

An investigation into the evolution of users' graphical needs for VDI

Assessing GPU demand in the age of modern delivery

The need for high-performing digital workspaces that are accessible from anywhere, on any device, and at any time has never been more important. Today, many IT teams are faced with what will undoubtedly be one of the greatest challenges of their careers: supporting widespread remote work. IT must ensure not only that all employees have the devices and applications needed for productivity, but that the experiences those technologies provide match the quality standards users are accustomed to in the office.

For many organizations, the shift to remote work has renewed interest in virtual desktop deployments, which provide a secure mechanism for delivering familiar desktop and application experiences that are abstracted from the device itself. However, VDI brings its own set of challenges, not the least of which is determining the optimal resource setup for a productive digital experience.

Overpowered virtual desktops can quickly consume more budget than IT had bargained for, while underpowered desktops result in clunky, frustrating experiences for workers and decreased productivity.

One of the most critical resources to evaluate with any VDI project is GPU. Commonly asked questions include: What is the impact of discrete GPUs on computing performance? And how big of a difference does graphics acceleration make to end-user experience?

These are the questions that have inspired Lakeside Software's latest research investigation into GPU demand in the modern workplace. In this white paper, we explore the impact of GPUs for VDI through an analysis of detailed endpoint data gathered from real enterprise IT environments, including factors like multimonitor set-ups, video/audio conferencing usage, and the graphical demand of popular productivity applications.

Introduction

How GPUs Accelerate Work-from-Home Productivity

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Key findings & methodology

Our research into GPU requirements has been driven by industry interest in the evolving graphics demands of both applications and users. We compared data from 2020 and previous years to understand how GPU usage has changed and how working from home has impacted the employee experience.

Key research findings

- End-user experience scores dropped 5% between 2019 and 2020, representing an additional 2 hours of productivity impact per 40-hour work week.
- Interaction with graphical apps has increased year over year for both virtualized and physical desktop users.
- The average number of monitors per user has increased over the past five years. However, some industries show a decrease in average monitor numbers in 2020 potentially due to increased working from home.
- There has been a shift in the market with regards to the use and proliferation of video conferencing tools.
 Notably a large up-tick in the consumption of some newer providers of services like Zoom.

 Overall, the trend of graphical consumption has been to increase as time progresses, much as we'd expect from our past research. Specifically, the consumption is increasing both in terms of the overall total time users are engaged with graphical content and the expectations around multiple monitors.

Methodology

The data analyzed in this report was sourced from SysTrack Community, a rich source of anonymized customer data from thousands of physical and virtual endpoints across which SysTrack is deployed.

Primary metrics:

- App focus time: The percent of time a user spends focused on an application within a given time period
- End-user experience score*: A high-level KPI calculated based on productivity impact
- **GPU usage:** The percent of time spent consuming GPU
- CPU usage: The percent of time spent consuming CPU



^{*} SysTrack end-user experience scoring is a top-level key performance indicator (KPI) built out of lower-level KPIs (application performance, login time, CPU, memory, etc.). To calculate the score, we divide the total time a user is impacted by the total time they are active. By subtracting that number from 100, we are left with the percentage of time that a user was experiencing a non-impacted session. We group scores into four categories: Excellent is 97% and above, Good is > 90% and < 97%, Fair is > 80% and < 90%, and Poor is everything below that.

Remote work's impact on productivity

Before we dive into our GPU analysis, we'd like to set the stage with an overall understanding of how productivity been impacted by the ongoing Covid-19 pandemic.

The question of whether employees can be as productive at home as they are in the office is difficult to answer under normal circumstances. With the pandemic upending most aspects of everyday life, there are numerous factors that can disrupt the workday.

When it comes to technology, organizations can measure how the performance of IT resources impacts end-user experience. By quantifying this metric and assigning a score, IT can track and work to improve experience and remove productivity roadblocks.

SysTrack's end-user experience (EUX) score is a high-level KPI that is tracked across SysTrack Community. The data shows a 5% drop in EUX from 2019 to 2020, representing an additional 2 hours of impacted experience per week for full time employees.

