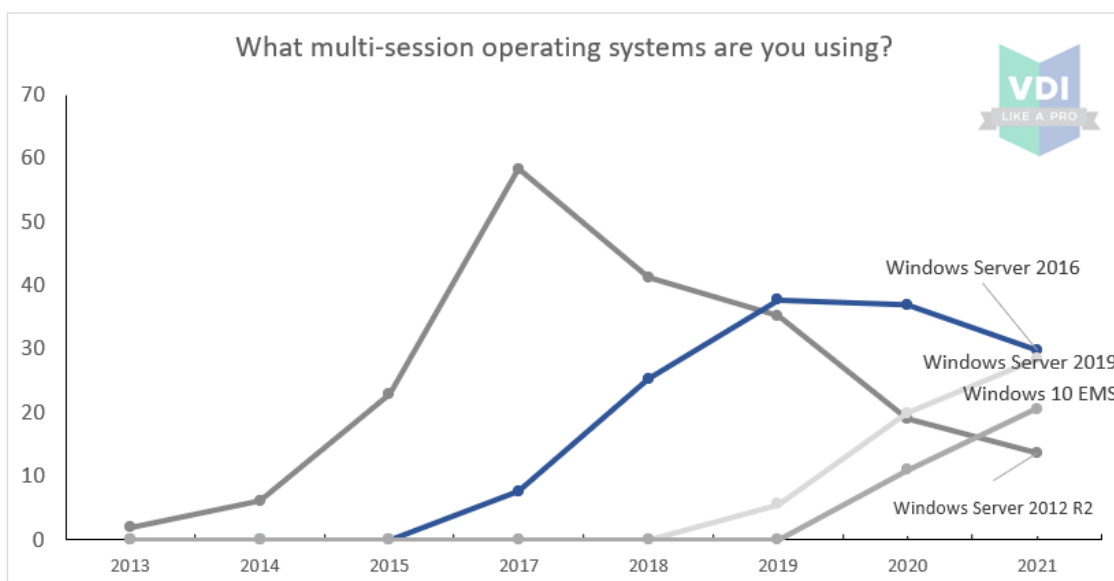
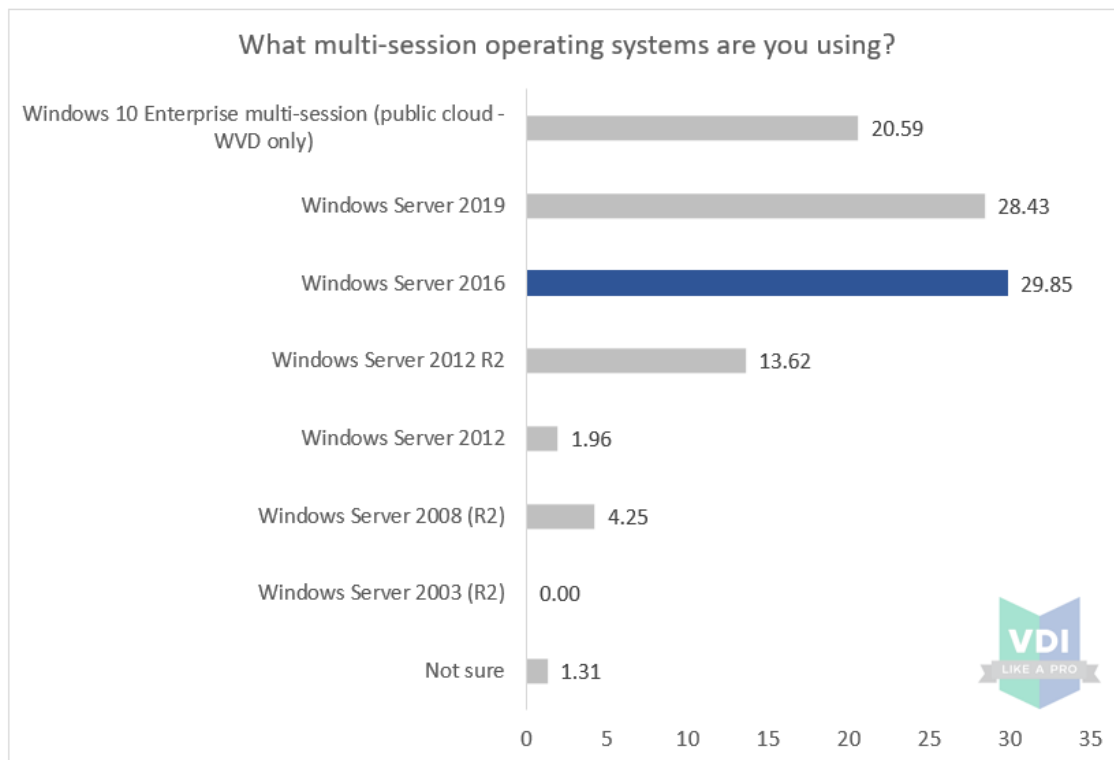


## What multi-session operating systems are you using?

A multi-session operating system is often referred to as Remote Desktop Session (RDS), RD session host (RDSH), XenApp, Terminal Services, or even Server Based Computing.

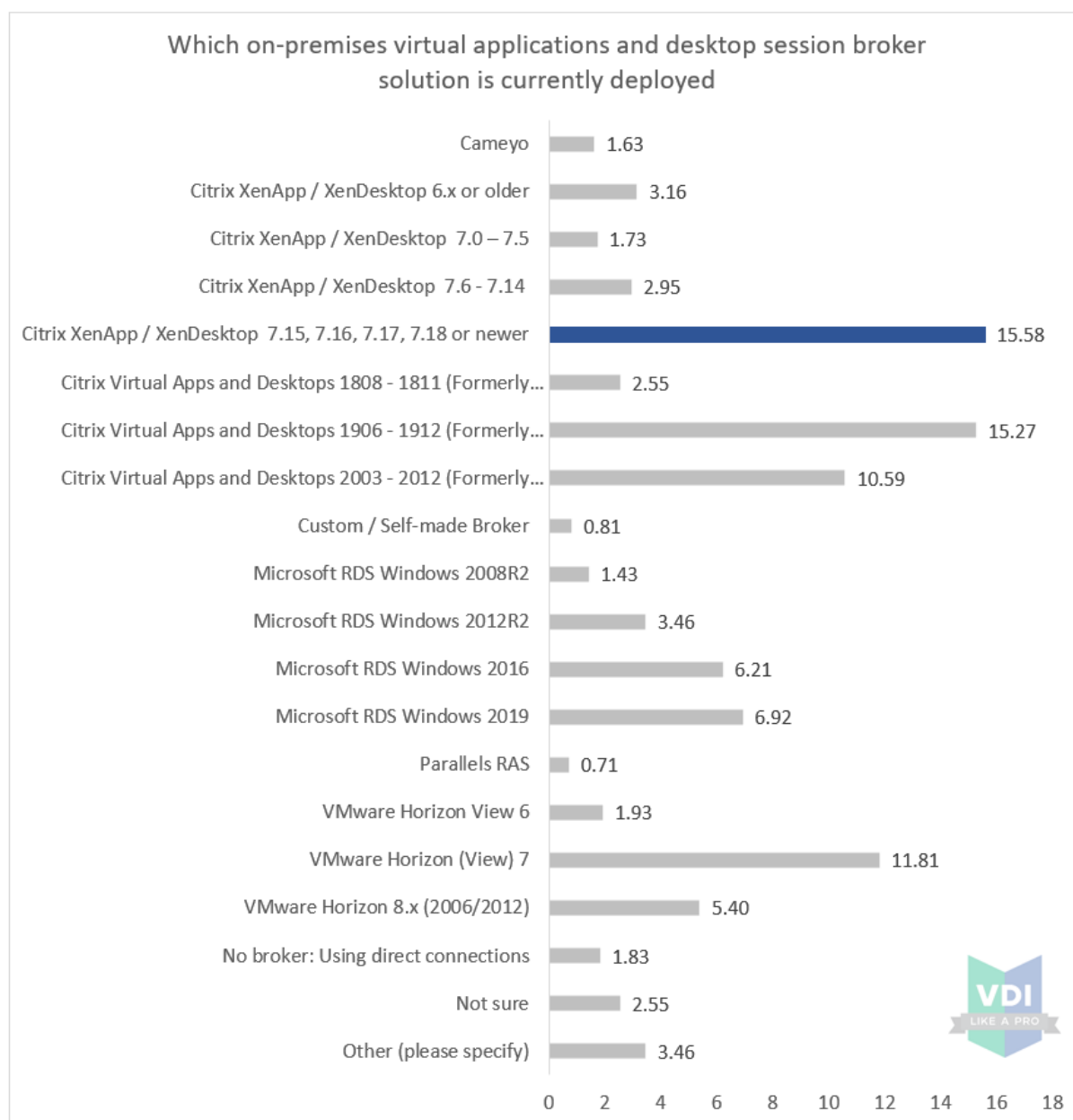
A multi-session operating system continues to be a popular choice for delivering published desktops or published applications into an organization. Windows 10 Enterprise multi-session as part of Windows Virtual Desktops (WVD) is another example of an operating system to support virtual desktops and applications.

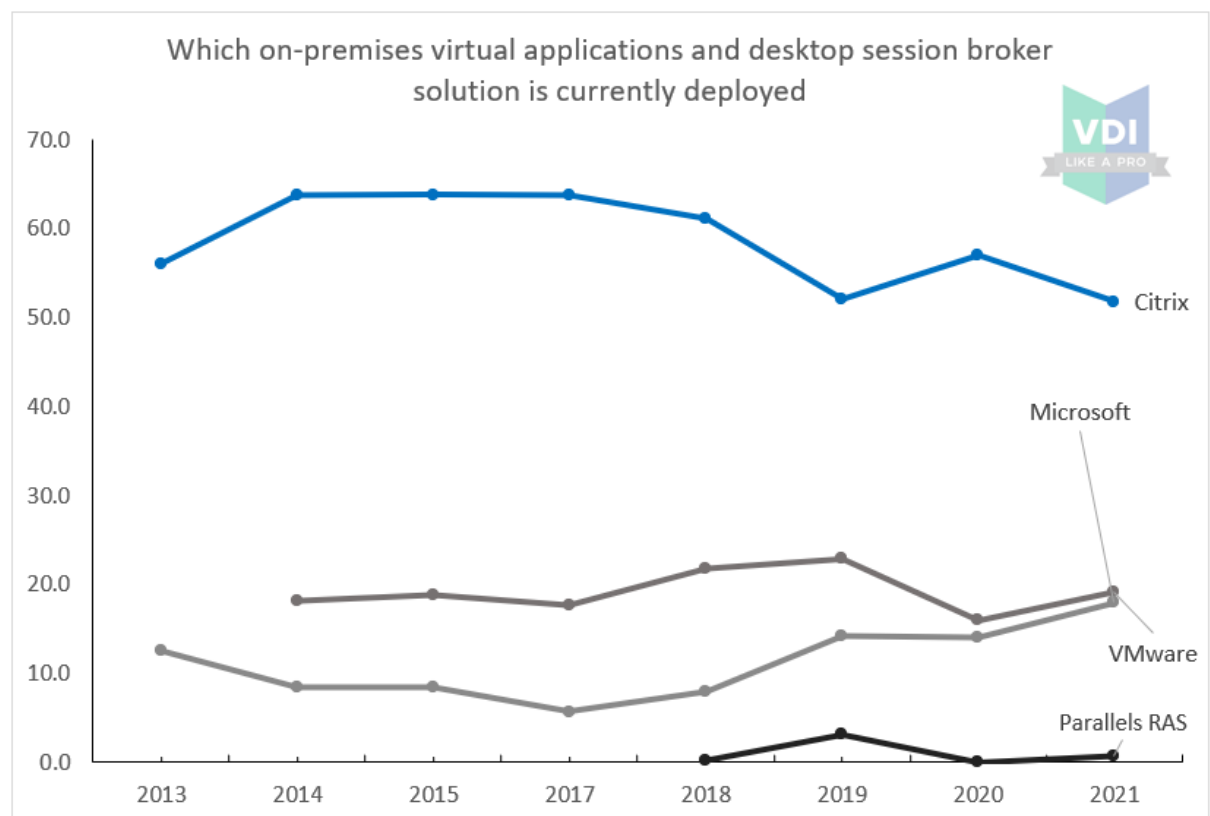
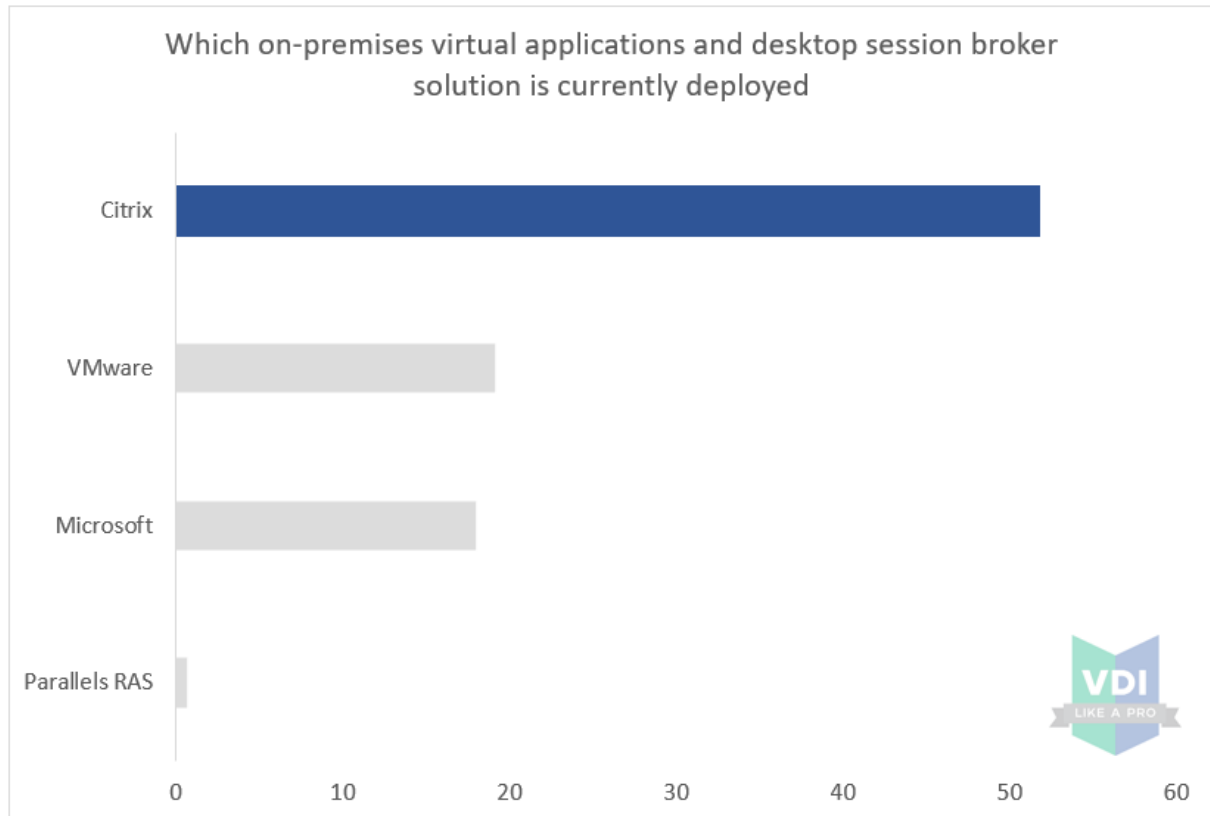
With 29.75% Windows Server 2016 is still the leading multi-user Operating System but usage is declined 7.15% compared to 2020. Adoption of Windows Server 2019 increased 8.84% in 2021, total usage is 28.43%. At third place is Windows 10 Enterprise multi-session with 20.59%. This number is high, and we believe this is because many organizations are evaluating Desktop as a Service.



## Which virtual applications and desktop session broker solution is currently deployed on-premises?

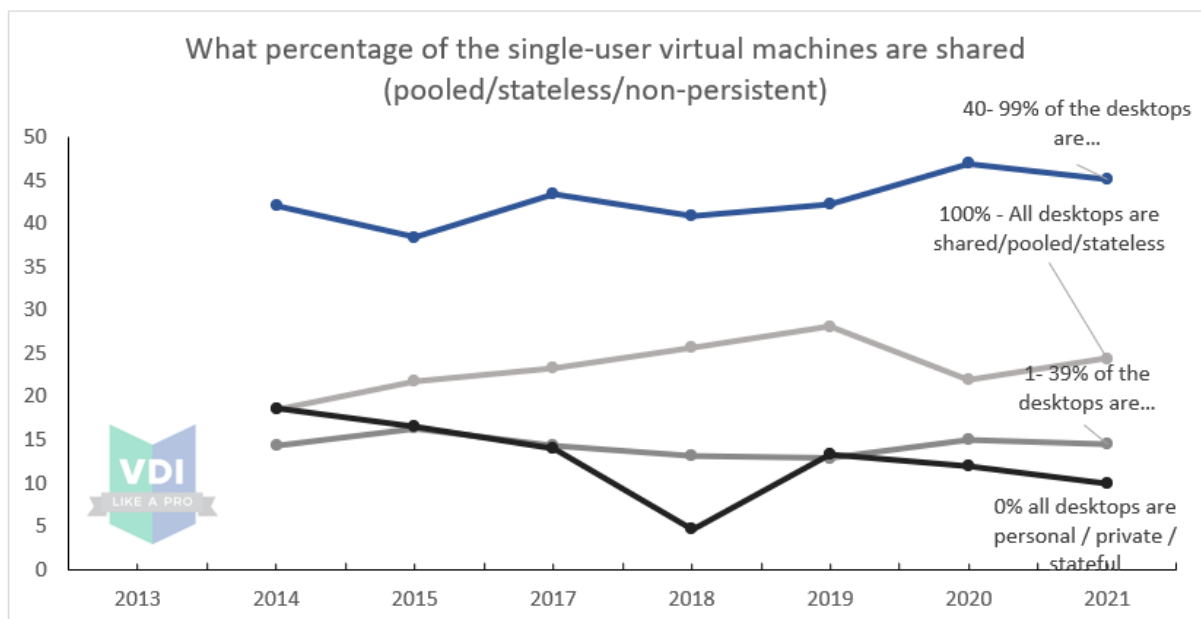
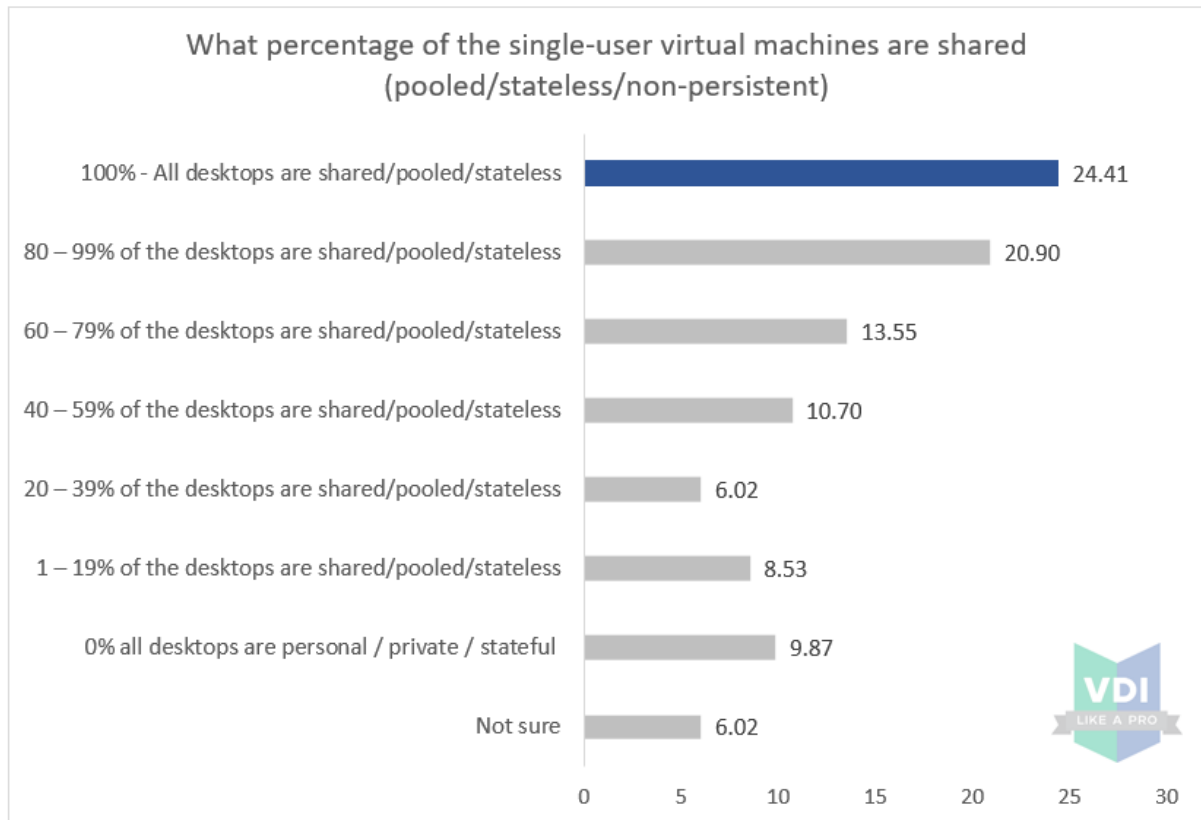
The virtual desktops and applications broker on-premises, Citrix is leading with 51.83% a decline of 5.17% compared to 2020. VMware Horizon is used with 19.14% of the respondents an increase of 3.14% compared to 2020 and Microsoft is 3<sup>rd</sup> with 18% an increase of 4% compared to 2020. 3.46% selected 'other', many of them are using Nutanix Frame – which doesn't deliver the session broker on-premises, customer do use this session broker in a hybrid deployment with workload VMs on-premises.





## What percentage of the single-user virtual machines are shared (pooled/stateless/non-persistent/personal?)

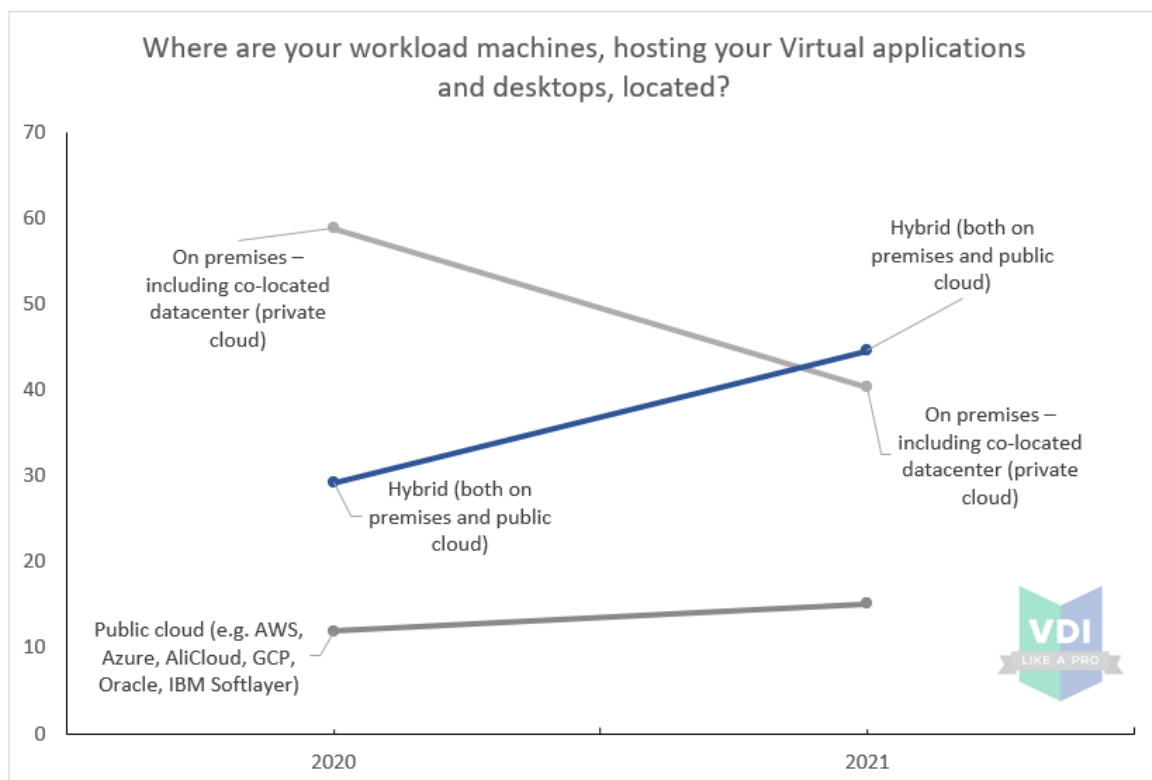
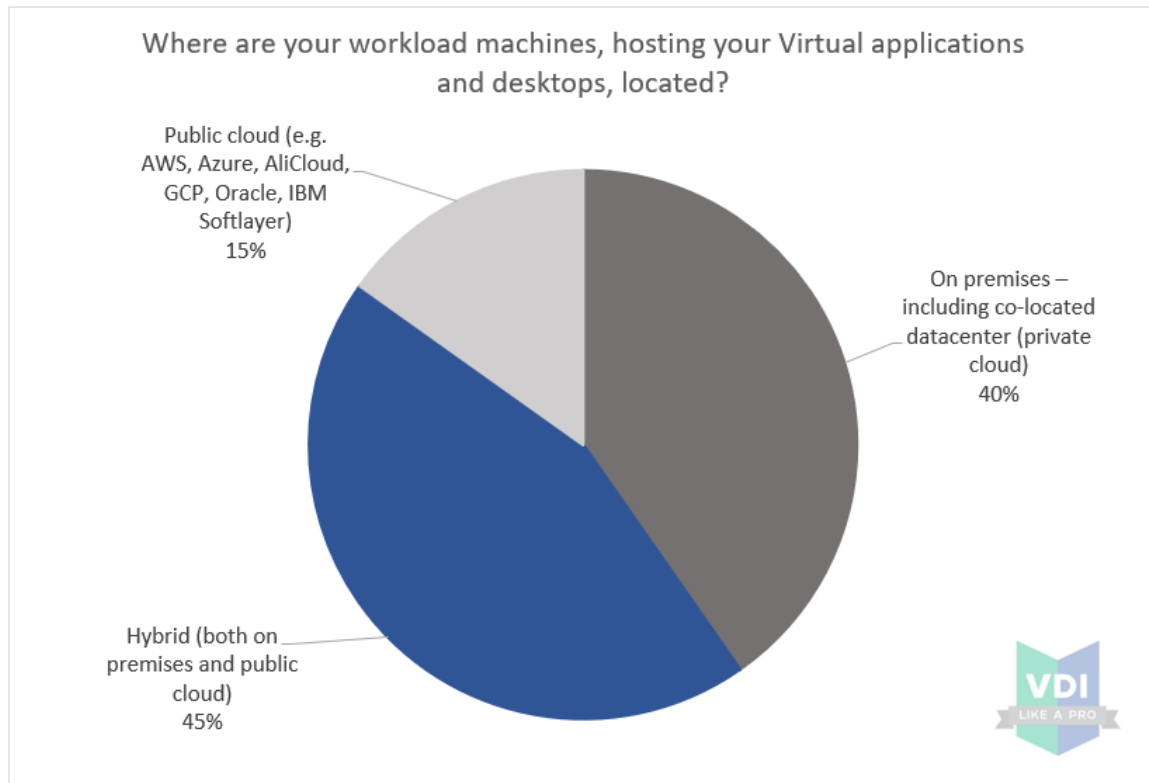
45.31% of the respondents are using virtual desktops and applications in an 80-100% stateless or 'pooled' configuration. While 9.87% of the respondents are using personal or private instances of virtual applications and desktops.



## Where are your workload machines, hosting your Virtual applications and desktops located?

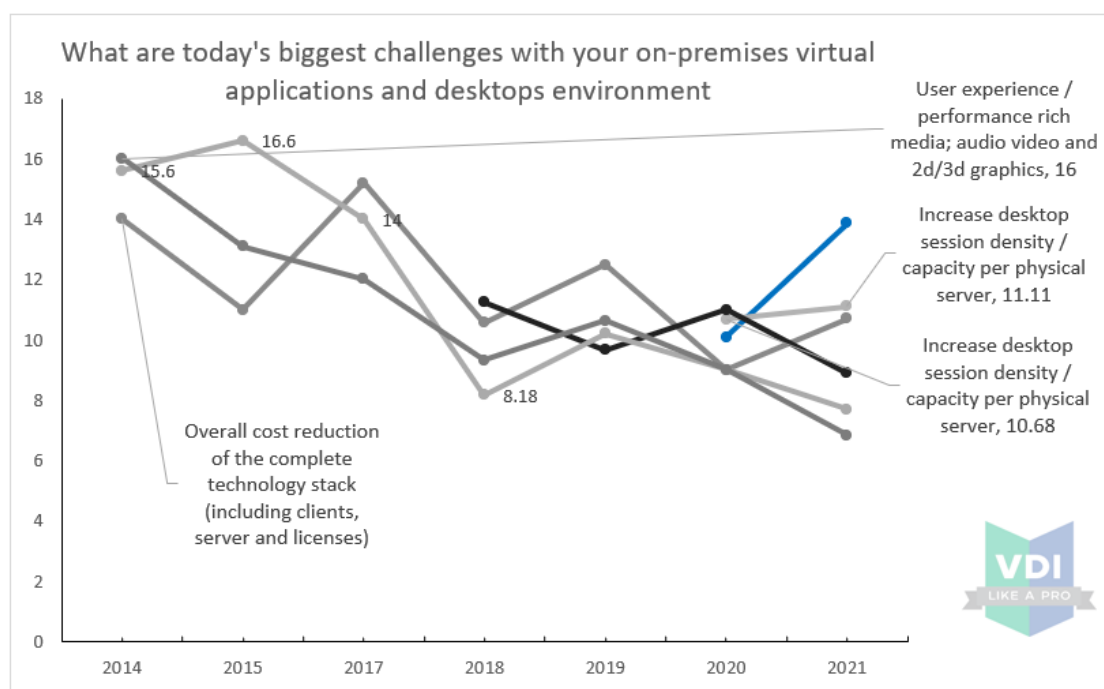
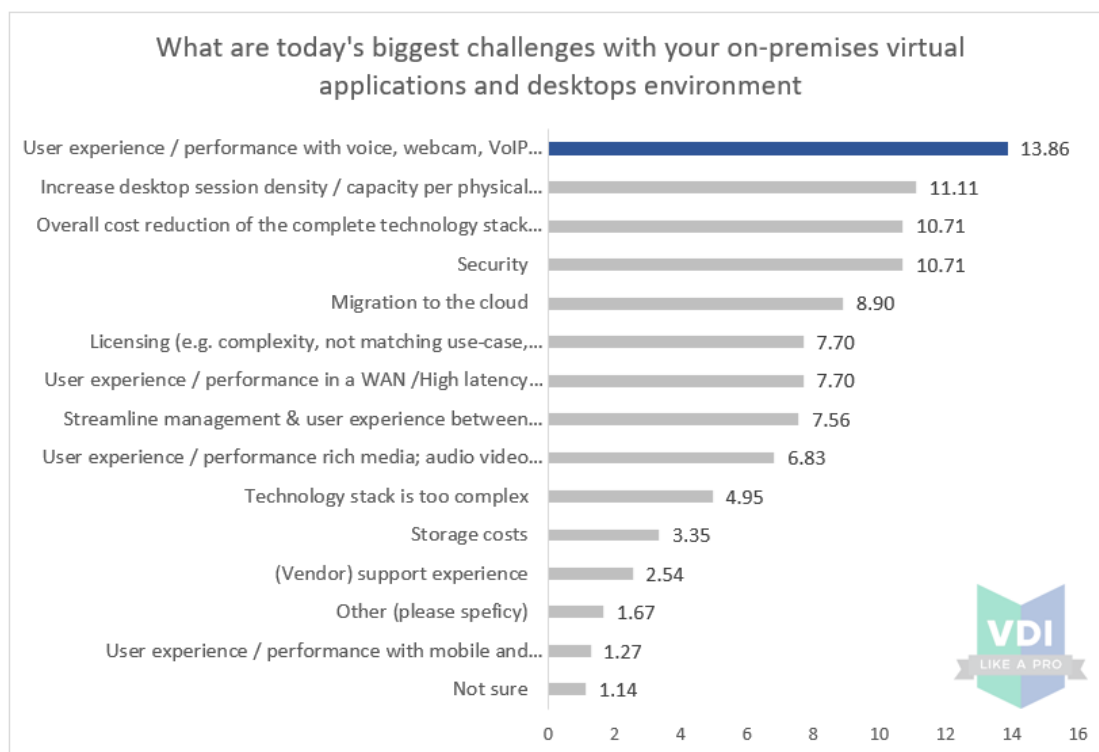
The majority of respondents, 44.55%, are running their workload machines in a hybrid environment, using on-premises and public cloud. In 2020 this was 29.25% an increase of 15.30%.

