VIRTUAL DESKTOP PERFORMANCE AND USER EXPERIENCE COMPARISON

A Comparison of Horizon on DTCP, Amazon WorkSpaces on AWS, and Microsoft Windows Virtual Desktop on Azure

ABSTRACT

Given today's conditions, it's become increasingly likely that for the foreseeable future, employers and educational institutions will be looking for solutions that allow their employees and students to work remotely. In fact, this may end up being a long-term business strategy for many organizations. In light of the current conditions, now is the right time for organizations to re-evaluate how they connect their remote workers to their corporate data infrastructure. In this paper, we'll compare the user experience and performance characteristics of three popular remote working solutions: Horizon on Dell Technologies Cloud Platform (VMware Cloud Foundation on Dell EMC VxRail), Amazon WorkSpaces on AWS, and Microsoft Windows Virtual Desktop on Azure.

82% of organizations plan to let employees continue to work from home at least some of the time.

47% of organizations plan to allow employees to work from home permanently.

Source: Gartner, July 14, 2020

Executive Summary

With the current trend toward distance working and learning, many organizations are currently reevaluating their remote connectivity architectures. The ability to provide files and applications to users at scale within a secure, efficient, and cost-effective environment are key strengths of Virtual Desktop Infrastructure (VDI) and Desktop-As-A-Service (DaaS) environments.

Virtual Desktops are a way to connect user desktops to corporate IT regardless of whether they're working from inside the IT network—or remotely from across the internet. Virtual desktops work by streaming a desktop image to any device running the remote access software or with equivalent capability provided through a web browser. Thus, it is possible to stream a high-powered desktop to an end-user's low-powered PC, tablet—or even smartphone. The remote user interacts with the virtual desktop as if it were running locally.

VDI and DaaS environments also provide IT with robust tools to manage users and applications. Access controls for all users are common, no matter if they connect from inside the company network or outside on a public network. Since all data and applications reside on host servers, remote workers can access critical business datasets remotely, without compromising data security.

For all its benefits, it should be noted that designing a remote worker environment can be a complex task. To get the most out of the investment, the remote environment must be designed for scalability while at the same time providing a consistent user experience to remote workers as the infrastructure grows. Because of this, evaluating the overall user experience (including desktop performance) is crucial in choosing the remote platform best suited for your environment.

Dell Technologies has been an ardent supporter of remote data accessibility for many years, and is an early advocate of evaluating *user experience* as a key metric in comparing

remote desktop platforms. In this paper, we will compare three popular remote worker platforms on the basis of *user experience* and *overall performance* criteria. The platforms included in this comparison are:

- Horizon on Dell Technologies Cloud Platform (DTCP)
- Amazon WorkSpaces on AWS
- Microsoft Windows Virtual Desktop on Azure

Test Criteria

For many organizations, remote access begins with the implementation of simple Virtual Private Network (VPN) connections. While this may be acceptable in allowing a small number of users to work remotely; it is well-known that VPN gateways simply weren't designed to support a large number of simultaneous users. Conversely, a well-designed remote worker environment offers substantial performance advantages over VPN, especially at large scale. Simply stated, a well-designed remote access environment allows more users to access company resources—without running into system and network bottlenecks.

Another major advantage of today's remote worker platforms is that they are device agnostic. All that is needed to access the environment is a device with a reasonable internet connection and a web browser—whether that device is a smartphone, tablet, desktop, laptop, or thin client. While the variety of connected devices is an obvious advantage for remote users, it can also be a headache for IT to administer—making remote management a critical task.

From a user experience perspective, the goal in every remote session should be to deliver a user experience that does not impact productivity, application responsiveness, boot up and login time—in other words, provide equivalent performance to corporate desktops.

Test Configuration

Although desktop virtualization operates entirely over the network, there is much more to designing a robust remote environment than just 'tuning the network'. Remote environments are heterogeneous by nature, with complexity that grows with scale. Any bottlenecks in the virtualization software layer or the cloud infrastructure will result in device sluggishness (and user complaints.)

