WHAT IS CLOUDPAGING?

Simplifying the mobilization and management of applications across modern workspace and multi-cloud environments by breaking applications down into "pages," allowing you to run them at native speeds.

ORIGINS

Cloudpaging was created by a world-class team of inventors and software engineers to simplify the mobilization and management of Windows applications across modern workspace and multi-cloud environments. Many of these folks met during their doctoral research at the University of California, Irvine where they invented application virtualization and streaming.

Numecent was launched in stealth mode, funded by the United States Defense Advanced Research Projects Agency (DARPA) due to its implications for national security. Since then, the company has been awarded 56 foundational patents, with more in the works. Chances are you have already benefited from Cloudpaging, as the largest cloud, software engineering, healthcare, financial services, and educational institutions are leveraging it to deliver applications to their employees and end users on a daily basis.

CLOUDPAGING FUNDAMENTALS

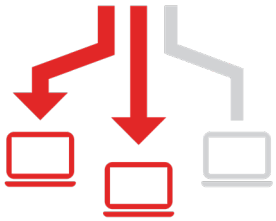
Cloudpaging is a platform-agnostic technology framework that enables organizations to package, migrate, manage, and run applications to their preferred cloud, virtual desktop infrastructure (VDI), desktop-as-a-service (DaaS), or on-premises environments without changing any coding changes, regardless of their operating system (OS). This makes it possible to deliver applications to users anywhere, anytime, without the hassle and expense of upgrading to new versions of your existing software.

CLOUDPAGING COMPONENTS

Cloudpaging consists of three primary components:

CLOUDPAGING STUDIO

Cloudpaging Studio abstracts applications from their OS and formats them in a package once, deploy infinitely model



CLOUDPAGING SERVER

Applications are sent to Cloudpaging Server, enabling users to access them from Enterprise Portal or your internal application store

CLOUDPAGING PLAYER

Upon selection, Cloudpaging Player runs applications at native speed on end user's Windows Virtual Desktop session

Cloudpaging Studio is where the science begins, in the form of application packaging. It prepares applications for automated deployment, updates, and access settings based by abstracting them from their OS and aligning to organizations' predetermined permission levels. Cloudpaging Studio enables users to package applications for the lowest common denominator of Windows OS, meaning you will not need to repackage it when you move operating systems. For example, you can package your applications for Windows 7 and easily lift-and-shift them to Windows 10 without any changes to their source code.

Cloudpaging Server is where your applications reside after they are packaged. From here, provisioning and monitoring take place. It can be hosted in the cloud of your choice, or your on-premises servers. The fastest and most valuable option to get up and running on Numecent's Cloudpaging Content Delivery Network (CCDN). It is a secure, global cloud infrastructure hosted by AWS – with no upfront costs for adoption. Once your applications are on Cloudpaging Server, your IT department can use virtually any provisioning tool, including

Microsoft System Center Configuration Manager (SCCM) – also known as ConfigMgr – for managing the application deployments and updates to your workforce on their virtual or physical devices.

Cloudpaging Player is a light-weight agent installed on end user devices to access applications from Enterprise Portal or organizations' preferred third-party portal. From here, applications can be run as if natively installed on your physical or virtual devices, without any of the complications associated with pixel streaming. Cloudpaging Player can be configured to be visible or hidden to the end user and accessed with single sign-on (SSO) if desired. Either way, all applications designated for a given individual, group, or cluster will appear to the end user as though installed on their device. This empowers employees with self-service options and alleviates manual administration from your IT department – drastically reducing help desk support requests. Moreover, you gain complete visibility and control into your organization's application usage.

The Cloudpaging system is designed to be extremely versatile to deliver what you what, when you want, to whomever you want. The Cloudpaging system seamlessly plugs into existing portals and Active Directory. Cloudpaging plays well on its own, but it's also a stackable solution that plays well with others, without adversely affecting the momentum of your enterprise productivity.

HOW IT WORKS

Cloudpaging consists of abstracting applications from their OS and breaking them down into "pages". These Cloudpaging containers isolate troublesome drivers and dependencies that typically prevent applications from running on modern platforms, ensuring application compatibility regardless of where they are provisioned. This means even the most difficult user mode and kernel mode applications, drivers, and multi-million-dollar line-of-business applications and ERP systems can move across servers, devices, or operating systems.

This process relies on two key technologies: a virtual memory management unit (VMMU) and their respective Cloudpaging containers.

Virtual Memory Management Unit (VMMU)
The VMMU works by paging a pre-virtualized image and virtualized instruction set of the appliction, then directly pages those instructions to the Cloudpaging container, which can reside on local or virtual machines. Cloudpaging Studio reformats the software application into those pre-virtualized instructions, encrypts it leveraging AES 256-bit encryption, then divides them into code fragments called 'pages'. Those pages are then placed in our cloudified format so that it can be consumed by the VMMU. By leveraging our Cloudpaging Server or Cloudpaging Content Delivery Network (CCDN), those cloudified pages can be delivered across any cloud or on-premises server.