The use of workload VMs running only on-premises is declining from 58.81% in 2020 to 40.3% in 2021. Running workload machines in public cloud only is increased from 11.95% to 16.1% in 2021.



## What are today's biggest challenges with your on-premises virtual applications and desktops environment?

The biggest challenges with the on-premises virtual desktop and application environments are User experience / performance with voice, webcam and unified communications with 13.86%. More end-users are using unified communications solutions because of work from home, unified communications in a virtual application and desktop deployment always have been “attention” which is also seen in the survey results. The 2<sup>nd</sup> biggest challenge is the ability to increase session density, capacity per server with 11.11%. Newer versions of Windows10, modern browsers and unified communications applications do have a real impact in user density and resource usage, also seen in the survey results. With 10.71% both overall costs and security are on 3<sup>rd</sup> place.



## Infrastructure: Hypervisor, Servers, Storage, GPUs and more

### What hypervisor is currently deployed for your virtual Applications and Desktops?

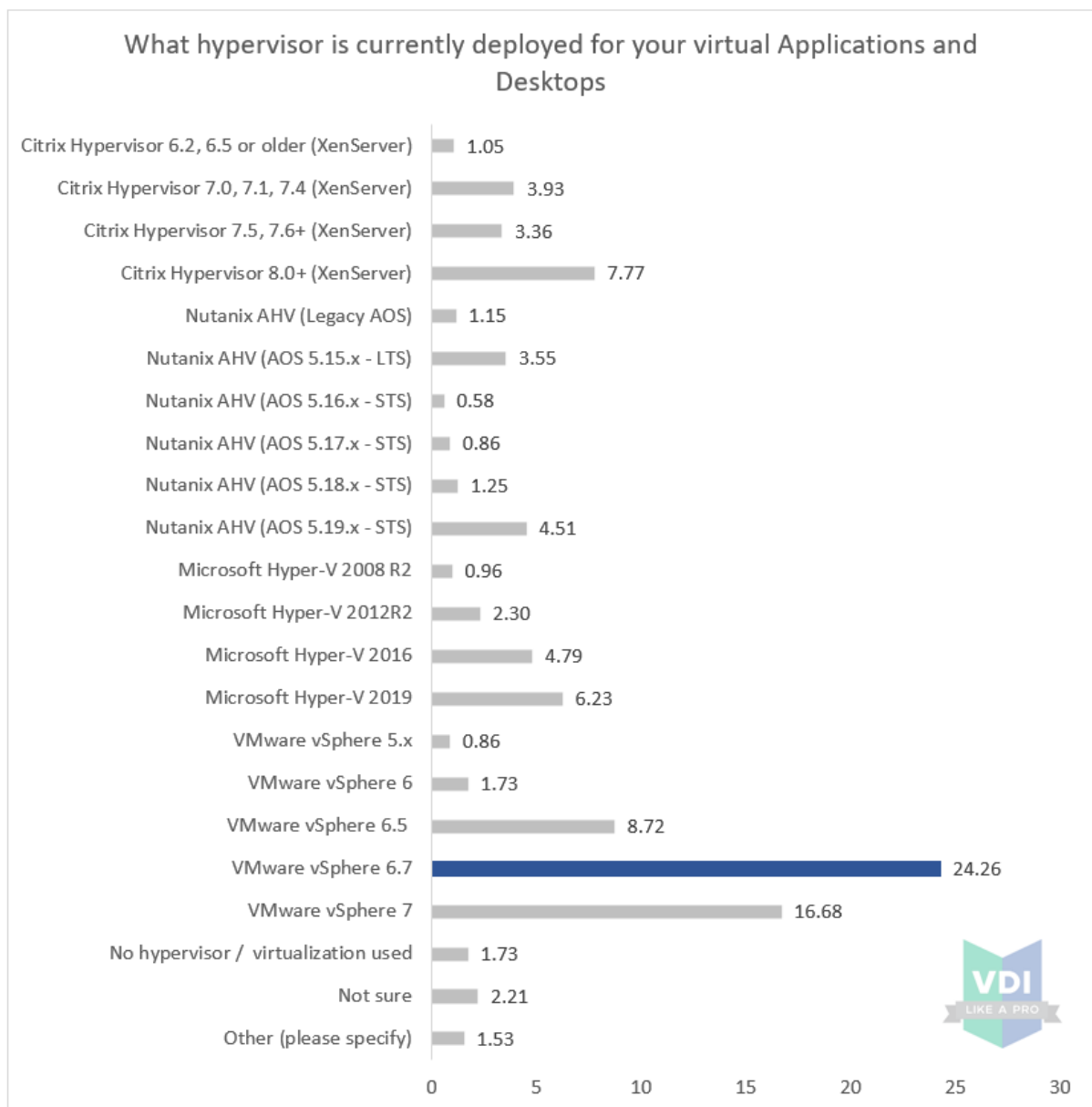
VMware remains by far the largest hypervisor vendor delivering virtual infrastructure for virtual desktops and applications, although the usage is decreasing from 65.8% in 2014, 61.4% in 2018, 55% in 2020 and 52.25% in 2021. VMware vSphere 6.7 is used at 24.26% of the respondents.

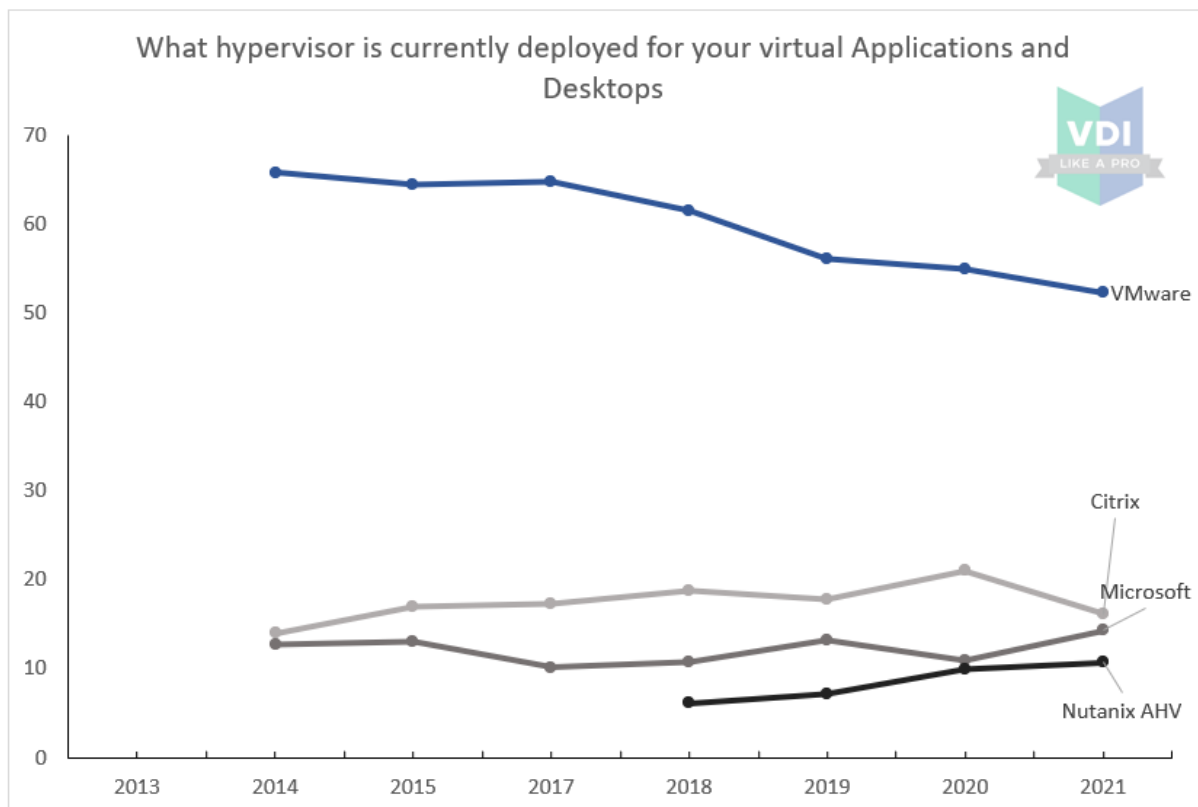
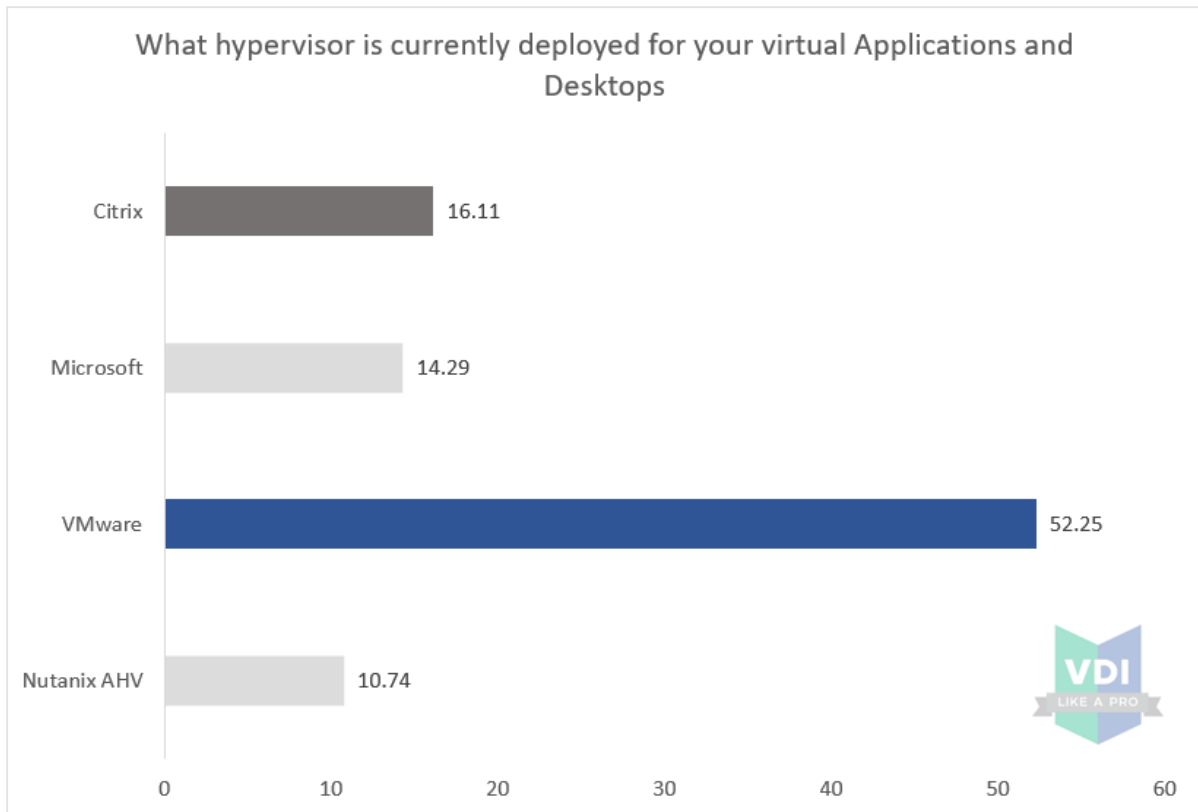
Citrix Hypervisor usage is decreasing from 21% in 2020 to 16.11% in 2021, Citrix Hypervisor 8.0 is used at 7.77% of the respondents.

Microsoft Hyper-V usage is increasing from 11% in 2020 to 14.29% in 2021, Hyper-V 2019 is used at 6.23% of the respondents.

Adoption of Nutanix is growing from 6.13% in 2018, 7.15%, 10% in 2020 and 10.74% in 2021.

It's important to mention that multiple hypervisors could be selected. Selecting your hypervisor is a long-term commitment, organizations are updating their solutions but the migration to another platform isn't happening overnight





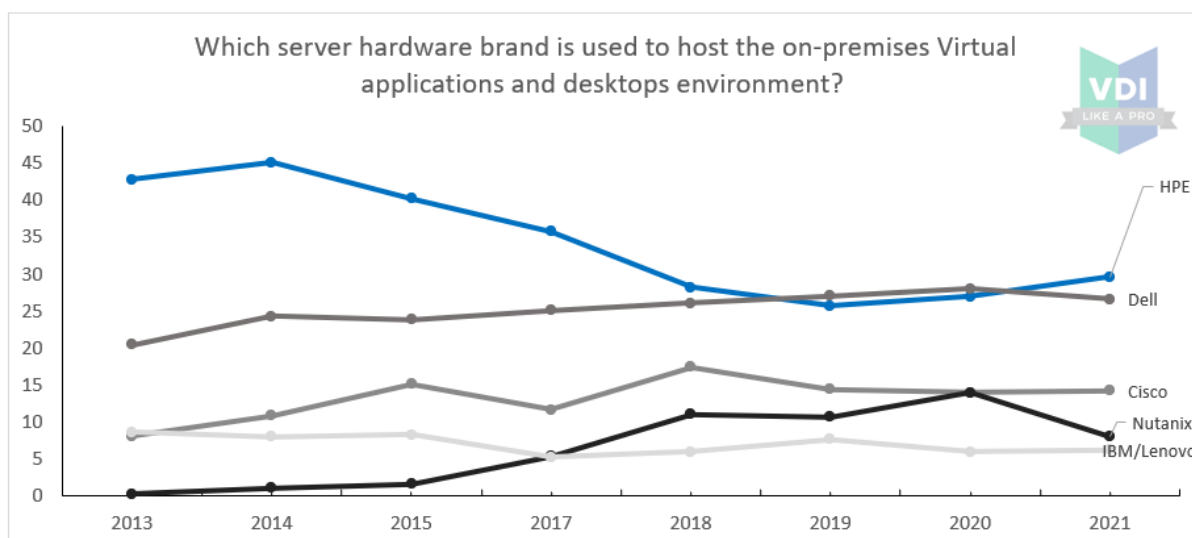
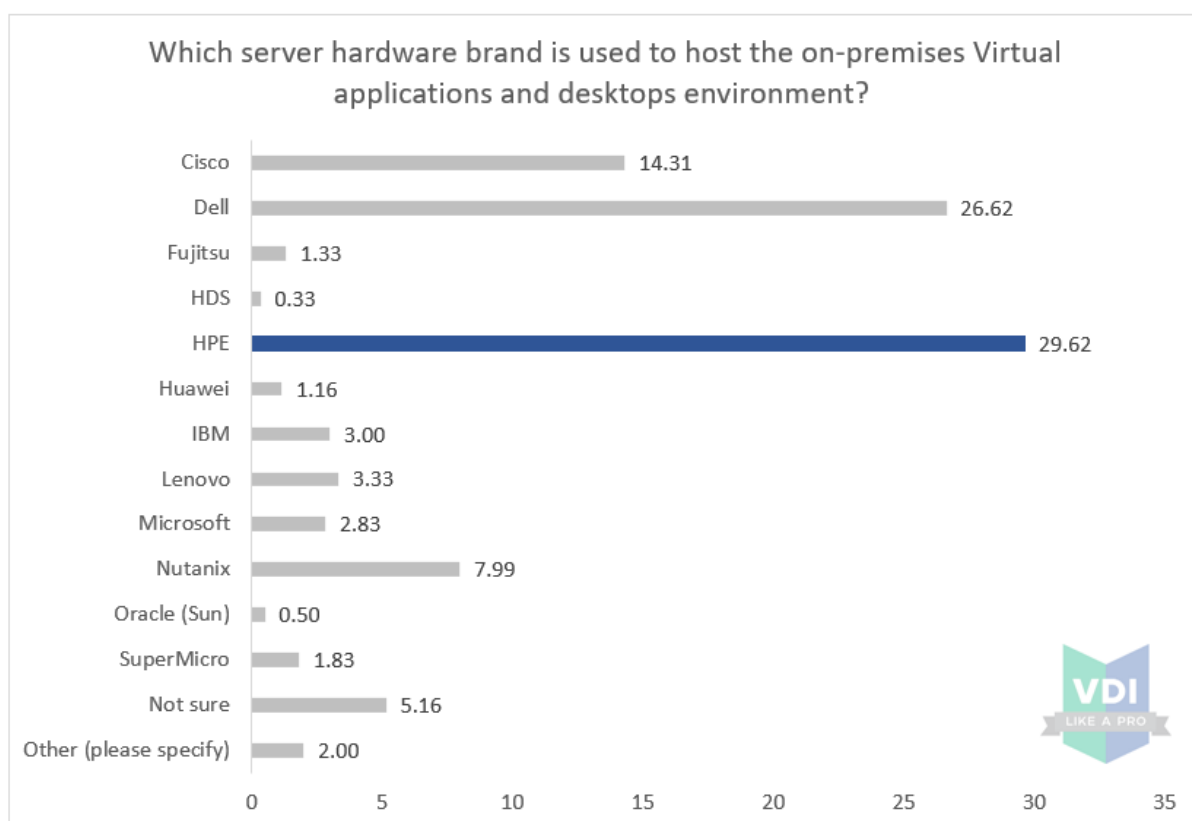


## Which server hardware brand is used to host the Virtual Applications and Desktops environment?

With 29.62%, HPE is the server vendor being used the most with virtual applications and desktops workloads, closely followed by Dell with 26.62%.

HPE is slowly increasing its market share—from 25.70% in 2019, 27.94% in 2020 to 29.62% in 2021. Cisco market-share last 3-years is stable with 14.31% in 2021.

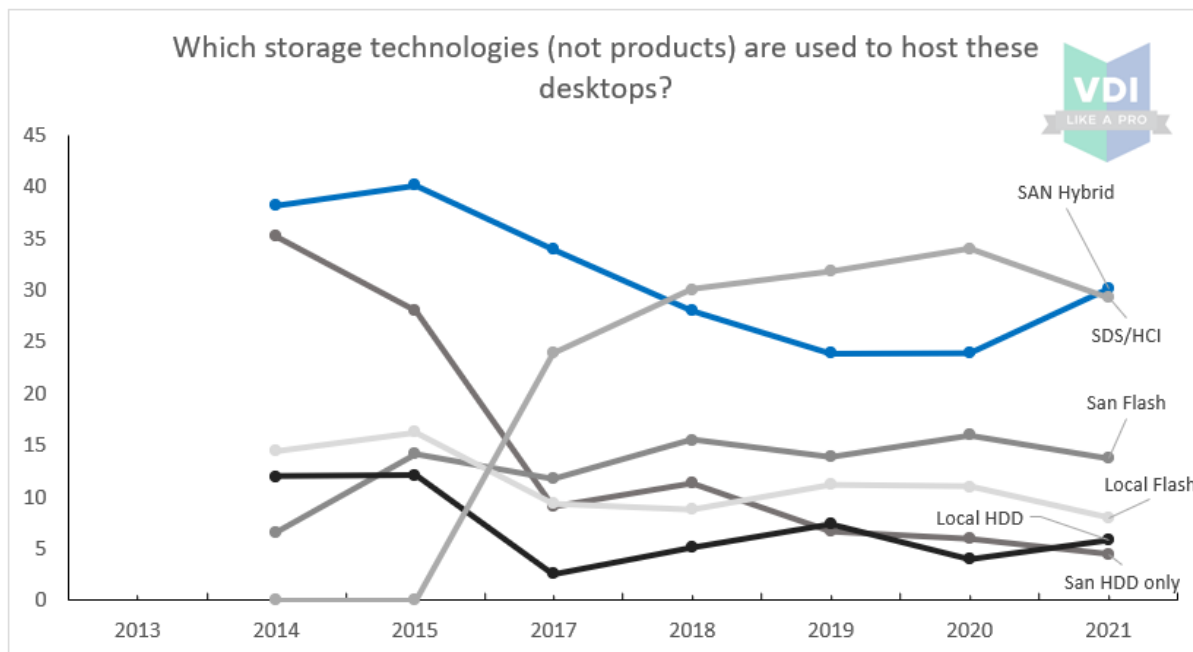
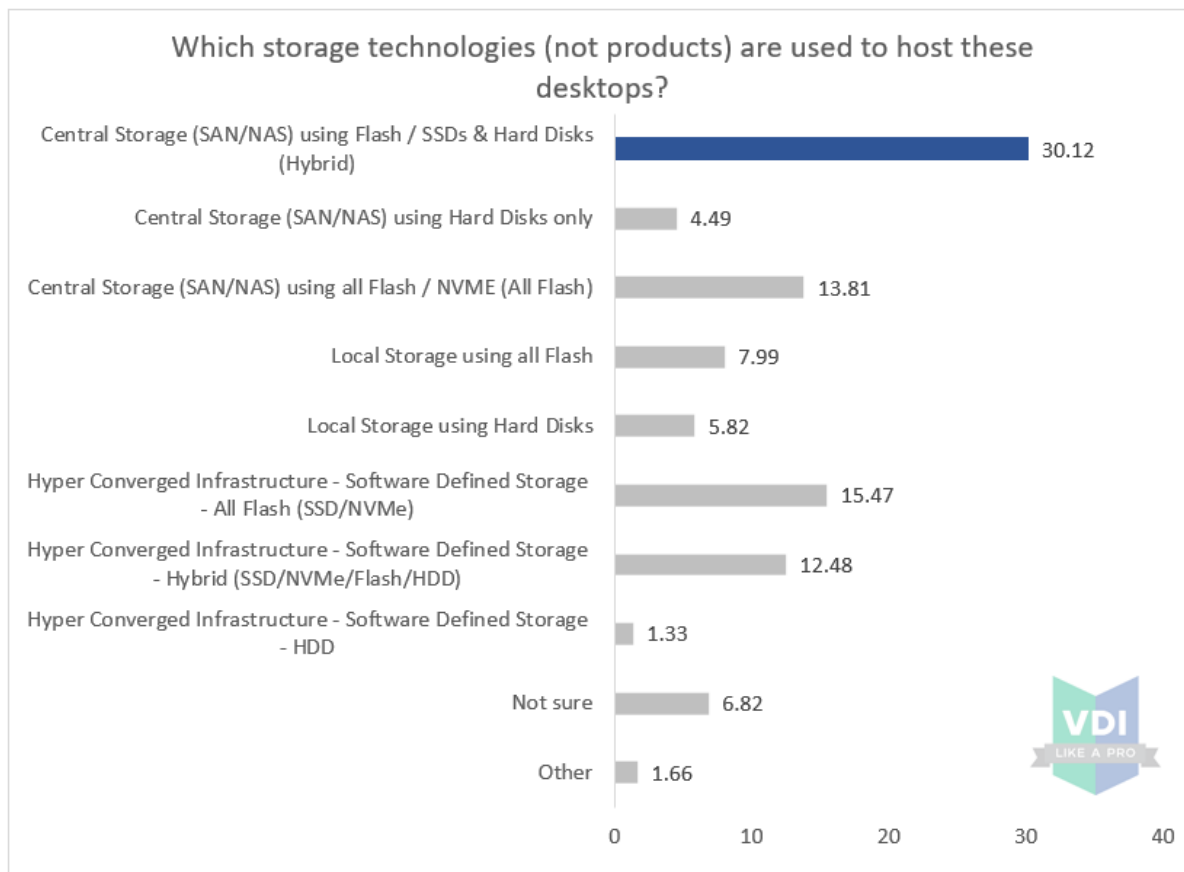
Nutanix jumped from just 1.1% in 2014, 1.6% in 2015, 5.42% in 2017, 11.03% in 2018, 10.75% in 2019 and 14% in 2020. Nutanix server hardware declined to 7.99% in 2021. We expect that the switch from Nutanix hardware appliances to software subscription does play an important role here since Nutanix software is capable of running on various server brands, including HPE, Dell, Lenovo and Cisco.



## Which storage technologies are used to host the workload VMs?

Traditional Storage Area Network (SAN) technologies are being used in 48.42% of the virtual desktop and application scenarios, hybrid SAN is leading with 30.12% and all-flash at 13.81%.

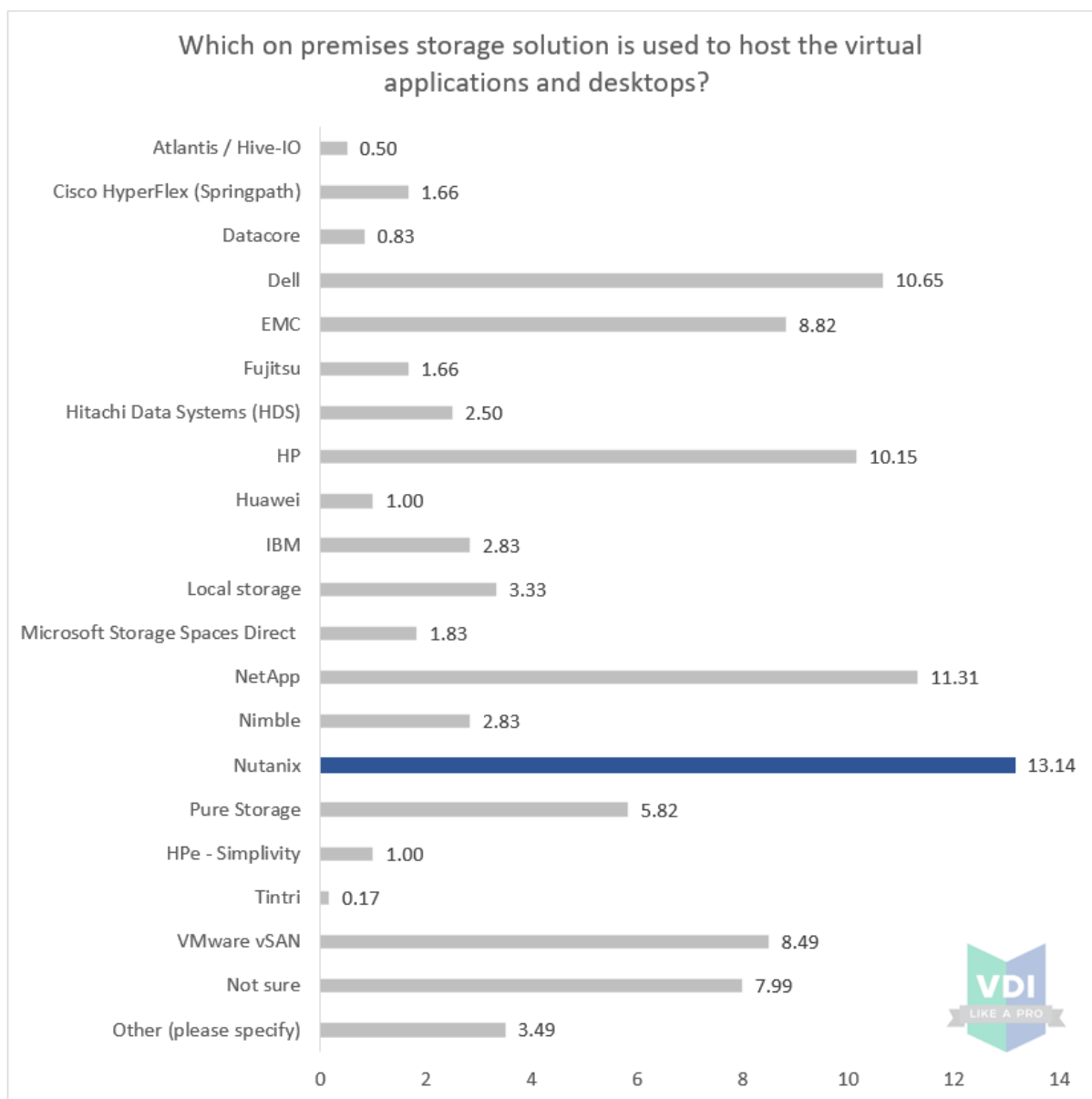
Hyper-converged infrastructure (HCI) and Software-defined storage (SDS) usage is being used in 29.28% of the deployments in 2021 a decrease of 4.61% from 2020. HCI all-flash is used the most with 15.47% followed by hybrid with 12.48%.

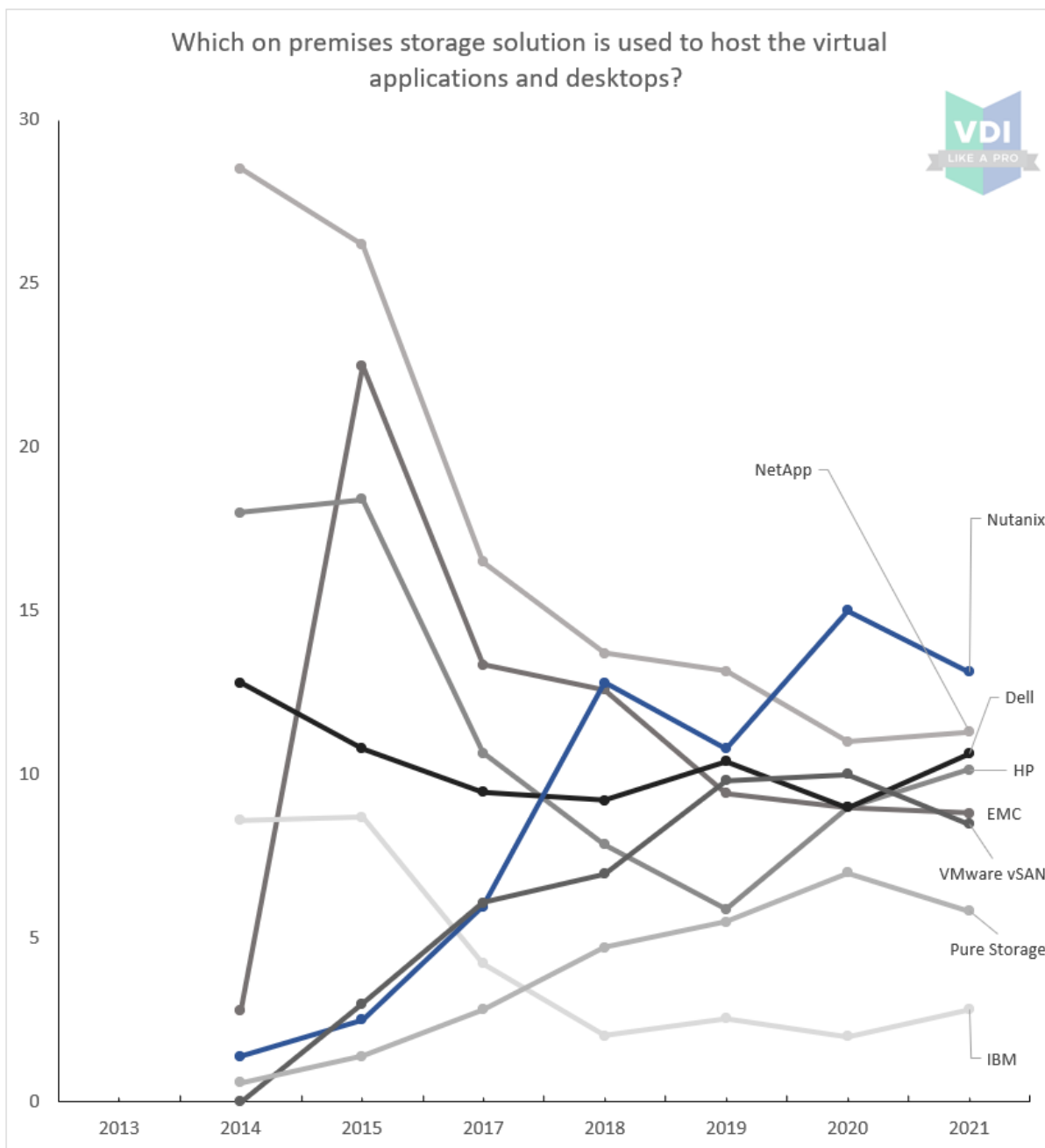


## Which on-premises storage product is used to host the virtual applications and desktops?

NetApp dropped from 28.5% in 2014, 17% in 2017, 13.71% in 2018, 13.16% in 2019, 11% in 2020 and increased to 11.31% in 2021. EMC declined from 22.8% in 2014, 12.58% in 2018, 9.43% in 2019, 9.27% in 2020 and 9% in 2021. HPE declined from 18% in 2014, 7.87% in 2018 and 5.89% in 2019 and increased to 9.27% in 2020 and 10.15% in 2021. Pure storage adoption increased from 2.81% in 2017, 4.72% in 2018, 5.50% in 2019, 6.85% in 2020 and decreased to 5.82% in 2021. VMware VSAN usage increased from 6.97% in 2018, 9.82% in 2019, 10.08% in 2020 and decreased to 8.49% in 2021. HCI solutions from Cisco and HPE/Simplivity combined are declining from 5.24% in 2020 to 2.66% in 2021 of the deployments in 2021.

