



IDC TECHNOLOGY SPOTLIGHT

The Need for Graphics Virtualization in Modern End-User Computing Environments

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Adapted from *IDC Market Forecast: Virtual Client Computing Software Forecast: 2017 to 2021*
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As more enterprises undergo digital transformation to the 3rd Platform of computing — comprising cloud, mobility, big data/analytics, and social business — the manner in which desktop operating systems (OSs) and applications must be deployed and accessed is rapidly changing. With more lines of business (LOBs) making their own technology decisions, IT must remake itself into a more business-oriented organization and deliver services faster than ever. This Technology Spotlight describes digital transformation and how it affects the delivery of desktop OSs and applications. The paper examines the rapid growth of the Windows 10 market, the increasing role of user experience in digital transformation, and the increasing virtualizing of graphics-intensive applications delivered through the cloud. It also looks at the role of NVIDIA's GRID technologies in delivering graphics acceleration to these modern workloads.

Digital Transformation's Impact on End-User Computing

The disruption from 3rd Platform technologies — cloud, mobility, big data/analytics, and social business — is forcing businesses to transform. While IT organizations have worked hard over the years to learn how to cope with change, the current rate of acceleration and the order-of-magnitude increases in every measure of volume present IT with a seemingly impossible challenge. Traditional approaches to delivering IT applications and services are too slow, while business organizations need speed. Therefore, LOB executives are taking charge of their destiny. IDC surveys show that 43% of LOB business managers are driving their own technology projects because they are comfortable with technology.

This transformation is forcing a difference in the way enterprises deploy and consume applications and IT services. In many cases, this means a shift from on-premises software to a cloud-hosted model. The ability to host and run desktop OSs and applications on a cloud offers advantages such as elasticity, flexibility, reliability, and costing models that are more OPEX or usage based, and LOBs want these advantages. As a result, IT is increasingly measured based on service consumption, as opposed to operational activity or project results. Therefore, the new business imperative of IT is to create customer value through highly efficient and effective IT service innovation.

Proliferation of Hardware and Software Increases Complexity

For approximately the past 10 years, many physical devices have been manufactured with built-in graphics processing unit (GPU) technologies. As a result, independent software vendors (ISVs) are increasingly developing applications that rely on the GPU for optimized rendering and performance. In fact, IDC is finding that the increased use of graphics capabilities in modern applications (e.g., Microsoft Office 2016/365, various web browsers, video/unified communication) as well as in

long-standing high-end applications (e.g., Adobe Photoshop, AutoCAD, SOLIDWORKS) drives a corresponding need for GPU utilization across the board, and independently of the operating system.

To that end, IDC sees the Windows 10 operating environment as a potential and significant driver of virtualization. Microsoft has publicly confirmed over 500 million Windows 10 installations. IDC projects 341 million Windows 10 installations on PCs, tablets, and 2-in-1 devices in Q4 2017, growing to 406M by Q4 2021. The end of life (EOL) for extended support of Windows 7 is in January 2020 years (2 years at time of writing), which means that customers have already begun the process of moving to mainstream deployments of Windows 10. Enterprises will need to ensure business applications are accessible Day One.

For Windows 10, unlike previous versions of Windows, Microsoft limited the ability of IT administrators to turn off advanced features/functions, specifically those that consume hardware resources, to ensure better user experience. In addition, application platforms are more diverse than ever. For instance, there's often a wide mix of legacy on-premises, SaaS, native mobile, and graphics-intensive applications (Windows and non-Windows based) that need to be delivered, supported, and managed by IT today. What's more, with new versions of Windows 10 (e.g., Creators Update) aiming to bring more and more 3D and 4D capabilities to base OSs, as well as everyday business applications such as Microsoft PowerPoint, the need for IT organizations to leverage GPUs to deliver a superior virtual graphics experience to any device, anytime, anywhere will continue to grow exponentially.

Because of the growing acceptance and utilization of mobile devices and cloud technologies in the workplace, the corporate IT end-user computing landscape is becoming ever more heterogeneous, consisting of traditional endpoints (e.g., desktops and laptops) and modern mobile devices (e.g., smartphones, tablets, and thin clients) that are both corporate liable and employee owned.

Today, many enterprises are faced with the daunting task of selecting the best option(s) for distributing applications from a host of delivery models — for example, native, virtual, HTML5, hybrid (native and HTML5), and SaaS. Native applications tend to offer optimal performance. However, they can be less secure than hosted apps and often involve higher development and support costs. And while virtual, HTML5, and SaaS offerings can lend themselves to faster deployment time frames and tighter security than native applications, there is also the potential for trade-offs with each of these models. For instance, varying levels of user experience optimizations and the ease of integration with on-premises resources are common concerns with non-native applications.

