Boost productivity with a high-definition user workspace

Give your employees the choice and exceptional experience they need to drive business productivity — anywhere, anytime, on any device.

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Users have come to expect real-time responses from their apps. They want a fast, reliable connection regardless of whether they are on a corporate network (LAN), or wide area network (WAN), which are often low in bandwidth or high in latency. With Citrix HDX technologies, your users get the best possible user experience — across all virtualized apps and desktops.

What is HDX?

It delivers a "high-definition" experience to users of centralized applications and desktops, on any device and over any network. Built on top of the Independent Computing Architecture (ICA) remoting protocol, which is renowned for best-of-breed networking and representing more than 20 years of innovation, HDX is proven in large enterprise environments and accessed by millions of users globally.

HDX is designed around three technical principles: intelligent redirection, adaptive compression, and data de-duplication. Applied in different combinations, they are designed to:

- Optimize the IT and user experience
- Decrease bandwidth consumption
- Increase user density per hosting server

Three technical principles behind HDX

1. **Intelligent redirection** examines screen activity, application commands, endpoint device, and network and server capabilities to instantly determine how and where to render an application or desktop activity. Rendering can occur on either the endpoint device or hosting server.

    a. Client redirection leverages processing power on endpoints, if available, to free up the server to handle other processes or more users

    b. Device redirection intercepts peripherals such as webcams, printers, scanners, digital pens, and 3D mice at a local level to allow users to interact with these devices in sessions

2. **Adaptive compression** is a core intellectual property of the ICA protocol which allows rich multimedia displays to be delivered on thin network connections. HDX first evaluates a number of variables —such as the type of input, device, and display (text, video, voice, multimedia). Next, it chooses the optimal compression codec and the best proportion of CPU and/or GPU utilization. It then intelligently adapts based on each unique user and basis. This is intelligently adapted per user, or even per-session.
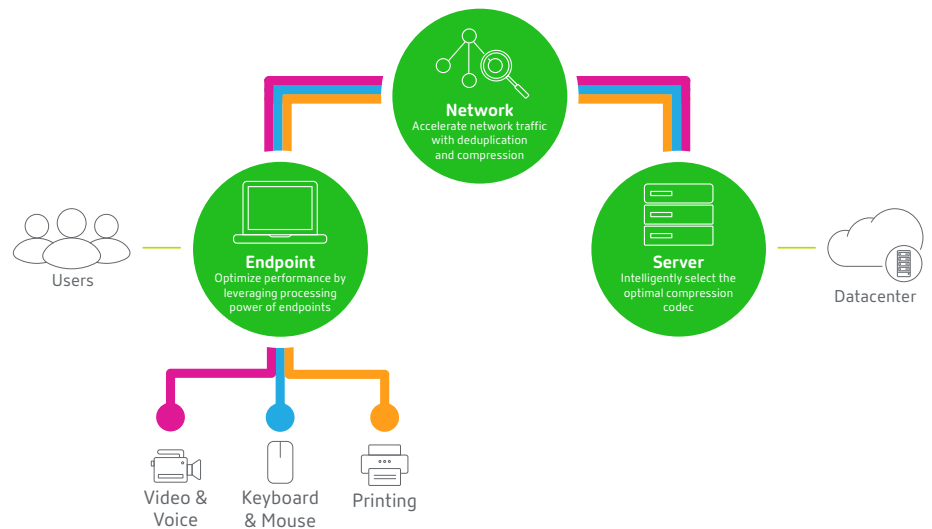
3. **De-duplication of network traffic** reduces the aggregate data sent between client and server by taking advantage of repeated patterns in commonly accessed data such as bitmap graphics, documents, print jobs and streamed media. Caching these patterns allows only the changes to be transmitted across the network, eliminating duplicate traffic. HDX also supports multicasting of multimedia streams, where a single transmission from the source is viewed by multiple "subscribers" at one location, rather than a one-to-one connection for each user.

