

A Lakeside Software White Paper

# Elevating User Experience through GPU Acceleration

*A Windows 10 versus Windows 7 Analysis*



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## Introduction

In a previous white paper, "[Analysis of Windows 10 versus Windows 7 Performance Implications](#)," we discussed how different computing scenarios are affected by a Windows 10 migration. To inform our analysis, we used the latest data from SysTrack Community, a rich source of anonymized data from the tremendous number of endpoints, both physical and virtual, across which SysTrack is deployed. Our previous exploration focused on three primary metrics: system boot times, Office application performance, and SysTrack health scoring. From there, we determined the minimum Windows 10 hardware requirements for different classes of users. Our analysis showed that, given adequate hardware, Windows 10 outperforms Windows 7 for most users.

Since publishing that paper, the number of Windows 10 users in SysTrack Community has increased by 18%. As businesses continue to migrate from Windows 7 to Windows 10, IT professionals must identify and address performance differences between the two operating systems. Since our last round of analysis was performed, a growing area of concern among our customers has been end-user graphics requirements. This topic has come up enough that we were inspired to do a more detailed investigation on the graphical differences between Windows 7 and Windows 10. We speculated that, as application and OS developers continue to enrich the user experience by creating software with more robust graphical experiences, we'd find evidence of this improvement in our community data. However, without adequate graphics processing hardware, there is a possibility that increased graphics demands could negatively affect key performance metrics. With this dilemma in mind, we set out to examine our clients' graphical experiences when upgrading to Windows 10 through analysis of data derived from SysTrack Community.

## The Rise of GPUs

Physical desktops have had graphics for a long time—certainly since the beginning of most users' computing journeys. Today, even mobile devices (smartphones, tablets, etc.) have graphics. As such, modern users have an expectation of a certain level of graphical quality and processing speed when interacting with their devices both at home and in the office. The ubiquity of graphics-enabled devices has led to the assumption on the part of software developers that hardware will have adequate graphics support. Consequently, developers write software with rich user experiences. Examples include modern applications, such as Office 365, web browsers, video (YouTube/Skype for Business), streaming services, Adobe Creative Suite, etc. GPUs have enabled the rise of graphics through efficient processing. Without a dedicated GPU, the experience of an end-user is impacted—from slower performance, to increased CPU requirements, to reduced feature sets, even applications that refuse to launch.

However, the experience of a user without GPU on a virtual desktop can be much worse, as virtual desktop infrastructure (VDI) presents unique graphical challenges. Any issues that a desktop user without a GPU might

experience are compounded in a VDI environment, as multiple users share server resources. One user driving graphics demands on a virtual desktop could have an impact on its performance for everyone in the system; with graphics-intensive applications like video streaming becoming more common in the workspace, it is easy to see how sensitive VDI is to users' graphical demands. Furthermore, users are unlikely to accept reduced graphical experiences, which can turn some companies away from VDI adoption. With a GPU, a virtual desktop can alleviate some of the pressure placed on CPU and accommodate more users, increasing density on a server. GPU also enhances user experience in a VDI environment by enabling users to access their favorite graphics-intensive applications without negative performance consequences.

With what is broadly known about GPUs in physical and virtual environments, there is no argument about whether graphics requirements will differ between Windows 7 and Windows 10; the questions of interest are by what degree and to what end? How much does a company stand to benefit from wider discrete GPU implementation? What combinations of software and hardware ultimately result in excellent user experiences?

## Our Metrics

We harnessed our knowledge of the distinct graphics requirements of physical and virtual systems to inform our investigation into the graphics-related performance implications of Windows 10 adoption. Drawing on two decades of industry experience, we made several hypotheses: 1. If a user is on Windows 10, their CPU usage will be higher than a Windows 7 user on the same machine type, and; 2. Users with discrete GPUs will consume less CPU than those without.