To provide an apples-to-apples comparison of the remote user desktop experience, we configured a similar test environment for each platform. In each case, a cloud environment was created with two domains: 1) a **workload domain** which provided desktop resources to remote workers and 2) a **management domain** which provided administration resources to IT. This configuration simulates the design of a typical remote worker environment, and was the basis for all tests performed in this document.
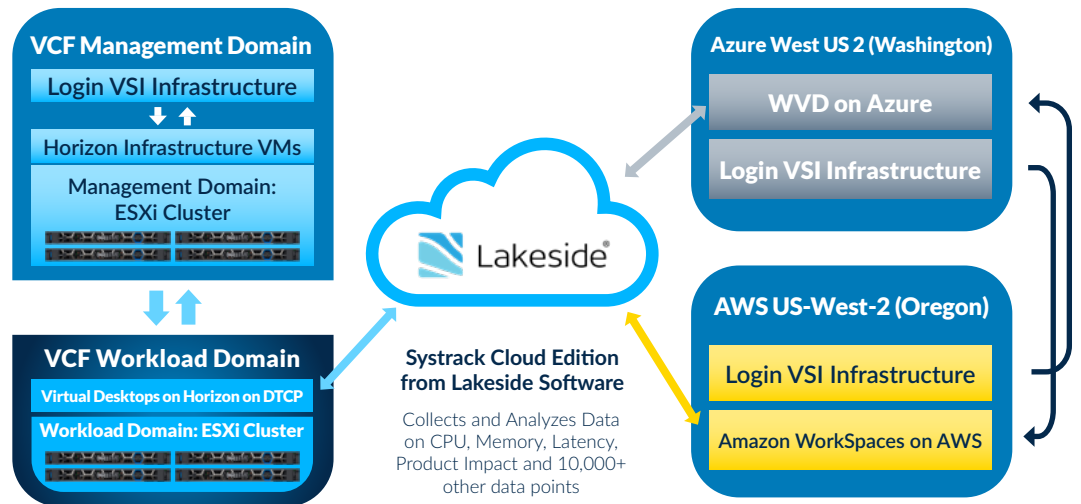
About Horizon on Dell Technologies Cloud Platform

VMware Horizon on Dell Technologies Cloud Platform (DTCP) is a simple, flexible, and agile hybrid cloud solution. It provides a streamlined approach to deliver, protect, and manage virtual desktops and applications. DTCP is a hybrid cloud platform that consists of Dell EMC VxRail Hyperconverged Infrastructure (HCI) and VMware Cloud Foundation.

For our tests, two industry-standard remote benchmarking tools were used. For performance tests, we utilized Login VSI, an independent load-testing application. Using Login VSI, we simulated 432 remote client sessions and compared baseline performance of the three platforms.

To simulate remote application usage, and measure the end user experience, Lakeside Software's industry-standard SysTrack monitoring tool was utilized. SysTrack is run over a period of time, during which thousands of key data points are recorded. These data points monitor everything that may impact the end-user experience, including trend data for Average Latency, Average Receive Packet Loss, and Average Transmit Packet Loss. System resources are also monitored, including CPU, Memory, and Storage consumption.

The DTCP environment provides consistent infrastructure and makes workload mobility seamless across private and public cloud environments. It takes complexity out of multicloud environments by delivering consistent operations to manage private, public and edge computing scenarios. For the tests contained within this paper, the following DTCP components were utilized:

	VDI Server Environment	**VDI Client Environment**
SYSTEM	4-node Dell EMC VxRail E560F	4-node Dell EMC VxRail E560N
CPU	(8) Intel Xeon Gold 6248R (3.0GHZ)	(8) Intel Xeon Gold 6240R (2.4GHZ)
MEMORY	576GB RAM	768GB RAM
STORAGE	Dell EMC vSAN with all-Flash NVMe	Dell EMC vSAN with all-Flash NVMe

1 Remote User Experience Comparison

When an organization makes the transition from physical to virtual desktops, IT does everything that they can to make sure that the virtual desktops perform as well, if not better than the physical desktops that they are replacing. To do so, administrators have long relied on performance metrics.