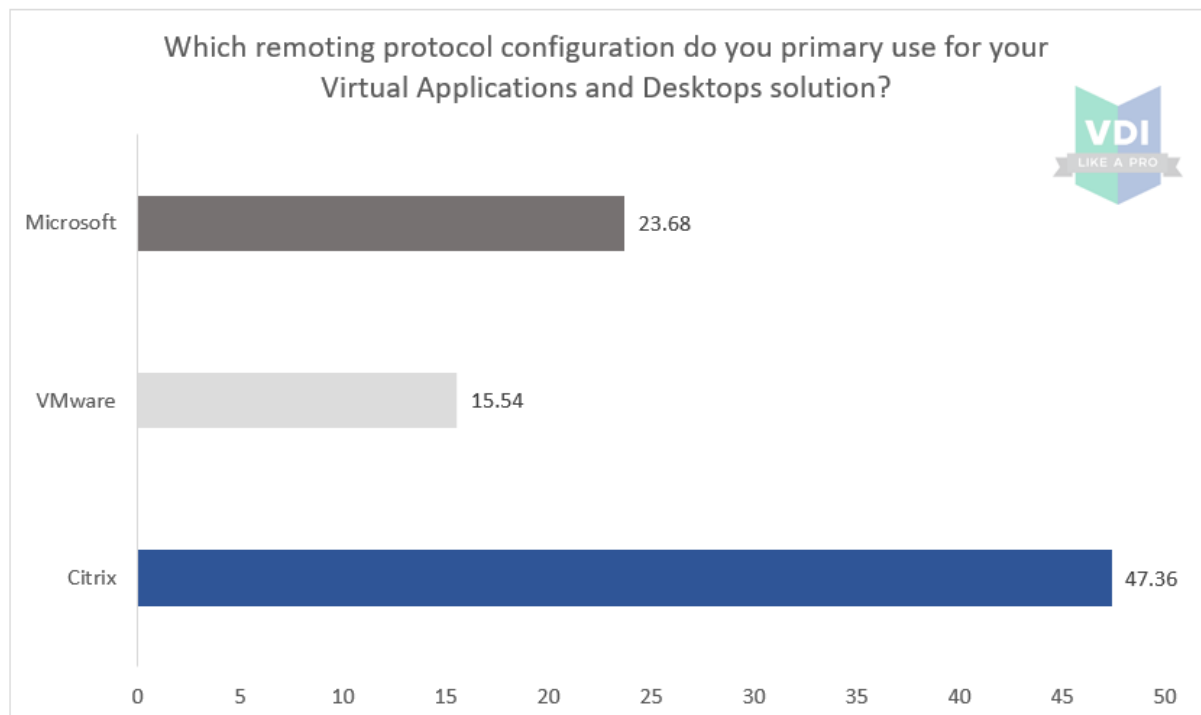
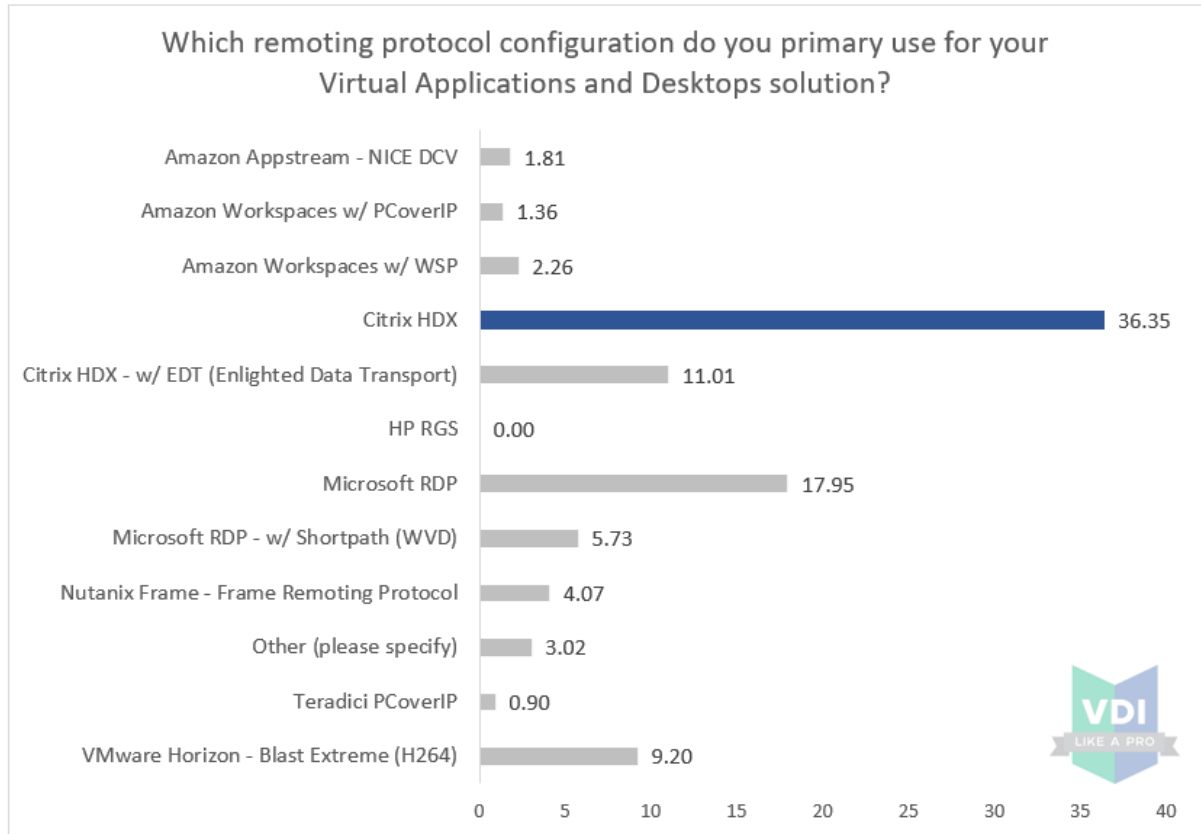
Nutanix usage increased from 1.4% in 2015, 5.97% in 2017, 12.81% in 2018 and decreased to 10.81% in 2019 followed by an increased to 14.92% in 2020 and decreased in 2021 to 13.14%. Nutanix is the leading platform for virtual applications and desktops with 13.14%





## Which remoting protocol configuration do you primary use for your Virtual Applications and Desktops solution?

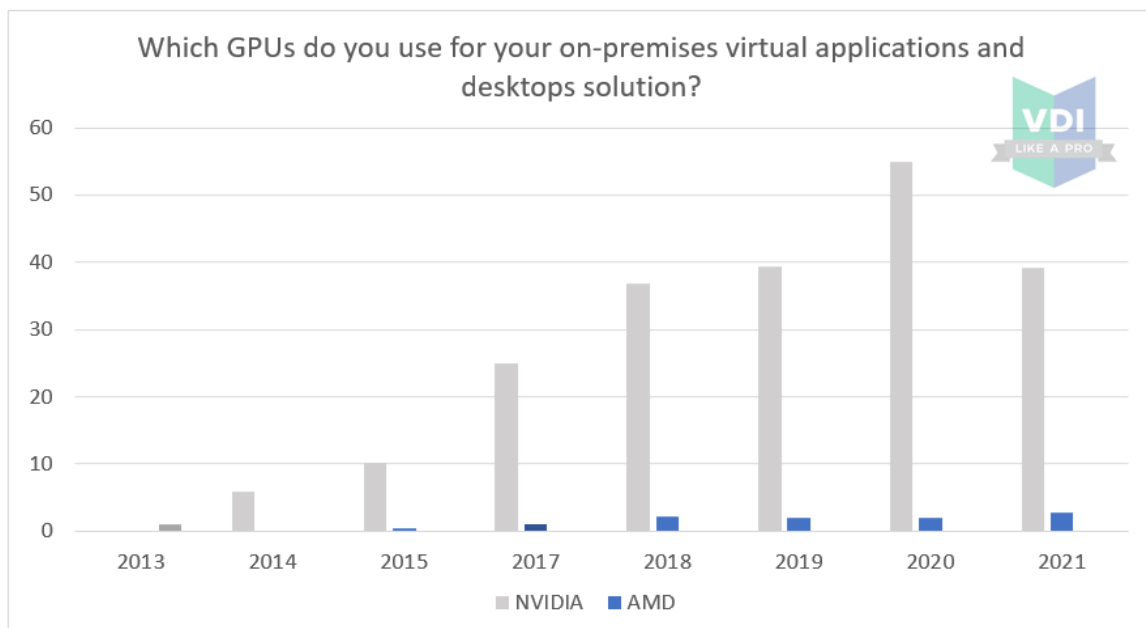
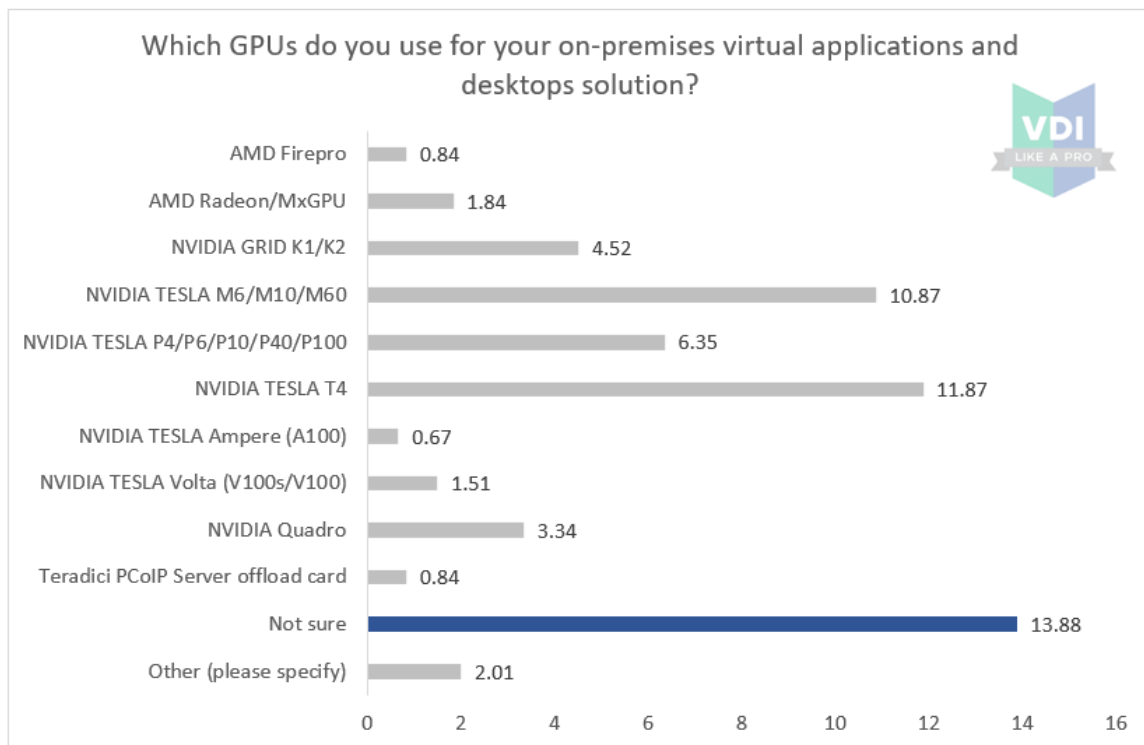
A new question in the 2021 survey this year is around the Protocol being used in the context of on-premises and Desktop-as-a-Service. Citrix HDX is the leading remoting protocol with 36.35%, followed by Microsoft RDP with 17.95%. Citrix HDX w/ EDT is 3<sup>rd</sup> with 11.01% and 4<sup>th</sup> is VMware Blast Extreme with 9.20% of the deployments.



## Which GPUs do you use for your virtual applications and desktops?

The biggest GPU competitors isn't AMD versus NVIDIA—it's the CPU. "No GPU" declined from 78% in 2014, 67% in 2016, 56% in 2017, 44.92% in 2018, 43.06% in 2019, 35.41% in 2020. In 2021 GPU adoption declined by 6.06%, 41.47% isn't using GPU technology. Usage of GPUs (NVIDIA specifically) grew from 6% in 2014, 10% in 2015, 25% in 2017, 40.60% in 2018, 43.35% in 2019, 55% in 2020 and declined to 41.81% in 2021. The NVIDIA TESLA T4 is used the most with 11.87%. AMD is slowly entering the EUC space with EPYC CPUs and Radeon GPUs, the AMD GPUs have entered the public cloud space with Azure NVv4 machines, but on-premises AMD GPUs unfortunately aren't used a lot in 2021, as in 2020.

A new question we will ask in the 2022 survey is the actual % usage of GPUs in virtual desktops and application deployments.

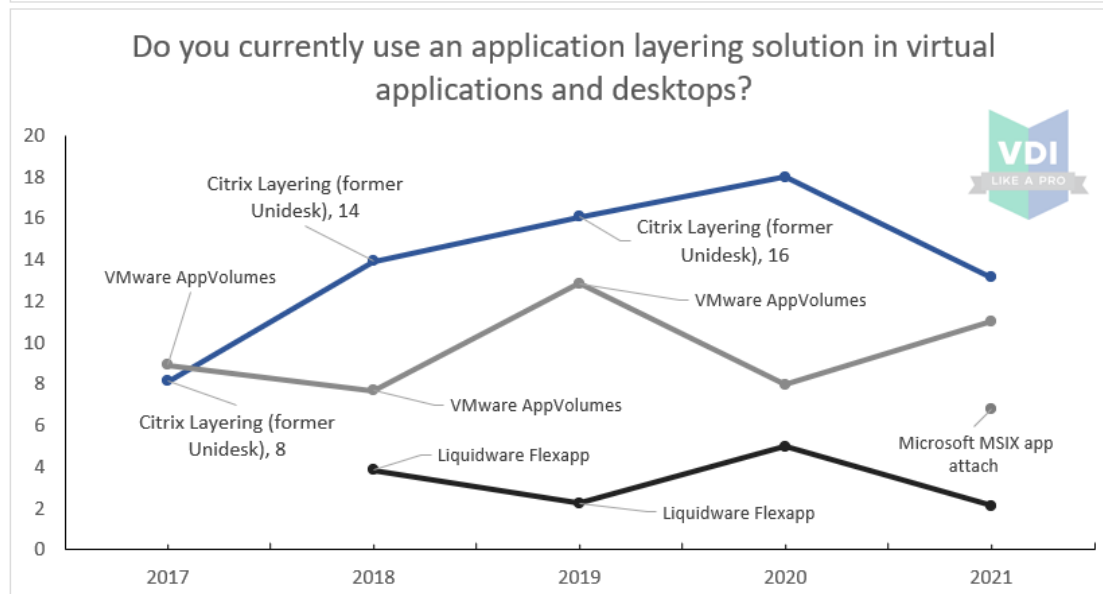
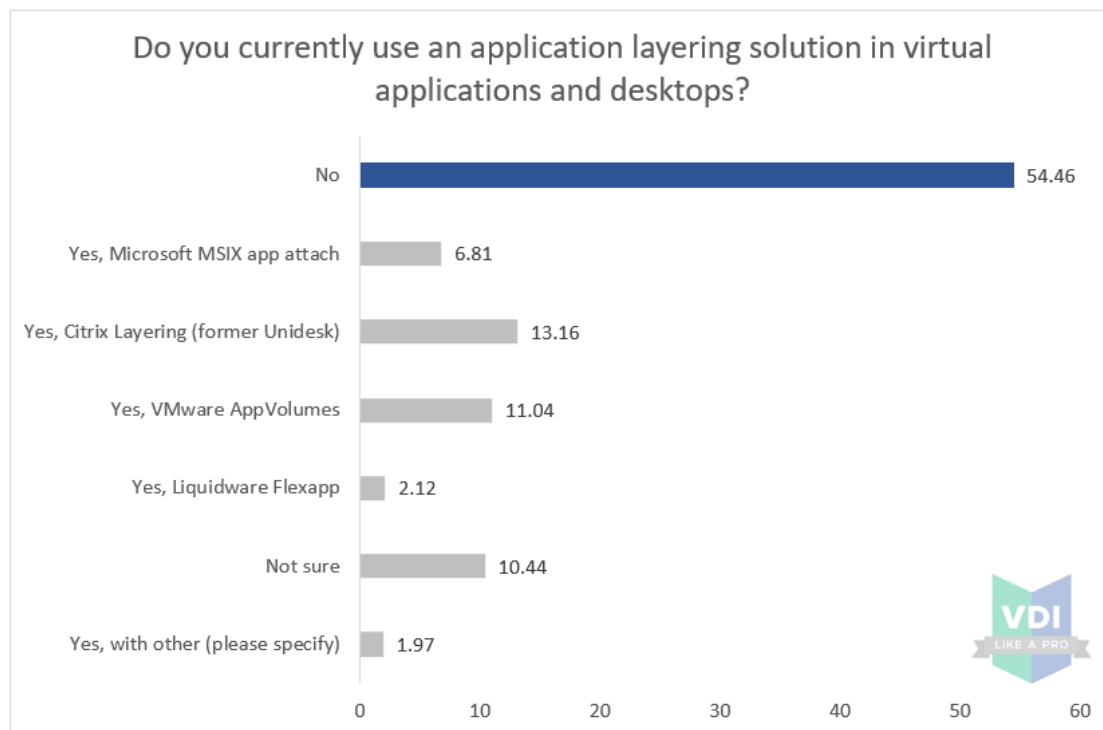


## Applications: Layering, imaging, updates, management, isolation, antivirus, workspace portal and more

### Do you currently use an application layering solution in virtual applications and desktops?

While most respondents aren't using layering solutions in virtual desktops and applications, 74.16% in 2017, 66.59% in 2018, 60.13% in 2019, 61.45% in 2020, 54.46% in 2021. Application layering is taking ground with 35.10% usage in 2021.

In 2021, Citrix is leading with 13.16% but a decrease of 4.66% compared to 2020. 2<sup>nd</sup> is VMware with 11.04% in 2021 an increase of 2.67% compared to 2020. Liquidware FlexApp usage decreased from 4.72% in 2020 to 2.12% in 2021. Microsoft MSIX app attach entered the stage with usage of 6.81% in 2021.

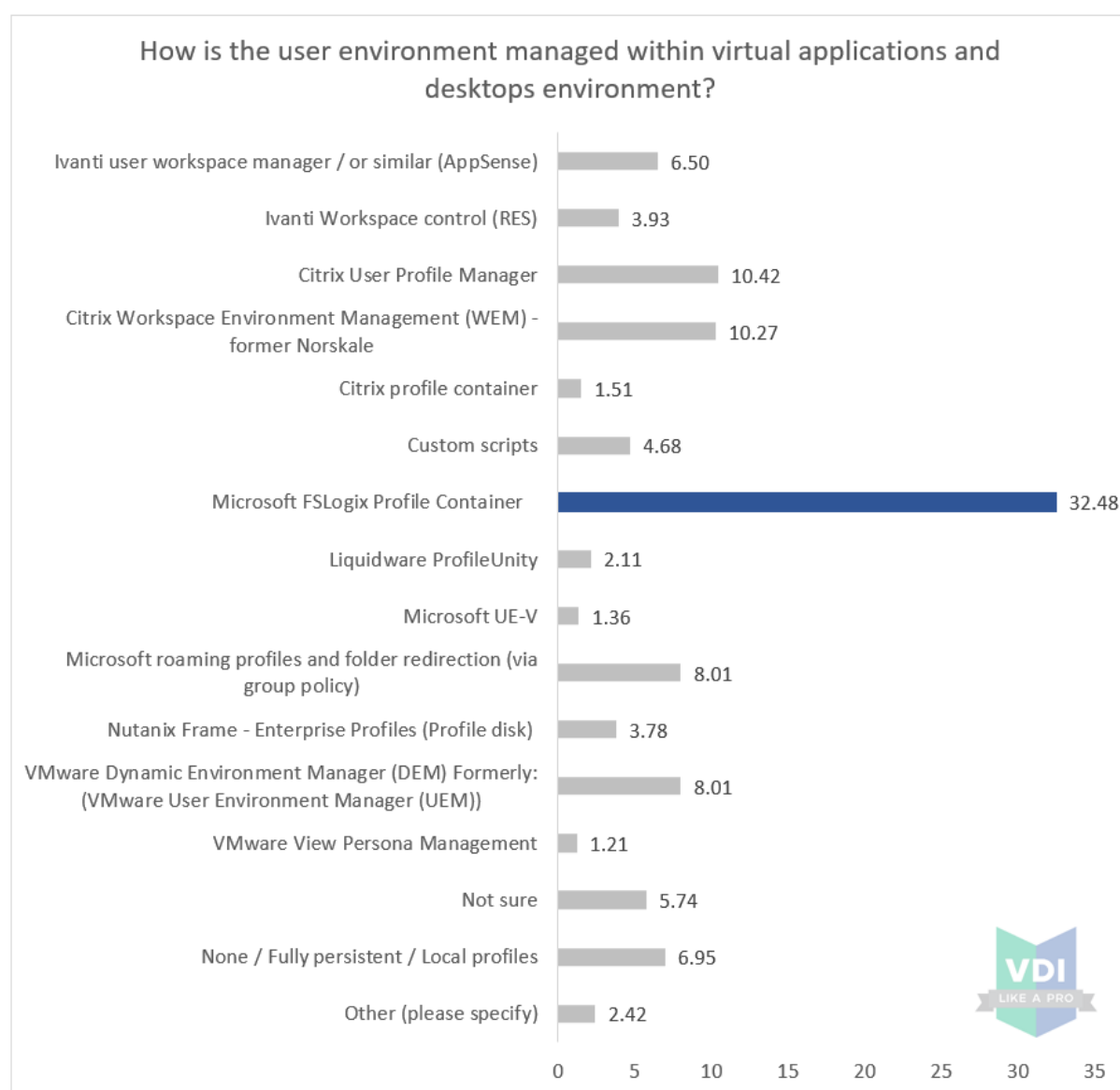


## How is the user environment managed?

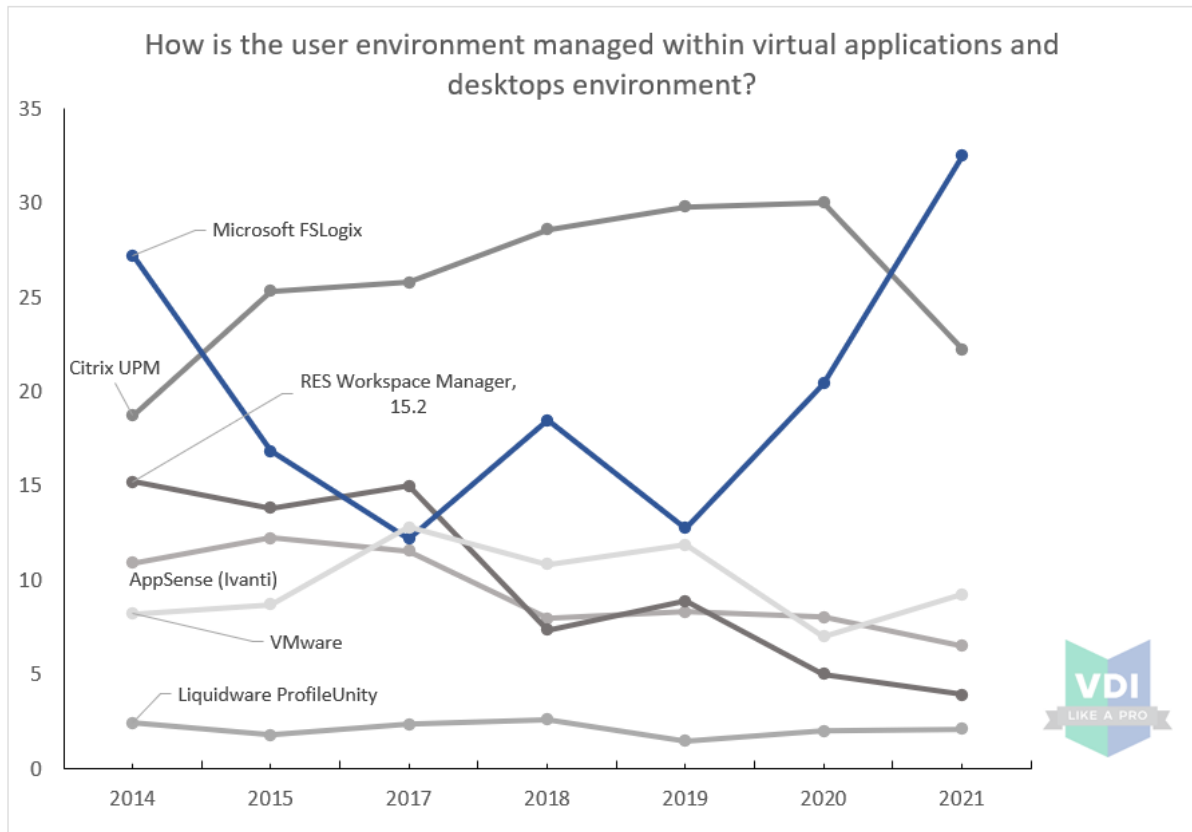
User Environment Management (UEM) software solutions do provide a wide range of functionality to set up, configure, control, and overall manage the complete Windows user environment. Managing and storing the Windows user profiles is one (important) element of UEM.

The total usage of Microsoft FSLogix Profile Container is 32.48% an increase of more than 11% compared to 2020. Citrix user environment management decreased almost 10%, usage is 20.69% in 2021, VMware solutions is 9.22% in increase of 2.01% compared to 2020 with DEM usage at 8.01%.

AppSense (Ivanti) usage declined from 8.32% in 2019 to 7.54% in 2020 and 6.50% in 2021 while RES Workspace Manager (Ivanti) declined from 8.87% in 2019, 4.59% in 2020 and 3.93% in 2021. Nutanix Frame enterprise profiles usage entered 2021 with 3.78%. Liquidware Profile Unity usage is 2.11% in 2021. The use of custom scripts declined from 8.23% in 2018, 7.76% in 2019, 6.07% in 2020 and 4.68% in 2021.

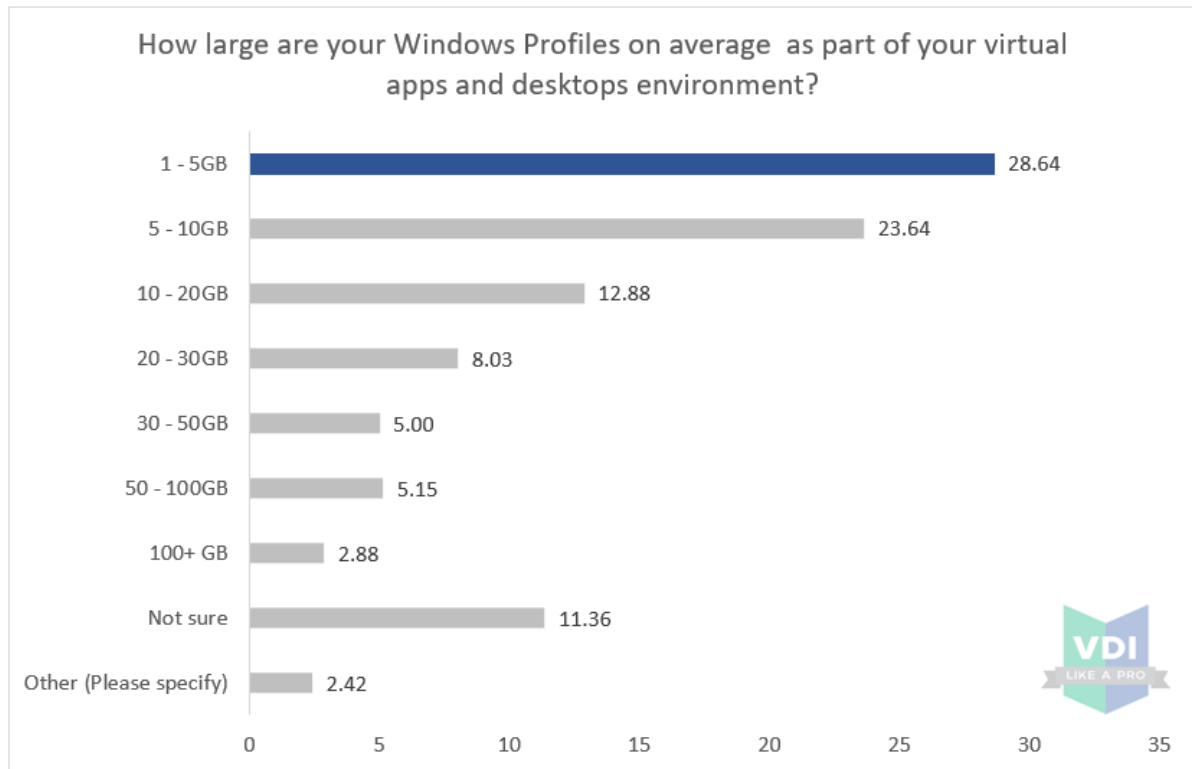






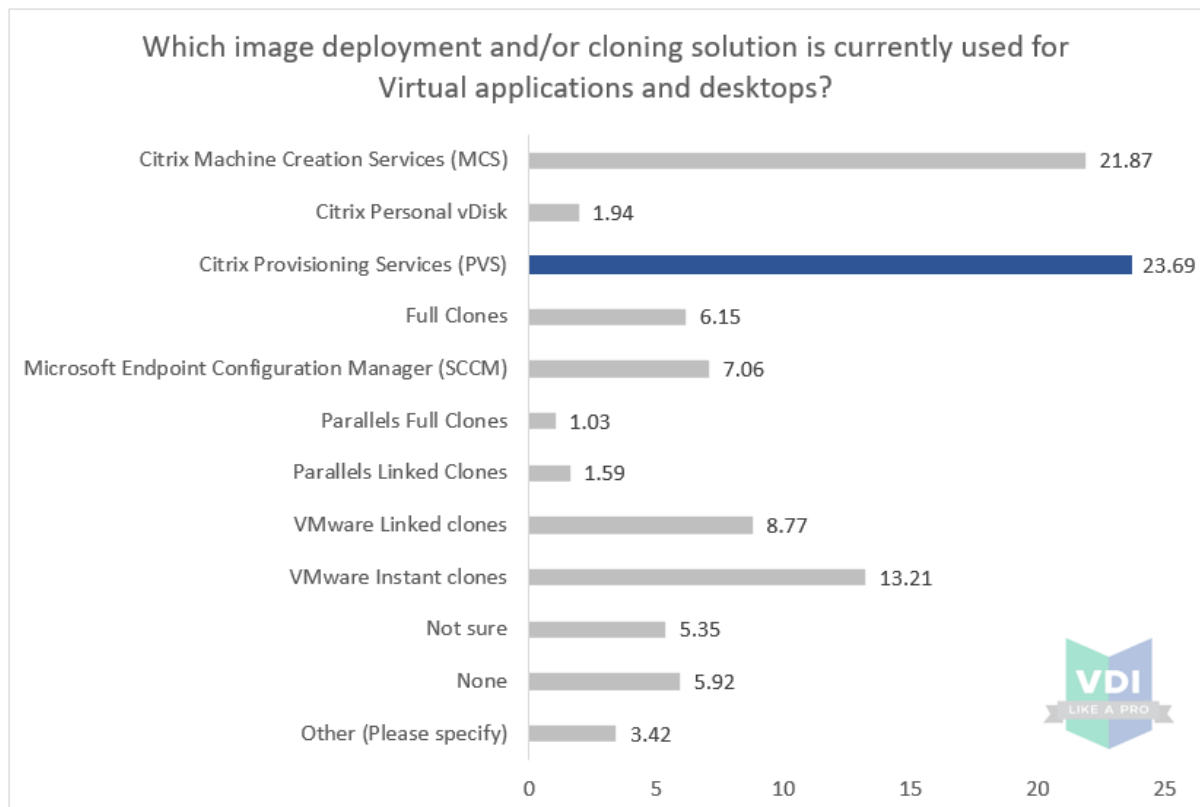
### How large are your Windows Profiles on average as part of your virtual apps and desktops environment?