After consultation with industry-leading graphics hardware creators, we decided to examine three major metrics that provide the best insight into graphics requirements for Windows 10 and Windows 7. Using data from SysTrack Community, our assessment focused on:

- The percentage of time applications consume GPU
- Average active CPU usage
- SysTrack user experience scoring (i.e. end-user experience quality)<sup>1</sup>

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<sup>1</sup> SysTrack 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. For VDI, we do not recommend deployment to users with scores below 80%.

## Assessment Results

Using data from SysTrack Community, we uncovered trends in our analysis that are highly relevant to IT professionals seeking information on the graphics processing differences between Windows 10 and Windows 7. Based on our observations, we feel confident in recommending the implementation of discrete GPUs in both physical and virtual environments to guarantee that your users are getting the most out of their operating systems.

### Percentage of Time Driving Graphics Consumption

Enterprise workers use a diverse set of applications that are graphics-intensive, the most common being Office and web browsers. The latest versions of applications tend to have more graphically-intensive features (and generally a better user experience) than older versions, naturally requiring more processing cycles. By examining the percentage of time that popular applications were consuming GPU, we found major increases in graphical demand for Windows 10 versus Windows 7.

Average of Windows 10	Average of Windows 7	Percent Increase
11.30%	8.58%	<b>31.67%</b>

Table 1: Percentage of Time Consuming GPU (DirectX or OpenGL)

Graphics usage increases **32%** from Windows 7 (8.58%) to Windows 10 (11.30%). This means that across the board, a system with a similar application set with Windows 10 requires substantially more processing of graphics. This led us to ask some fundamental questions about differences in graphical consumption of common applications. We picked the most ubiquitous software for our area of focus: browsers and the Microsoft Office suite.

Example Applications	Average of Windows 10	Average of Windows 7	Percentage Increase
Firefox	31.69%	19.90%	<b>59.29%</b>
Google Chrome	13.09%	9.64%	<b>35.75%</b>
Microsoft Office	4.32%	0.35%	<b>1130.73%</b>

Table 2: Percentage of Time Consuming GPU for Sample Applications

Interestingly, the versions of applications used in Windows 10 seem to drive higher graphical consumption than their counterparts in Windows 7. With Microsoft products in general, we do see a very large increase in GPU consumption with the more modern versions of the applications and those generally used on Windows 10.

Office Apps	Average of Windows 10	Average of Windows 7	Percentage Increase
Excel	4.62%	3.02%	52.88%
Outlook	16.34%	8.85%	84.65%
PowerPoint	5.45%	3.33%	63.64%
Skype for Business	11.97%	2.35%	408.99%
Visio	3.67%	1.18%	211.56%
Word	4.57%	4.35%	5.24%

Table 3: Office Application Percentage of Time Consuming GPU

We see again a substantial increase in time driving graphical processing for the core Office suite. This is generally attributable to changes from older versions of Office more commonly found on Windows 7 machines versus those found on Windows 10.

Office Version	Time Consuming GPU
Microsoft Office 2010	2.75%
Microsoft Office 2013	3.07%
Microsoft Office 2016	9.11%

Table 4: The growth of graphics consumption by Microsoft Office version

So, this covers one aspect of the consumption, but what is the actual ramification on the system for that increased demand?

## Graphics-Driven CPU Consumption: Analyzing Average Active CPU

One of the most important questions to try and answer with our assessment of the Community data is to sort out what the impact of not having a discrete GPU is on the system and, in turn, the user experience. For the purpose of our assessment, “no GPU” refers to systems without discrete GPUs. Perhaps the clearest cost of not having a dedicated GPU relates to the consumption of CPU cycles when graphics calls are made. In our analysis, we focused on average active CPU values, which we measure in MIPS (millions of instructions per second).<sup>2</sup> With a dedicated GPU, systems don’t have to rely solely on CPU for graphics processing, and are therefore able to run more efficiently. This results in a net decrease in CPU usage while applications and users are active. So, what kind of impact do we see?