Today, however, Dell Technologies is driving a fundamental shift with regard to the way that virtual desktops are evaluated. To put it simply, organization are beginning to realize that measuring the end-user experience is just as important as raw performance metrics. Monitoring the end user experience provides a path to resolve common remote user complaints including:

Slow Logon – The Windows logon process is complex and includes many phases. Systems that require arduous boot cycles, particularly during "boot storm" events, result in lost productivity.

Excessive Application Load Time –The root cause for slow application load time will vary depending on the application type and dependencies. While often assumed to be a hardware performance issue, the issue may in fact be an internal application issue.

Excessive Application Response Time – Response time can be defined as the time between when the user clicks their mouse and when the action translates on screen.

Poor Graphic Performance – Image quality is based on the difference between what the image should look like and what it looks like on the user's endpoint. Poor graphics often appear as an effort save on other resources, such as bandwidth.

In each case, the key to resolving the issue is to identify the resource that is in short supply and then making any necessary adjustments. Again, it is important to keep in mind that performance issues are not always hardware related. An improper application configuration can just as easily cause user experience problems.

Although it is easy to become preoccupied with performance metrics, it is ultimately the end user experience that really matters. The key to providing your users with a good experience is to understand the relationship between applications, hardware resources, user activities, and then use that information in a way that allocates the necessary resources to the individual virtual desktops.

To measure the remote end user experience, the SysTrack monitoring tool was utilized. By capturing over 10,000+ data points every 15 seconds from each remote session, SysTrack provides a comprehensive benchmark which simulates the remote user experience in an impartial manner. Once all data points have been

analyzed, SysTrack provides an EUX score (End User Experience) for each session. The following table summarizes the results derived by SysTrack at the conclusion of our tests:

	Horizon on DTCP	Windows Virtual Desktop on Azure	Amazon WorkSpaces on AWS
# of VDI Sessions Measured	433	432	434

SYSTRACK EUX SCORES

|	Horizon on DTCP	Windows Virtual Desktop on Azure	Amazon WorkSpaces on AWS
Failed Sessions (Not Ranked)	2	4	11
Very Poor (0% - 59%)	0	0	60
Poor (60% - 69%)	0	2	68
Fair (70% - 79%)	0	11	74
Good (80% - 89%)	5	26	100
Very Good (90% - 99%)	148	384	121
Exceptional (100%)	278	7	0
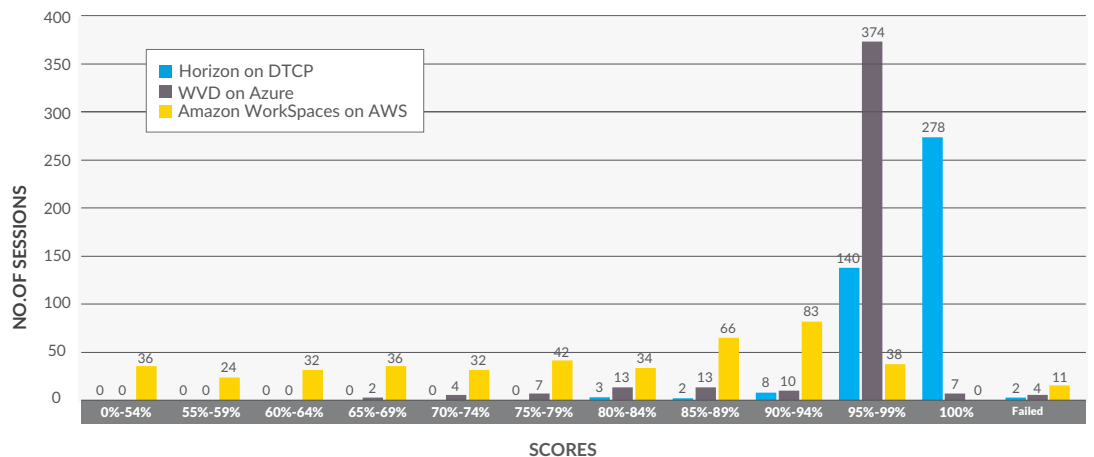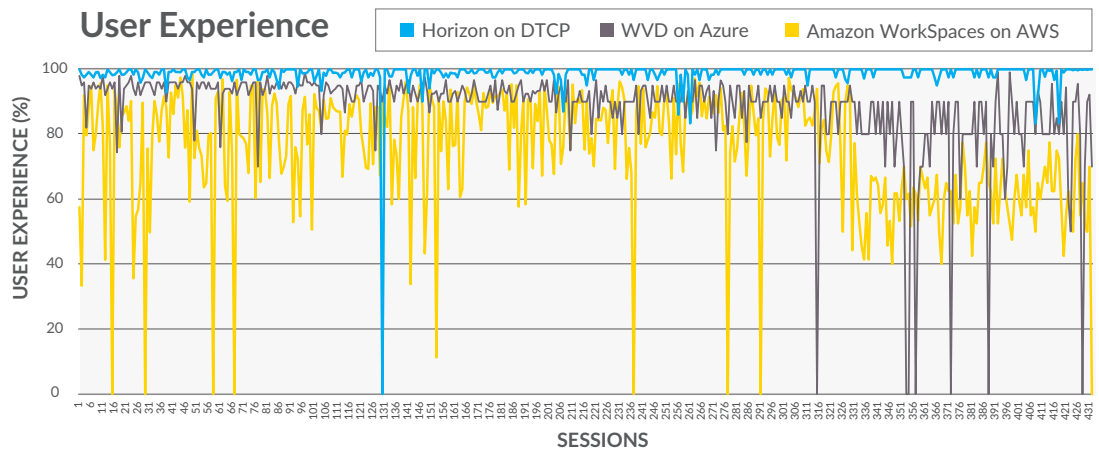
REMOTE USER EXPERIENCE SUMMARY