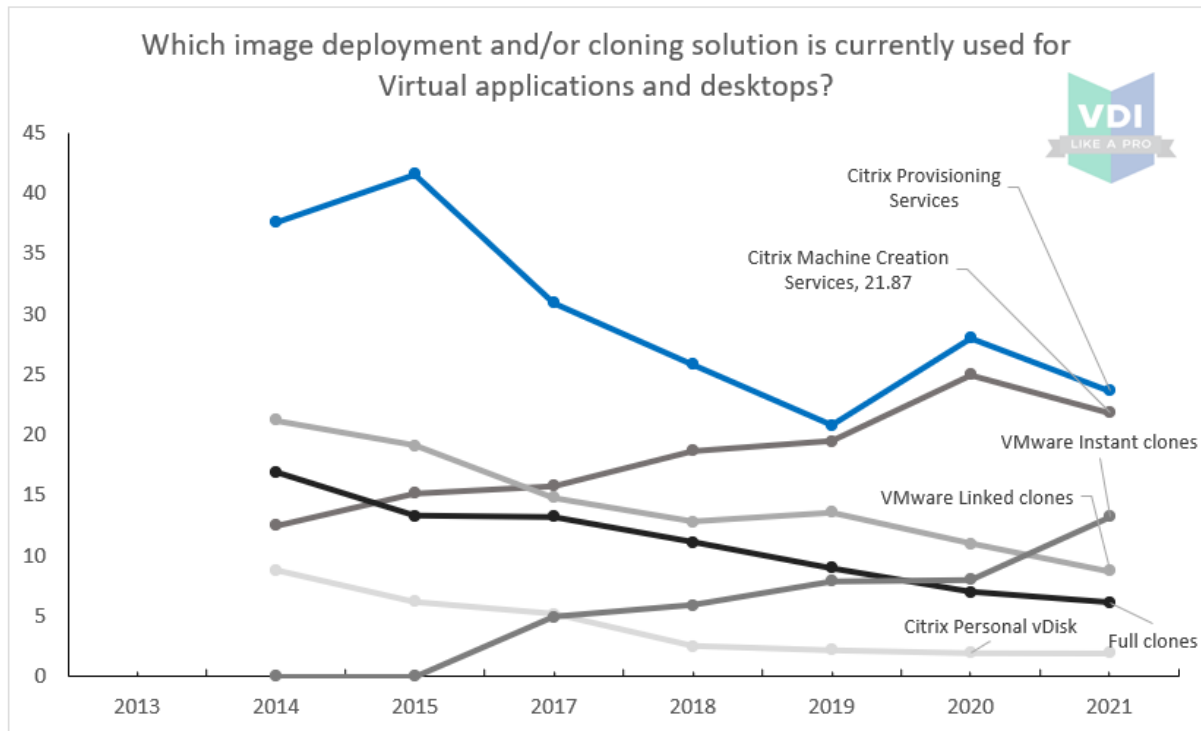
One of the new survey questions added in 2021 is the size of the Windows user profile. A Windows Profile size between of 1-5GB is common for 28.64% of the respondents followed by a user profile of 5-10GB in size by 23.64% of the respondents. The 3<sup>rd</sup> place with 12.88% are user profiles of 10-20GB in size. Only 2.88% has a windows profiles of 100+ GB in size. Also, interesting to note is that 11.36% doesn't know what the average user profile size for virtual applications and desktops is.



### Which image deployment and/or cloning solution is currently used?

While Citrix Provisioning Services (PVS) remains a popular choice in many Citrix environments with 28.27% in 2020 and 23.69% in 2021 Citrix Machine Creation Services (MCS) usage has increased from 15.78% in 2017, 18.72% in 2018, 19.47% in 2019, 24.95% in 2020 and decreased to 21.87% in 2021. VMware instant and linked clones are used in 21.98% of the deployments in 2021 an increase of 2.98% compared to 2020 with instant clones leading with 13.21%.

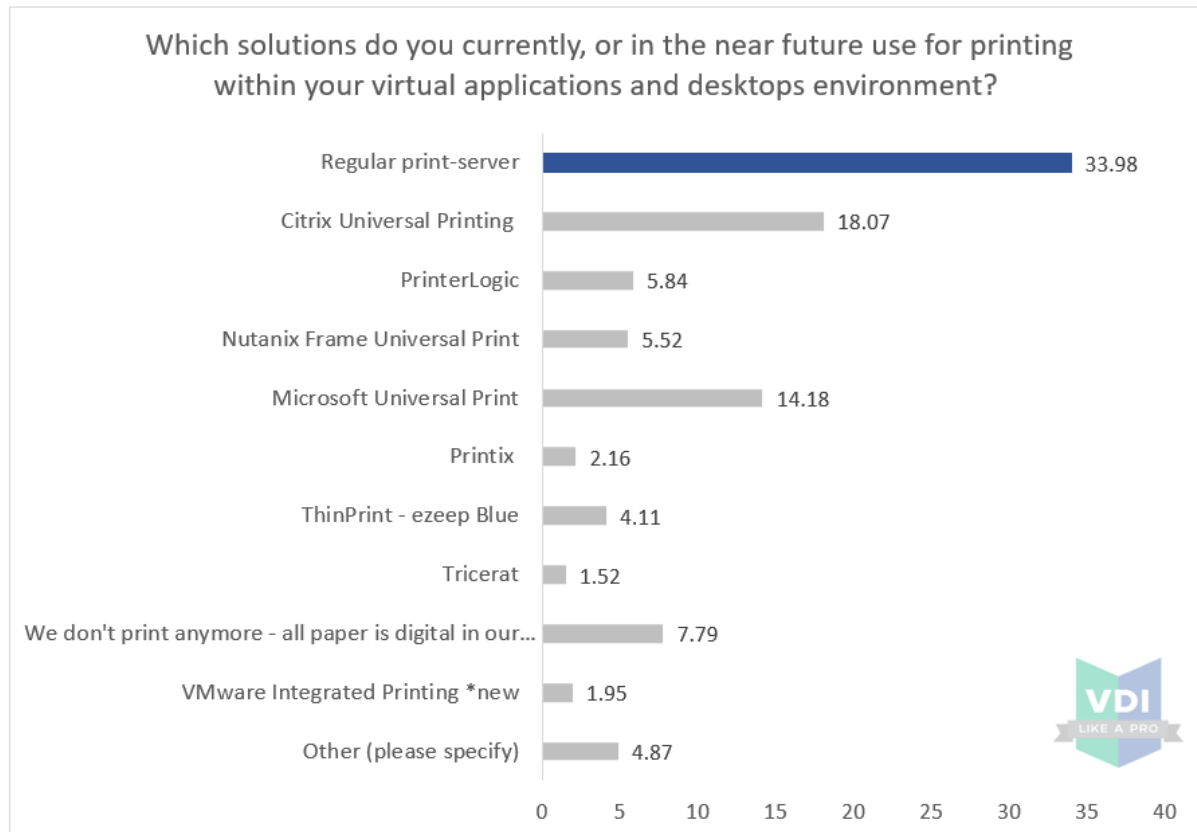




## Which solutions do you currently, or in the near future use for printing within your virtual applications and desktops environment? (multi-select)

Another new question in the 2021 survey is the question which printing solutions is being used. 33.98% is using a regular Microsoft Windows print server, Citrix Universal printing is 2<sup>nd</sup> with 18.07% followed by new Cloud printing solution Universal Print from Microsoft with 14.18%. 7.79% of the audience don't print anymore.

Interesting results, as with the demand for remote working, we expected less printing. The results proof the opposite. Let's see how the results look like next year...

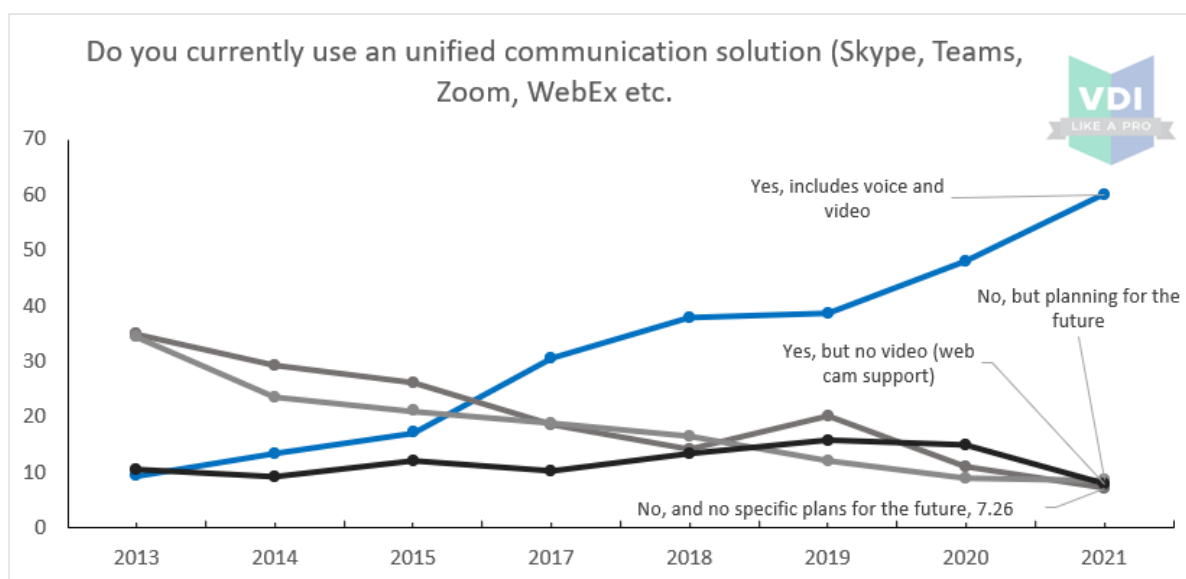
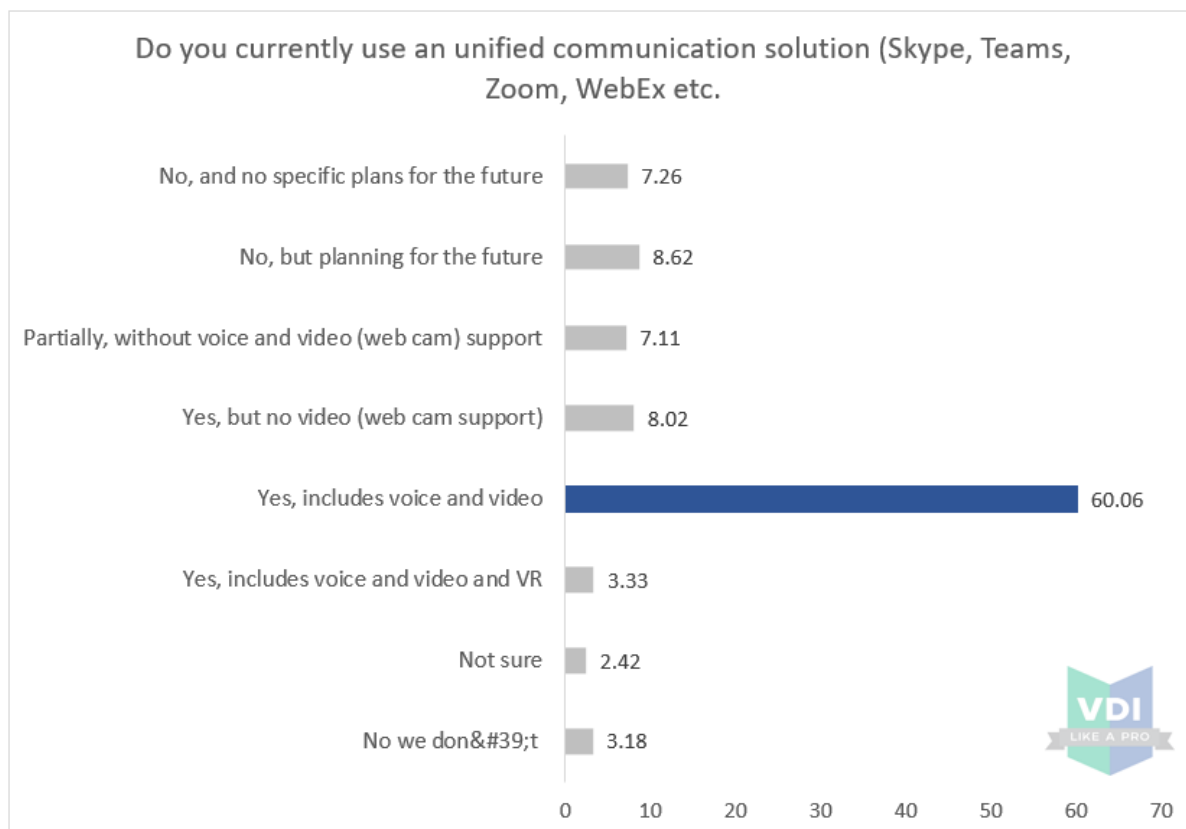


## Do you currently use unified communication solution?

“Work isn’t a place, it’s something you do” -- this statement applies to many especially these days. With increasing focus on work from home, future of work and digital transformation, we have seen a huge uptake in the use of unified communications solutions such as Zoom and Teams.

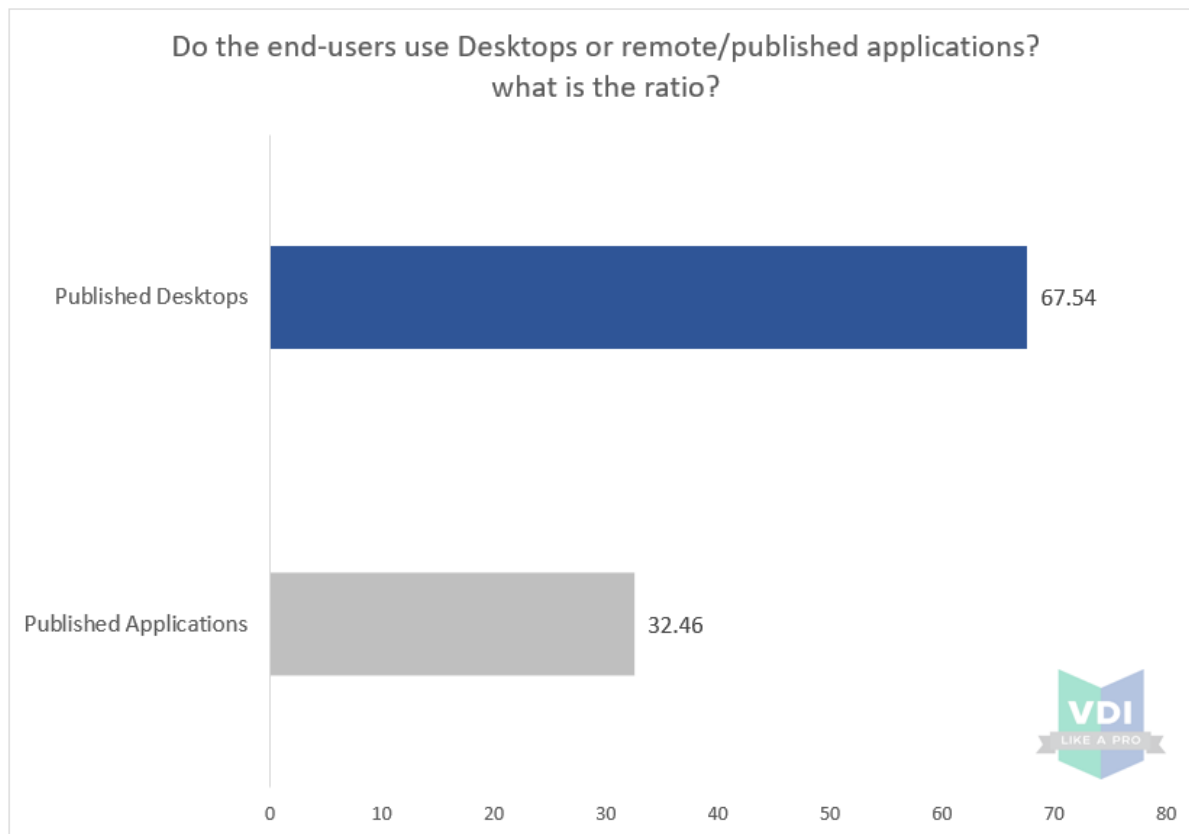
The use of unified communications with voice and video support has increased rapidly from 13.4% in 2014, 30.6% in 2017, 38.72% in 2019, 47.92% in 2020 to 60.06% in 2021.

While Unified Communications in virtual applications and desktops always is ‘attention’ and often challenging it is great to see usage increasing.



## Do the end-users use Desktops or remote/published applications?

Publishing Desktops instead of published applications is the mainstream method for end-users to access their virtual desktops and applications. 67.54% of the total respondent's do use virtual desktops and 32.46% do use virtual / published applications.



## How are Windows OS and applications installed, updated and managed on your main platform?

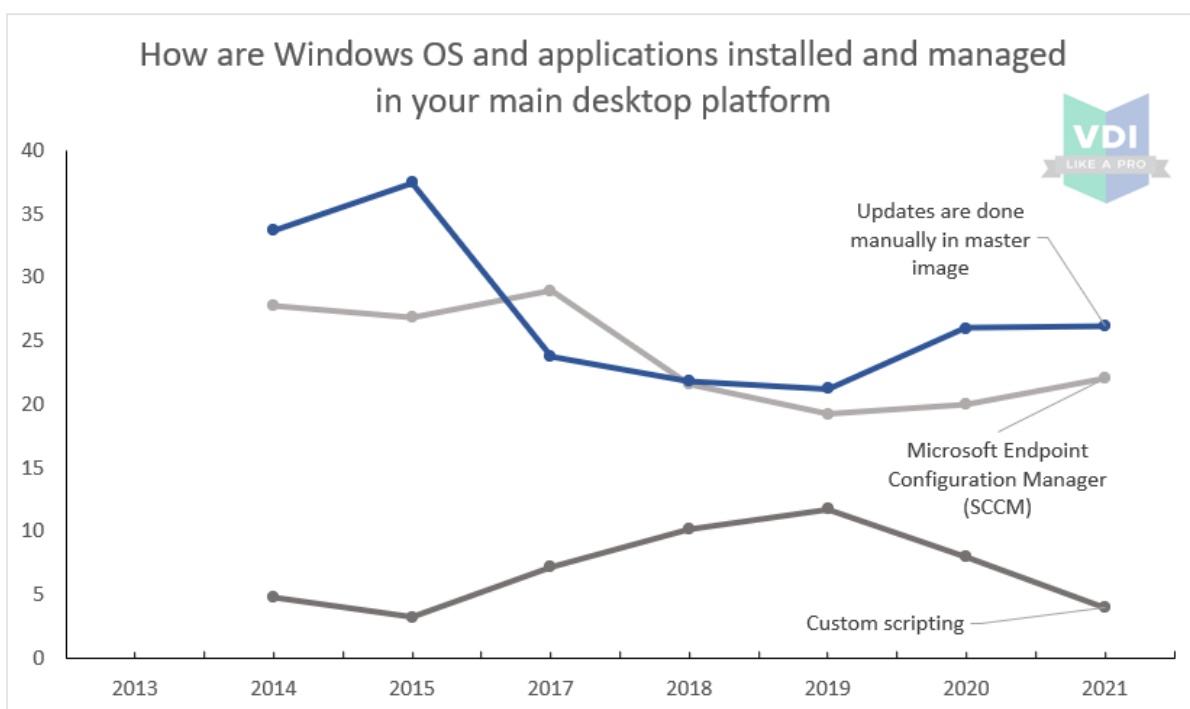
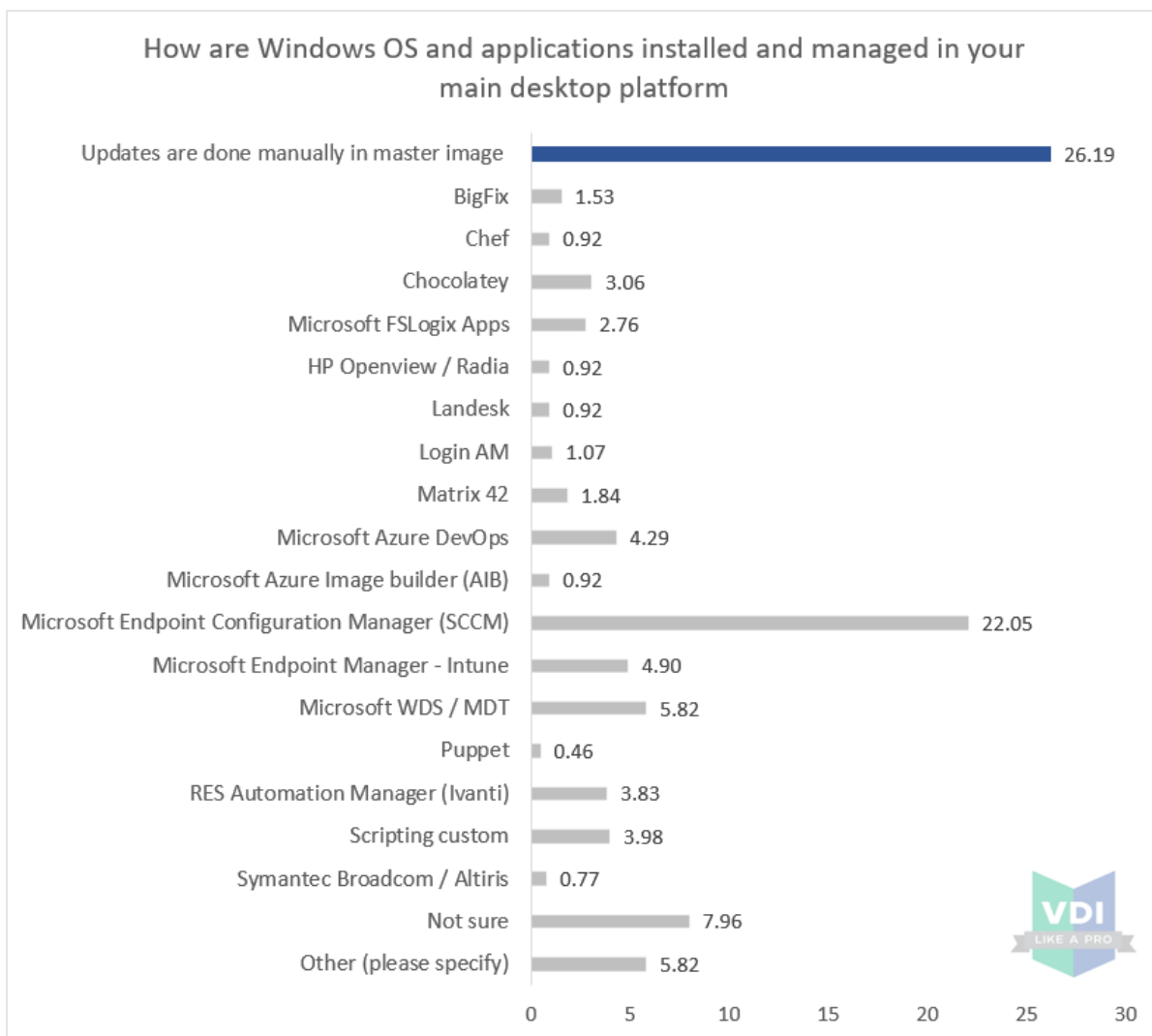
We are surprised to see that IT Admins are increasingly using manually installation and update of OS and applications within the master image. 26.19% in 2021 which was 25.82% in 2020 which already was an increase of 6.59% compared to 2019. This labor-intensive and error-prone way of working can seriously impact the performance and uptime of your environment, while plenty of alternatives already exist that can automate these tasks.

Microsoft endpoint configuration manager (SCCM) adoption was declining from 28.93% in 2017, 21.86% in 2018, 19.23% in 2019 and slightly increased to 20.48% in 2020 to 22.05% in 2021.

Microsoft WDS/MDT decreased from 8.78% in 2020 to 5.82% in 2021.

Microsoft endpoint manager (Intune) is used in 4.90% of the deployments,

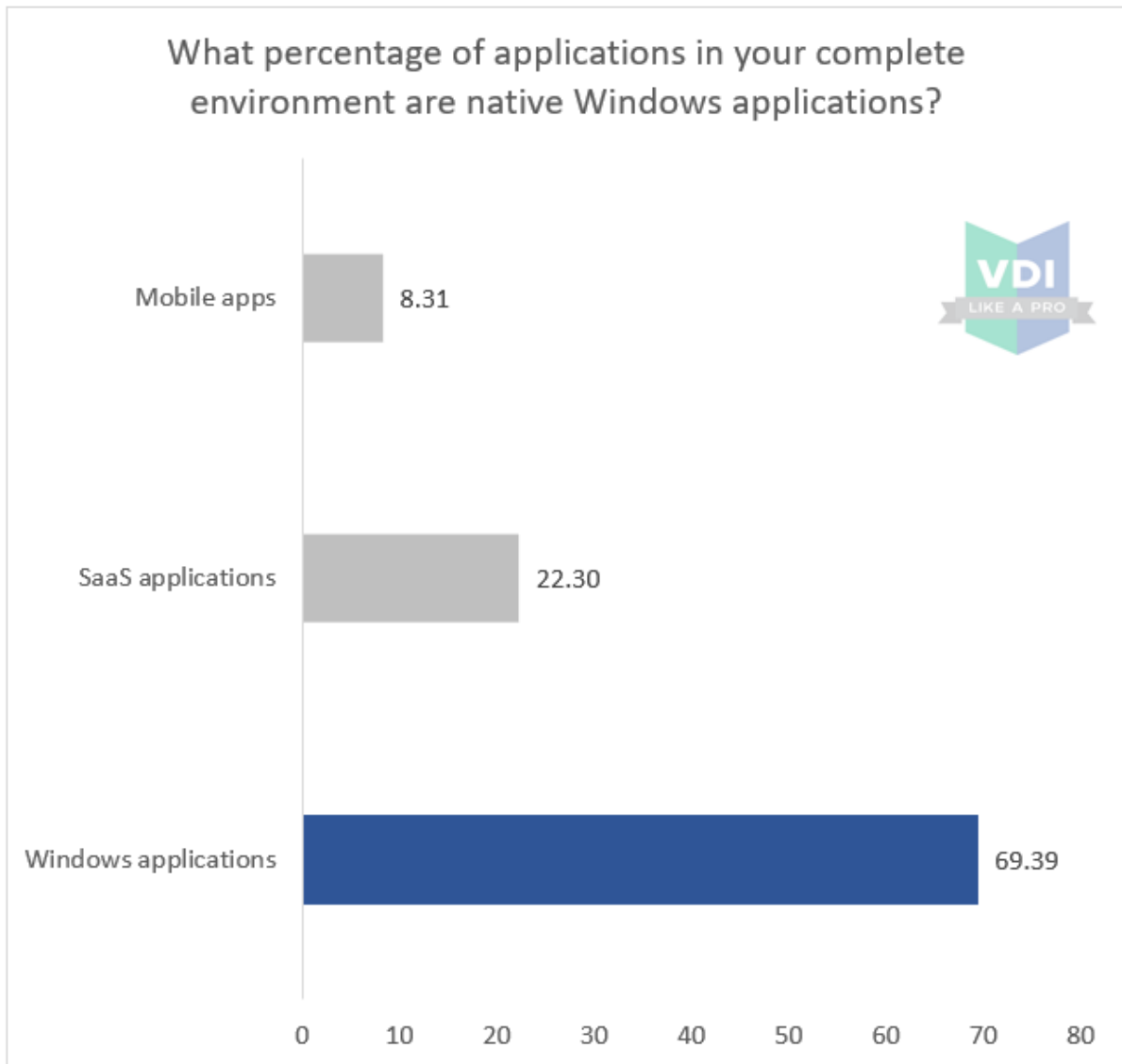
Microsoft Azure DevOps is used in 4.29% of the deployments.



### What % of applications in your environment are native Windows applications?

69.39% of all the applications in the organization are Windows based applications, followed by 22.30% Web/SaaS applications and 8.31% of the applications are mobile.

No surprise with millions of Windows applications available globally, Windows is a core part of today's and tomorrow's workspace.

