White Paper

OS Streaming and
Application Virtualization

OS Streaming and Application Virtualization

A Case Study from Financial Services

Executive Summary

Driven by the need to stay competitive under brutally challenging market conditions, a global financial services firm has mounted an innovative "stateless" desktop virtualization initiative, using streaming OS and application technology to make IT more agile and cost-effective. (The firm wishes to remain anonymous due to internal policies.)

In a previous effort to control desktop management costs for over 100,000 workstations, the firm implemented a solution based on VDI (virtual desktop infrastructure). VDI worked well for a number of user communities but not power users and some knowledge workers, nor did it solve the underlying complexity issue of managing at least one desktop image for each user. Image management just moved from the desktop to the datacenter. To service the power users and provide a solution for centralized desktop image management, the firm implemented a "stateless client" architecture that centralized management and distribution of desktop images through real-time streaming technology, deployed on economical, scalable PCs or "virtual thin desktops."

The firm's stateless solution assembles desktop images on the fly from a set of master OS images combined with virtualized, streamed applications. Once assembled, these dynamic desktop images can be deployed either to virtual or physical machines, running on thin clients or high-performance workstations as needed. This solution combines the security and control of server-based models with the high performance and multimedia user experience offered by rich client workstations.

The stateless pilot project is on track to deliver a production-ready solution by the end of 2008. When fully implemented, according to the chief architect, the firm's stateless solution has the potential to deliver radical decreases in TCO, as well as an industry-changing prototype for the future of business computing.

Table of Contents

About the Environment

With over 85,000 employees and consultants on over 100,000 Windows* machines, the firm has a complex computing environment which takes advantage of several different compute models, including a thin client VDI-based solution, rich client computing, and application virtualization. Over 8,000 applications are in use enterprise-wide.

95 percent of workstations are standardized on a basic OS build based on Windows XP* SP2. For most users, a local operating system gets installed when the system is built. A standard suite of applications (Microsoft Office* applications, Adobe Acrobat Reader,* Shockwave,* Flash,* WinZip,* Java,* etc.) is loaded on top of that, and the machine is frozen at that point. Security updates and patching are handled by means of various tools, including Microsoft System Center Configuration Manager* (SCCM), BigFix* Patch Management, and CA Unicenter.*

Over 1,000 unique streaming packages, representing various versions of approximately 450 applications, are available today with SoftGrid (now Microsoft Application Virtualization,* or App-V). Application virtualization was first implemented on the debt and equity trading floors and has spread to corporate and retail offices.

A typical manual OS rebuild and data migration takes three to four hours of a technician's time, so many machines have been running the same OS image for over three years.

User segments

The firm envisions its stateless solution as eventually encompassing its entire user base, which consists of several segments with widely divergent computing needs.

Retail branch and brokerage offices

Approximately 34,000 stockbrokers, financial planners, etc. are located in 600 branch offices across the U.S., with access via WAN to regional data centers. These clients tend to be very "cookie-cutter": the machines are exactly the same, with the same applications. The retail offices are almost like franchises, with a very locked-down computing environment.

Investment banking and research

Investment bankers are located mainly in the Northeast region, while researchers are distributed across the U.S. These users are highly mobile, with high demand for performance and numerous home-grown applications.

Equity and debt traders

Traders are high-profile users with high performance needs. Traders typically don't have just one workstation under their desks, moving instead among several multi-core workstations with multiple hundred-megabyte Ethernet* connections of market data. Workstations are based on standard builds, but applications are highly variable, with custom Excel* plug-ins and other applications that trigger actions based on market conditions.

Corporate

Call center employees use a standard set of applications to handle backoffice work for retail brokerages. Other corporate users include HR, finance, internal IT, and application developers.

General User Types

The firm has thousands of employees in jobs beyond those mentioned here. In general, they fall into three categories:

Task workers — These employees work in a fixed location and use a handful of server-based or Web-based application to perform transactional tasks. They are prime candidates for the firm's VDI deployment.

Knowledge Workers — These employees are a mix of fixed-location and mobile workers, and regularly multi-task among office productivity and role-specific applications. While some of these workers may be served by VDI, their compute and storage demands on the server tend to lower the number of users per server compared to task workers.

Power Users — These advanced users and developers tax the performance limits of even the most modern PCs, and generally require local computing resources. The extremely low number of power users per server would make VDI infeasible for this population.

Scalability Issues Encountered with Initial VDI Deployment VDI

In addition to cost issues, the firm's ability to roll out VDI beyond a limited set of user types was impeded by a variety of scalability issues and missing capabilities. Some of these issues might have been mitigated by means of additional products, custom engineering, or improvements in VDI products; however, these steps would have further eroded the economics of VDI.