The results of the SysTrack user experience tests clearly indicate that Horizon on DTCP outperformed Amazon WorkSpaces on AWS and Microsoft Windows Virtual Desktop on Azure. Specifically, 98% of Horizon on DTCP sessions scored in the 90th percentile or higher, with nearly two-thirds (64.2%) of all Horizon on DTCP sessions falling in the "Exceptional" user experience range.

By comparison, in sessions reporting a 90% or greater user experience ranking, Horizon on DTCP (426 sessions) outscored Amazon WorkSpaces on AWS (121 sessions) by 252% and outscored Microsoft Windows Virtual Desktop on Azure (382 sessions) by 10.4%.

2 Remote User Productivity Comparison

After examining all relevant data points, SysTrack also provides a comparison of the productivity impact of each remote worker session. The result of this comparison for our tests indicated that Horizon on DTCP was the only remote platform in which SysTrack calculated *no loss in productivity*.

Impact on Productivity Hr/Wk
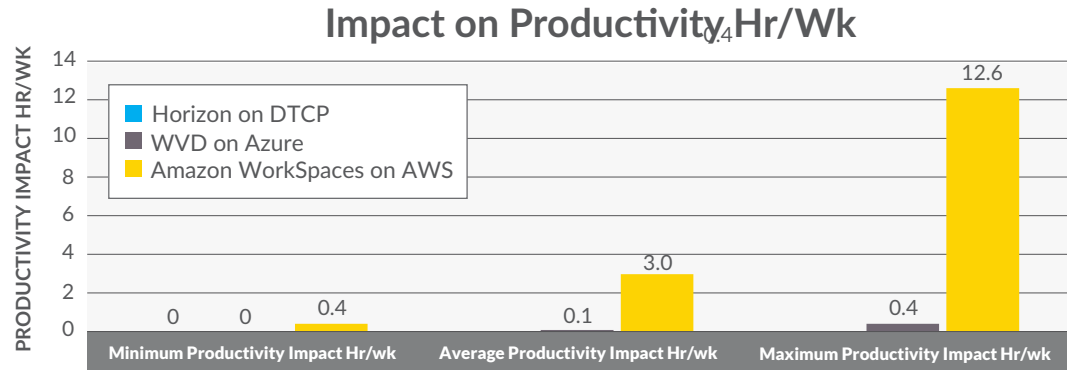
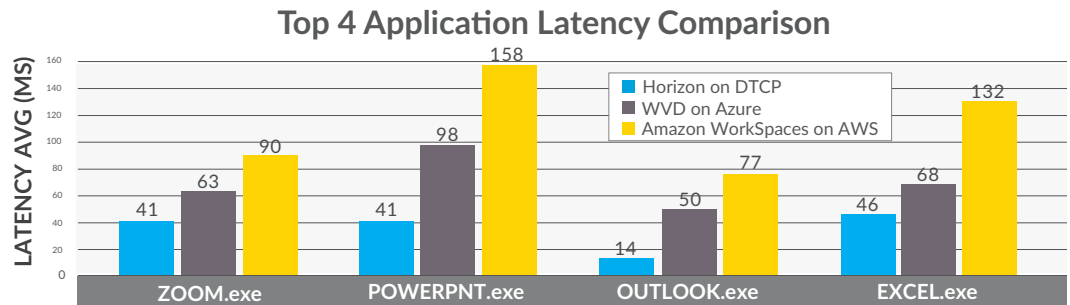# REMOTE USER PRODUCTIVITY SUMMARY