Cloudified applications are then fetched by the user's computer, via the VMMU, and paged into our container. When the VMMU requests to start an application, it knows what needs to be pulled down to get the application running, which is typically 1/20th of the size of the application in the beginning. As the application executes, the VMMU is smart enough to pipeline additional instructions which are required to run before the CPU is required to execute them. This VMMU is part of our embedded Cloudpaging Player, a lightweight agent that runs in the kernel of the end-user devices and incorporates our Cloudpaging container.

Cloudpaging Containers
Our container technology works in conjunction with the VMMU and its digital rights management (DRM) component. Our container consists of configuration information about the system and applications, and a Least Recently Used (LRU) cache which can be set up to persist (or not) between sessions depending on the configuration. The container itself has patented technologies called layers which we also invented to handle conflicts between applications and the operating system.

Two Primary Benefits of VMMU and Cloudpaging Containers

First, they accelerate the delivery of applications between 20x to 100x by virtualizing the asset to be delivered in the Cloud (read further below). Unlike traditional remoting solutions, Cloudpaging does not transmit pixels from the cloud like Remote Desktop Services (RDS) and Remote Desktop Session Host (RDSH), nor do we execute the application on a server. In fact, many of our largest customers use Cloudpaging as their key technology to improve their remoting solutions. Cloudpaging transmits pre-virtualized software instructions from the Cloud (a page at a time and on-demand) which are then executed on the user's machine transiently. Our protocol and technology allow running applications over bad, high-latency Internet and WAN connections such as mobile and wireless connections a practical reality.

Second, Cloudpaging technology can be used to deliver many types of digital assets, including Windows applications, Android applications, operating systems, and more while providing the highest level of compatibility between all applications and the operating system.

PRIMARY BENEFITS OF CLOUDPAGING

Cloudpaging consists of abstracting applications from their OS and breaking them down into "pages". These Cloudpaging containers isolate troublesome drivers and dependencies that typically prevent applications from running on modern platforms, ensuring application compatibility regardless of where they are provisioned. This means even the most difficult user mode and kernel mode applications, drivers, and multi-million-dollar line-of-business applications and ERP systems can move across servers, devices, or operating systems.

Simplified Application and OS Migration

As noted before, Cloudpaging containers enable you to lift-and-shift your applications to your preferred cloud, VDI, DaaS, or physical desktop environments without any changes to their source code. Not only does this save you time and resources, but it prevents you from having to commit to a given platform to execute on your technology roadmap. Once your applications are packaged, they can seamlessly move across operating systems and server environments, providing unparalleled flexibility.

Enhanced Application Performance

Cloudpaging requires less than ten percent of a software application to fully launch. This is because it only delivers the page fragments required for end users to launch an application to Cloudpaging Player and never truly installs anything on client devices. Once applications are running, the remaining page fragments are sent to Cloudpaging Player as needed. The result is a faster experience for the application user. In fact, independent software vendors are often interested in Cloudpaging technology to enhance their end users' experiences with their applications, while enterprises and IT departments enjoy the benefits of increased productivity and decreased support tickets.

Moreover, this enables IT to achieve a single base image, drastically reducing storage capacity requirements and eliminating the need to repackage and redeploy applications.

CLOUDPAGING SYSTEM REQUIREMENTS

Physical End-User Compatibility

- Windows Applications: 16-bit, 32-bit, 64-bit
- Windows Desktops: Windows 7 (x86 and x64), 8, 8.1, and 10 (x86 and x64)
- Physical user devices such as notebooks, desktops, and thin clients

VDI End-User Compatibility

- VMware Horizon
- Citrix Virtual Apps and Desktops (formerly XenApp and XenDesktop)
- Microsoft Server 2012, 2016, 2019 using RDS or RDSH
- Microsoft Windows Virtual Desktop

