Microsoft®

Virtualizing Windows on Sun Ray Thin Clients at the Microsoft® Enterprise Engineering Center

White Paper

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Executive Summary

At its corporate campus in Redmond, WA, Microsoft maintains a state-of-the-art facility — the Microsoft Enterprise Engineering Center (EEC) — for reproducing customer environments and conducting product validation. A steady stream of customers flows through the EEC each day to evaluate Microsoft technologies in a production-like, enterprise setting designed to recreate proposed solutions and customer applications.

EEC program managers strive to keep pace with the demand for the center and its valuable compute, storage, networking, and engineering resources. They face a challenging set of tasks in provisioning and re-provisioning test resources to create an environment that closely matches visiting customer requirements. For every engagement, provisioning requires OS and software installation, patch installation, data and application uploads, application testing, and network switch rewiring to make test environments available to specific customers who will reside in a particular EEC lab. Once the engagement concludes, the cycle of software tear-down and rebuilding begins again. The difficult challenge for EEC program managers is to put together the precise test environment and to finalize preparations by the deadline of when the on-site engagement begins. At the same time, program managers are responsible for isolating and securing access to Microsoft and customer data and applications.

To accommodate the constant demand for the EEC, Microsoft has expanded the facility's capabilities and increased the size of the data center. Recognizing the need for greater agility and speed in allocating resources and preparing for customer engagements, EEC system architects revamped the testing environment. Part of the change focused on the integration of two core technologies: virtualization technology from Microsoft and Sun Ray thin client technology from Sun Microsystems.

Combining virtualization and Sun Ray thin client technology creates a test environment that is agile and responsive to customer requirements. Since both technologies centralize data on back-end servers, they help to simplify the administrative workload and increase server utilization while protecting valuable data and application assets. Virtualization allows multiple OS instances (or “virtual machines”) to be constructed in advance, quickly replicated for different customers, patched or otherwise customized, and managed — all centrally on physically secured servers. Deploying virtual machines vastly decreases the time it takes for EEC program managers to prepare and tailor test environments. As a result, the EEC can expand the number of engagements, benefitting a larger customer base while better managing IT resources.

Sun Ray thin client devices complement virtualization in that all desktop sessions reside on back-end servers — the devices themselves have no local disk storage and are totally stateless, which brings distinct advantages in the EEC: Sun Ray thin clients require no maintenance, promote user mobility, and help to protect both Microsoft and customer intellectual property. Users can move to any Sun Ray thin client in the EEC and resume their exact desktop state, which encourages collaboration while safely enabling access to data and applications on centralized, protected servers. Since no desktop maintenance is needed, program managers can focus their time and energy towards the provisioning process, quickly creating and customizing new virtual machines. Best of all, with off-the-shelf software from Sun, Sun Ray thin clients present a familiar Windows desktop experience to EEC users.

The EEC solution also follows Microsoft's corporate direction of environmental sustainability. Low-power Sun servers support the virtualization and Sun Ray software, which, when combined with low power consumption of the Sun Ray thin clients themselves, reduces the overall energy footprint. Since both companies seek to reduce data center energy consumption, they are focused on the common goal of a cost-effective and eco-friendly solution, and are working closely to make the EEC initiative a success.

The Microsoft Enterprise Engineering Center (EEC)

Located at the corporate campus in Redmond, Washington, the Microsoft Enterprise Engineering Center (EEC) is a state-of-the-art proving ground for complex computing environments. With over $100 million in hardware and networking equipment, the EEC can tackle complicated re-creations of real-world enterprise production environments.

Creating a proof-of-concept scenario in a controlled environment allows customers to put Microsoft and third-party technologies to the test before deploying solutions at their own sites. The EEC is designed to give customers the tools, hardware, software, and technical expertise needed to run diverse and elaborate testing workloads. In addition to providing a powerful and heterogeneous infrastructure, the EEC supplies direct access to product development groups, promoting the free-flowing interchange of ideas between customers and engineering teams.