<sup>2</sup> We use MIPS to measure CPU usage as a way to normalize that value. SysTrack Community environments have multiple types of machines, and therefore multiple types of CPUs. Using MIPS allows you to get an accurate count of what kind of CPU resources are being used, which is important for future growth as it allows you to know exactly what to account for in your environment.

	Physical Desktop		Virtual Machine	
	GPU	No GPU	GPU	No GPU
<b>Windows 10 Average</b>	<b>1850</b>	<b>2180</b>	<b>1283</b>	<b>1883</b>
Excellent	1898	2318	1271	1855
Fair	1764	2184		
Good	1956	2172	1295	1827
Poor	1782	2045		1967
<b>Windows 7 Average</b>	<b>1186</b>	<b>1396</b>	<b>1371</b>	<b>1450</b>
Excellent	1246	1516	1371	1472
Fair	1222	1486		1406
Good	1194	1303		1584
Poor	1082	1280		1339

Table 5: Average of Active CPU sorted by OS, machine type, and user experience category

One thing is clear: on systems without a GPU the overall average active CPU usage is higher. This seems to be the case both for physical and for virtual systems, and is even more noticeable for Windows 10 systems. To better represent this load, we decided to isolate the systems with an all-around Excellent user experience. This helps us pinpoint cases where the overall user experience score is ideal and the system isn't limited by other factors.

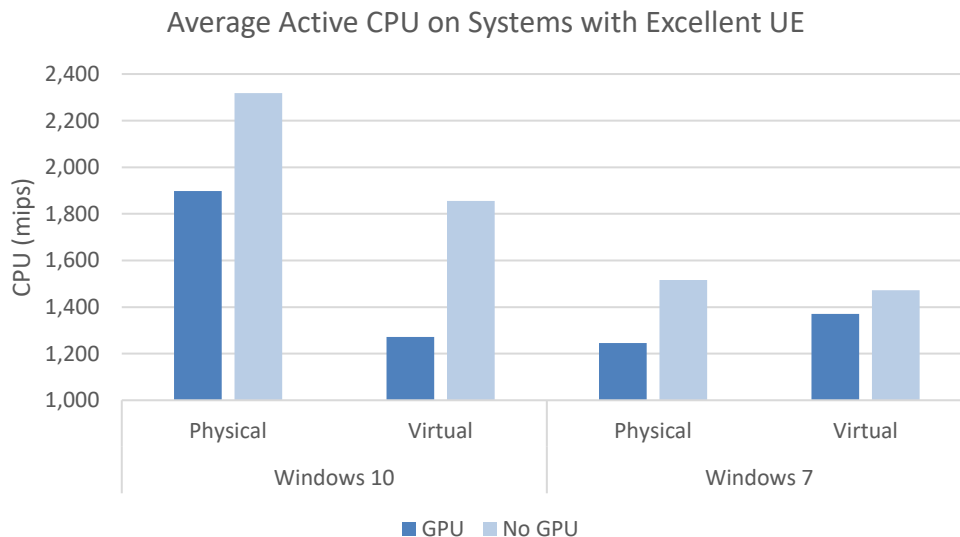


Figure 1: Average active CPU on systems with Excellent health scores by OS and machine type

By isolating systems with excellent user experience scores, as in Figure 1, we can see that one obvious way to decrease active CPU on a system is by adding a GPU. The difference is particularly noticeable in Windows 10 virtual systems, where the addition of a GPU results in 30% less CPU consumption. As a result, Windows 10 VDI architects can generally increase density (in CPU bound cases) by 30% through inclusion of vGPU.

	GPU	No GPU
Windows 10	Active CPU	Active CPU
Physical	1849.7	2179.5
Virtual Machine	1283.0	1883.0
Windows 7	Active CPU	Active CPU
Physical	1185.8	1396.2
Virtual Machine	1371.0	1450.3

Table 6: Average active CPU sorted by OS, machine type, and GPU status

## User Experience

Now we answer the question of how a Windows 10 transformation affects end-user experience specific to users' graphics requirements. This is perhaps the most important metric, as system performance is most relevant as it relates to overall user experience. The central question we want to answer is this: what kind of user experience changes can we expect with the introduction of a GPU? Figure 2 illustrates a compelling point: GPUs in general seem to relate to higher user experience scores.