Let's take a look at how these principles apply to different HDX technologies in more detail.

Smooth voice, video, and multimedia performance

Users expect app and desktop delivery solutions to have near real-time audio and multimedia characteristics — similar to those they receive from local app and desktop implementations. HDX technologies deliver bandwidth-efficient, crystal-clear voice, multimedia and video with session refinements possible through the use of policies and templates — and they do it with exceptional display optimization and performance.

Display optimization

- HDX Adaptive Transport ensures that all functions within user sessions perform well, including graphics — even as network characteristics change. This is accomplished through Citrix's Enlightened Data Transport (EDT) Protocol which makes intelligent, reliable use of UDP for optimum performance. Adaptive Transport allows sessions to seamlessly switch between EDT/UDP and TCP as needed without any configuration required. The end result is a highly responsive session for a wide range of client endpoints.

- Citrix display optimizations make use of both H.264 and H.265 codecs for superior image quality with minimal bandwidth consumption. Encoding using these standards can happen for the entire session, ideal for full-screen motion, or selectively to certain regions with motion as required for optimum efficiency. Both server and client GPU hardware are leveraged where available for stunning visuals that also conserve resources.

Unified communications

- Web conferences require real-time audio and, increasingly, high-fidelity video and screen-sharing as well. HDX ensures audio traffic always receives the highest network priority and includes packet tagging for QoS, on a dedicated virtual channel within the ICA protocol for RTP/UDP audio. This minimizes latency for jitter-free audio quality.

- Client-side webcam compression for video communication reduces bandwidth requirements by an order of magnitude, ensuring a native user experience even on mobile networks or at very remote locations.

- Citrix has joint solutions with major unified communication (UC) vendors including Microsoft (Skype for Business), Cisco (Jabber), and Avaya (one-X) to enable peer-to-peer communication between endpoints, when the app is centrally hosted in a virtual environment. Real-time optimization policies prevent latency due to "hairpinning", so audio and video can move from endpoint to endpoint without traveling all the way back to the central host in the datacenter. The result is a great user experience and higher user density on the host server.

Multimedia

- Offload YouTube video rendering, along with other types of intensive web-based content, to the local endpoint with Browser Content Redirection. Fully configurable via policies for URL control, fetching behavior and more, this feature dramatically reduces server resource consumption and host to client network traffic while delivering a truly local experience — all within the context of a web browser running published or in a virtual desktop.

- Multicast video support for Windows Media and Flash video permits a few, hundreds or even thousands of users to view video content that may be rendered and transmitted just once. This can produce as much as 95% savings in bandwidth and datacenter resources for live video events, news channels, and training programs delivered to branch offices.

- Multimedia redirection has a huge impact on reducing CPU utilization of the host servers allowing more users to be supported per server for greater scalability. Flash redirection and Windows Media redirection offload the playback rendering of rich content to compatible client devices, using server-rendered multimedia only as a fallback option.

Broad support for 4K resolution and multi-monitors

Use-cases in verticals such as medical, manufacturing and finance are ever increasing and require high-resolution displays and/or setups with more than one monitor. Citrix Workspace, XenApp and XenDesktop have extensive support for these scenarios by leveraging underlying graphics hardware capabilities along with HDX technologies for crisp, detailed images, smooth video and clear text.

Optimizing business and professional graphics with HDX 3D Pro

HDX 3D Pro is a specialized technology that pioneered the use of graphics processors (GPUs) in virtual apps and desktops. Today, there are virtualization-aware GPU cards available, which provide hardware acceleration to multiple virtual machines (VMs) using a single physical GPU. Originally designed for high-end 3D professional graphics, the technology is now available to optimize the performance of business graphics apps that leverage GPU acceleration, such as web browsers and Microsoft Office apps.