Finally, executives surveyed by IDC in multiple markets indicate that user experience (broadly defined) is a critical component of their digital transformation efforts. The trends in hardware, operating systems, device utilization, and application development noted above suggest that user experience design will become increasingly graphics-intensive over the next five-year period.

The Virtual Client Computing Approach

Today, we are already witnessing the onset of a rapid influx of smart devices, including tablets and phones, entering the enterprise via bring-your-own-device (BYOD) and mobile workforce trends. While consumerization trends are adding significant data security and governance complexity to IT operations, the increase in employee productivity, collaboration, and satisfaction that mobile technologies offer is not lost on business leaders. These leaders are increasingly looking to IT organizations to enable employees with access to corporate data, applications, and communication resources on their devices of choice.

This trend helps drive the growth in virtual client computing (VCC), which enables businesses to move from PC-centric IT to data-centric and even cloud-centric IT. In turn, IT needs to shift from the PC-centric world of managing and protecting individual PC components, such as hard drives, to a datacenter model where corporate data is centrally stored, managed, and secured.

According to IDC, the worldwide VCC software market totaled \$3.55 billion in 2016, representing an increase of 7.6% from 2015 and growing to \$5.2 billion by 2021 (five year CAGR 8%). VCC has long held the promise of easing the delivery of desktops and applications to business users in an efficient and secure way while reducing operational costs. However, when attempting to centralize and run desktop/application workloads in the datacenter, IT often struggles with the complexity of designing, implementing, and managing the infrastructure required to operate a high-availability virtualized client environment. The inability to address these challenges can directly impact end-user experience, adoption, and ultimately the success of the implementation.

Business users are increasingly expecting the fast, convenient, and simple access to technology resources available to them in their personal lives to be matched in the workplace. Thus, with the rapid influx of consumers adopting Windows 10, many of whom took advantage of Microsoft's free in-place upgrade, IT organizations are facing increased pressure from LOB units to implement Windows 10 in the workplace. What's more, as if it weren't enough of a challenge for IT organizations to upgrade the business' plethora of existing device types to Windows 10, they are also expected to test, deliver, and offer support for Windows 10 across existing applications, which, by and large, were designed and coded for earlier versions of the Windows OS. It's important to point out that rewriting business applications so that they operate properly across modern hardware and software platforms can be an extremely difficult and costly, if not impossible, endeavor.

Furthermore, the rise of modern operating systems and applications is driving the need for more compute power on edge devices as well as increased IOPS on the underlying back-end infrastructure to ensure optimal performance. If this situation is left unaddressed, it will continue to strain device and application performance and, in turn, user experience. Therefore, leveraging legacy endpoint devices and datacenter infrastructure within a new Windows 10 environment may be problematic. As a result, savvy IT leaders are increasingly seeking VCC technologies to remove or mitigate the performance and support dependencies between operating systems, applications, and device types.

An adjacent trend to VCC is desktop as a service (DaaS). While it has been several years since desktop virtualization solutions were first brought to market, many IT organizations have struggled to overcome infrastructure implementation roadblocks such as designing, scaling, and managing the necessary storage, networking, and compute required to run a high-availability virtualized desktop environment. Increasingly, IT organizations are seeking DaaS offerings to overcome common obstacles in implementing optimized and secure virtual desktop environments while enabling a more agile and mobile workforce.

Enterprises are also continuing to seek solutions that reduce up-front capex as well as ongoing maintenance costs. DaaS solutions can often offer faster procurement and delivery time frames than on-premises implementations. They also provide on-demand workspace (full desktops or just applications), require no large up-front infrastructure investment, and can be scaled by user or by group. Organizations can become less constrained by geography and benefit from the global scale that their cloud service providers can deliver. Further, this approach can decrease the total cost of ownership (TCO) of VCC software while offering a faster time to value.

IDC estimates that the software-enabling hosted DaaS segment of the VCC market will grow from \$743 million in 2016 to \$2.99 billion in 2021 (five-year CAGR 32.1%). Over this timeframe, DaaS will expand to represent a majority of the VCC market, up from 21% in 2016 to 58% in 2021. This trend suggests that 2020-2021 represents a tipping point in hosted desktop adoption, likely analogous to the emergence of hybrid clouds for datacenters.

Considering NVIDIA GRID Virtual GPU Solutions

With NVIDIA GRID virtual GPU hardware and software solution, IT can deliver great user experiences for even the most demanding graphics-intensive workloads. Many applications that

require large and costly workstations can now be virtualized and accessed across many devices, including smartphones, tablets, and thin clients, fostering new mobile use cases. As a result of performance and rendering degradation, the ability to effectively deliver and secure enterprise workloads such as Windows 10, Office 2016/365, web browsers, and video/unified communication in a VCC environment is a challenge for many IT organizations. Because more of today's modern applications are graphics accelerated, organizations need to consider adding GPUs to their virtual office workloads.