Through engagement opportunities at the EEC, Microsoft strives to meet these goals for its visiting customer teams:

- **Developing a plan to achieve success.** Each EEC engagement is well-defined prior to when it begins and specifies viability and success criteria. Program managers work with customers in advance to define the goals and a test plan to facilitate a successful engagement.
- **Providing a precise test environment.** The EEC partners with many leading networking, storage, and client/server solution providers to offer a mix of cutting-edge technologies and legacy platforms. This helps each test engagement accurately reflect the customer's current environment and future direction.
- **Supplying technical and project management expertise.** The EEC engagement team is designed to help customers in all phases of the engagement. EEC staff connects customers with engineers that develop code for currently shipping products. It consists of program managers who have expertise in maintaining large network infrastructures and technical experts that have years of experience working with Microsoft products and customer implementations.
- **Reducing time-to-deployment.** Customers that bring solutions into the EEC typically reduce time-to-deployment, sometimes by as much as nine months. Because Microsoft product groups are involved directly with customers at the EEC, they are often able to resolve technical issues quickly that arise during testing. One of the key benefits of an EEC engagement is the ability for customers to interact, exchange ideas, and provide feedback to Microsoft product development groups, which can, in turn, impact product features and future deliverables.
- **Reducing deployment costs.** With a technical staff of dedicated engineers, the EEC works with customers to construct an environment and software instances that meet exact specifications *before* the customer team arrives on site. This allows customers to prepare for the engagement without impacting their own production environments and optimizes the use of customer time during the on-site portion of the engagement.
- **Building relationships.** The EEC is part of the Windows Server System group, and is created and hosted by development groups so that they can interact and learn directly from customers. An engagement allows engineers to investigate product limitations and real-world customer applications so that they can continue to innovate yet create useful solutions. The EEC fosters an environment in which engineers can more fully understand and appreciate how customers deploy Microsoft and third-party technologies in production environments.

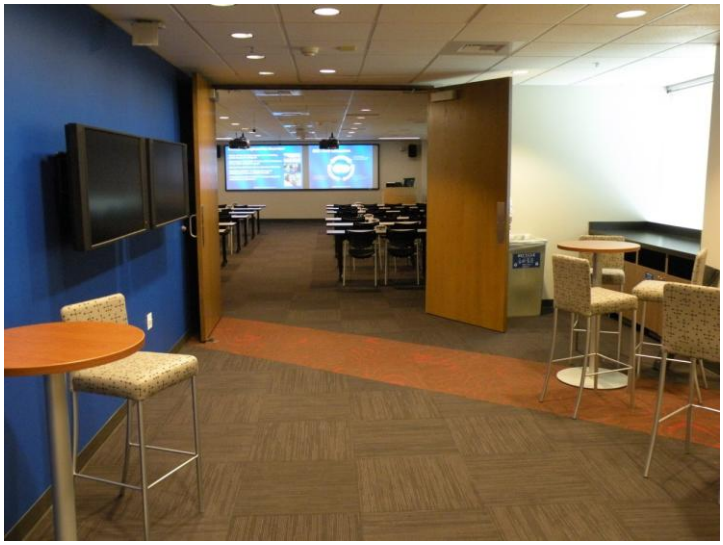

Figure 1 New Technical Briefing Center in the EEC

Redesigning the EEC Testing Infrastructure

To meet escalating demand for customer engagements, the Microsoft EEC underwent major facility renovations, doubling the data center capacity and adding a cutting-edge Technical Briefing Center. In the brand new lab facilities, Microsoft highlights its latest technology innovations, making pre-released products available to customers for proof-of-concept testing. The construction project prompted an initiative to re-examine the architecture of the testing infrastructure.

In the past, the EEC architecture relied heavily on analog KVM (Keyboard/Video/Mouse) switches to grant customers access to certain physically secured servers and software products. To protect customer and Microsoft information assets, some servers are housed in computer rooms to which only Microsoft-badged employees have access. In labs outside of the computer rooms, customers use Keyboard/Video/Mouse devices connected to the KVM switches, which, in turn, are wired to specific servers (Figure 2).