In this paper, we will explore the role dedicated GPUs may play in restoring productive time.

Year	Average EUX Score
2016	86.46%
2017	84.55%
2018	84.68%
2019	86.53%
2020	81.50%
Q1 2020	82.00%
Q2 2020	80.06%
Q3 2020	80.38%

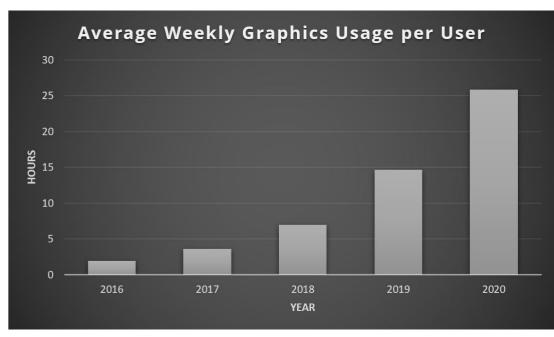
Table 1. Average end-user experience scores over time

The evolution of graphical demand

Historically, GPU for VDI was used on an ad hoc basis to support the needs of notoriously graphic-intensive job roles such as graphic designers, software engineers, and architects. With the rise of remote work and the increased graphics requirements for productivity and video conferencing tools, GPU-accelerated VDI is a critical solution for knowledge workers as well.

Today's knowledge workers rely on SaaS solutions like Office 365 and video conferencing for collaboration and productivity. These tools have become more graphically demanding over the years as new features and capabilities have emerged, which we will explore later on in this paper.

Across the board, we've seen an increase in users' consumption of graphically rich content over the past four years. "Rich content" is a phrase that will be used throughout this paper to describe graphically intensive applications or content. As an example, streaming media or GPU consuming applications like 3D modeling applications (e.g. CATIA). This is categorized a bit differently than GPU applications that are more for machine learning or non-user interactive features.



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Figure 1. The evolution of graphical demand by year

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End-user experience scores

dropped 5% between 2019

and 2020, representing

an additional 2 hours of

hour work week.

productivity impact per 40-

This trend of increasing demand holds true for VDI users as well. Figure 2 shows a steady increase in the time users spend interacting with graphical applications since 2016, with a large spike in 2020 for both physical and VM users.

These trends indicate that the usage of graphical applications has expanded across job roles and work styles, increasing the need to design end-user computing environments with adequate GPU to support the user experience.

Understanding user needs

Because of the increasing flexibilities of delivery and the variety of services available to make end users productive, it can be paradoxically more difficult to understand what fits their needs because of the overwhelming possibilities. One of the items that has been consistent and, given the state of the consumer market, understandable, is the ever-increasing need to make graphical content accessible to users.

Table 2 represents data from our community on the overall average utilization of graphical content on a weekly basis per user. One item to note immediately is the very rapid up-tick for average consumers as more and more of the core IT applications they consume are presenting "rich content" (visual elements or media that require graphical acceleration). This would be inclusive of later versions of the Microsoft Office suite as well as most browsers. This marks a serious departure for the common computing needs for most users in comparison to where they were even a few years ago.

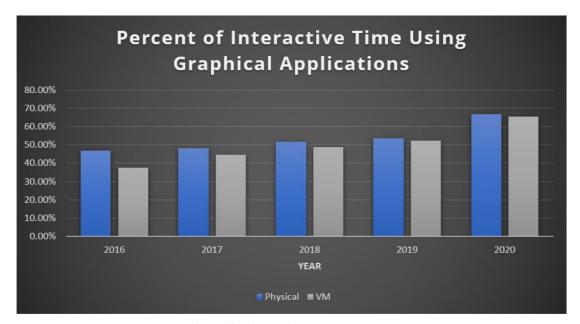


Figure 2. User interactive time with graphical apps by year

Year	Average of Graphics Hours per System per Week
2016	1.97
2017	3.60
2018	7.01
2019	14.68
2020	25.84

Table 2. The growth of graphical consumption over time for average users

As a split between workloads narrows in physical and the virtual desktop space, this tells us that we've got two points of interest:

- Most people are now spending most of their productive time in apps that use graphics.
- The expectation for virtual machines is the same as the expectation for physical: you should be able to run graphical workloads most of the time with a good experience.