No support for USB devices

With increased usage of specialized USB devices for VOIP (voice over Internet protocol) and video conferencing, users complained about not being able to use USB devices, such as cameras, microphones, and headsets. The best solution available under VDI was a simulated USB connection, which users found unsatisfactory.

Poor video and Flash experience

Some users had four to six channels of live TV streaming across the network, along with increasing use of Flash for training and other content. VDI could not render video and Flash fast enough, resulting in "pixilated" display and poor sound quality and synchronization.

Problems with specialized peripherals

Traders use Bloomberg keyboards, with specialized functionality such as extra keys, a built-in ticker bar, sound output, and a thumb reader, which don't function properly with existing VDI technology.

Issues with Cleartype fonts

ClearType* fonts, used by default on Windows XP and Vista*, didn't display smoothly when rendered via RDP (Remote Desktop Protocol).

Problems with multiple monitors

Some users had multiple large monitors. The Wyse thin terminals could provide analog and digital display on the same device, but not dual analog or dual digital. As a result, users experienced issues with brightness, font, and smoothness they did not experience with a local graphics card.

Previous solution

About four years ago, motivated by the need to find an easier way to provision and maintain desktops, the firm implemented a desktop management initiative based on then-newly emerging VDI technology and running on Wyse thin client terminals.

A large-scale pilot of 1,000 workstations was deployed in 2006, with plans to replace 15,000 workstations with thin clients in 2007. However, the firm limited its initial VDI deployment to 4,500 (about 4% of total clients) because of scalability issues when extended to additional user populations which led to higher than expected TCO (see sidebar, left). Some factors that drove up the cost of VDI at the deployment grew included:

Storage costs higher than expected

The available VDI solution required 10–20 GB per virtual workstation of Tier 1 storage on a SAN (storage array network) in the datacenter. As more users were converted, the storage costs for VDI rose rapidly. This became increasingly problematic in comparison to the low cost of desktop hard drive storage.

Users per server below required target

The business case for large-scale VDI was based on 60 users per four-way server with 16 GB main memory. For each VDI session, 512 MB of server memory per user was originally assigned. But with Windows XP SP2 plus four applications loading in this space, users experienced performance problems, which affected other users on that server.

> "We did achieve a better model for break-fix with thin client vs. thick client, but we never achieved the scale we thought we'd be able to. Now you can buy a quad-core desktop with 4 GB of memory for a nominal premium over the thin client device, and that delta doesn't include the cost of the hardware on the back end to feed that session. In essence, we removed hardware from underneath the desk and moved it to the datacenter, where the costs are significantly greater."
>
> Director, Client-Facing Infrastructure, Architecture & Engineering

To correct this, memory allocation was increased by stages to 1 GB. As a consequence, the actual number of users per server ended up at 25–50, rather than the 60 users required to make it economical.

In addition, the original concept called for on-demand instantiation of applications inside of virtual machines, based on an assumption that virtual machines could pool resources. However, clients ended up with VDI sessions paired one for one with users. As a result, they were never able to get to a pooled model, with the available VDI products which contributed to fewer users per server than expected.

Cost of managing VM images

Even though virtual machines run in the datacenter, they still need to be tested, patched, and upgraded like any other client, contributing to the cost of ownership. In other words, the firm found that server-based execution resulted in moving rather than eliminating their existing challenges in image management.

About the Solution

The firm went back to the drawing board to find a more scalable solution that met all of its needs: centralized management, data security, rapid provisioning, high performance, a PC-like user experience, and positive economics.

They were inspired by the vision of "stateless computing": a model where no software is installed locally and there is nothing unique about a given client node. With stateless computing, you can pull a workstation out, put another one in, log in, and get the exact same behavior. Stateless computing promises a radical decrease in OpEx (operating expenses) by reducing the marginal cost of adding new client workstations to zero.

With a stateless solution, every time a client machine is booted, a master operating system image and application icons are sent to the PC. As a consequence, employees get only the software they need based on who they are, what privileges they have, and what they're trying to do.

While a thin-client/VDI solution will be deployed for task workers and certain specific usage models, the firm recognized that server-based computing was not appropriate for all user populations. For many knowledge workers, a stateless client with plenty of computing power, provisioned on the fly and executed locally, is the answer. So they focused on developing a flexible solution that takes advantage of computing power wherever it's cheapest to produce an optimal experience for the user.