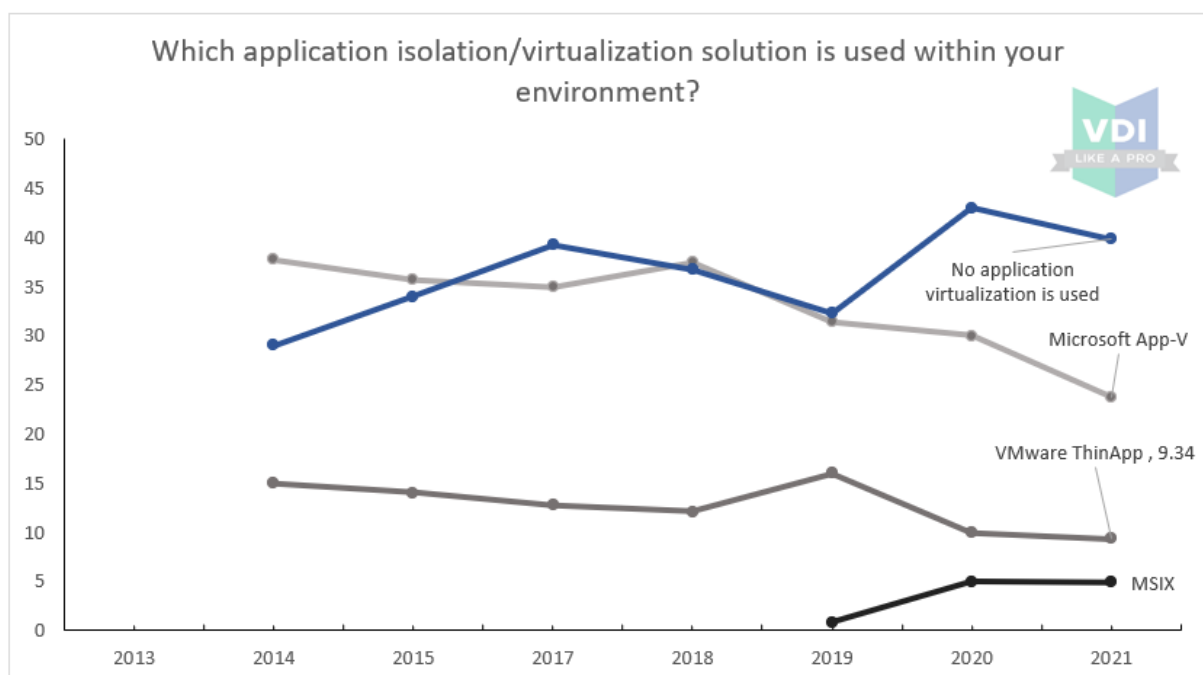
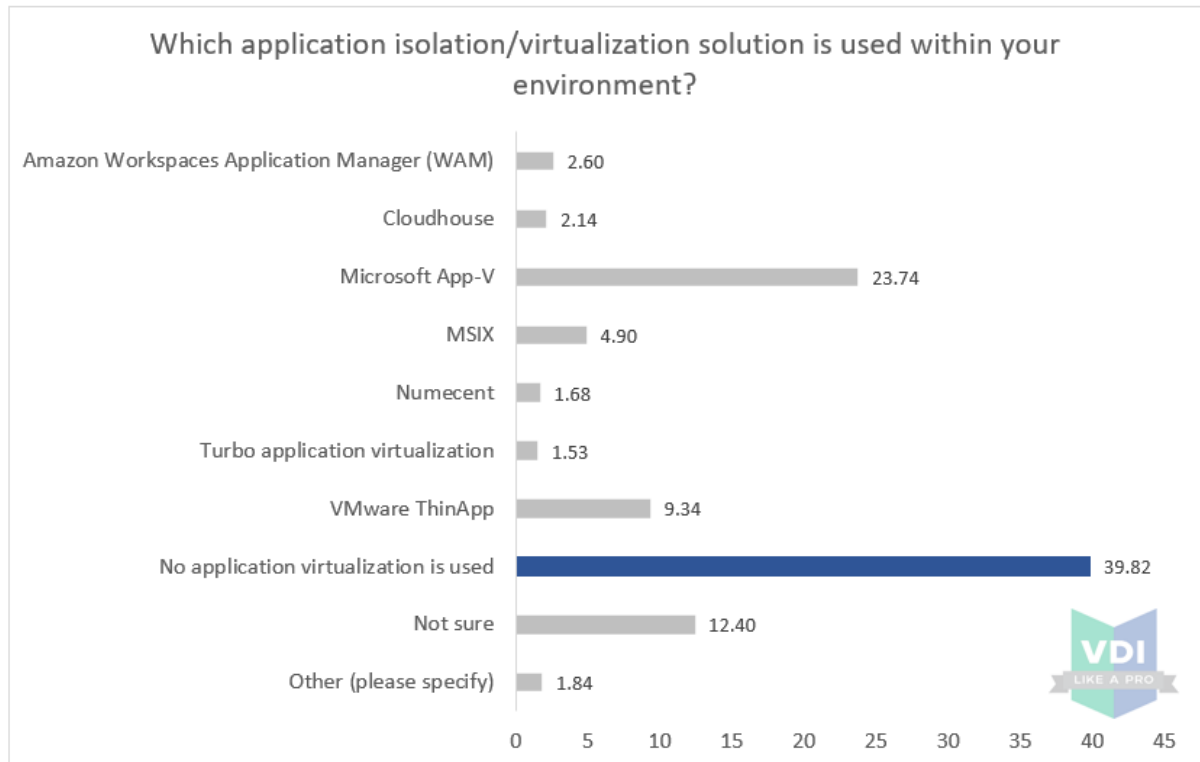




## Which application isolation/virtualization solution is used within your environment?

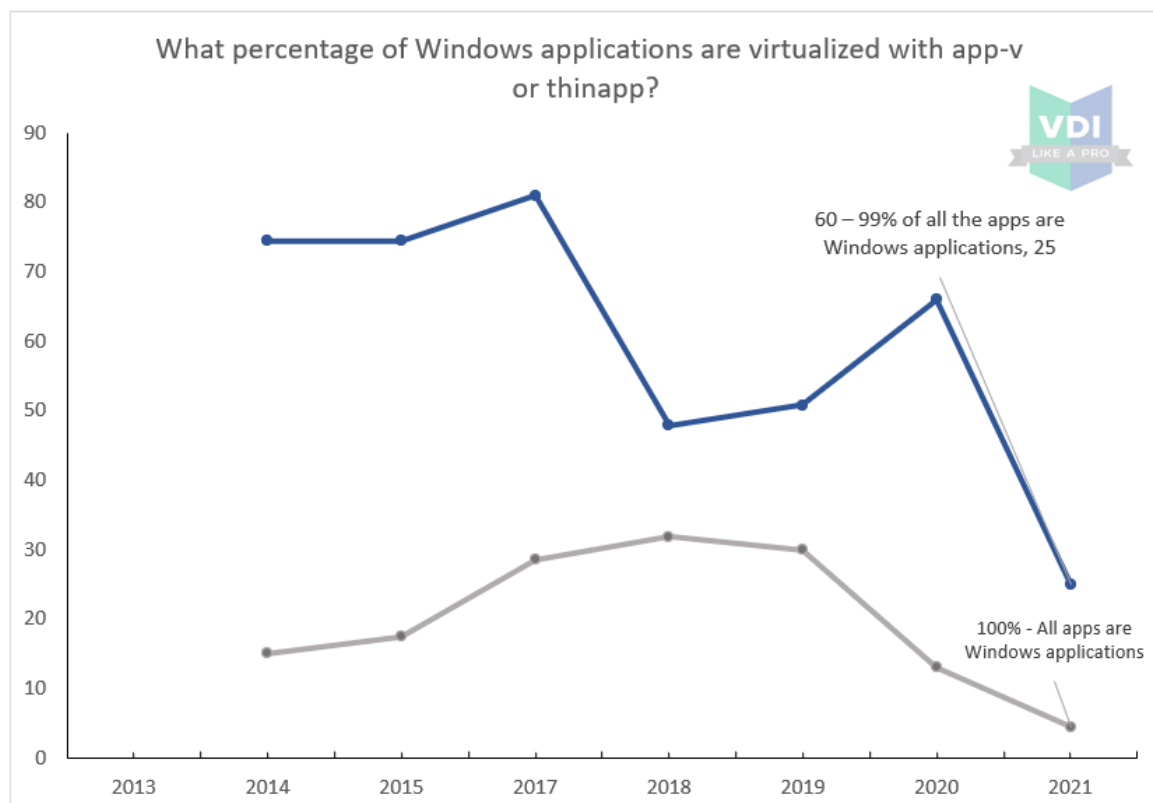
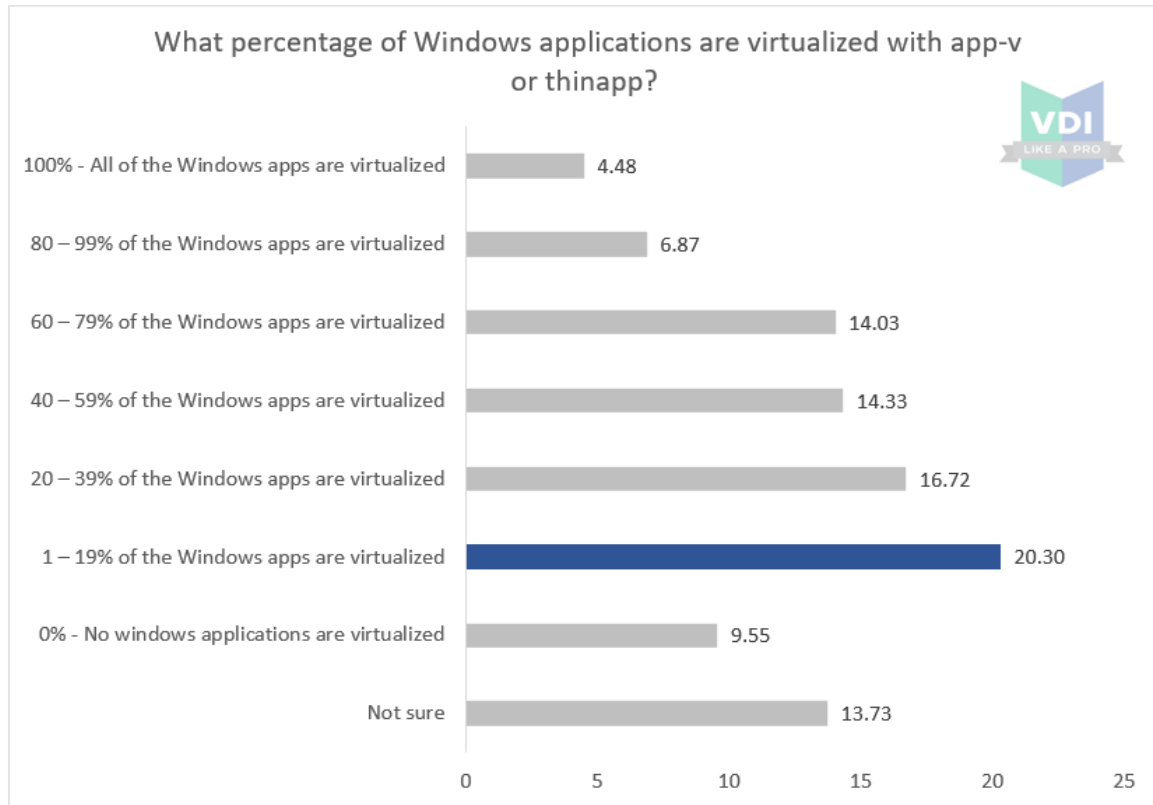
The biggest competitor for application isolation/virtualization solutions isn't Microsoft or VMware -- it's 'NoAppVirt'. Almost 39.82% of the organizations are not using any application virtualization solutions (like Microsoft App-V, VMware ThinApp, Cloudhouse, Numecent or Turbo).

Microsoft App-V still is the main application virtualization solution in virtual desktops and applications with 23.74% in 2021. VMware ThinApp, with 9.34% is the second most common application virtualization solution for virtual desktops and applications. ThinApp usage increased from 12.09% in 2018, 15.99% in 2019, declined to 9.92% in 2020 and 9.34% in 2021. MSIX usage is 4.90% and Amazon Workspaces application manager is 2.60%.



## What percentage of Windows applications are virtualized?

Fewer participants are using application virtualization solutions. We do see that those who do virtualize their applications have a lower adoption rate as the 80-100% category dropped from 30.86% in 2019 to 26.83% in 2020 and 11.35% in 2021. The category of 1-40% of the applications is virtualized increased from 21.91% in 2019, 35.78% in 2020 to 37.02% in 2021.

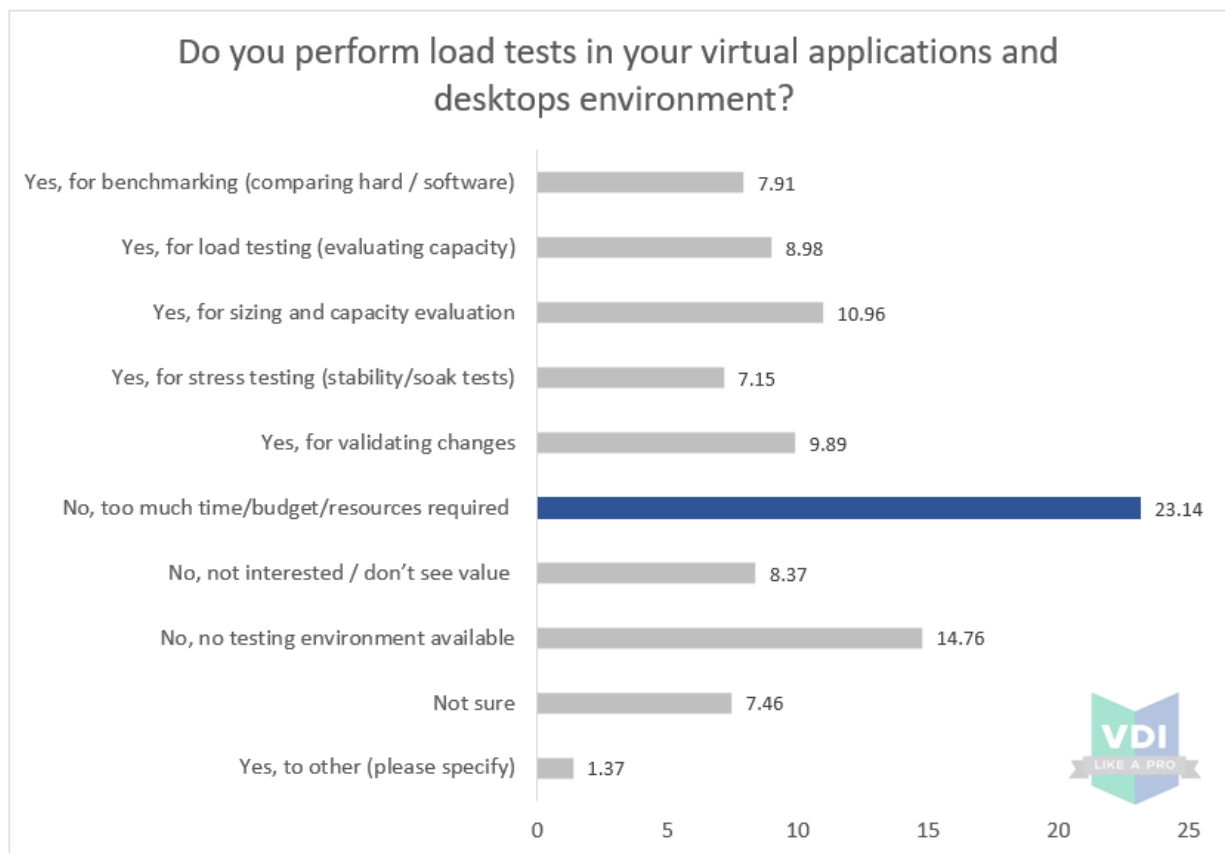


## Various questions: Load testing, patching, devices, display config and more

### Do you perform load tests in your virtual applications and desktops environment?

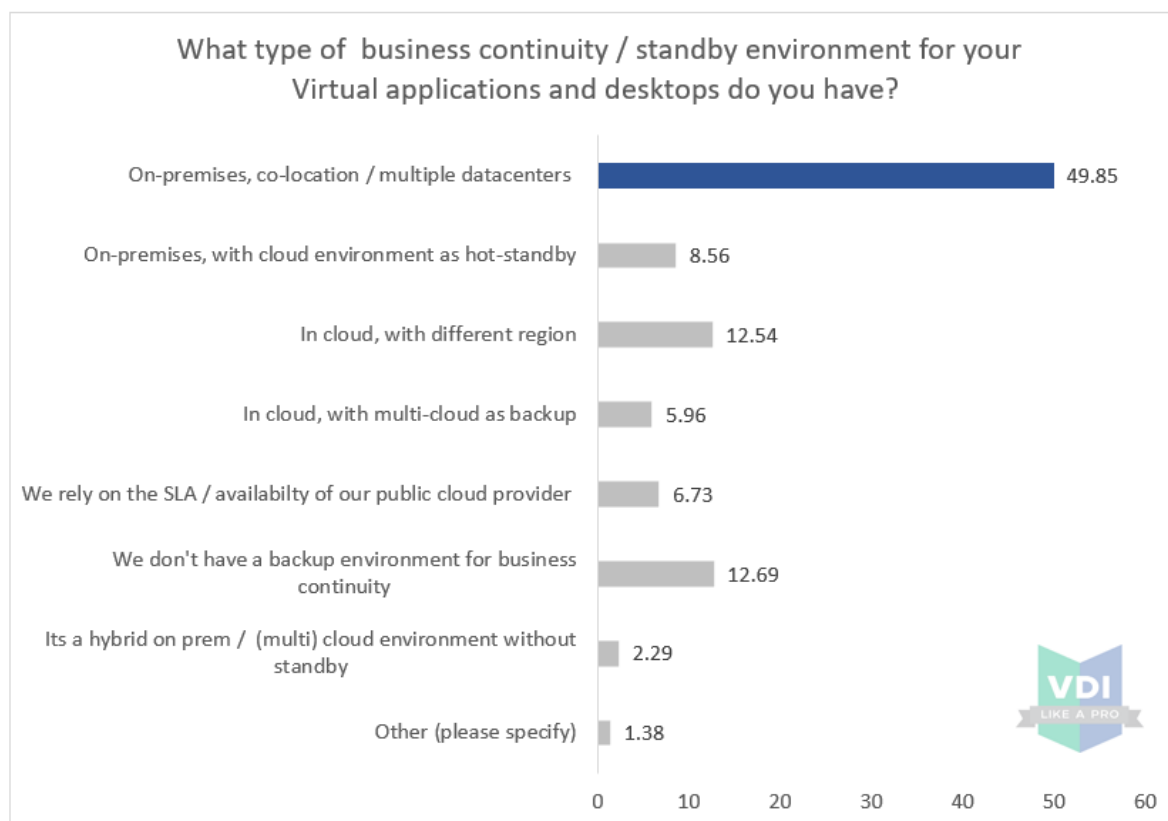
In total 44.89% of the respondents do perform load tests in their virtual desktop and application environment. Load testing is important, not only for newly built environments but more importantly to continuously monitor the performance of the applications and desktop from the end-user perspective -- especially after various intel security fixes.

Many of the participants (14.76%) don't have a test environment available to do performance testing. While 23.14% of the respondents don't perform load/stress tests because of budget/resources or time constraints



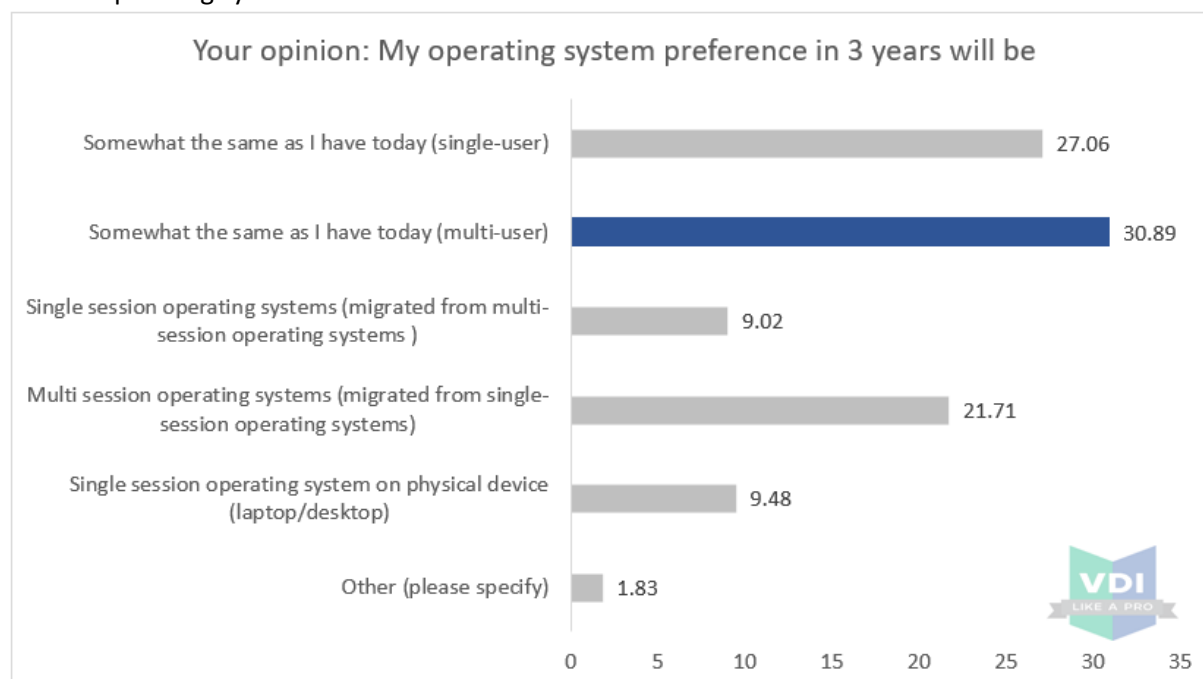
## What type of business continuity / standby environment for your Virtual applications and desktops do you have?

49.85% of the respondents do have an on-premises/multiple datacenter environment available for business continuity while 12.69% doesn't have a standby environment at all.



## Your opinion: My operating system preference in 3 years will be

57.95% of the respondents expect their operating system, single-user or multi-user, to be the same in the next 3 years. 9.02% expect to switch from a multi-session operating system to a single session operating system while 21.71% expect to switch from a single session operating system to a multi-session operating system.

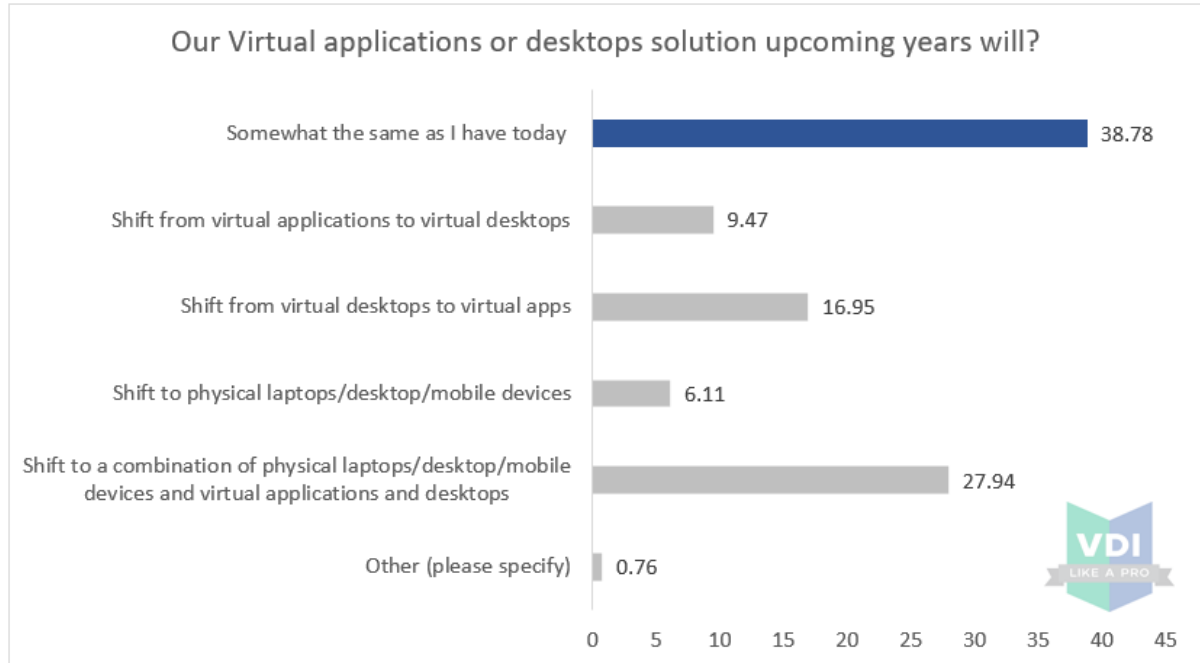


### Our Virtual applications or desktops solution upcoming years will:

Upcoming years, how will the virtual application and desktop solution look like?

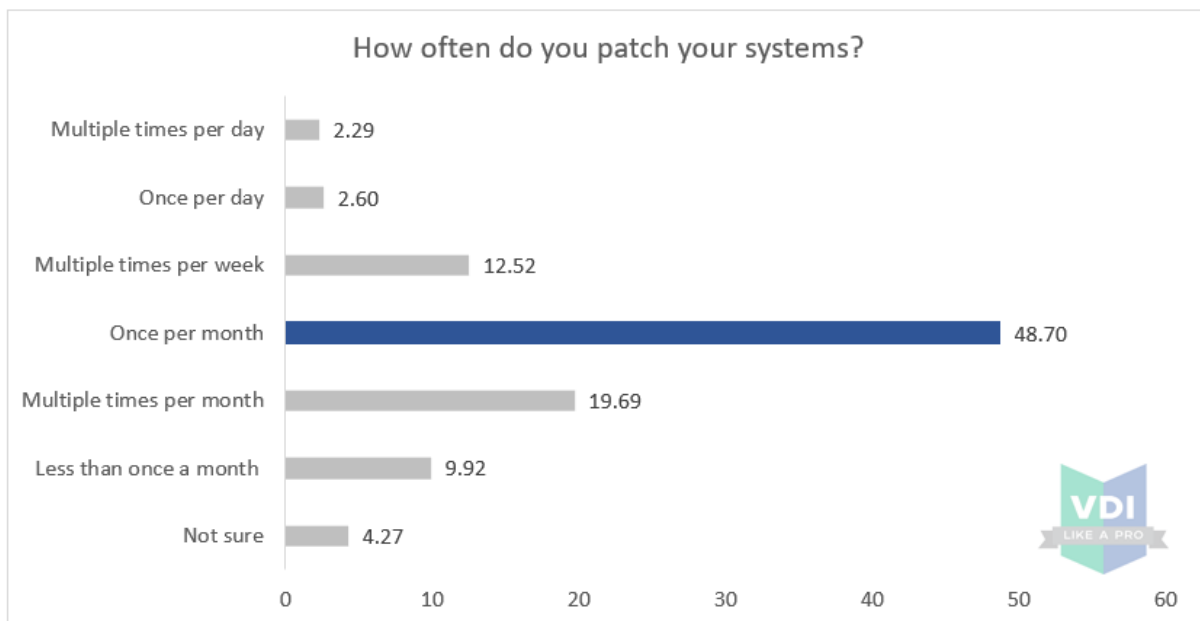
38.78% expect it will look somewhat the same as today while 27.94% expect it will shift more towards a combination of physical PCs and virtual applications and desktops.

16.95% expect more virtual application focus instead of a virtual desktop.



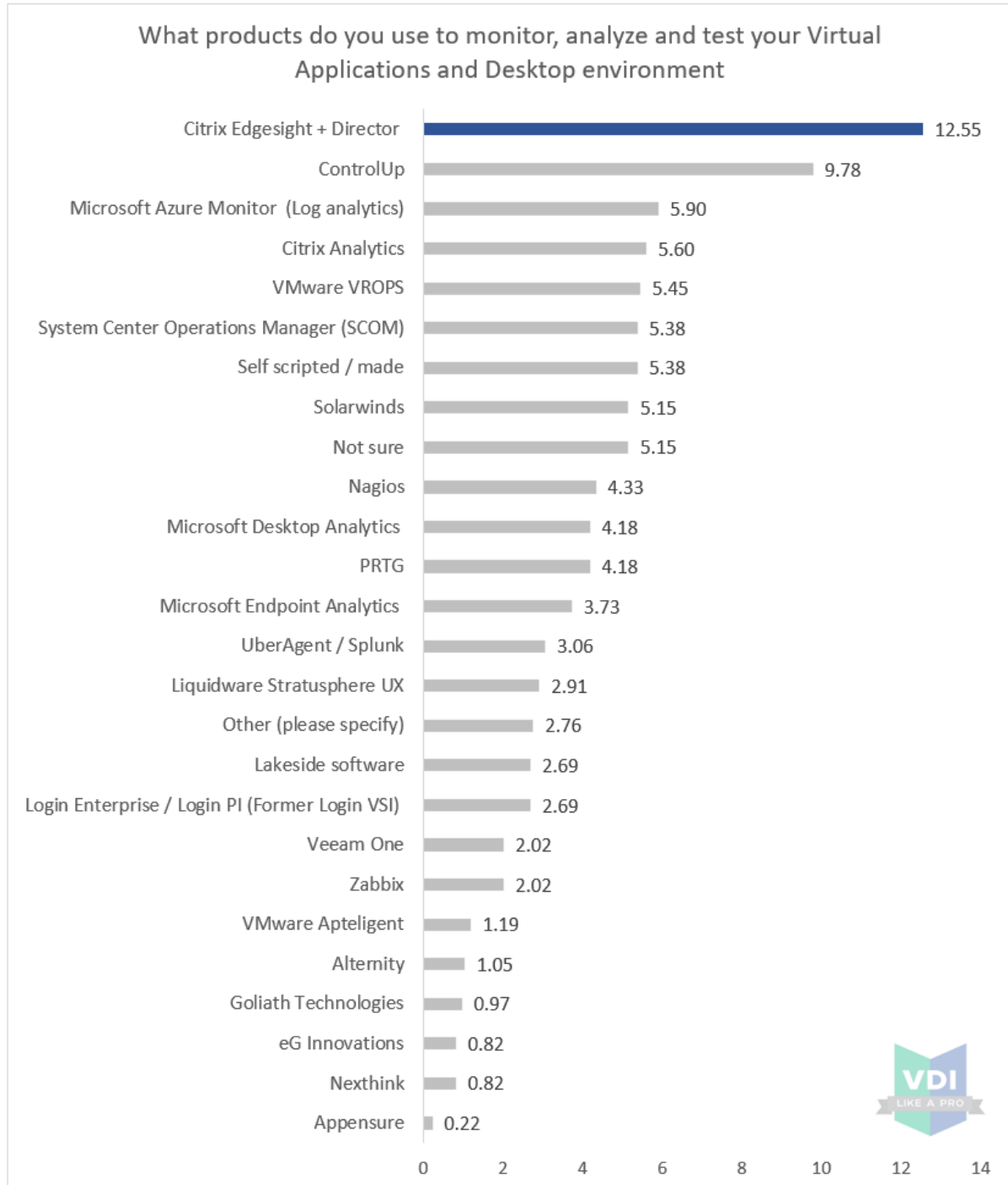
### How often do you patch your systems?

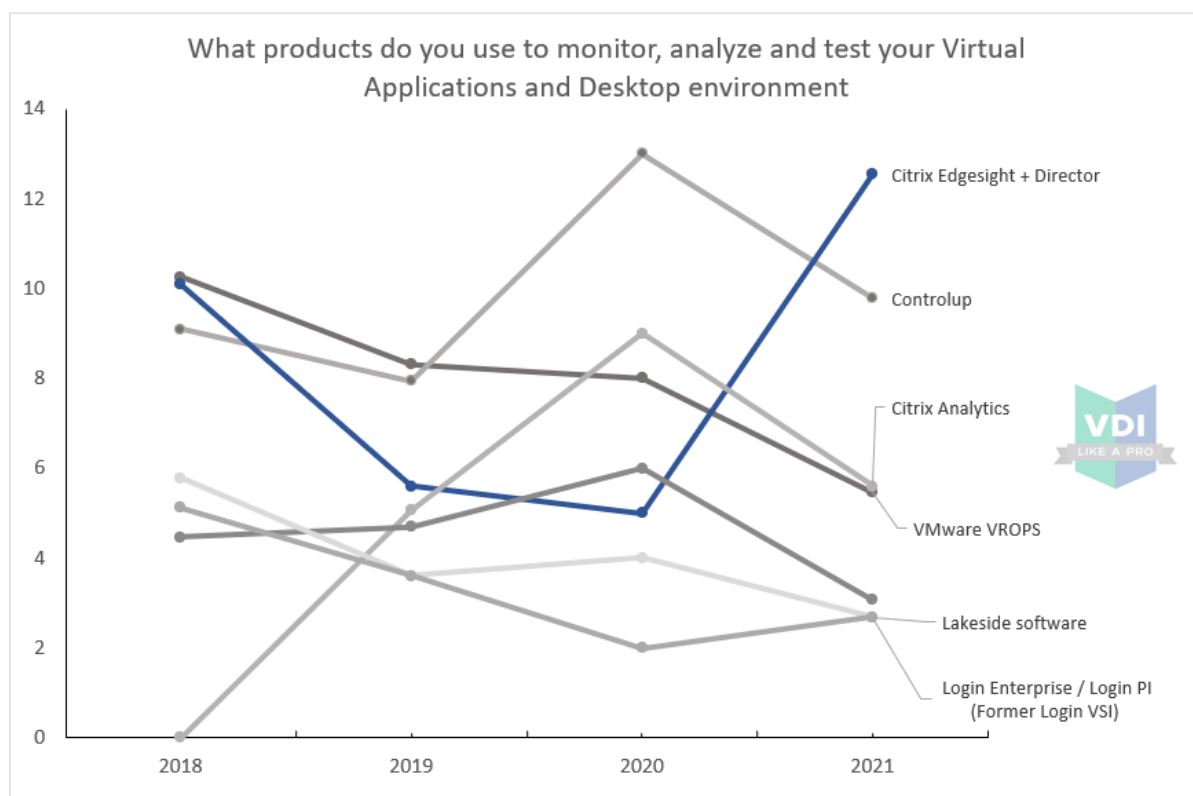
Close to half of the respondents (48.70%) patch their systems once per month, a small decrease compared to 2020 while 19.69% of the respondents patch their systems multiple times per month which is a small increase compared to 2020. 12.52% does patch multiple times per week while 9.92% is patching less than once a month.