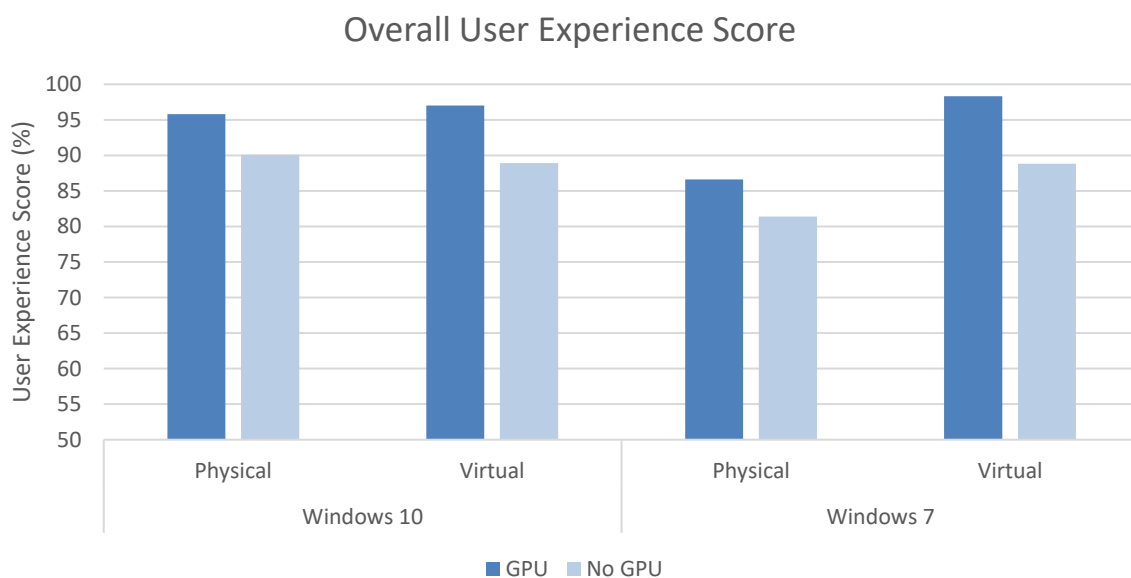


Figure 2: Overall SysTrack user experience scoring by OS and machine type (higher is better)



In all scenarios, inclusion of GPU correlates with high user experience scores, and this seems to be predicted quite well by the overall decrease in CPU related impact witnessed on systems that have discrete GPUs versus those that do not.

OS Version	Machine Type	User Experience with GPU	User Experience with no GPU
Windows 10	Physical	95.8	90.1
	Virtual	97.0	88.9
Windows 7	Physical	86.6	81.4
	Virtual	98.3	88.8

Table 7: User experience score sorted by OS and machine type

## Assessment Summary

When customers ask us about the Windows 7 to Windows 10 impact for VDI, their main concerns are user density and user experience. Overall, our assessment has shown: 1. Graphics usage increases in Windows 10; 2. Systems without discrete GPU have higher CPU usage, and; 3. User experience is higher with discrete GPU than without. While there is a slight dip in user experience in Windows 10 virtual systems vs. Windows 7, it is important to remember that “user experience” in this case is simply a measure of non-impacted time, not overall quality of engagement with an OS. Higher CPU usage in Windows 10 is likely an indicator of an enriched user experience with newer applications and overall OS improvements. That being said, a clear way to greatly reduce negative system performance in VDI is with implementation of vGPU. A reduction in system performance impacts ultimately enables VDI architects to increase user density, therefore requiring fewer servers and reducing costs.