Remote user productivity is extremely important when considering today's economic uncertainty and the need for organizations to reduce all possible costs, including losses in worker productively. By demonstrating zero productivity loss, it is readily apparent that remote users can work effectively if they utilize a well-designed virtual desktop platform such as Horizon on DTCP.

3 Remote Knowledge Worker with Multimedia Plugin + Zoom Performance Comparison

Knowledge Workers are personnel who are engaged primarily in the acquisition, analysis, and manipulation of information as opposed to in production of goods or services. As such, remote Knowledge Workers are those that are most likely to require high speed, robust, and secure access to corporate data—in addition to the baseline performance requirements of "generic" remote workers.

For example, collaboration is key component in the effectiveness of remote Knowledge Workers. Zoom has become an important tool in this realm, providing video-telephony and online chat services through a cloud-based peer-to-peer software platform. To enable remote Knowledge Workers to work effectively, collaborative tools such as Zoom must operate seamlessly.

To simulate the remote desktop performance of Knowledge Workers, Lakeside Software's SysTrack application was again utilized. To examine the efficiency of Knowledge Workers during remote access, four common Windows workloads were analyzed by SysTrack, including the Microsoft Office Suite, and Zoom. The results of this simulation, measured in msec of latency, were recorded in the following table:

Top 4 Application Latency Comparison

Bar chart titled "Top 4 Application Latency Comparison". Y-axis: LATENCY AVG (MS), 0 to 160. Legend: Horizon on DTCP (blue), WVD on Azure (dark gray), Amazon WorkSpaces on AWS (yellow).

- ZOOM.exe: Horizon on DTCP 41, WVD on Azure 63, Amazon WorkSpaces on AWS 90
- POWERPNT.exe: Horizon on DTCP 41, WVD on Azure 98, Amazon WorkSpaces on AWS 158
- OUTLOOK.exe: Horizon on DTCP 14, WVD on Azure 50, Amazon WorkSpaces on AWS 77
- EXCEL.exe: Horizon on DTCP 46, WVD on Azure 68, Amazon WorkSpaces on AWS 132

REMOTE KNOWLEDGE WORKER SUMMARY

Workload latency is an important factor when considering the productivity of remote Knowledge Workers. Lost time waiting for applications to display equals lost time in analyzing important data. As demonstrated across Knowledge Worker applications, Horizon on DTCP outperformed both Amazon WorkSpaces and Microsoft Windows Virtual Desktop on Azure in four of the five workloads.

When simulating the all-important Zoom collaborative application (SysTrack refers to this test as "multimedia + Zoom"), Horizon on DTCP (41 msec average latency) outperformed Microsoft Windows Virtual Desktop on Azure (63 msec average latency) by 34% and outperformed Amazon WorkSpaces on AWS (90 msec average latency) by 54%.

4 Remote User Boot and Logon Comparison

Once the user experience is fully understood, with its strengths and weak points - performance testing can help identify specific resources that are over or under provisioned. Baseline performance tests should be performed periodically as a method of validating (and correcting) faults exposed in the user experience tests.