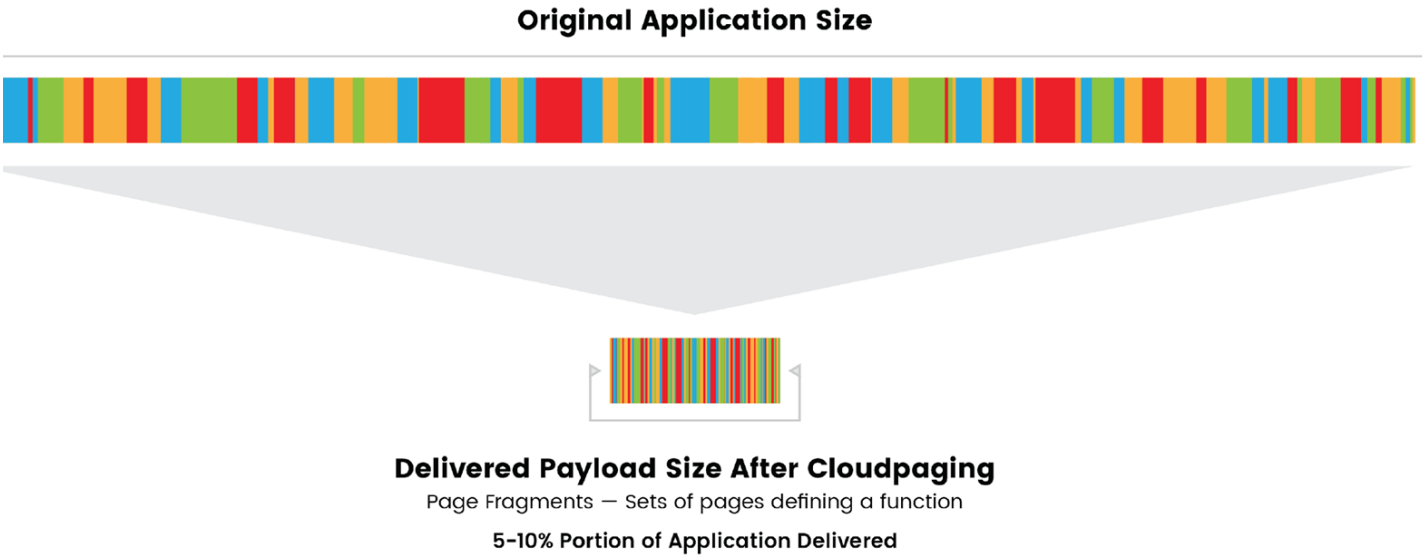
On-Premises Servers

- Microsoft Windows Server 2012, 2016, 2019
- Microsoft SQL Server 2012, 2016, 2019

Microsoft Active Directory (versions 2003 and above) is optional

Cloudpaging Content Delivery Network (CCDN)

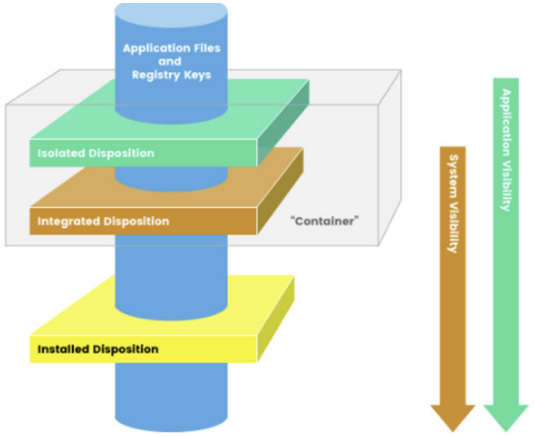
- No infrastructure required (Numecent-hosted)
- 30mbps recommended



Maximized Application Compatibility

Cloudpaging does not use traditional layers or containers. In fact, we invented containers before there was a word for it – but we operate in a fundamentally different way than the likes of Docker.

Cloudpaging technology is unique because it combines the benefits of layers and containers, without any of the challenges and conflicts. Its distinct combination of dispositions allows your applications to run on any virtual or physical desktops with a Windows OS. During the initial packaging process, application files and registry keys are assigned to any of three dispositions.



Isolated Disposition

Assets are paged into a "container" and only visible to the application itself. The advantage of the isolated disposition is the low risk of conflicts between the app and the OS.

Integrated Disposition

Assets are paged into a "container" and only visible to the application itself, yet visible to the local system and other traditionally installed or paged apps. This patented disposition is unique to Cloudpaging, allowing apps to behave as though they are natively installed, yet easy to lift and shift.

Installed Disposition

This physical disposition actually pages assets from the app onto the OS and restores original content upon deactivation, eliminating the need for cumbersome workarounds and scripts. The result of these dispositions is superior application compatibility.

The first disposition is an isolated "layer" wherein assets are paged into a "container" and only visible to the application itself. This method of isolation is similar to the traditional application virtualization technology as seen in App-V and ThinApp, products of our partners, Microsoft and VMware, respectively. The advantage of the isolated disposition is the low risk of conflicts between the application and the OS.

The second disposition is an integrated "layer" wherein the assets are paged into a container, yet visible to the local system and other traditionally installed or paged applications. This patented disposition is unique to Cloudpaging, allowing applications to behave as though they are natively installed, yet easy to lift and shift.

The third disposition is an installed "layer" which is also unique to Cloudpaging. This physical disposition actually pages assets from the app onto the OS and restores original content upon deactivation, eliminating the need for cumbersome workarounds and scripts. The result of these dispositions is superior application compatibility.

Seamless Integration with Your Preferred Third-Party Tools

Cloudpaging's provisioning and management capabilities are offered as a web service, enabling them to seamlessly integrate to your existing tools so your IT department doesn't have to learn a new system. This includes Microsoft SCCM (ConfigMgr), Citrix Management Console, VMware Management Interface, IBM TADDM, Oracle Enterprise Manager, and your existing continuous integration/continuous deployment (CI/CD) pipelines.

GETTING STARTED

From application compatibility challenges to enterprise-scale remote desktop environments, we would love to show you how we can help.

Contact us on our website or email sales@numecent.com to discuss your application needs, more product information, a product demonstration, or options for a proof-of-concept.

ABOUT NUMECENT

Invented by a world-class team of inventors and funded by DARPA, Cloudpaging was designed to simplify the mobilization and management of Windows applications across modern workspace and multi-cloud environments. Today, Numecent proudly serves more than 1.4 million users and holds 56 patents (with more on the way).