## NVIDIA Cloud Assessment

With the creation of NVIDIA GRID™, NVIDIA extended the use of their powerful GPU technology to the virtual space. When transitioning users from physical to virtual desktops in an enterprise environment, it can be difficult to predict how their current graphics needs might be affected. If you are looking for a starting point in assessing the virtualization readiness of systems based on their GPU consumption, we’ve partnered with NVIDIA to create a free tool that can help you identify good virtualization candidates. Our assessment features dashboards that provide insight into what’s driving demand in your systems, what hardware users have, users’ current GPU utilization, and users’ suggested fit for vGPU.

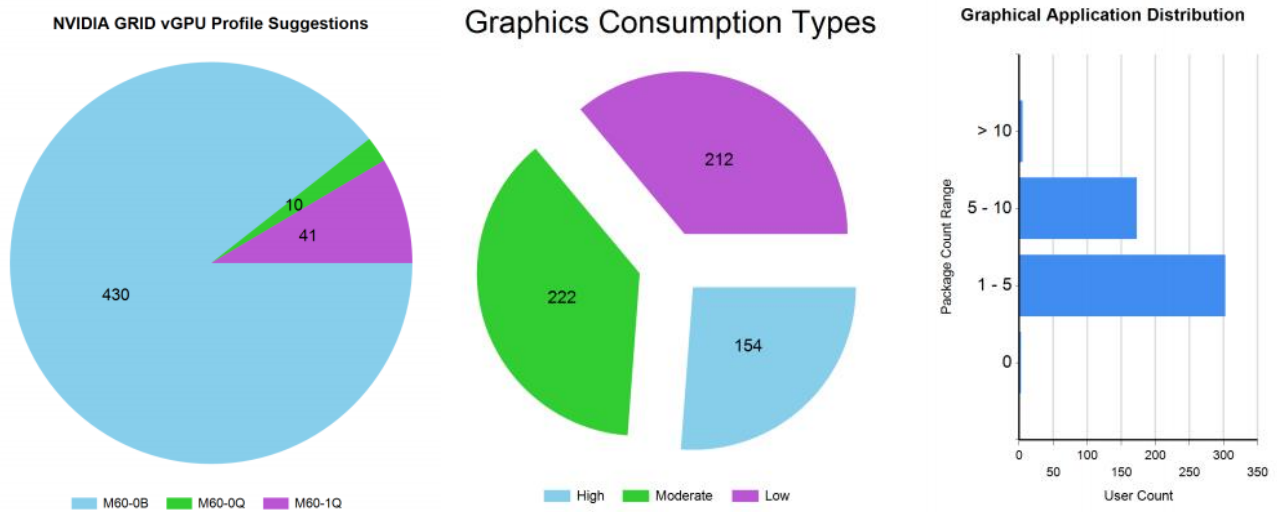


Figure 3: Examples of charts provided in the NVIDIA Cloud Assessment report