For generic remote desktop performance tests, we utilized *Login VSI*, an independent load-testing application. Using Login VSI, we simulated 432 remote client sessions and compared the performance of three platforms: Horizon on DTCP, Amazon WorkSpaces on AWS, and Microsoft Windows Virtual Desktop on Azure. The following table summarizes the results of the tests, with the top performer within each criterion highlighted in green:

|	Horizon on DTCP	Microsoft WVD on Azure	Amazon WorkSpaces on AWS
A VDI Sessions Launched	432	432	432
B Failed Sessions	2	4	11
C Average Session Logon Time	25 seconds	45 seconds	35 seconds
D VSIbase (Min. Workload)	823 msec	1,151 msec	966 msec
E VSImax Average (Avg. Workload)	982 msec	1,205 msec	1,092 msec
F VSImax Threshold (Max. Workload)	1,824 msec	2,151 msec	1,997 msec

A **VDI Sessions Launched**: for our test, an identical number of VDI sessions (432) were scripted to open sequentially on each platform. This simulates the typical VDI "Boot Storm" where the majority of users within a certain region begin to work remotely.

B **Failed Sessions**: the test software monitors the login of all VDI sessions and reports failures in three areas: a) VDI sessions which failed to launch; b) launched VDI sessions which failed to open; and c) open VDI sessions which failed to respond during performance tests.

C **Average Session Logon Time**: indicates the average logon time per session, measured from the time the test script starts running to the point when the Windows Shell (explorer.exe) is loaded.

D **VSIbase**: a measurement of the base performance of the VDI environment when there is no load on the environment. It indicates the best performance (lowest latency), measured in milliseconds, of the system during testing.

E **VSImax Average**: simulates a loaded VDI environment by applying several statistical rules to prevent anomalies from distorting performance calculations. For instance, VSImax Average removes noise (accidental spikes) from the VSIbase calculation by removing the top and bottom latency spikes from its calculation. In the below charts we removed 5 highest and 5 lowest reading from the table.

F **VSImax Threshold**: in most VDI environments, a 3x increase in response time compared to the baseline is regarded as the maximum acceptable performance degradation. VSImax Threshold simulates this point by adding latency to VSIbase until a point is reached where VSImax Average falls outside the acceptable performance range. VSImax Threshold simulates a true real-world environment and is considered the gold standard in measuring overall VDI performance. Measured in milliseconds, the lower the threshold, the more headroom available for unexpected spikes in demand.