The firm believes that the stateless initiative will reduce TCO and make IT more nimble by accomplishing the following goals:

- **Shifting away from a reactive break/fix model** for desktop maintenance to proactive management of standard images.
- **Rebuilding and reprovisioning workstations much more quickly and easily.** As the Manager of End User Platform Standards, Architecture & Engineering puts it: "We're changing from local hands and feet to a centralized team sitting in our operation centers just pushing a button."
- **Reducing the cost and time required for application testing and deployment.** Not only can applications be tested in a sandbox and deployed in a matter of minutes, but multiple versions of an application can be run simultaneously, decreasing the risk entailed in upgrading.
- **Improving support for user mobility.** Users typically move office locations 1.3 times per year. Right now each move costs several hours and a technician visit.

The firm's stateless solution takes advantage of increasingly reliable network bandwidth, mature desktop virtualization solutions, and cost-effective desktop computing. They attacked stateless computing by breaking the problem space into four buckets:

- **Operating system:** A small set of virtual OS images is streamed to either thin or rich clients using Citrix Provisioning Server.*
- **Applications:** Applications are packaged and streamed on demand using Microsoft Application Virtualization (App-V) and InstallFree Application Virtualization Bridge.* Virtualized

> "In the old days, updating the OS could take six months to a year and require 30 to 40 resources. Then you've got failures and retries, and when it fails, the machine gets corrupted and you have to rebuild. In the new world, upgrading 100,000 desktops means changing less than a dozen gold images, and that can happen in days rather than months."
>
> Director, Client-Facing Infrastructure, Architecture & Engineering