## What products do you use to monitor your environment?

Citrix Director+ EdgeSight is the most popular solution to monitor the virtual desktop and application environment, 12.55% of the respondents are using the solution. ControlUP is second with 9.78% followed by Microsoft Azure monitor (Log analytics) with 5.90%. Citrix Analytics is used with 5.60% and VMware VROPS with 5.45%.

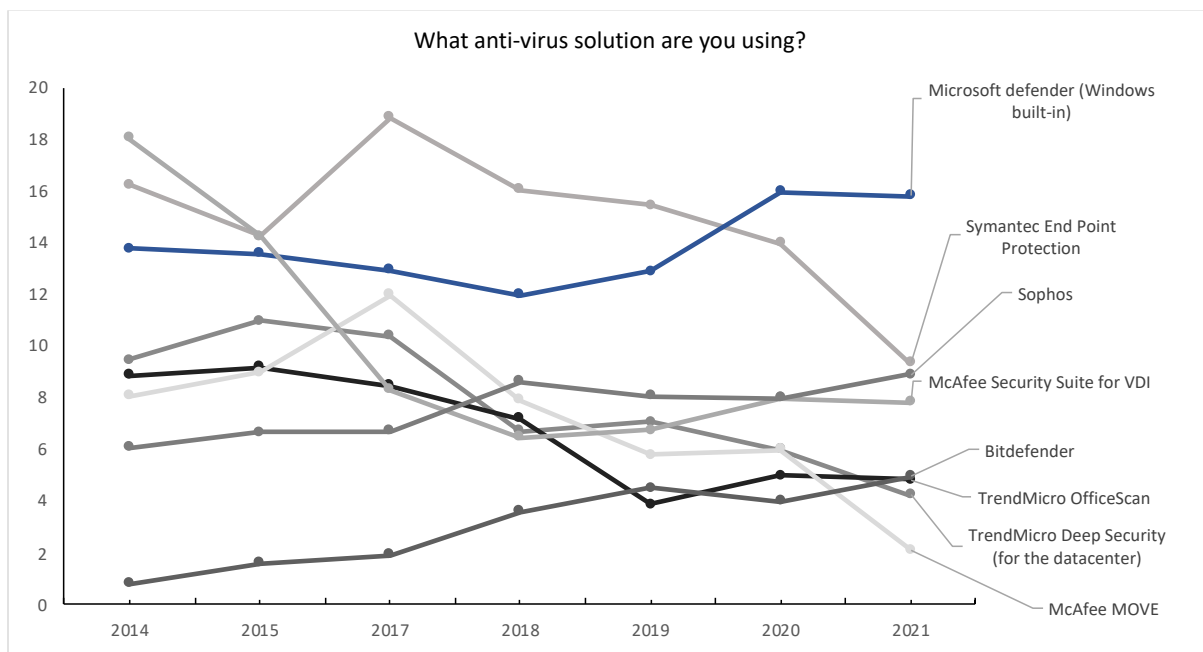
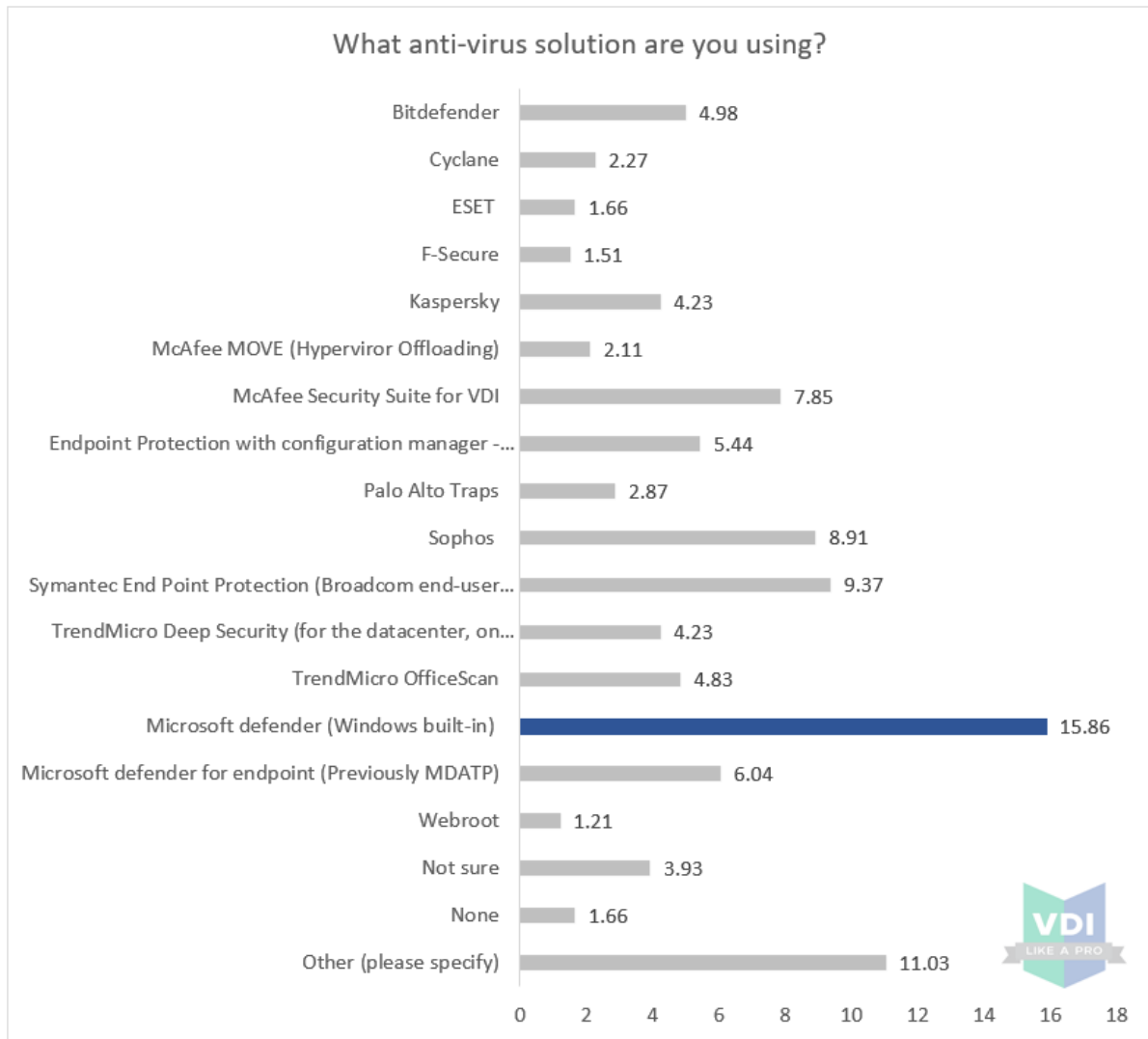




### What anti-virus solution are you using?

With common and recent outbreaks of ransomware, the leaks of government-funded zero-day exploits, and the threats of traditional viruses—it's no surprise that, even in virtual environments, anti-virus and malware protection remains popular.

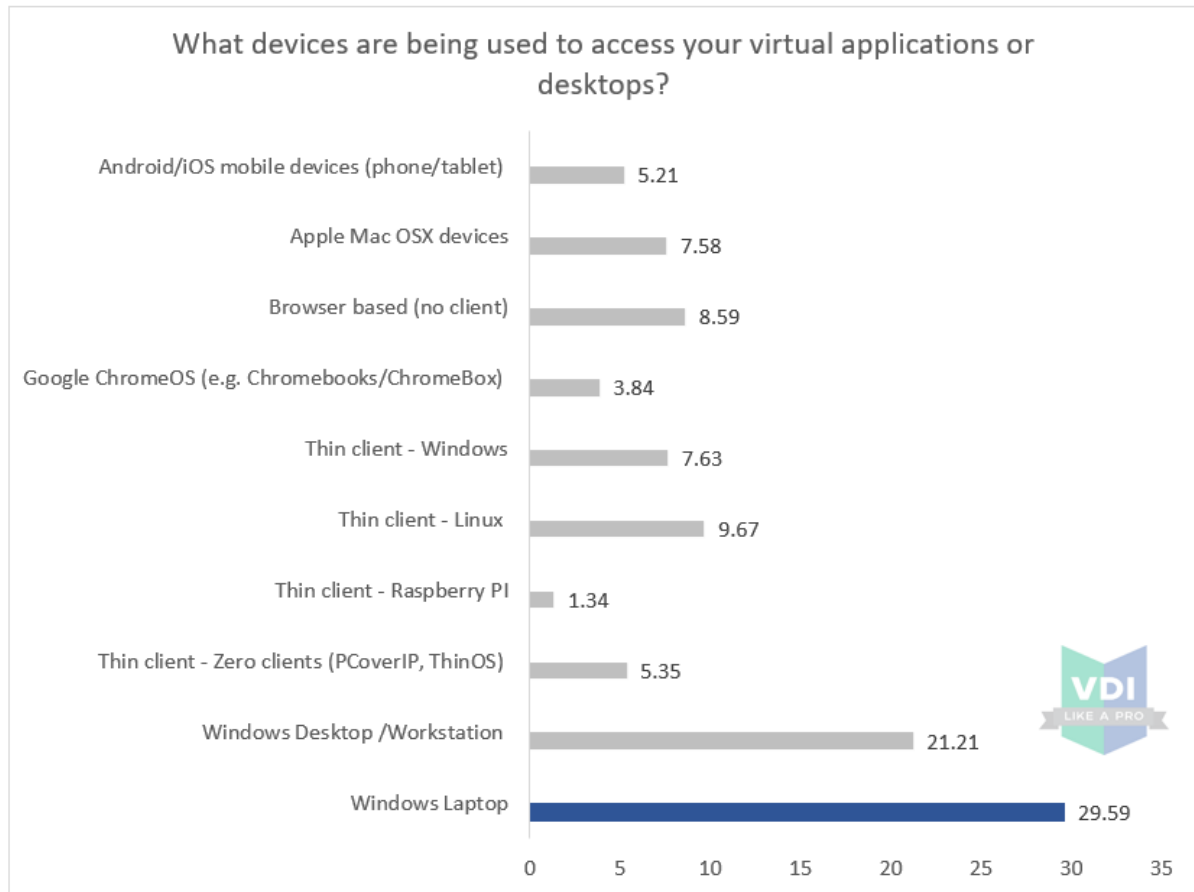
Windows Defender increased from 12.90% in 2019 to 15.61% in 2020 and stabilized at 15.86% in 2021 and is leading this solutions space. The major brands such as Symantec, McAfee, and TrendMicro all see a decline in usage in 2018. Symantec declined from 18.8% in 2017, 16.07% in 2018, 15.48% in 2019, 13.69% in 2020 and 9.37% in 2021. McAfee solutions declined from 20.32% in 2017, 14.38% in 2018, 12.58% in 2019, increase to 13.69% in 2020 and decreased to 9.96% in 2021. TrendMicro declined from 18.88% in 2017, 13.90% in 2018, 10.97% in 2019, 10.51% in 2020 and 9.06% in 2021. Bitdefender usage increased from 3.60% in 2018 to 4.52% in 2019, decrease to 3.50% in 2020 and increased to 4.98% in 2021. Sophos usage in 2020 is 8.91%





## What devices are being used to access your virtual applications or desktops?

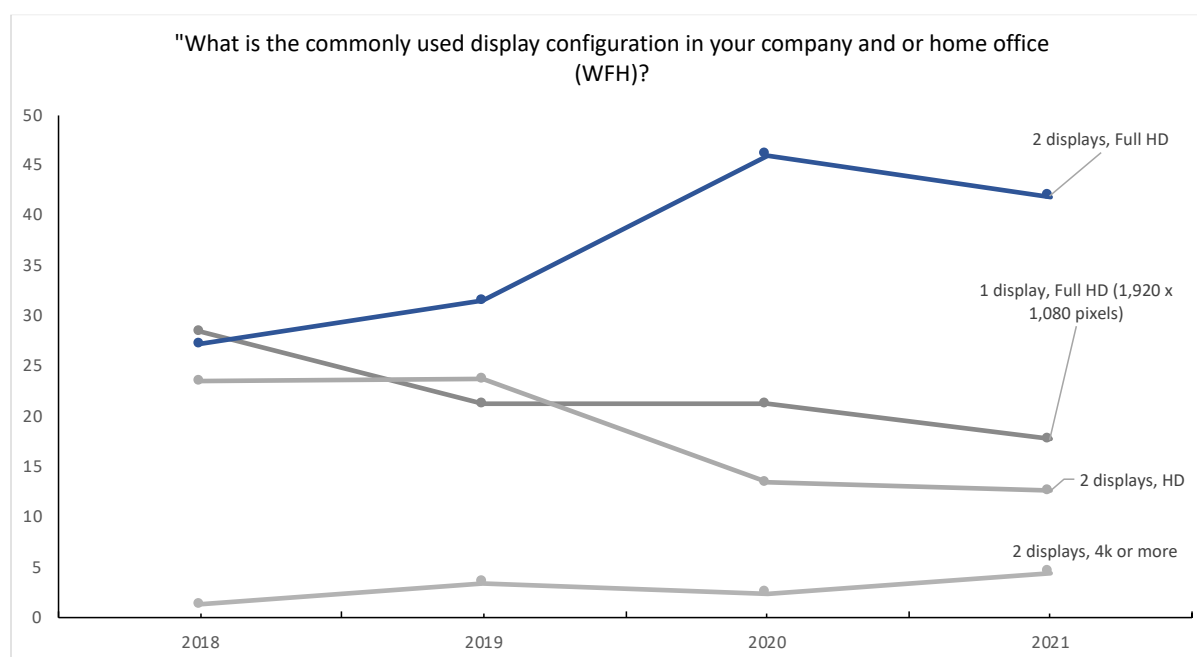
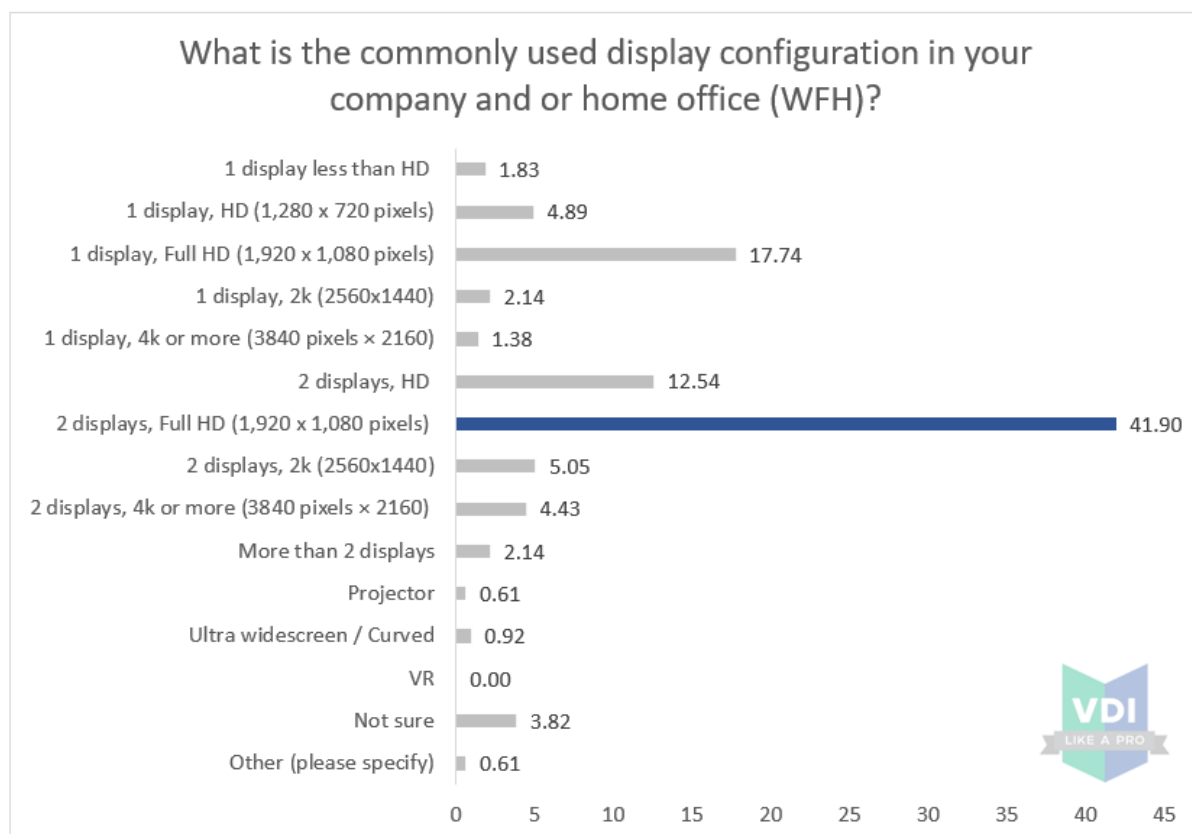
With 50.80%, Windows laptops, desktops and workstations are a common solution to access virtual applications and desktops. Linux based Thin Clients are 2<sup>nd</sup> with 9.67% followed by browser (HTML5) based solutions at 8.59%. 7.63% of the respondents is using Windows based Thin Clients and 7.58% is using Apple Mac OSX based devices. Google OS based devices are used with 3.84% of the respondents.



## What is the commonly used display configuration in your company and or home office (WFH)?

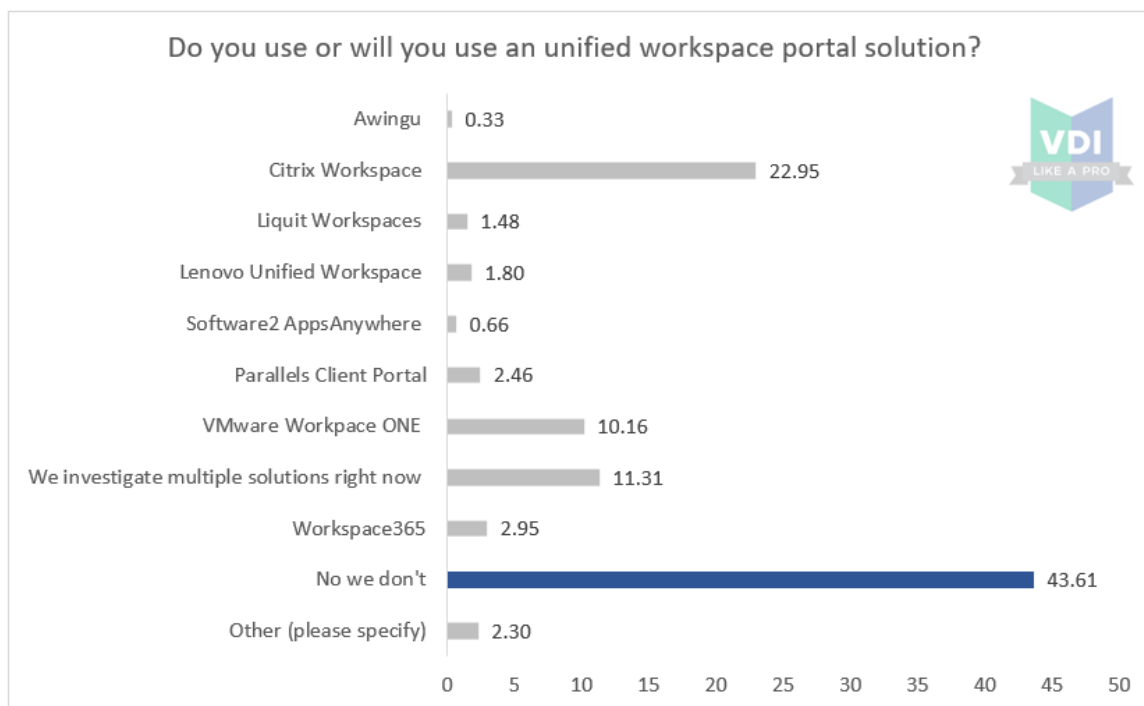
Dual-display configurations combined totals of 63.92% in 2021 an increase of 2.18% compared to 2020. Dual display at Full HD is used the most with 41.90%.

Single display FullHD configuration is used at 17.74% followed by two displays at HD with 12.54%. Ultrawide screen aren't common, only 0.92% is using such a display.



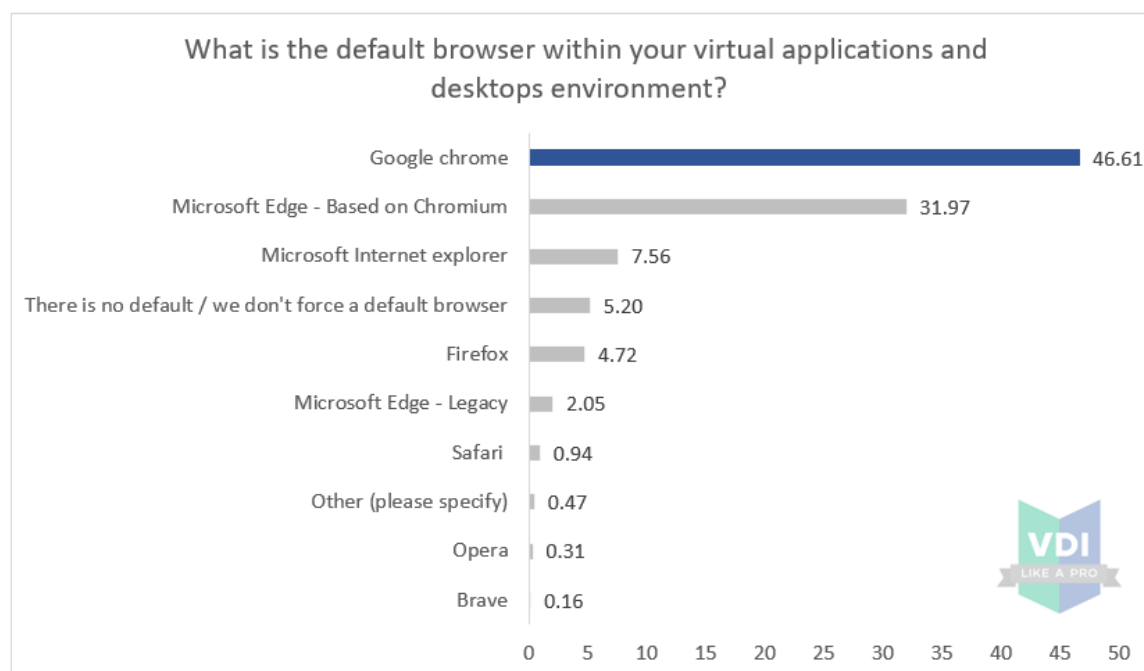
## Do you use or will you use a unified workspace portal solution?

A Unified Workspace portal does bring Windows, Web/SaaS applications and data together. Most of the respondents, 43.61%, aren't using a unified workspace portal. That being said, Citrix Workspace is used the most with 22.95% followed by VMware Workspace ONE usage at 10.16%. Also 11.31% of the respondents are investigating different options which is a 12.29% decline compared to 2020.



## What is the default browser within your virtual application and desktop environment?

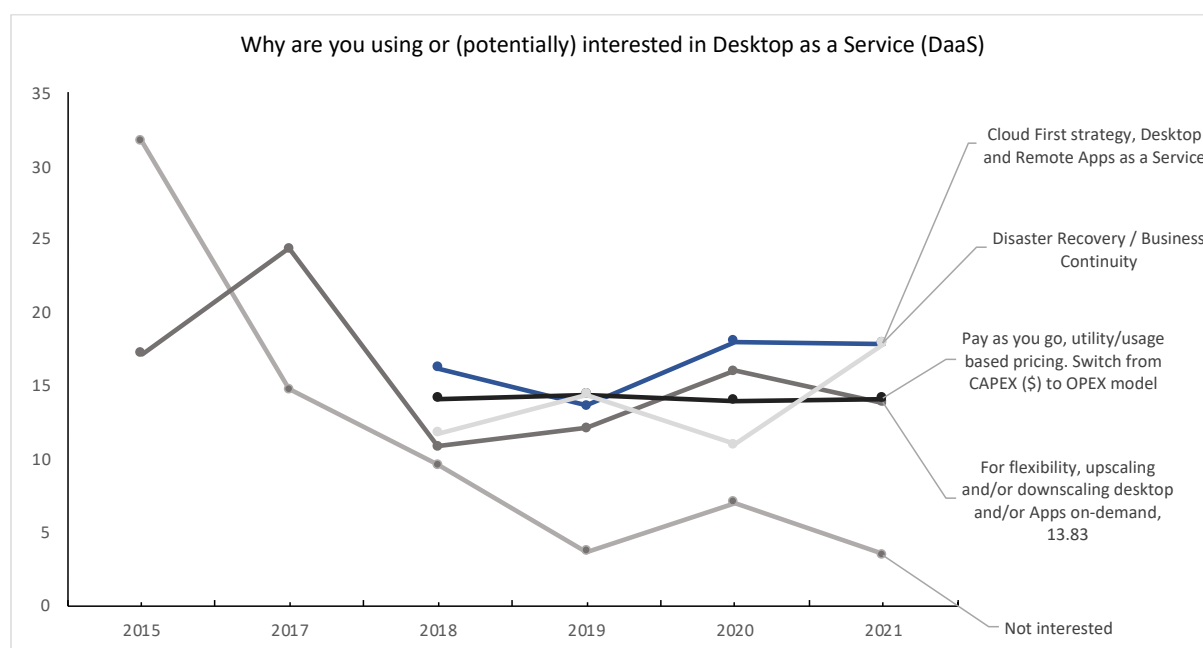
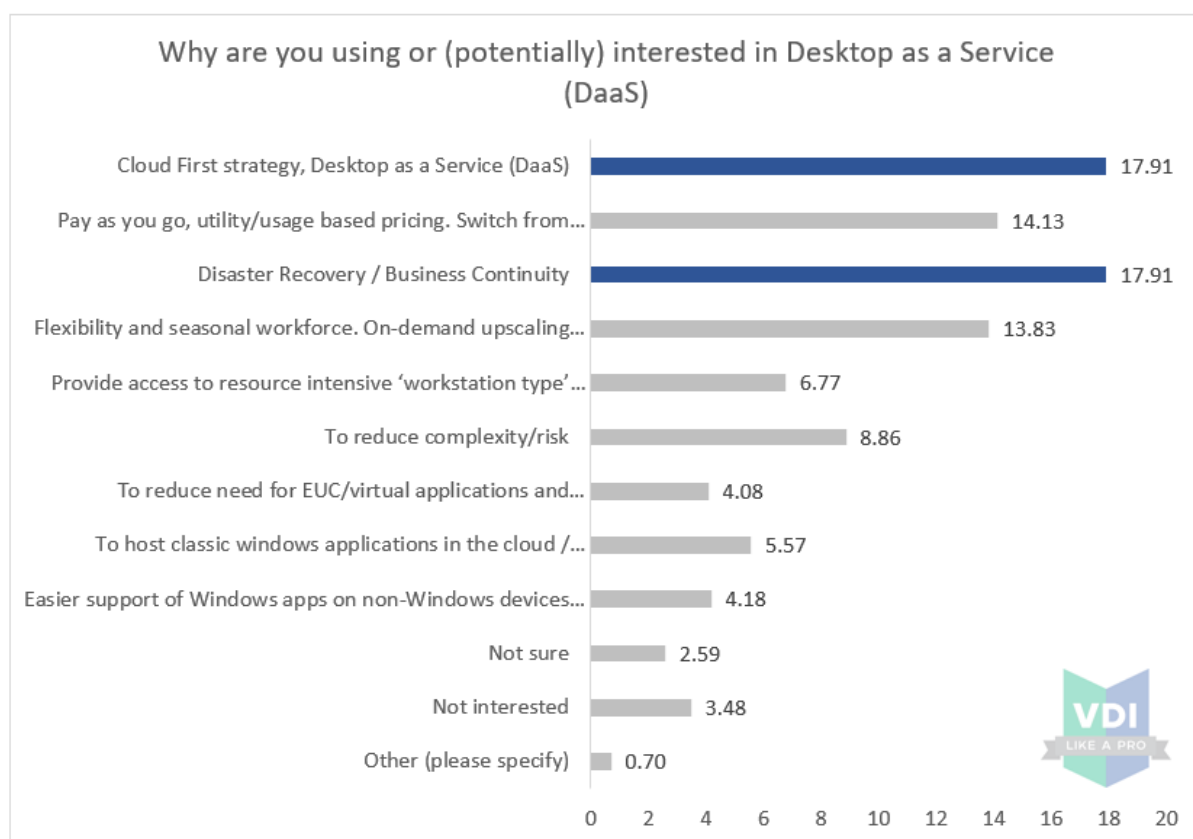
Google Chrome is used the most within the virtual application and desktop deployments, 46.61% of the respondents do use Chrome, followed by the Chromium based Microsoft Edge with 31.97%. Still 7.56% of the respondents are using Internet Explorer as their default browser.



## Public Cloud: use-cases, challenges, products, strategy, GPUs, Why are you using or (potentially) interested in Virtual applications or Desktop as a Service (DaaS)?