LoginVSI Logon Time

Number of Sessions That Failed to Launch
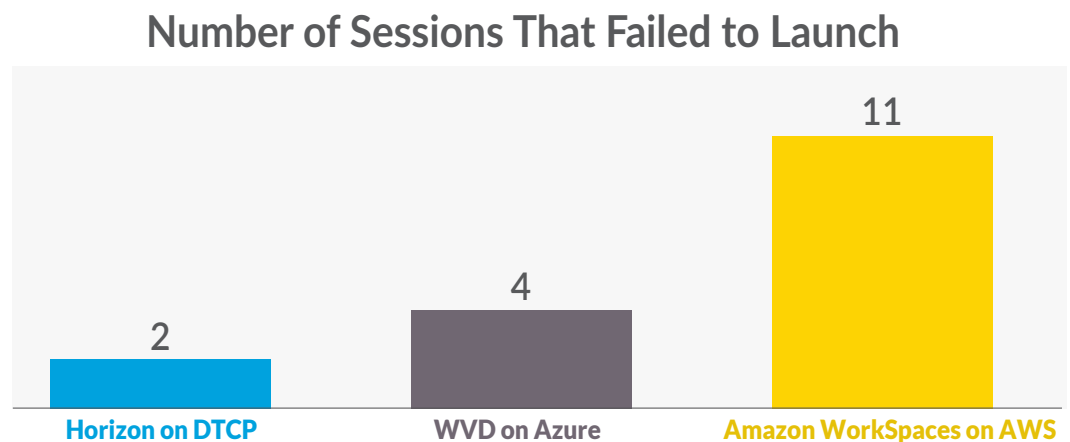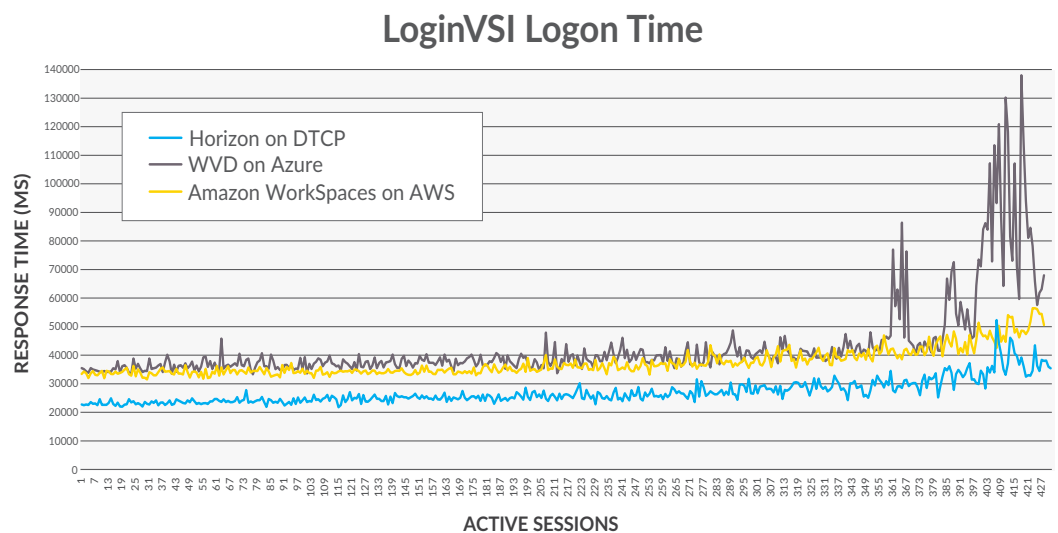
REMOTE USER BOOT AND LOGON SUMMARY

The results of the overall performance tests clearly indicate that Horizon on DTCP outperformed Amazon WorkSpaces on AWS and Microsoft Windows Virtual Desktop on Azure. With the best ranking in logon times, sessions completed, and latency across all load ranges, Horizon on DTCP is indicative of a robust design that is best prepared to take full advantage of a high performance remote environment.

In average remote session boot and logon time, Horizon on DTCP (25 seconds) outperformed Amazon WorkSpaces (35 seconds) by 28%, and outperformed Microsoft Windows Virtual Desktop on Azure (45 seconds) by 44%. In measuring average latency across all remote desktops, Horizon on DTCP (982 msec) outperformed Amazon WorkSpaces (1,092 msec) by 10%, and outperformed Microsoft Windows Virtual Desktop on Azure (1,205 msec) by 23%.

When measuring failed remote user sessions, Horizon on DTCP (2 sessions) again outperformed Amazon WorkSpaces (11 sessions) by 5.5x, and outperformed Microsoft Windows Virtual Desktop on Azure (4 sessions) by 2x.

CONCLUSION

Virtual Desktop Infrastructure (VDI) and Desktop-as-a-Service (DaaS) have become key technologies in enabling workers and students to work remotely without losing productivity. In comparing remote desktop platforms; performance and user experience are important criteria in determining ultimate success.

For any organization contemplating remote worker deployment, and based on the test results outlined in this paper, Horizon on DTCP is an obvious consideration. Along with providing a robust environment, Horizon on DTCP also includes a complete set of its own measurement tools. This in turn identifies bottlenecks to scalability with detailed reports on users, sessions, services, apps, VMs, hardware, storage, network and other components for deep insights into remote performance bottlenecks.

Using results provided by industry standard test suites LoginVSI and SysTrack from Lakeside Software, the remote worker environment hosted by Horizon on DTCP repeatedly showed superior results when compared to Amazon WorkSpaces on AWS and Microsoft Windows Virtual Desktop on Azure in the areas of typical user experience and baseline performance.

DTCP provides a hybrid cloud environment and standardized infrastructure experience; a common set of data services for workloads; a common management model; and workloads abstracted and decoupled from the underlying hardware to enable workload mobility. Horizon on DTCP is a true hybrid cloud platform for running remote workloads, ensuring users can work anywhere, across any device.