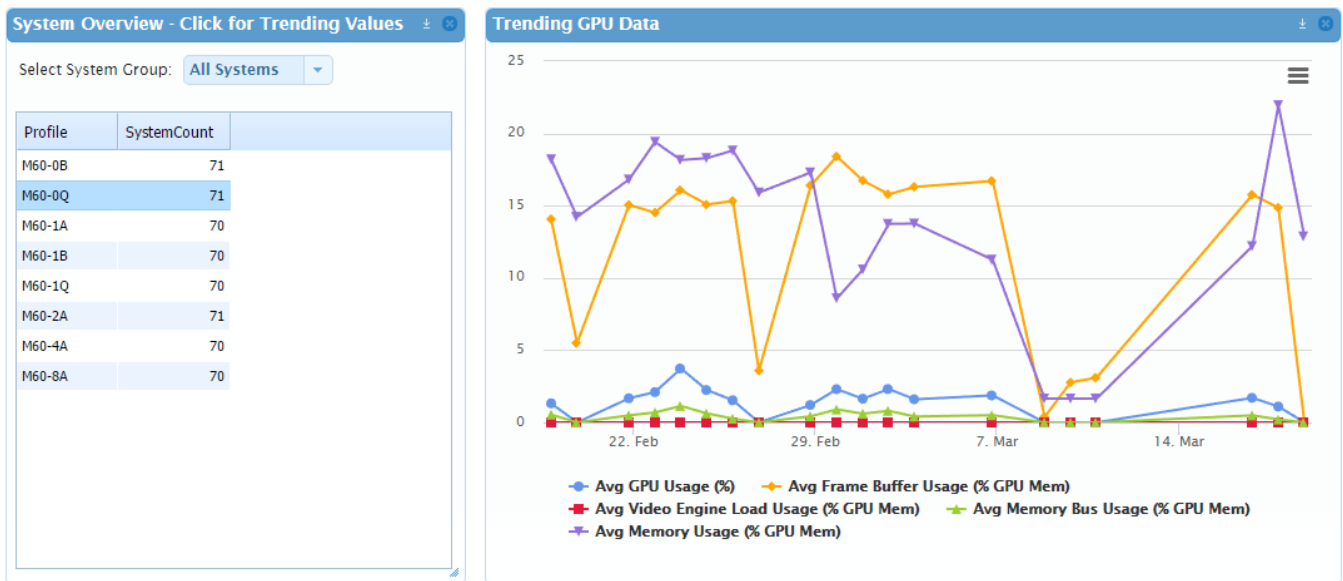


Figure 4: Assessment dashboard overview of vGPU usage

Additionally, the assessment provides access to two products from the SysTrack suite: Visualizer and Resolve. Visualizer allows you to track overall performance in your environment, whereas Resolve provides an in-depth view of key data on an individual system. The NVIDIA Cloud Assessment also offers a custom report that summarizes the data available at the end of the 30-day collection period to help you make decisions about what GRID profiles best align with [your users' graphical needs](#).

After you've completed your free assessment, you have the option of continuing to monitor GPU usage in your environment through a SysTrack deployment. With SysTrack, you gain real-time views into individual system's graphics usage, as seen below.