This issue is being mitigated, however, by the falling cost of network and compute resources, coupled with technology advancements such as the NVIDIA virtual GPU products, NVIDIA GRID vPC, and GRID vApps entering the market. NVIDIA GRID is fully supported by the top four centralized virtual desktop (CVD aka virtualized desktop infrastructure [VDI]) vendors — Citrix, Microsoft, Nutanix, and VMware. NVIDIA GRID is designed to bring graphics acceleration to a virtualized environment, allowing organizations to deliver any application, at full performance, across a wide range of device types (including mobile smartphones and tablets) and thus enabling new mobile workforce use cases. Business productivity applications benefit from this type of graphics acceleration, improving user experience across the board.

The latest NVIDIA GRID packages include both CPU workload offloading and Quality of Service (QoS) features. CPU workload offloading allows the GRID to balance processing with the CPU, providing a boost to virtual client performance. The QoS features integrate with the NVIDIA monitoring tools, allowing GRID to balance loads across the hardware stack, reducing the chance of capacity contention and alerting IT when it does occur. This combination also allows for an increase in user density per hardware device.

For organizations exploring DaaS, many public cloud vendors (e.g. Amazon, Microsoft, and VMware) provide virtual servers and workstations supported by NVIDIA GRID. Currently these instances come at an increased rate, trading opex expenditure for additional performance and usability.

IDC believes that technologies such as NVIDIA GRID, which are designed to enable access to graphics-intensive applications on a wide range of device types, will continue to greatly contribute to the affordability/usability of the VCC solutions and corresponding market growth.

Challenges

NVIDIA faces challenges related to its attachment to the VCC market. First and foremost, the VCC market has not accelerated as fast as many in the industry had anticipated. Likewise, there is still work to be done in regard to educating the market on the modern-day value proposition of VCC technology in terms of enabling a mobile workforce. However, IDC is finding this dynamic to be increasingly mitigated, as VCC software vendors continue to incorporate virtualized GPU technologies into their offerings and associated go-to-market initiatives.

That said, as more and more modern applications with graphics capabilities enter the workplace and, in turn, broaden VCC adoption across industry verticals and new use cases, NVIDIA must continue to clearly articulate and demonstrate the value proposition of the NVIDIA GRID technology across multiple use cases in the VCC market.

In addition, establishing attractive price points has been a common obstacle for high-performance graphics technology vendors seeking traction in both enterprise and small- and mid-sized business (SMB) organizations. NVIDIA recently introduced new hardware and software offerings as well as pricing and packaging changes to help address this concern. This pricing pressure is further alleviated by the improvements in user density seen in the latest GRID releases.

Moreover, with the growing demand for cloud-hosted desktops and applications (commonly referred to as DaaS), NVIDIA must work to ensure that cloud-based deployments delivered through its partners offer a level of functionality and support that is the same as, if not greater than, that of on-premises-based implementations. This will become especially important as the VCC market shifts from primarily on-premises to primarily hosted by 2021.

Conclusion

As enterprises undergo digital transformation to the 3rd Platform, IT organizations must be able to deliver services and support to business users who are leveraging disparate hardware and software platforms, often across dispersed geographies. Business users are demanding fast and easy access to a wide range of applications and services, residing both on-premises and off-premises, to enhance productivity. As a result, IT organizations must remain focused on improving service delivery to business users and reducing costs while increasing operating efficiency and agility.

More and more IT organizations are seeking the benefits of desktop virtualization, such as centralized desktop and application management, "any device" access to corporate data, and the ability to protect the business' intellectual property and meet business users' growing demands on technology services. Windows 10 will continue to drive client virtualization on-premises and in the cloud while increasing graphics requirements to deliver a native user experience virtually. Organizations moving to Windows 10 for virtualization need to consider leveraging GPUs for all workloads, not just traditionally graphics-intensive applications such as 3D and computer-aided design.

NVIDIA GRID offers the value proposition of enabling IT organizations to deliver applications previously considered too resource-demanding to be good candidates for client virtualization. With virtualized GPUs such as GRID, common business applications can be optimized for performance and graphic rendering.

Digital transformation efforts will continue to dramatically change the IT landscape — particularly at the edge, with an explosion of new device types and applications. NVIDIA's GPU value proposition is expanding, as the range of devices and applications grows in relation to key trends such as Internet of Things (IoT), virtual and augmented reality, and cognitive computing.

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