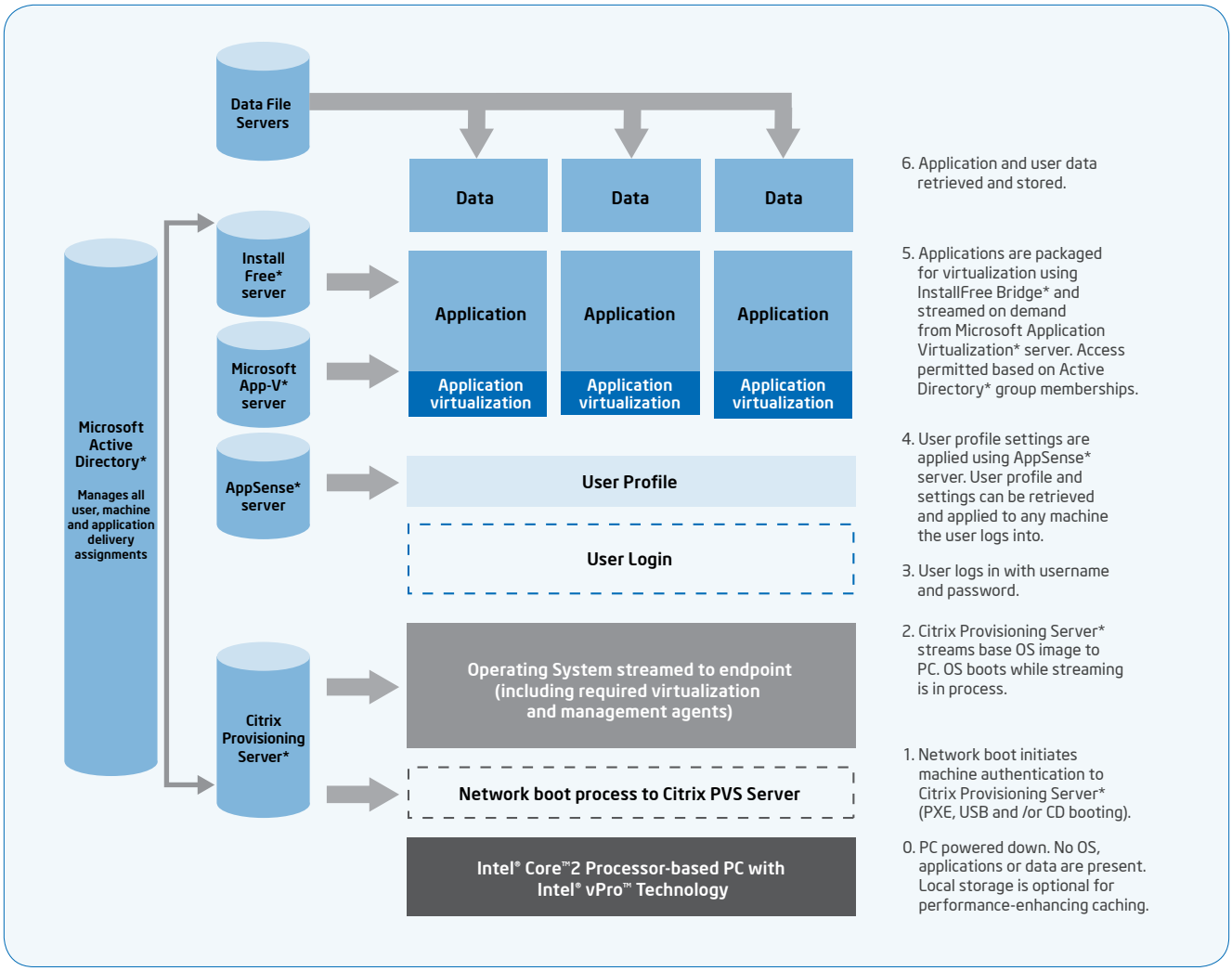

Figure 1. Diagram of stateless client stack and launch process

applications rarely conflict with OS elements or other applications because they aren't installed in the OS registry. Abstracting the applications from the registry also contributes to long-term system stability, since they do not contribute to the gradual buildup of entropy in the OS build.

- **User profile:** To maintain zero information state on a workstation, user "personalities" (individual settings and state) are virtualized and delivered to any workstation using AppSense Environment Manager.*
- **User data:** No user data is stored locally. All data is redirected using the centrally managed and deployed AppSense Environment Manager* configuration.

About the Project

The research and design phase of the stateless initiative began in early 2008. The pilot program involves three rounds of testing:

- "Dog food test" of features and functionality among production engineering group (the desktop IT group is "eating its own dog food")
- Infrastructure and deployment testing among "friends and family" inside the Operations groups
- Production-ready polishing preparatory to general deployment in early 2009

Issues and lessons learned

The team is very much aware of the risks involved in being a trailblazer. While some solution elements are well tested, others are less far along on the maturity curve. Moreover, integrating so many pieces and deploying them on such a large scale is very much a new science.

It's important to work with expertise wherever you find it, whether with vendors or system integrators. The team acknowledges that vendors such as Citrix, Dell, and Intel have been invaluable in moving their project along so quickly. At the same time, they're finding that they're pushing the knowledge curve with some of their smaller, newer vendors.

Software licensing in particular presents new challenges. Their advice to IT managers is to work with vendors to make sure you're in compliance, since most licensing schemes weren't designed with non-traditional compute models in mind. According to the Director, Client-Facing Infrastructure, Architecture & Engineering: "We're changing the paradigm of how traditional ISVs license software. It's even more complicated than subscription—it's almost a per-use model. It's going to be tricky to figure out with software vendors how to license this stuff. We'll get there, but we'll have to push the industry to figure out what the model is."

Another issue has been the complexity of the desktop build and the amount of configuration it requires. The Manager of End-User Platform Standards, Architecture & Engineering says: "It's not just a matter of taking a Windows* CD out and wrapping a couple of scripts around it. There's a tremendous amount of configuration and automation involved."

Overall, the firm's advice to IT managers is: do your homework. There are a lot of options, so take the time to make good product decisions. "The end result is a very simple interface for the user, but don't underestimate the back-end engineering."

Future plans

After general availability, plans for future development include:

- Development and implementation of a unified name space that will enable any user at any workstation with the right privileges to access any application across the organization.
- The ability to run user-installed apps inside a safe "sandbox."
- Support for user mobility (computing without network access) via caching of a streamed OS and applications.
- More research in application and OS layering technologies shown by vendors such as Atlantis Computing, where applications layers are embedded in the I/O stream of the OS at boot time to improve the user experience.
- Provisioning VDI virtual machines with the stateless computing infrastructure. The OS streaming technology, application virtualization and user profiling tools will be applied to virtual clients as well as physical PC clients. The core stateless infrastructure will be used to provision task, knowledge and power users, regardless of local or server-based computing.
- Taking stateless to the next level by distributing managed stateless images to a client-hosted virtual machine container, further isolating it from the hardware, and enabling clients to run different images depending on workstation computing power available at a given location.

Conclusion

Taking advantage of high-performance client computing, this innovative stateless model has the potential to combine the best of all worlds.

In its fully realized form, it will combine the broad availability of applications and peripherals supported by Windows with a Linux*-like registry-free simplified file system. It also blends the centralized manageability and security of server-based computing with the user experience and mobility of high-performance clients.

Along with the benefits it hopes to reap from its stateless initiative, the firm has another, broader goal: To change the industry by spurring innovation and cooperation among vendors, and by generating industry momentum for a stateless model.

According to the Director, Client-Facing Infrastructure, Architecture & Engineering, "We think there's a big play here, and this is how the industry will go. But right now, we're way out ahead of where everybody will be. And that gives us the competitive edge."

Printed in USA 0109/WW/OCG/XX/PDF Please Recycle 321118-001US