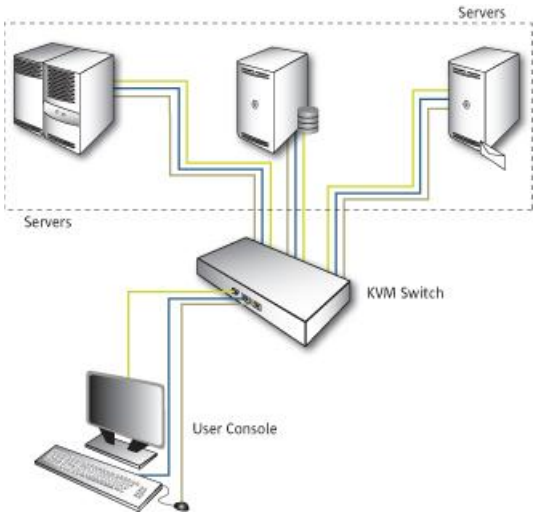

Figure 2 Original EEC architecture

While the old architecture was quite functional and effectively enforces security, it lacked the flexibility and agility needed to take advantage of new technologies and deploy new products quickly. It was also difficult to rapidly re-provision the environment to meet the needs of the steady stream of incoming EEC customers. Allocating and de-allocating physical systems, reloading operating systems on the servers, and putting in place a precise customer environment was extremely time-consuming and costly. In addition, back-end server resources tend to suffer from low and inconsistent utilization levels.

Meeting the Challenges of the EEC Redesign

In revamping the architecture of the test environment, the EEC met these goals:

- **Flexibility.** Many of Microsoft's customers must access more than one operating system or even different versions of the same operating system. Although this capability was possible in the old KVM architecture, it typically required rewiring of the KVM switches to grant access to alternate servers and installed software environments.
- **Agility.** EEC engineers must be able to re-provision the environment quickly to meet constantly changing requirements for new engagements. In addition, as product development groups develop a new software version or patch, is it critical to be able to deploy these modified versions rapidly to continue the testing process efficiently.
- **Mobility.** KVM switch wiring restricts users to a certain lab location, making user mobility a limitation of the past test environment. The revamped architecture allows customers the freedom to move about the EEC's state-of-the-art facility — to a conference room, to a different lab, or to a different desktop. Mobility allows customers to collaborate more effectively with Microsoft product group engineers, whether they are located in the same lab, the room next door, or down the hall.
- **Security**. As in the past, the new architecture protects valuable customer data, applications, and Microsoft intellectual property. In many cases, customers access pre-released Microsoft software in the EEC or bring in their own applications and data. The test environment must provide strong authentication, limit access to authorized users, and ensure the physical security of both Microsoft and customer information assets.
- **Customization.** In an effort to enhance the richness of the customer experience, the Microsoft EEC wants the opportunity to personalize or customize the customer-facing environment. By making the engagement experience a positive one, the EEC hopes to nurture a favorable impression and convey to customers how Microsoft values the joint relationship.
- **Low energy footprint and reduced costs.** In addition to lowering administrative complexity and reducing management costs, any solution in the EEC must meet Microsoft's targets for acquisition and ongoing operational costs. Like all consumers burdened with skyrocketing energy costs, the EEC seeks future computing solutions that are eco-friendly and offer low power consumption. In addition to benefitting the environment, reducing the energy footprint in the data center dramatically lowers ongoing operational costs.
- **Optimizing utilization.** Since the EEC houses a wealth of compute horsepower, improving the overall utilization of back-end server resources is a measure that also helps to effectively manage cost. Organizations sometimes provision at least one physical server for every delivered application or service, resulting in many servers that operate well below total processing capacity. In the EEC, consolidating customer workloads to increase server utilization is a critical objective.

Combining the Power of Virtualization and Sun Ray Thin Client Technology

To achieve the EEC's goals in redesigning its test environment, Microsoft is working closely with Sun Microsystems, Inc. to leverage the powerful combination of virtualization and Sun Ray thin client technology. Today Sun has a cooperative relationship with Microsoft on many levels. Sun is a Windows® Server 2008 and 2003 OEM, a Microsoft Gold Certified Partner, a founding member of the Interoperability Vendor Alliance, and part of the Windows Server Virtualization Validation Program (SVVP). With a long history of successful thin client products as well as its extensive portfolio of compute and storage solutions, Sun is well-versed in virtualization technologies, and understands customers' needs for Microsoft Windows functionality at the desktop level. The ability to deliver secure, virtualized instances of Windows software on Sun Ray thin client technology provides a flexible and cost-effective solution that adds value to the EEC test environment.