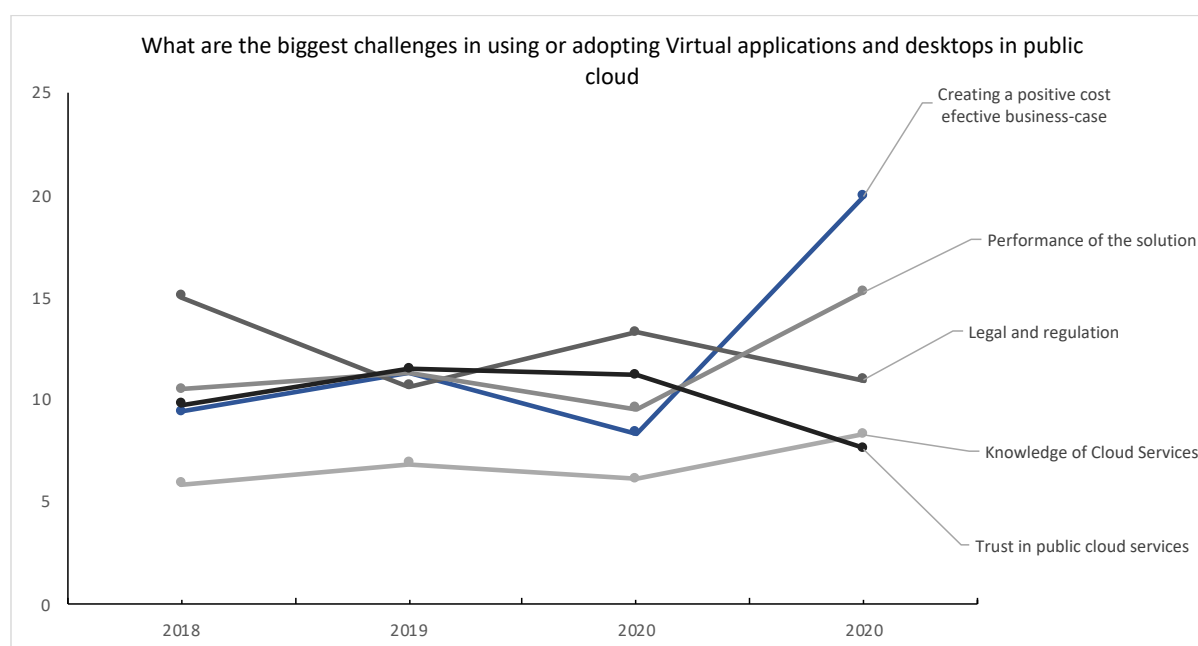
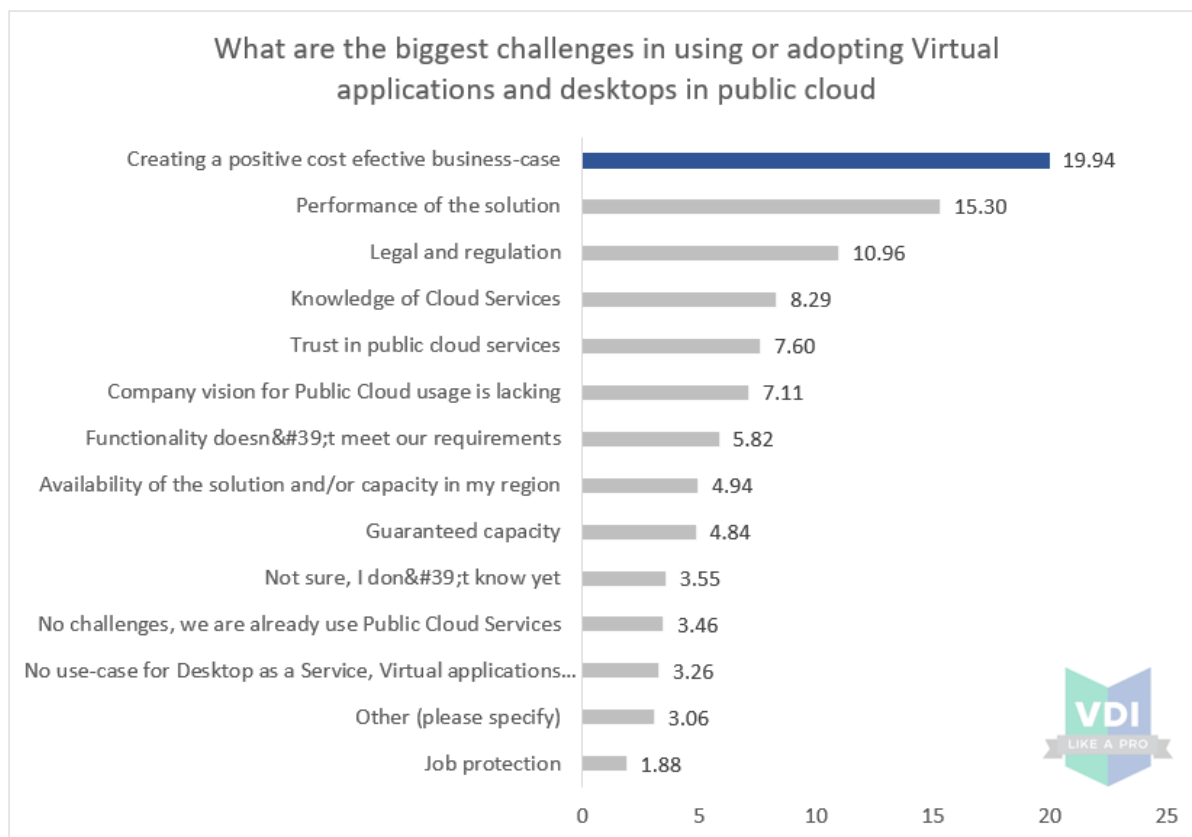
Cloud first strategy for virtual desktops and applications and Disaster recovery / Business Continuity are the two main reason for DaaS usage, both with 17.91%.

Another key reason to use DaaS in 2021 is pay as you go with 14.13% and flexibility, - on-demand up and/or downscaling with 13.83%.



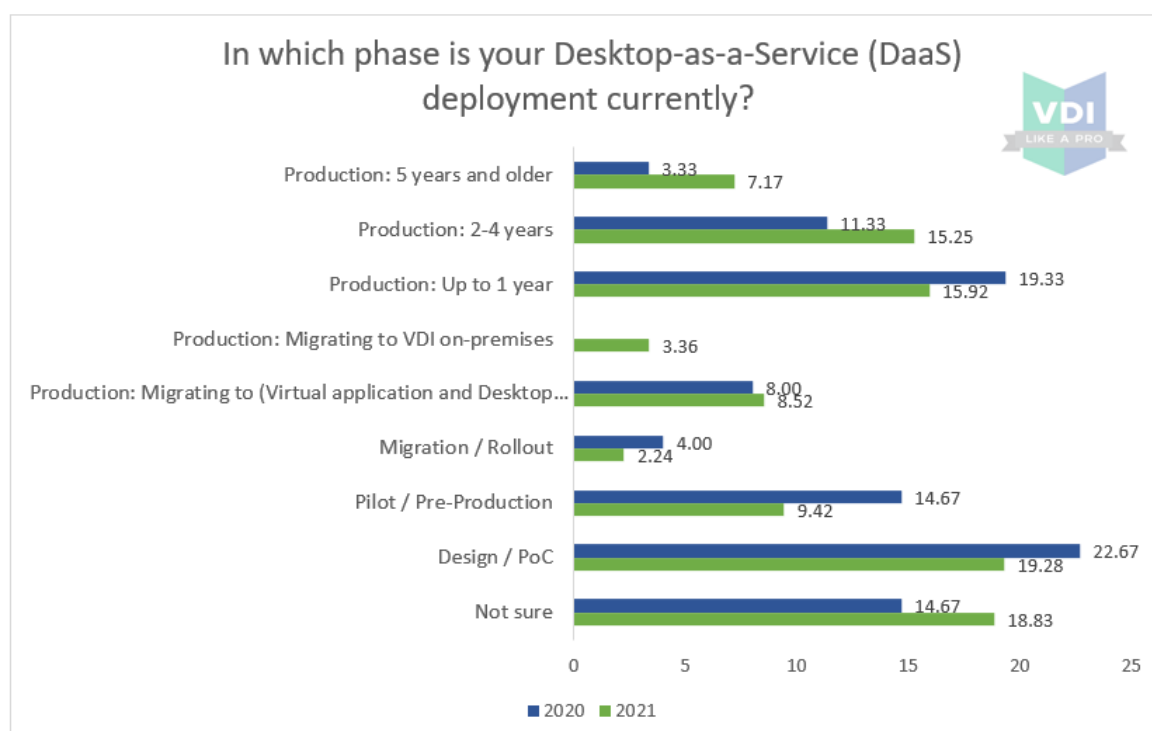
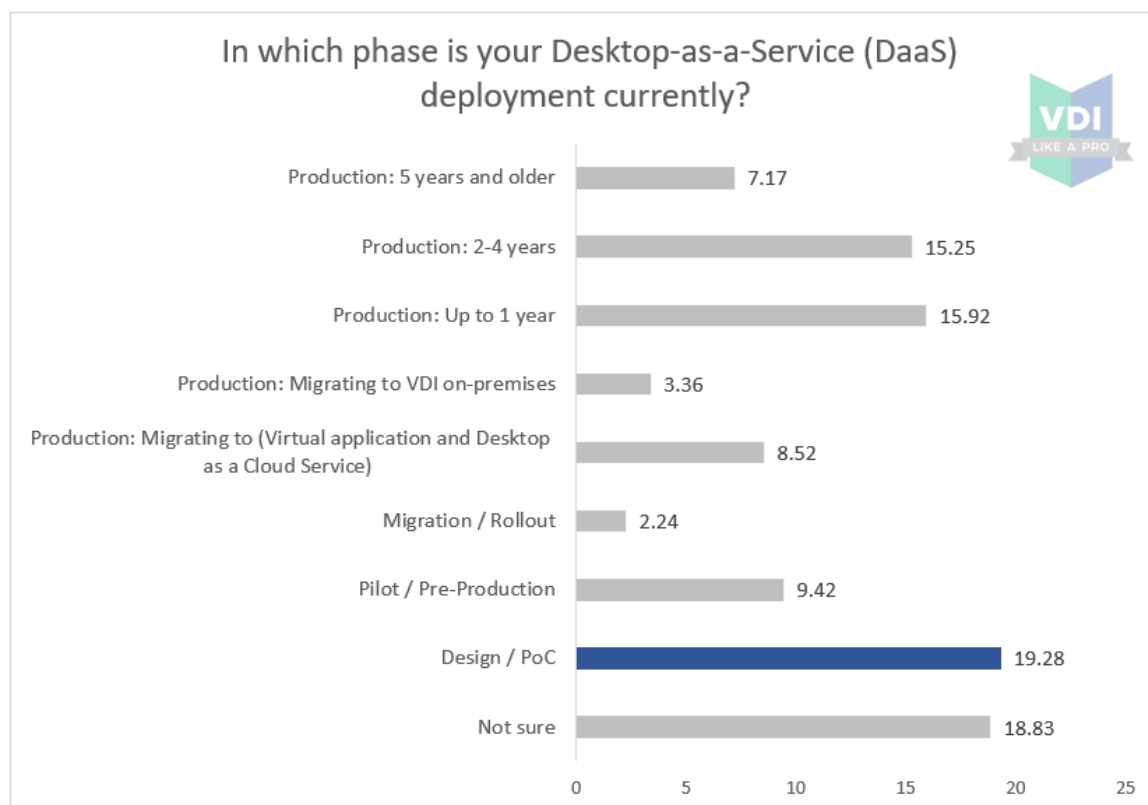
## What are the biggest challenges in using or adopting public Cloud?

The four biggest challenges in adopting public cloud for Desktop as a Service (DaaS) are creating a positive cost-effective business case at 19.94%, Performance of the solution at 15.30%. Legal and regulation at 10.96%, Knowledge of cloud services is a concern with 8.29% of the respondents.



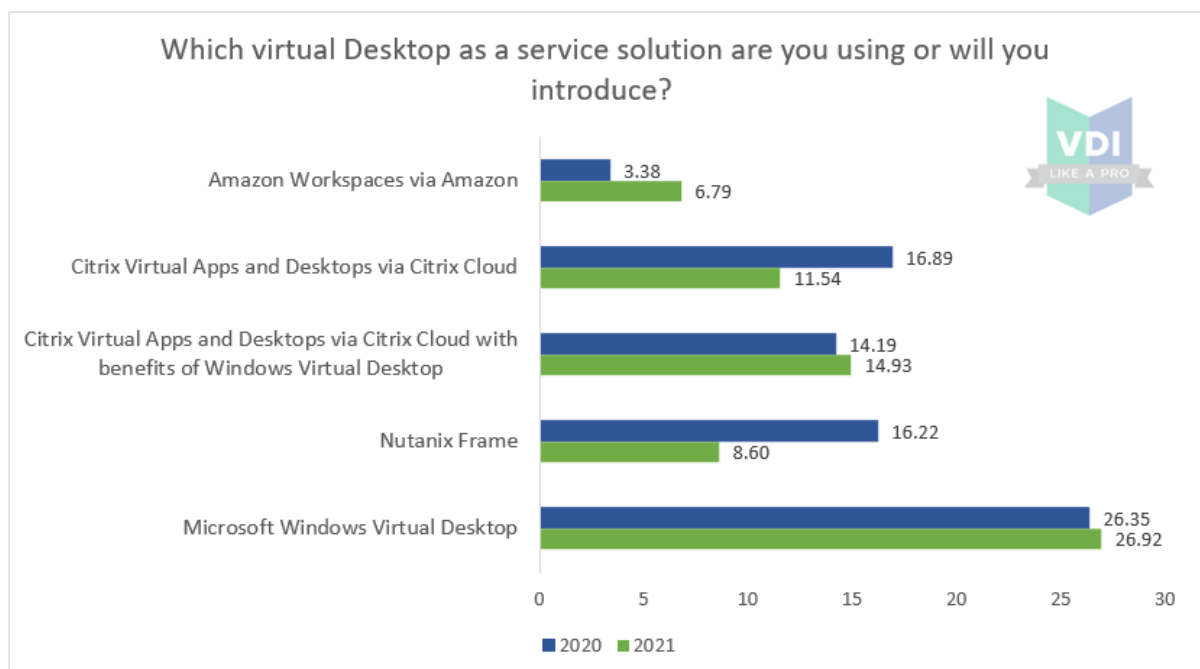
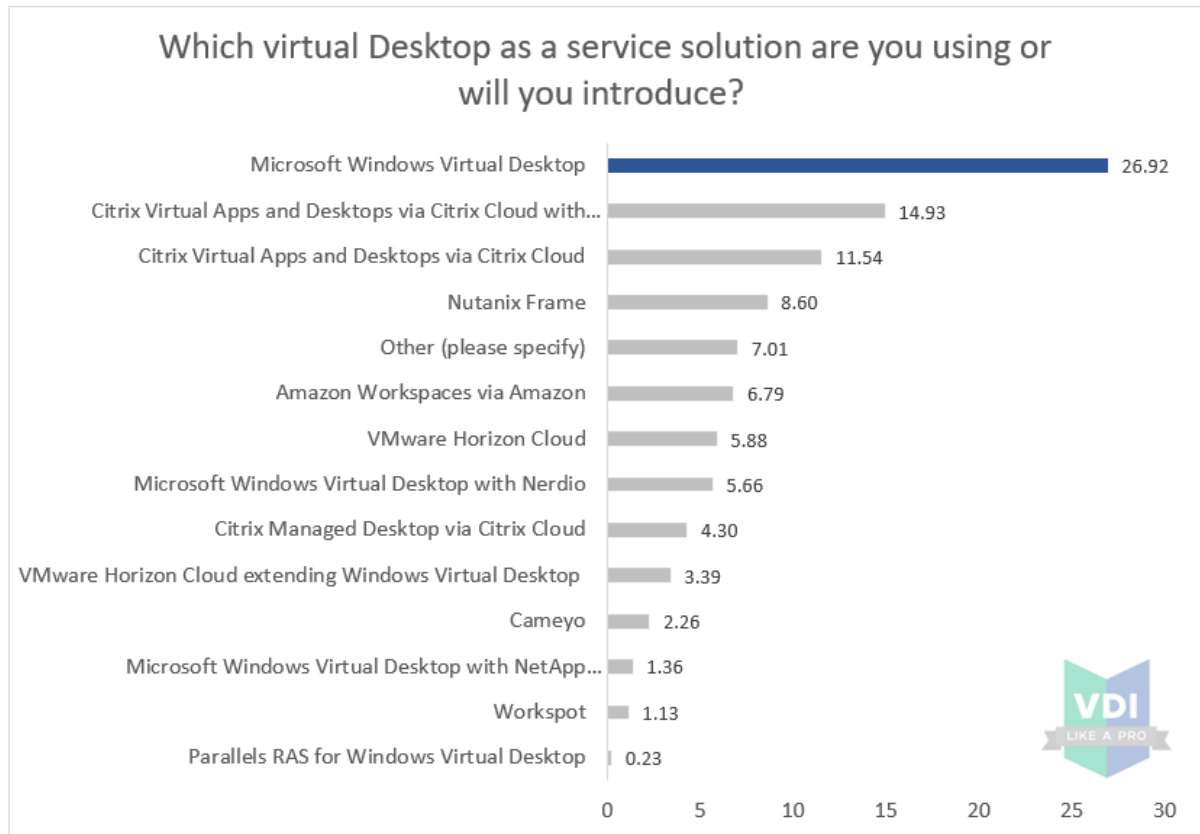
## In which phase is your Desktop-as-a-Service (DaaS) public cloud deployment currently?

19.28% of the respondents are designing or running a Desktop-as-a-Service Proof on Concept. Running a DaaS solution in production for up to one year applies to 15.92% of the respondents, followed by 15.25% who are running production for 2-4 years which is an increase of 3.92% compared to 2020. 7.17% is running production 5 years or more which is an increase of 3.84% compared to 2020.



## Which DaaS solution are you using, or will you introduce?

Microsoft Windows Virtual Desktop (WVD) is considered or being used with 26.92% which is similar compared to 2020. Citrix VADs at 14.93% and virtual applications and desktops via Citrix Cloud at 11.54%. The different Citrix solutions combined are being used or will be introduced by 30.77%. The different VMware solutions are being used or will be introduced by 9.27%. Nutanix Frame is used or will be introduced with 8.60% of the respondents followed by Amazon Workspaces at 6.79%.

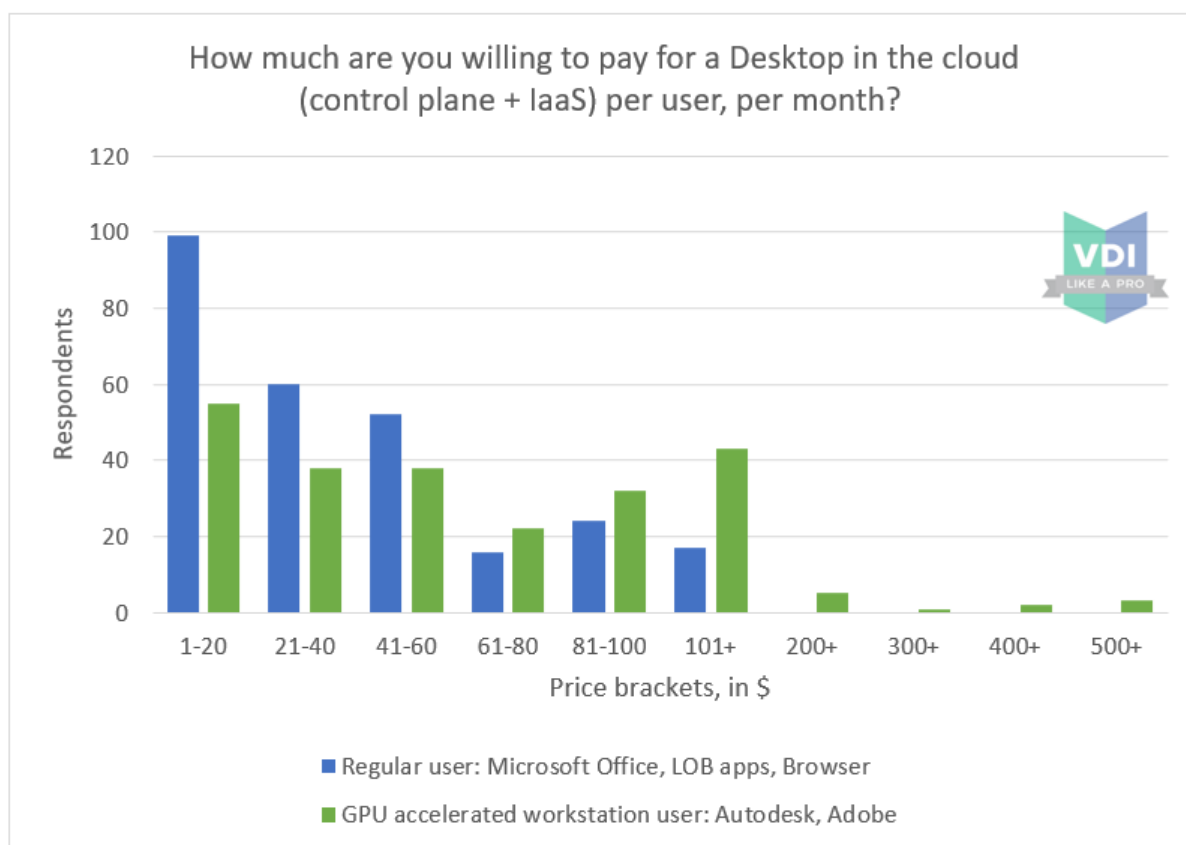


## How much are you willing to pay for a Desktop in the cloud (control plane + IaaS) per user, per month?

One of the newly added questions we asked during the 2021 survey are around indicating pricing per user, per month for different types of workloads – for both regular users and GPU-enabled workstation users.

The vast majority of our survey respondents are willing to pay somewhere between 1 – 20 and 21 – 40 \$ dollar per user, per month to run a Desktop in the cloud that is able to run Microsoft Office, browsers, and line-of-business applications. Results for GPU accelerated desktops are surprisingly lower than expected. The vast majority is responding to pay less than 61 \$ dollar, whereof around 60 of the respondents are willing to pay above 101 \$ dollar per user, per month for a GPU-enabled desktop running in the cloud to run resource intense applications that require GPU resources such as Autodesk and Adobe Photoshop.

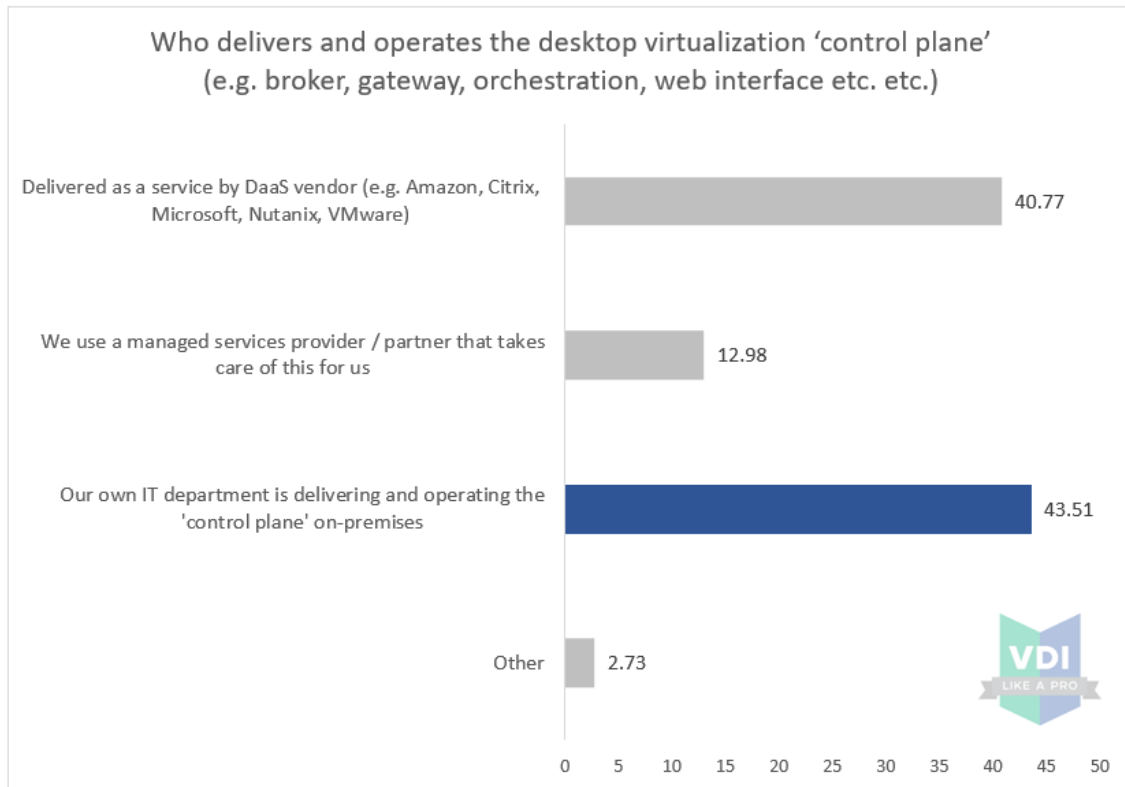
We don't expect that all IT Pros/survey participants using Desktop-as-a-Service/virtual apps and desktop today exactly know what their current price per user is in their environment. Therefore, we expect the numbers are not 100% based on reality. Let's see if next year's numbers will vary...





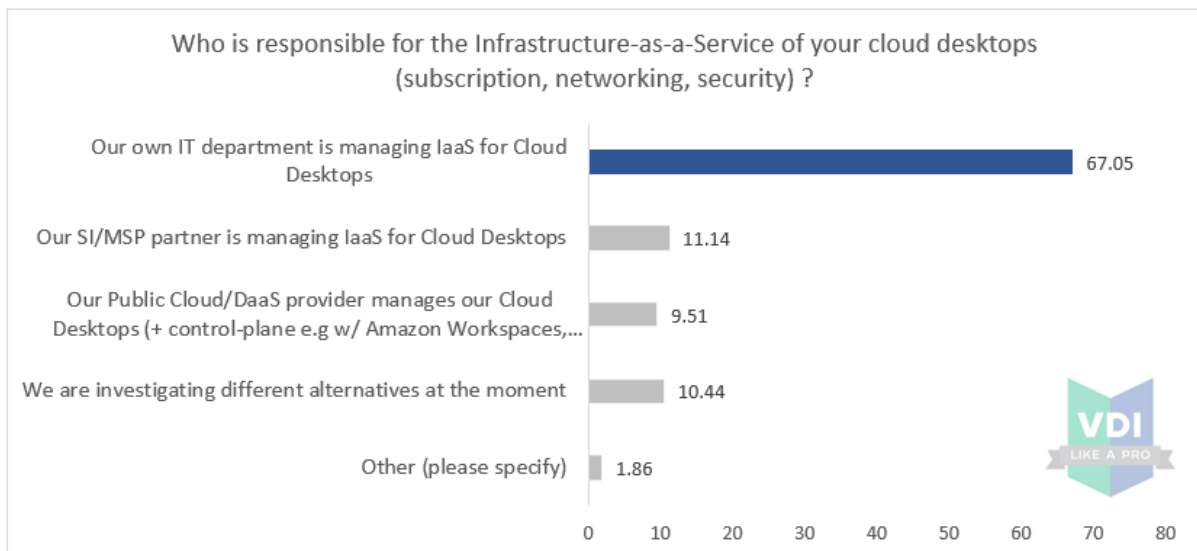
## Who delivers and operates the desktop virtualization 'control plane' (e.g. broker, gateway, orchestration, web interface etc.)

The IT department is responsible for delivery and operating the control plane at 43.51% of the respondents, followed by 40.77% of the respondents who consume the DaaS platform as a service from a vendors such as Amazon, Citrix, Microsoft, Nutanix and VMware.



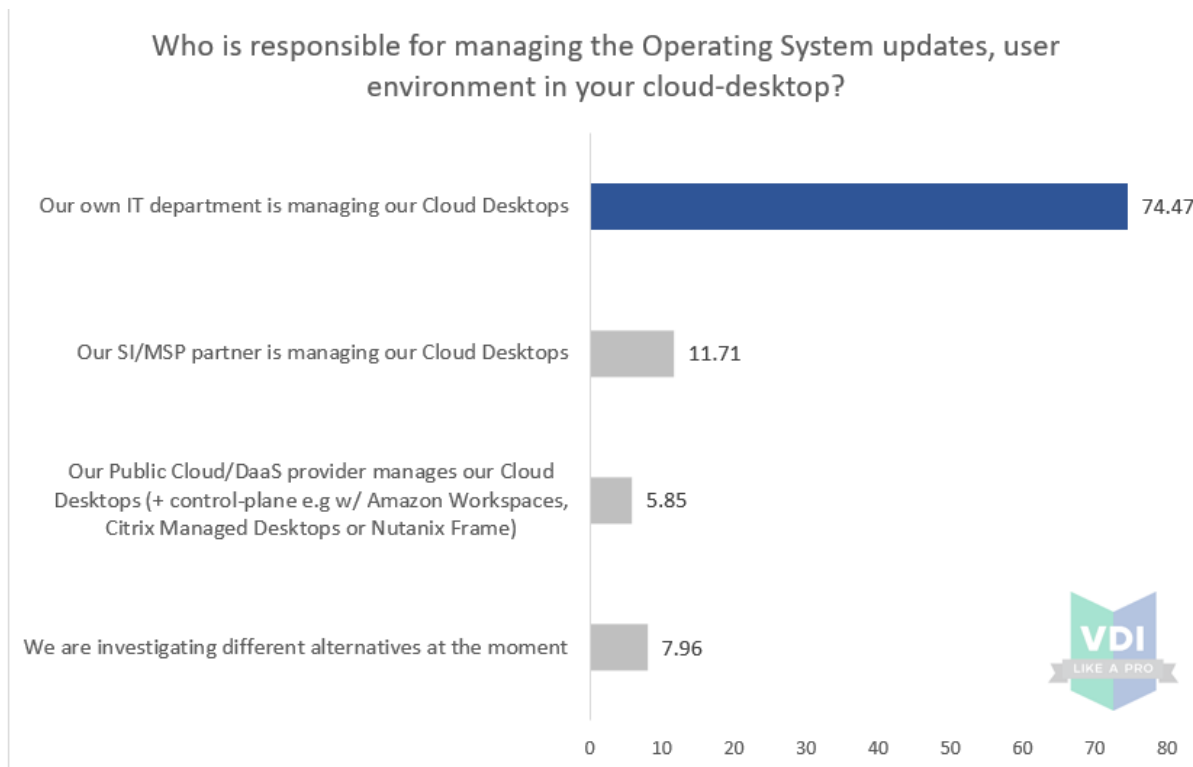
## Who is responsible for the Infrastructure-as-a-Service of your cloud desktops (subscription, networking, security)?

The IT department is responsible for managing the Infrastructure as a Service at 67.05% of the respondents, followed by 11.14% where the System Integrator or Managed Service Provider is responsible for these tasks. 9.51% of the respondents consume both the DaaS control plane and the IaaS for the workload VMs via the DaaS provider.



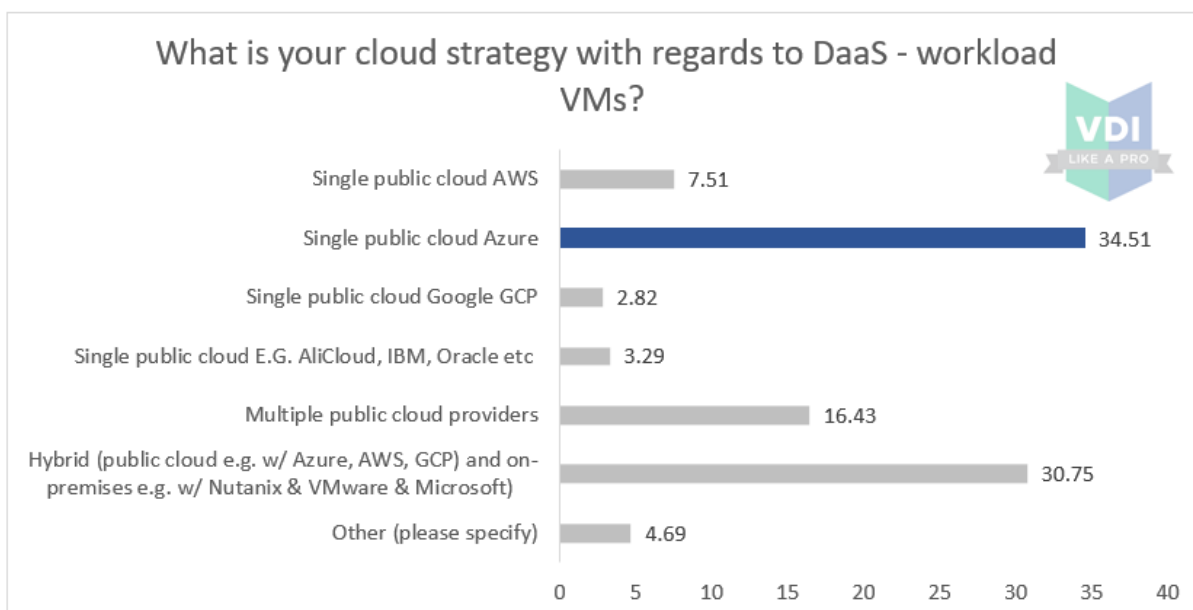
## Who is responsible for managing the Operating System updates, user environment in your cloud-desktop?

The IT department is responsible for managing the Operating System updates and user environment at 74.47% of the respondents followed by 11.71% where the System Integrator or Managed Service Provider is responsible for these tasks.