Rising multi-monitor set-ups

Another area of consideration for determining the necessity of GPU acceleration is the number of monitors per employee. The past five years have seen a steady increase in multi-monitor set-ups across industries within SysTrack Community.

In table 5, we've broken out monitor count over several industries. As might be expected, finance and government have seen the most growth in multi-monitor set-ups as those organizations are comprised of more knowledge workers than in healthcare or consumer goods. Interestingly, we see a dip in all four industries in 2020, likely indicating that employees reduced their monitor count in the shift to remote work.

Percent Time Using Graphical Apps		
Year	Physical Desktops	Virtual Desktops
2015	45.71%	14.72%
2016	46.99%	37.66%
2017	48.25%	44.68%
2018	51.88%	48.71%
2019	53.63%	52.50%
2020	66.99%	65.53%

Table 3. A time line of the percentage of devices using graphical applications by platform type. Of interest is the large increase in VDI rich content.

Year	Average Number of Monitors
2015	1.00
2016	1.06
2017	1.24
2018	1.45
2019	1.56
2020	1.78

Table 4. Average number of monitors per user

Average Number of Monitors by Industry				
Year	Consumer Goods	Finance	Government	Healthcare
2016	1.00	1.00	1.00	1.00
2017	1.00	1.43	1.10	1.26
2018	1.27	1.88	1.29	1.44
2019	1.48	2.00	1.99	1.49
2020	1.42	1.81	1.48	1.39

Table 5. A comparison of the increase in monitor usage by industry

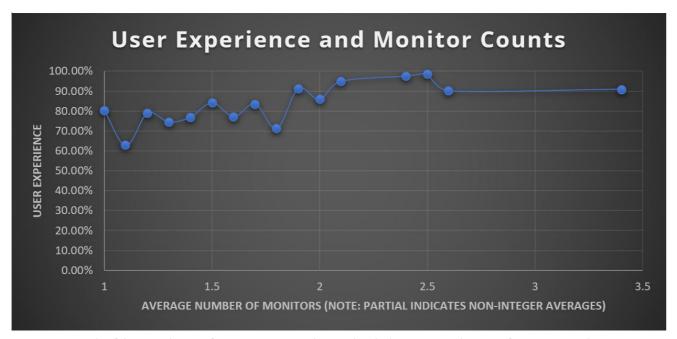


Figure 3. A graph of the correlation of user experience observed with the associated count of monitors on their primary device

As an interesting relation to the above, there was an interest in exploring what the relationship between monitors and user experience may be. Note that this is not going to be a directly causative link, but there may be some correlation of interest. In fact, as the data was reviewed, there was a correlation found between an increase in monitors and a general increase in user experience. While it's difficult to draw a direct reason for why that may be, some potential explanations follow:

- Multi-monitor set-ups may be more common as IT sophistication and/or budget increases
- Users with more than one monitor may be more advanced technology users with better IT practices

Categorizing applications and their resource usage

One of the trends that has been most interesting is precisely what the distribution of application graphics consumption has looked like in the enterprise over time. As we move more and more users into a modern application framework entering into 2020, it's evident that most of the common applications in use by typical users have begun to consume GPU—this is true even of applications that one may not initially expect.

Our analysis focused on three application categories that have become increasingly critical for knowledge workers working remotely: browsers, productivity applications, and virtual meeting tools.

Tables 6 and 7 show how both application graphical requirements and CPU usage per application have increased, with significant jumps in 2020.

Productivity apps

An overall analysis of productivity applications indicates that across the board most are now taking advantage of GPU acceleration. Table 8 establishes a general trend starting with the large up-tick in GPU consumption by more modern implementations of office suites (e.g. Office 365).