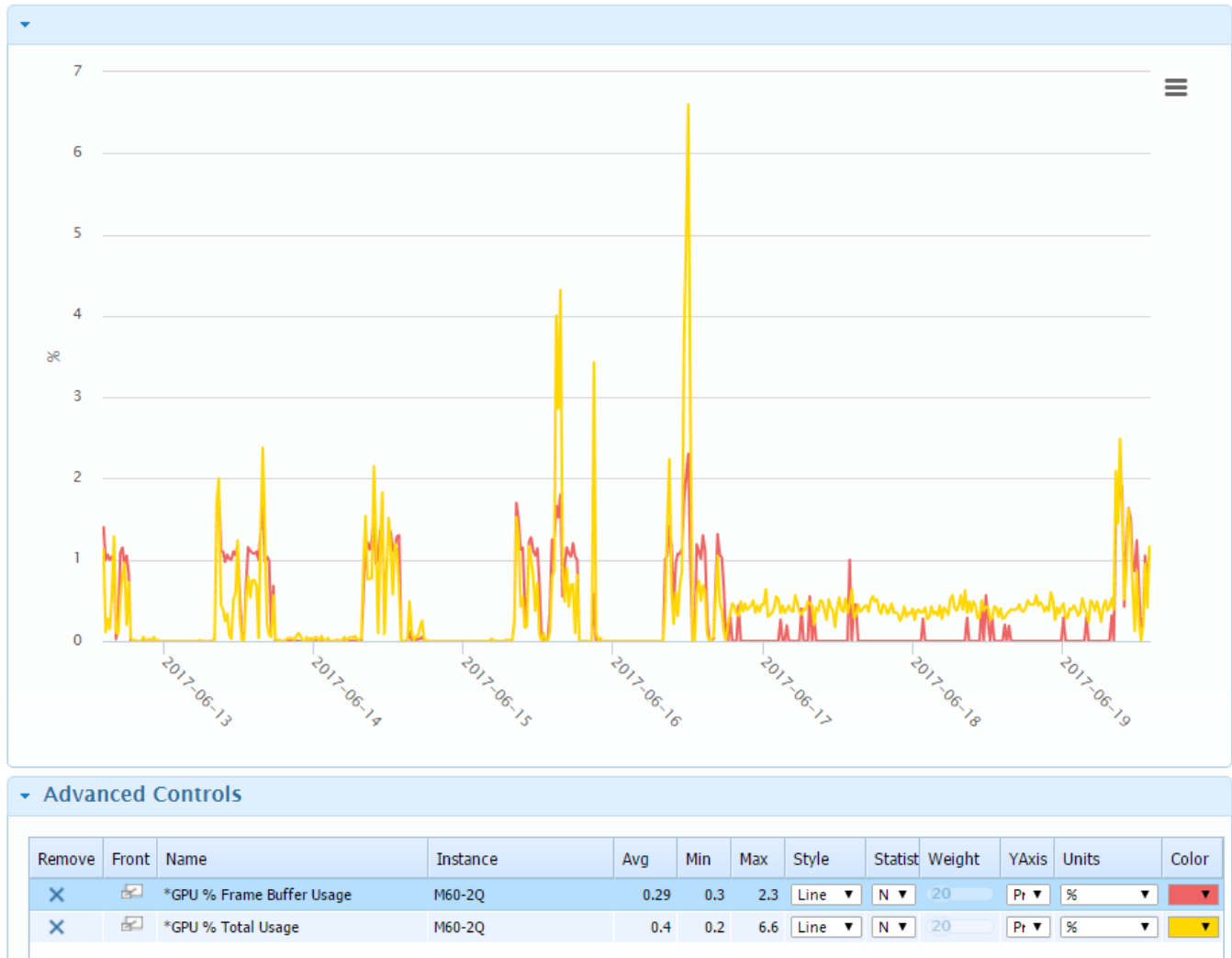


Figure 5: SysTrack Resolve graph showing GPU usage on a system

The SysTrack product suite enables continuous analysis of the graphics usage in your environment. These views allow for constant right-sizing of GPU profiles to match graphics requirements, resulting in potential cost savings versus provisioning graphics cards that are more powerful than users' actual needs.

## Looking Forward: Windows 10 as a Service

Windows 10 represents a departure from how Windows operating systems have traditionally been updated. Instead of releasing a new OS every few years, Microsoft has adopted a rolling update model, offering smaller and more frequent updates to slowly evolve the OS. This “as-a-service” model places less of a burden on IT to completely overhaul hardware with every OS refresh after Windows 10; however, IT must be more vigilant in monitoring their systems to assess the impact of rolling updates on their environment. Continual updates will drive additional resource requirements, necessitating an increased awareness of current system performance and potential hardware needs.

Without comprehensive enterprise monitoring software, it is hard to obtain a real-time view of system metrics. With Lakeside Software’s SysTrack, IT professionals can ensure that their systems are running smoothly with tools that enable monitoring of the entire enterprise as well as individual systems. Enterprises that utilize SysTrack during their Windows 7 to Windows 10 transition will have the benefit of views into metrics like those presented in this paper that can help IT make strategic decisions when refreshing applications and hardware. Data from SysTrack Community will also enable participants to see how the systems of other enterprises with Windows 10 are performing. Once the transition to Windows 10 is complete, SysTrack allows you to view exactly when the rolling Windows updates are taking place as well as identify any performance concerns that could be traced back to an update.

As demonstrated by our SysTrack-powered analysis of the Windows 10 impacts of real enterprise users, systems with dedicated GPUs experience a decrease in CPU usage and an increase in user experience. This observation is particularly interesting as relates to graphics needs in VDI environments, where vGPUs correlate with major improvements in user experience scores. Scaled over an enterprise, attaching dedicated graphics cards to virtual desktops can increase density, improve end-user experience, and help ensure that your Windows 10 transformation is a success.

## For More Information

For more information about SysTrack and Lakeside Software please visit us on the web

<http://www.lakesidesoftware.com>.



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