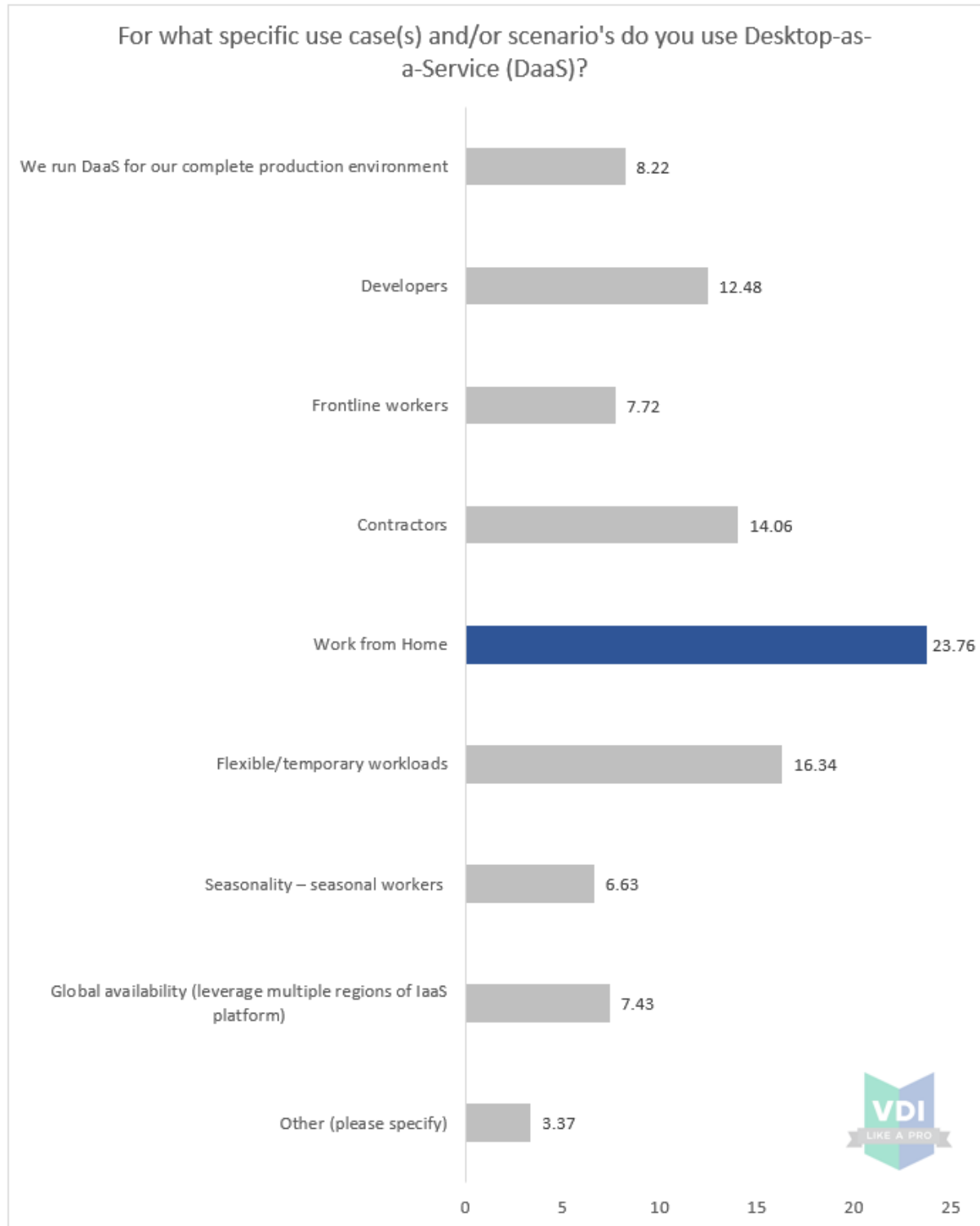
## What is your cloud strategy with regards to workload VMs?

The majority of the respondents have a single public cloud strategy using Microsoft Azure with 34.51% followed by a Hybrid Cloud strategy with 30.75%. Also, multiple public cloud provider strategy is used with 16.43% of the respondents.



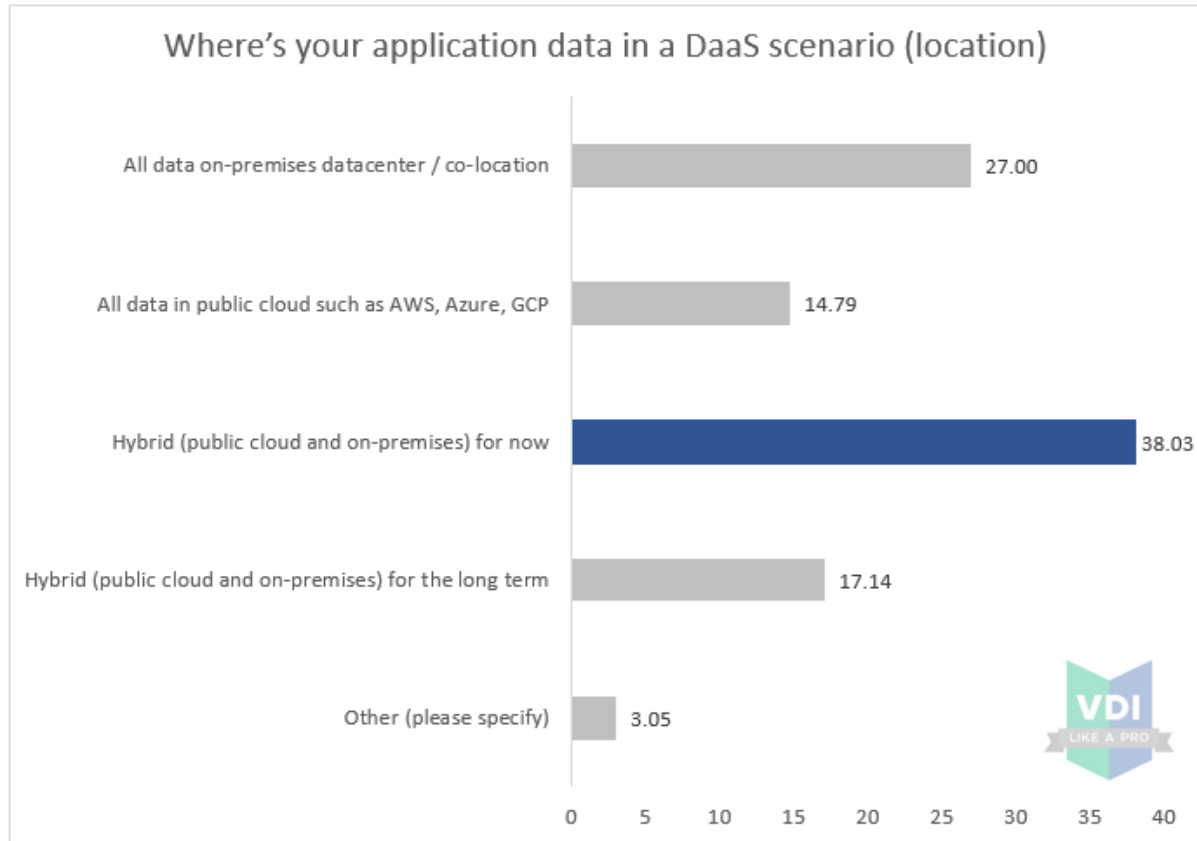
## For what specific use case(s) in your environment did you choose Desktop-as-a-Service (DaaS)?

The most important reason to use for Desktop as a Service is the ability to support Work from Home with 23.76%. The second use-case is ability to run support a flexible/temporary workforce with 16.34% followed by the ability to easily support contractors with 14.06% and developers with 12.48%.



### Where's your application data in a DaaS scenario (location)?

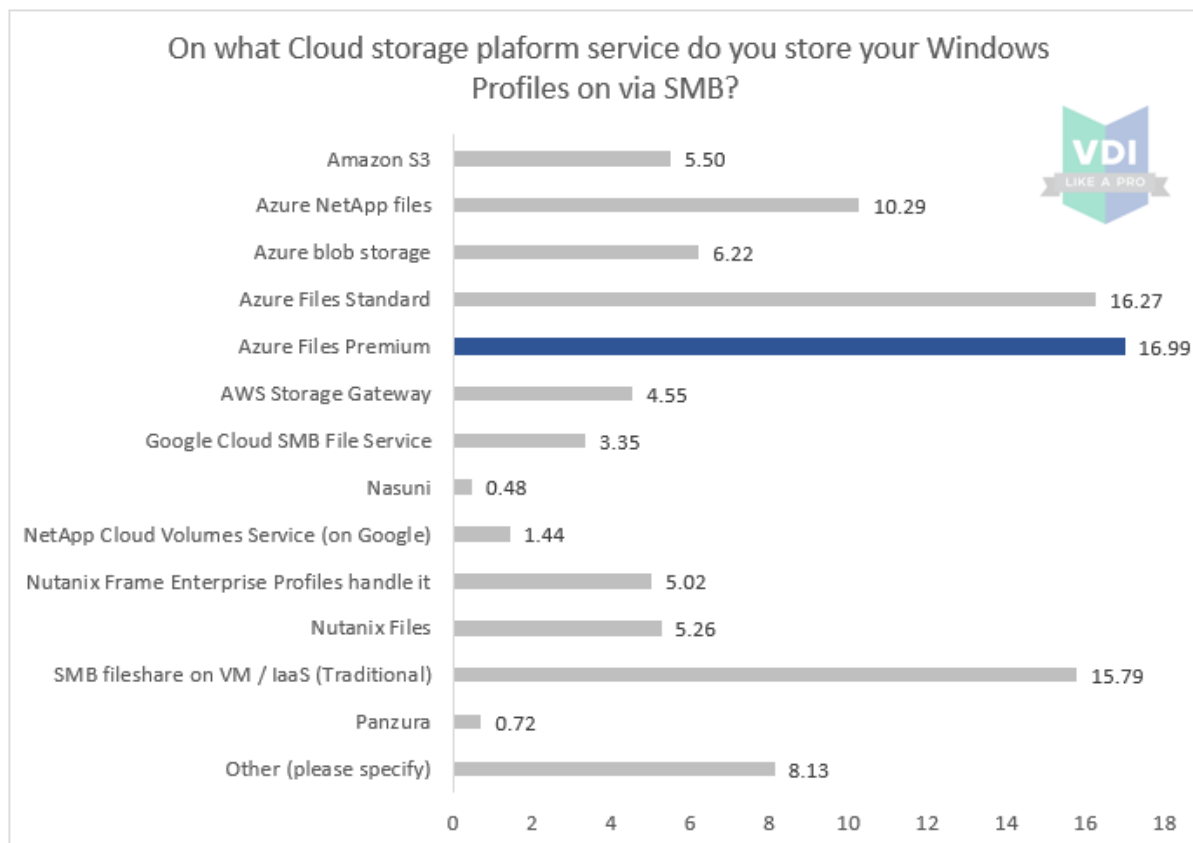
The majority of the respondents, 55.17%, do have store their application data / back-end services in a hybrid scenario using local / on-premises and use public cloud resources now or long term. 14.79% of the respondents do store all the data in public clouds(s) while 27.00% do store their data only on-premises.



## On what Cloud storage platform service do you store your Windows Profiles?

Where are the windows user profiles stored? 16.99% is using Azure Files Premium for the windows user profiles, followed by 16.27% who is using Azure Files Standard.

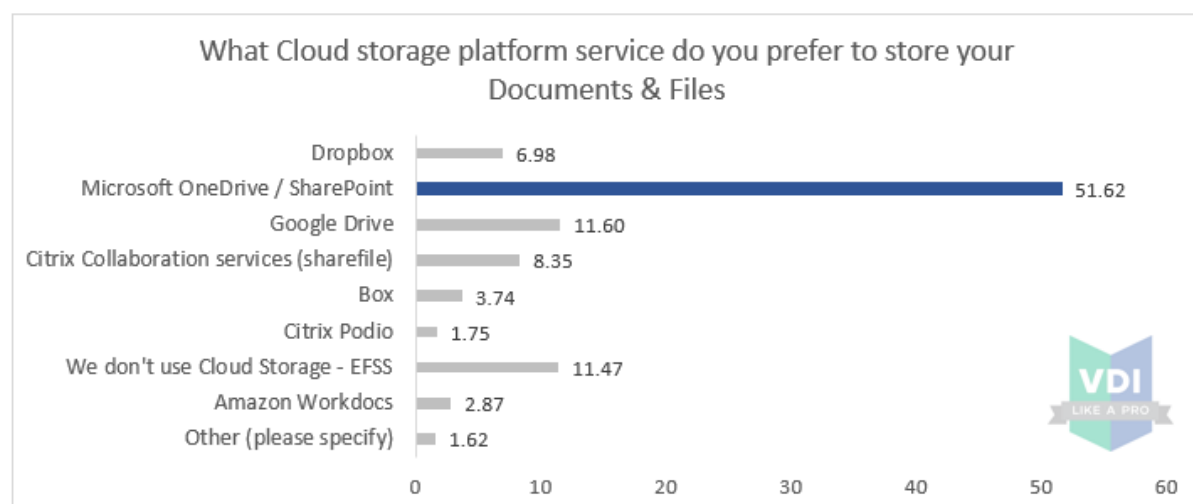
15.79% is using a traditional Windows file server(s) and on the 4<sup>th</sup> place is Azure Netapp files with 10.29%.



## What Cloud storage platform service do you prefer to store your Documents & Files (Enterprise file Synchronization and Sharing) within your Virtual apps and Desktop environment?

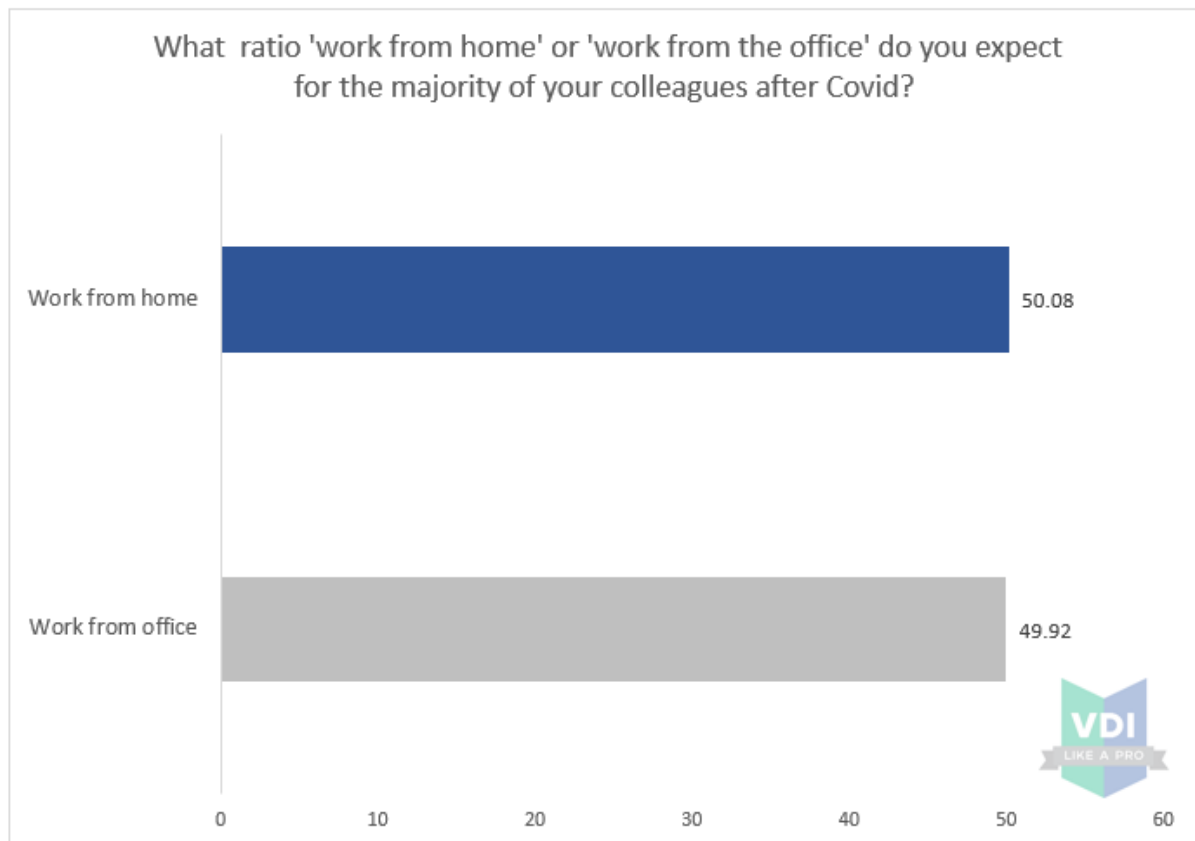
Microsoft OneDrive is used the most within the virtual application and desktop deployments, 51.62% of the respondents do use OneDrive followed by Google Drive with 11.60%.

Interesting is that 11.47% isn't using Enterprise file synchronization and sharing withing virtual applications and desktops.



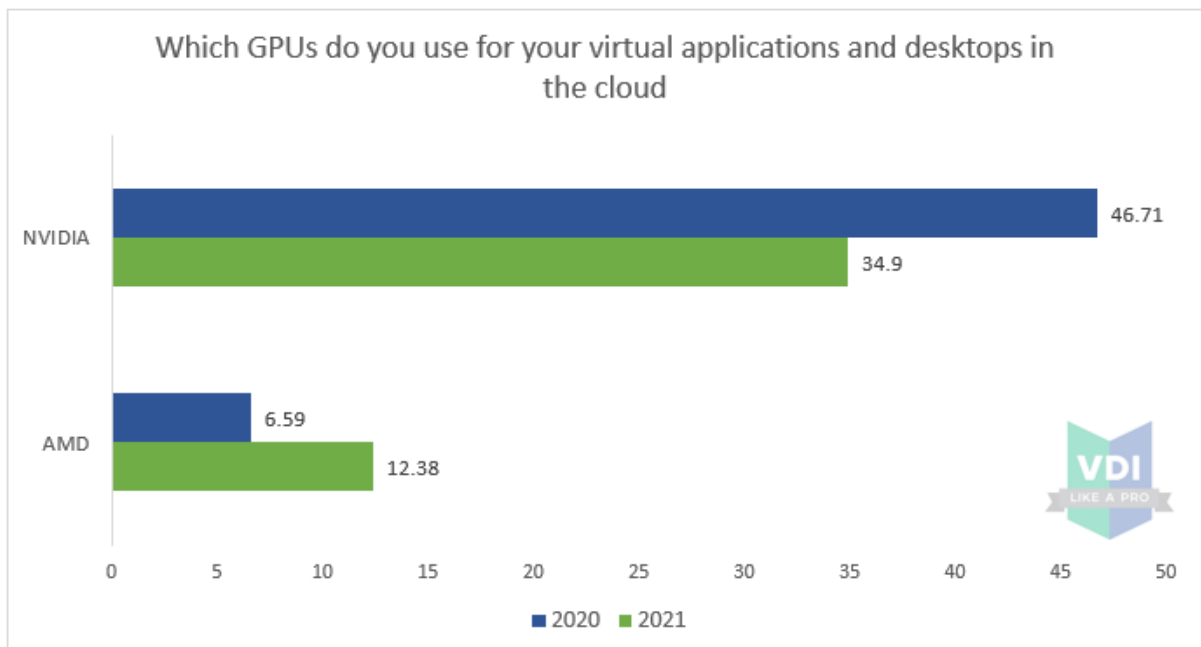
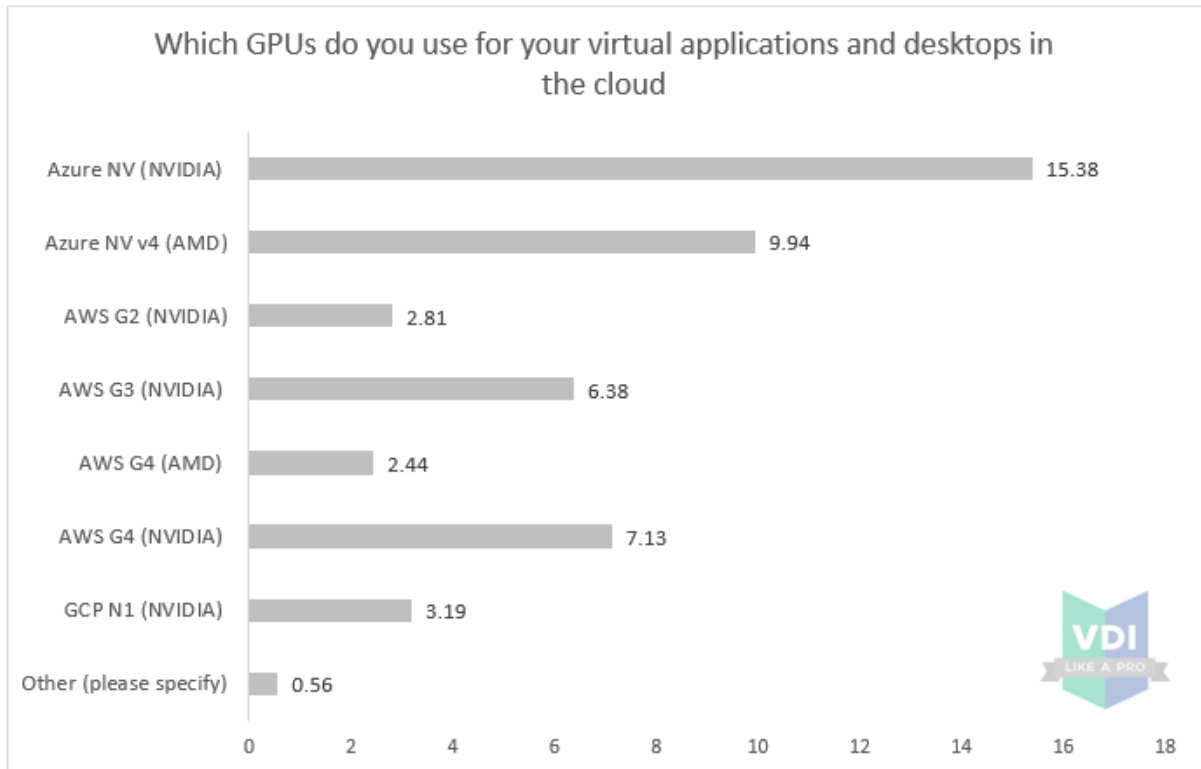
## What ratio 'work from home' or 'work from the office' do you expect for the majority of your colleagues after Covid? Please allocate 100 points (%)

One of the new questions for this year's survey is the question what the ratio "work from home" or "work from office" will be. Interesting is the result that it is a draw – 50% - 50% which means Hybrid work scenario for many of us.



## Which GPUs do you use for your virtual applications and desktops in the cloud?

The majority of virtual desktop and application deployments in the cloud aren't using GPUs, 52.16% while NVIDIA GPU NV instance types on Azure are used at 15.38%. The AMD GPU based instances are used at 9.94%.

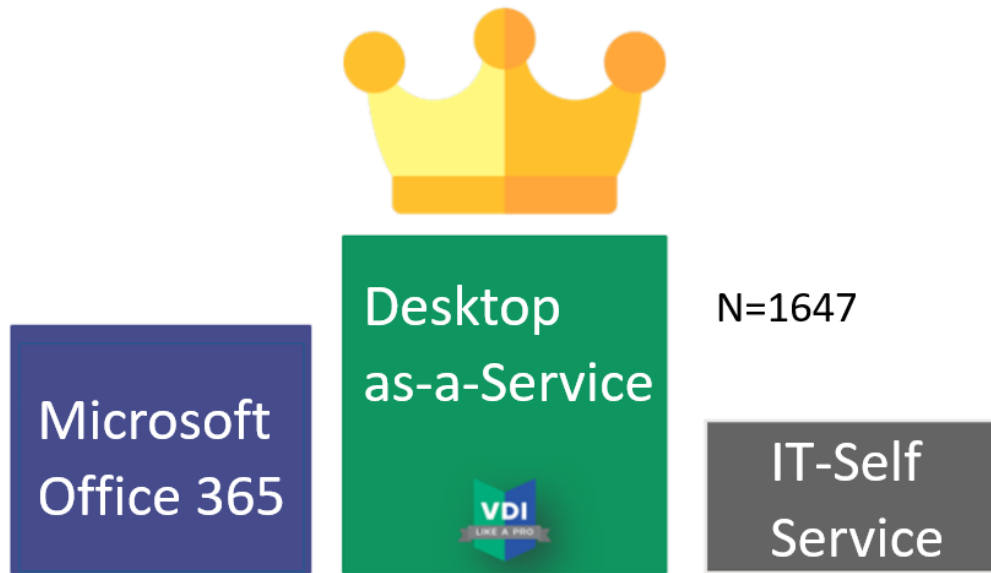


## Workspace initiatives, feedback, comments

What are your most important End User Computing (EUC) initiatives for 2021+?

Drumroll please...

The Top 3 of most important Workspace initiatives for 2021+ are:



### In the year 2020

1. **Desktop as a Service**
2. Application container technologies
3. Microsoft Office 365

### In the year 2019

1. **Windows 10 migrate from Win7/8**
2. Microsoft Office 365
3. Desktop as a Service

### In the year 2018

1. **Windows 10 migrate from Win7/8**
2. Desktop as a Service
3. Microsoft Office 365

### In the year 2017

1. **Windows 10 migrate from Win7/8**
2. Microsoft Office 365
3. GPU Technologies

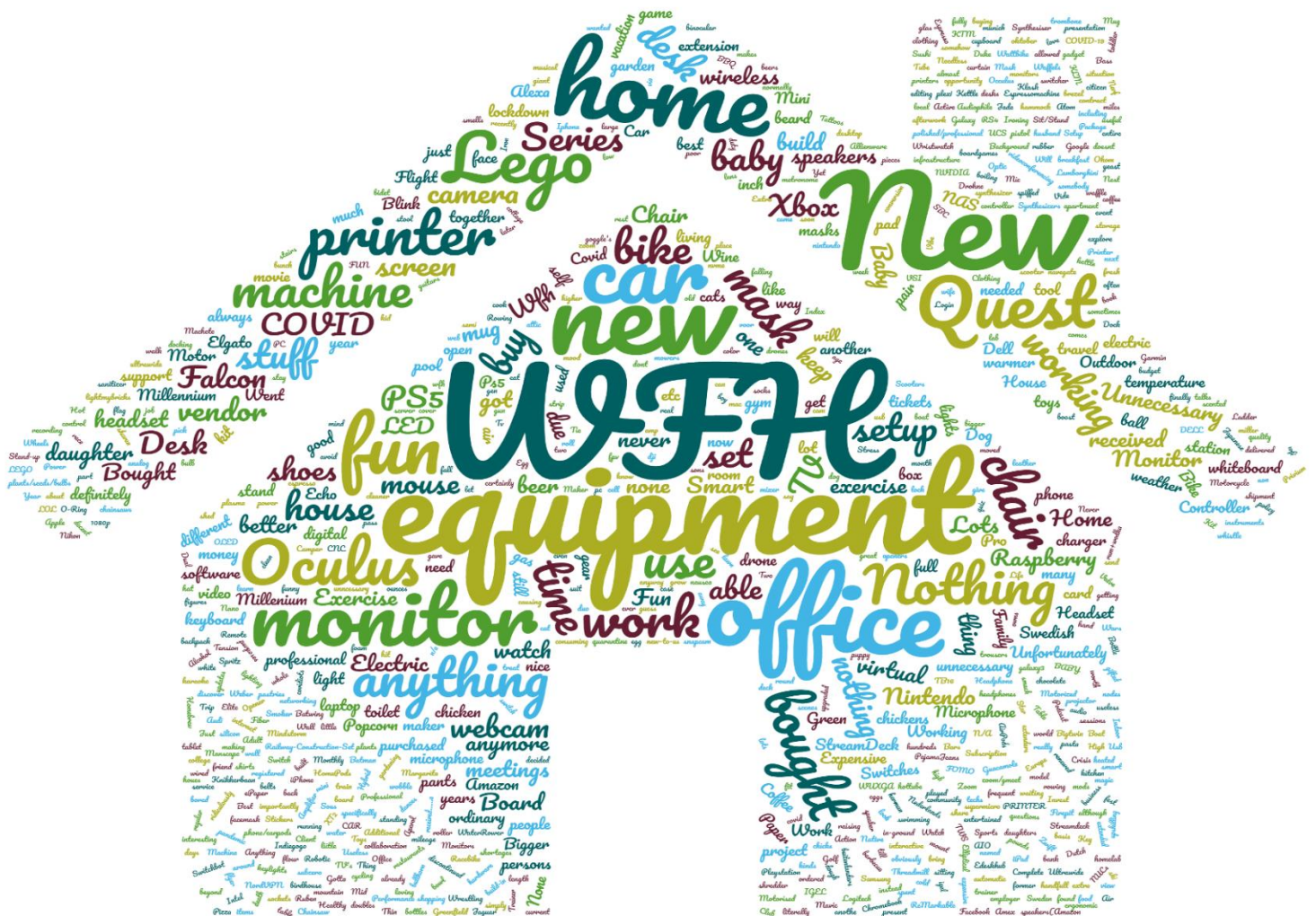
### In the year 2015

1. **Upgrade Virtual Applications and desktop platform**
2. BYO Initiative
3. Enterprise Mobility Management



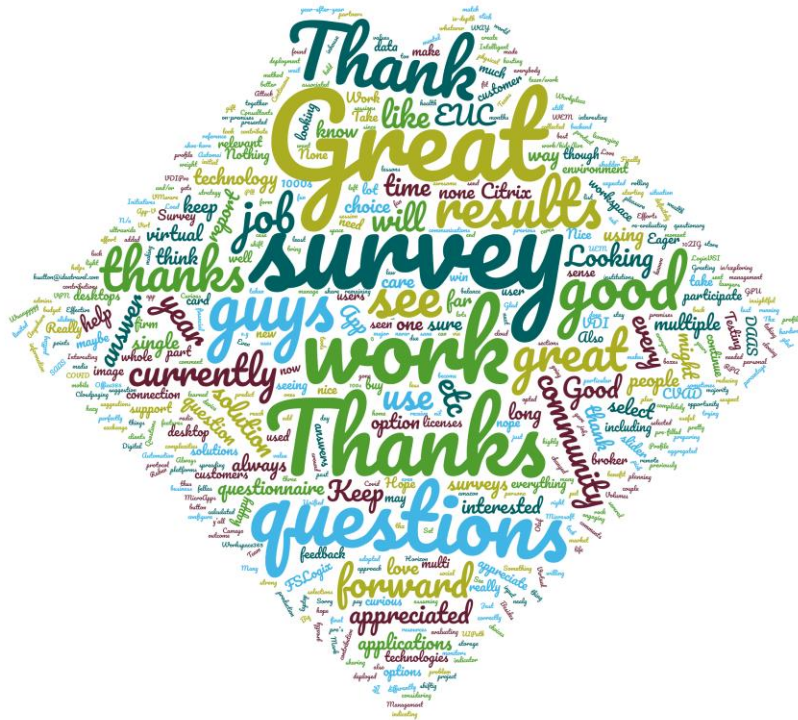
What's the most unnecessary/fun thing you bought or received during the COVID-19 pandemic?

We asked the participants what the most unnecessary/fun thing you bought or received during the COVID-19 pandemic – here are all the (quite funny) results out of 1600+ participants.



## Final comments from respondents

All the comments out of the comments section at the end of the survey, combined in one picture.



Finally comments respondents shared with Christiaan, Mark and Ruben Not curated – unfiltered insights.

- Great questions again this year, y'all rock
- Would be better if the app questions had multiple choice e.g., may use App Volumes and App Attach. Or using App-V and Cloudpaging etc.
- Eager to see the results! Great work guys.
- Also planning to look into ultrawide monitors and maybe new clients (10ZIG and the like)
- Good questions
- Cannot wait to see the results and as always thank you for putting this survey together!
- WAY to long.
- This survey every year is greatly appreciated! Thanks for doing this.
- Really great list of questions, I am looking forward to the aggregated data! I suspect this is a ton of work, and it is really appreciated!
- These surveys are done very well, and I appreciate the wealth of options to select for answers.

- Questions about how you store profile vs configure environment was hazy since like in our case we are FSLogix for profiles but use WEM for environment management.
- Sometimes going back in the questionnaire was not as expected but I could manage
- Thanks for your contributions to the EUC community!
- Thank you for taking the time to do this survey every year!!!

We would like to thank you for participating, sharing and donating your valuable time to the community, hope to see you back next year!

**THANK YOU!**

**Christiaan, Mark and Ruben**