App GPU Requirements		
Year	GPU	No GPU
2015	41.82%	58.18%
2016	51.02%	48.98%
2017	53.30%	46.70%
2018	63.46%	36.54%
2019	65.77%	34.23%
2020	75.48%	24.52%

Table 6. A representation of the relative growth of GPU requirements for standard applications over time

App CPU Usage			
Year	Browser	Productivity	Meetings
2016	13.22%	2.87%	3.45%
2017	10.12%	7.77%	6.20%
2018	16.46%	26.20%	18.65%
2019	21.75%	16.23%	25.68%
2020	38.44%	46.93%	46.03%

Table 7. A weighted overview of relative CPU usage per application type by year

Productivity App GPU Requirements			
Year	GPU Usage	No GPU Usage	
2015	48.21%	51.79%	
2016	84.61%	15.39%	
2017	83.65%	16.35%	
2018	96.09%	3.91%	
2019	97.70%	2.30%	
2020	99.02%	0.98%	

Table 8. A representation of the relative growth of GPU requirements for productivity applications over time

Notably, productivity applications were found to use GPU more than 99% of the time in 2020. Again, with the move to modern SaaS solutions, this requirement is to be expected.

A further consideration to determining whether VDI users need discrete GPUs is whether they access resource-intensive applications. Figure 4 shows CPU usage by common productivity applications. Nearly all have seen an up-tick in the percent of time spend consuming CPU in 2020, with Dropbox, OneNote, Excel, PowerPoint, and Word showing significant spikes.

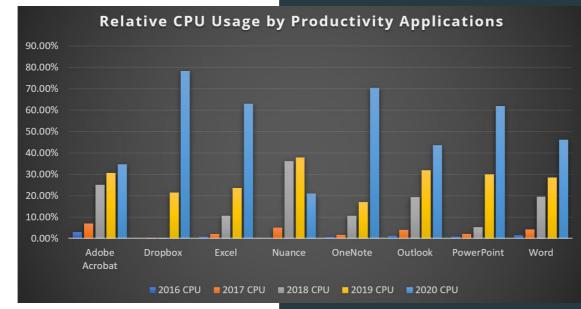


Figure 4. A breakdown of CPU usage by app

Video conferencing

2020 has seen an explosion in video conferencing use in both personal and professional settings. According to Pew Research Center, 25% of U.S. adults have reported using video calling or conferencing services to attend work meetings during the Covid-19 outbreak.

To understand the resource impact of the variety of video conferencing offerings available today, we examined both app popularity and percentage of time spent consuming CPU

Zoom, Microsoft Teams, and GoToMeeting were the most used conferencing applications within SysTrack Community. These apps also spent a high percentage of time consuming CPU, as seen in figure 5.

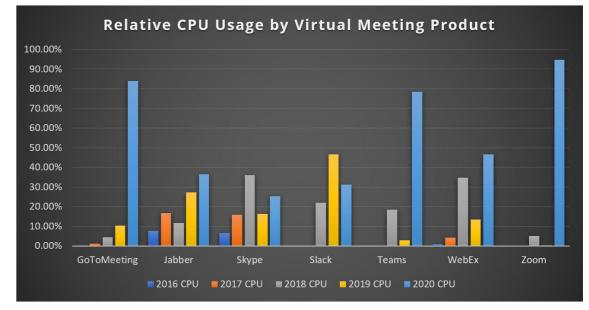


Figure 5. A breakdown of CPU usage by conferencing app

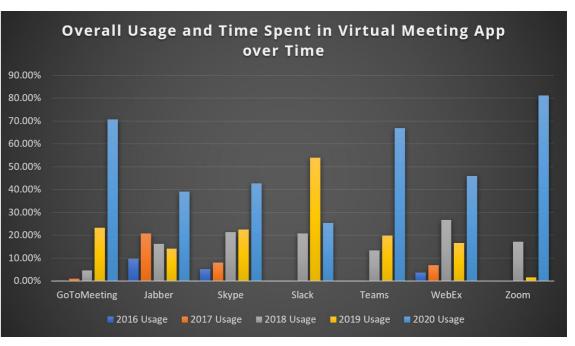


Figure 6. Video conferencing app usage over time

Web browsers

Finally, we looked at the resource requirements of the most widely used browsers in the enterprise: Google Chrome, Microsoft Edge, Firefox, and Internet Explorer. Note that Edge encompasses both the new Chromium version as well as legacy.