2D business graphics

Modern business apps, whether Microsoft Office apps or Web browsers, are often designed to leverage GPUs. The use of a GPU, whether physical or virtual, is becoming increasingly important for the delivery of modern Windows 10 workloads as well. HDX technologies support multiple GPU vendors to deliver cost-effective graphics performance using GPU sharing on different platforms, such as Citrix XenServer, VMware vSphere, or bare metal. Depending on the workload, up to 150-200 users may benefit from accelerated business graphics delivered from a single server.

3D professional graphics

Citrix developed the first virtualization solution to support hardware-based GPU sharing of OpenGL and DirectX-based 3D professional graphics apps. This led to hardware acceleration of graphics commands for achieving smooth graphics performance, and breakthrough deep compression technologies for maximizing traffic throughput over low-bandwidth networks. The parameters can be tuned all the way up to lossless compression that enables delivery of pixel-perfect images for applications such as medical imaging.

Some 3D professional graphics apps that benefit from HDX 3D Pro:

• Computer-aided design, manufacturing and engineering (CAD/CAM/CAE) applications
• Product lifecycle and product data management apps (PLM/PDM)
• Geographical information system (GIS) software
• Picture archiving and communication systems (PACS) such as medical imaging

GPU sharing support

HDX 3D Pro allows you to provision a GPU to users in a flexible manner. To support designers and engineers who require dedicated graphics performance, provision one virtual GPU per user or VM using XenDesktop, on either XenServer or VMware vSphere. For more cost-effective deployments, provision many users to share a GPU to view and edit 3D models depending on the workflows and demands. In all cases, the latest drivers and codec versions supported by GPU vendors are available to the user.

Giving Windows apps a mobile-native look and feel with HDX Mobile

HDX Mobile improves the experience of Citrix Receiver users working in supported Windows applications and server-based desktops on mobile devices. HDX includes a native interface control channel allowing Windows apps to be re-factored for a touch experience while leveraging device features such as multi- touch gestures, native menu controls, camera and GPS device functions. Many touch features are available natively in XenApp and XenDesktop and do not require any application source code changes to activate.

Native touch features include:

• Automatic display of the keyboard when a text field has focus
• Larger picker control to replace Windows combo box control
• Multi-touch gestures such as pinch and zoom
• Inertia-sensed scrolling
• Touchpad or direct cursor navigation

Additional capabilities can be implemented using the HDX Windows Mobile Application SDK. It enables enterprise developers to update Windows applications just once for mobile devices using familiar Windows programming languages. The SDK includes more than 50 APIs. Following are examples of programmable mobility enhancements:

• Control how buttons are used on the mobile device; use local user interface controls instead of Windows controls
• Autosense display size and re-factor apps to use available resolution and horizontal layout on a tablet or smaller mobile device screen
• Integrate device functions such as telephone, SMS, GPS and camera with Windows app workflows

Accelerating printing and scanning

Citrix supports both local and network printer types. Locally-defined printers on endpoint clients are redirected into sessions as required. Network printers may be assigned to user sessions based on Active Directory group membership, user physical location or other criteria. Admins can leverage the Citrix Universal Print Drivers and Citrix Universal Print Server for simplicity and stability along with native printer functionality.

Citrix developed these print driver and print server technologies from the ground up. They provide many of the features needed for daily printing while taking into consideration the amount of bandwidth a print job requires. Using a single driver to manage hundreds or thousands of printers greatly simplifies management of print drivers in the Citrix Workspace or XenApp and XenDesktop environment. With the Universal Print Server, the print engine is moved to a Windows print server which prevents the need to install device-specific drivers in the server or desktop image. Firewall-friendly printing protocols provide greater bandwidth efficiency than native Windows protocols and extend printing to non-Windows devices. The latest Universal Print Server also provides improved scalability, greater

OS-support and performance monitoring. Additionally, it integrates with Citrix's Customer Experience Improvement Program (CEIP) to continually help make the product better.

Although scanners can be supported through basic USB direction, the Citrix implementation permits additional intelligence between the endpoint and the host. Local scanner termination allows the user to interact with the peripheral at native USB speeds. Once the scan is completed, ICA compresses the scanned image and sends it to the host server; thus, the only content that travels over the network is a compressed image.

Supporting the largest variety of peripheral devices

HDX provides seamless plug-and-play connectivity for a broad range of devices such as webcams, music players, audio recorders and specialty peripherals. USB redirection to cloud makes these peripherals available within sessions hosted hundreds of miles away from the point of use. HDX technologies optimize USB traffic over common wide area network conditions to ensure real-time feedback and full-feature support. Support for digital pens, electronic signature pads, and drawing tablets in cloud-hosted apps is an important requirement in retail, finance, design, CAD and other such markets. View the wide array of peripherals and solutions certified for Citrix environments through our Citrix Ready Program at www.citrix.com/ready.

Ensuring the highest quality of service and reliability

HDX technologies ensure the highest quality of service and reliability through a combination of ICA traffic prioritization, branch office caching and ICA protocol optimizations.

Virtual app and desktop traffic competes with everything else on a network. To meet stringent service level agreements (SLAs), network administrators need tools that help prioritize and optimize application and desktop traffic to deliver a great user experience every day. HDX traffic prioritization capabilities include:

- Prioritizing virtual app and desktop traffic based on usage type by segmenting the communication channel into five independent streams through standard QoS routing techniques. Virtual desktop traffic can be segmented into:

  1. Dedicated real-time
  2. Interactive
  3. Background
  4. Bulk
  5. RTP/ UDP voice channels

- Application types can be identified, enabling network administrators to prioritize web and client-server applications alongside virtual app and desktop traffic to maintain QoS while achieving the absolute best utilization of the available network bandwidth.

HDX caching technology adaptively orchestrates with XenApp, XenDesktop, and Citrix Workspace to disable the native ICA compression used for optimizing single-user

sessions. It then optimizes XenApp and XenDesktop delivery across multiple user sessions by locally caching and de-duplicating transmission of commonly accessed data, including bitmap graphics, files, print jobs and streamed media.

ICA protocol optimizations include TCP flow control, traffic compression and protocol acceleration.

• Adaptive TCP flow control accelerates the flow of all TCP-based traffic, including ICA, by sensing and responding to high network latency and packet loss. The result is significantly higher network throughput and performance than with standard TCP implementations.
• Adaptive compression uses a highly tuned engine to compress ICA traffic based on its characteristics, as well as infrastructure capabilities and network conditions.
• Adaptive protocol acceleration performs intelligent acceleration of ICA traffic while sensing and responding to network and traffic conditions.

Improved overall diagnostics with new telemetry functionality is available to assist with environment health and troubleshooting. This capability also leverages the Citrix Insight Services platform (cis.citrix.com) and Smart Tools (smart.cloud.com) for centralized data collection and insights along with tight integration to Citrix Technical Support.

Simplifying administration with policy templates

Pre-defined HDX policy templates based on use cases make it easy to ensure that users receive the best possible experience for their connection scenario while also meeting IT objectives. Templates for high server scalability, bandwidth-constrained WAN users, security and control, and a high-definition experience are included. These templates may be customized as required and applied to sessions using a variety of policy filters.

Bringing it all together in the Citrix Workspace

HDX technologies are the foundation of the Citrix apps and desktop delivery platform, which provides a superior virtual app and desktop solution accessible from any device, over any network and gives end users an application and desktop experience that rivals that of a local PC—even when people are using multimedia, real-time collaboration, USB peripherals and 3D graphics apps over low-bandwidth, high-latency networks. With Citrix Workspace, XenApp and XenDesktop and HDX technologies, IT can successfully extend delivery of virtual apps and desktops beyond the corporate HQ to remote, mobile and branch office users — all while maintaining a high level of security and control over corporate data.

For additional information, please visit citrix.com/hdx.

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