Figure 7 shows the percentage of time spent consuming CPU by browser since 2016. Interestingly, we see the greatest variability in this category of application which may be due to different adoption levels over time or software changes.

Overall, we see increases in CPU usage for all browsers except IE from 2019 to 2020.

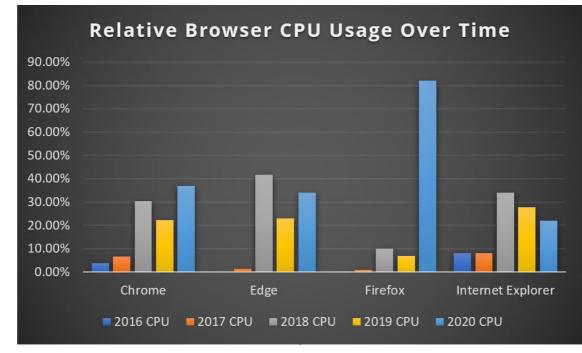


Figure 7. A breakdown of CPU usage by browser

Benefits of NVIDIA vGPU

To address the increasing graphical demands outlined in this paper, we recommend that organizations assess the needs of their own environment and evaluate the impact GPU acceleration may have.

The NVIDIA Virtual GPU (vGPU) solution provides a flexible way to accelerate virtualized workloads. NVIDIA GRID® Virtual PC (GRID vPC) software improves virtual desktops and applications for every user, with proven performance built on NVIDIA® GPUs for exceptional productivity, security, and IT manageability. The virtualization software divides NVIDIA GPU resources, so the GPU can be shared across multiple virtual machines running any application. Because work that was typically done by the CPU is offloaded to the GPU, users have a much better experience, and graphics demanding applications can be supported in a virtualized and cloud environment. This is especially relevant with the increase of CPU usage for productivity applications, web conferencing tools, and web browsers. NVIDIA GRID vPC enables organizations to extend the reach of their VDI investment and give every user a native-PC experience that meets the needs of today's graphic-intensive applications.

"Today, users have grown used to rich graphical experiences from devices they interact with on a daily basis, and increasingly it's an expectation that they can work in the style they want whenever and wherever they want. vGPU offerings from NVIDIA offer complete flexibility, complementing their physical offerings and completing the tool set for enterprises to deliver a great environment anywhere. Lakeside is pleased to partner with NVIDIA to help organizations assess their graphics requirements and size appropriately for optimal end-user experience."

— Ben Murphy Senior Director Product Management Lakeside Software



Assess your organization's remote work impact and GPU requirements with a free trial of SysTrack. Click here to get started today!

Conclusion

As organizations assess their options for enabling productive remote work in the long-term, many facets of IT must be re-examined to minimize end-user experience impacts. In this paper, we examined one of those pieces—graphics acceleration—and what the data shows about organization's evolving graphical needs.

Our analysis showed a clear increase in resource demand for both physical desktop and VDI, strongly indicating a need to evaluate the benefit GPU acceleration could offer your virtualized users.

Additionally, we uncovered an increase in multi-monitor set-ups, indicating that organizations are finding value in providing employees with more screen real estate. However, a decrease in multi-monitor set-ups in some industries may indicate a need for organizations to supply additional monitors to at-home users to match the experience they received in the office.

Finally, we found rising graphical requirements across application types, especially productivity applications and video conferencing tools. As employees rely on these applications to collaborate with co-workers and fulfill their job requirements from home, organizations must ensure that desktops are provisioned with adequate resources for optimal end-user experience.

CONTACT







Lakeside Software is a leader in digital experience monitoring. We develop software that provides the visibility IT teams need to design and support productive digital workplaces. Learn more at lakesidesoftware.com.