Virtualization is familiar to most businesses as a means of consolidating workloads and reducing costs. Given the pressing regulatory requirements of HIPPA, Sarbanes/Oxley, and other legislation, virtualization is often a strategic element in managing data assets and enforcing information privacy since it centralizes data management. The technology has evolved in recent years to allow virtualized workloads to be partitioned securely within a single server, allowing multiple applications and OS environments to be easily and safely consolidated on a single physical machine.

Desktop virtualization allows individual users to access strategic applications on different operating systems all on a single desktop platform. Recognizing the power inherent in virtualization solutions, Microsoft ships Windows Server 2008 Hyper-V virtualization technology as part of Windows Server 2008. Using Microsoft Hyper-V technology in conjunction with Sun Ray thin clients and off-the-shelf Sun Ray software, customers in the EEC can now securely access multiple OS instances or different OS versions on any Sun Ray thin client in the facility.

By lifting the Windows desktop off of personal computer hardware, relocating it to a virtualization environment, and accessing it with a Sun Ray client, the Microsoft EEC improves flexibility and agility. Creating, managing, and deleting virtual machines is performed simply by managing software instances on the back-end servers. Once a user is properly provisioned, he or she can use any Sun Ray thin client in the EEC to access a range of previously created virtual machines.

The Sun Ray thin clients are low-power, low-cost, stateless devices that operate almost like a frame buffer on the client side of the network. They have no local disk or operating system, and all software and session state resides on back-end servers. Applications render their output to a region of memory on a server — the Sun Ray server — which maintains the current state of each user's display. Software on the server formats and sends the rendered output to the appropriate Sun Ray thin client where the output is interpreted and displayed.

Sun Ray Software can be thought of as a broadcaster that delivers customized content to each client. On one channel, the software might broadcast Windows Vista — on another, it might be Windows 7. On a third, it could provide access to Linux, the Solaris OS, or some other operating system.

The “New” User Experience

Today, engineers from Sun are working closely with Microsoft EEC system architects to design, implement, and fine-tune a solution that brings together the benefits of Hyper-V virtualization and Sun Ray thin client technologies. Based on initial solution designs and a successful proof-of-concept implementation, the EEC is now deploying an innovative, new test environment as construction concludes on the new facility.

With the new environment in place, EEC program managers prepare for a customer engagement by creating a Windows 7 or Windows Vista “landing pad” for each user. The landing pad is essentially a Hyper-V virtual machine (running on a x64 Sun Microsystems server with Windows Server 2008) that can be customized and accessed from any Sun Ray thin client. Prior to the customer's arrival on-site, all virtual machines that are needed for testing are created on the back-end servers, and the customer's landing pad is tailored with connections to those virtual machines. At the same time, the EEC program manager adds entries for visiting users to the Windows Active Directory database.

When the customer arrives, he or she is given a user id, password, and a smart card. When the customer inserts the smart card into a Sun Ray thin client, the Sun Ray Server searches the Active Directory database to see if the card is already assigned to a user. If not, the customer is then prompted for a user id and the card's identifier is added to the user's Active Directory entry. (Associating the card with a specific user entry enforces two-factor identification in subsequent login attempts.) Once the user is properly authenticated, the Sun Ray thin client displays a Windows 7 or Windows Vista virtual machine as a part of the landing pad environment. At this point, the customer uses Internet Explorer to connect to the Web-based KVM-over-IP solution to access any of the virtual machines that have been created and made available to them.

Figure 3 Inserting a smart card into a Sun Ray thin client

At any time, the customer can remove the smart card and continue the session on another Sun Ray thin client simply by inserting the card into a different thin client. This enables mobility and encourages collaboration since the customer can go to a different Sun Ray thin client, insert the smart card, and automatically resume the previous session. When the session resumes on the new device, the Sun Ray thin client displays precisely the same applications that were running at the time that the card was removed.

Solution Architecture

High-Level Overview

Figure 4 shows a high-level overview of the solution, which includes these components:

- One or more back-end virtualization server platforms, which host the virtual machines
- The native operating system on the virtualization server or a hypervisor (a hypervisor is a thin layer of software that allows multiple guest operating systems to run on a host computer at the same time)
- The virtualization engine and the virtual machines
- The display management layer
- The display devices

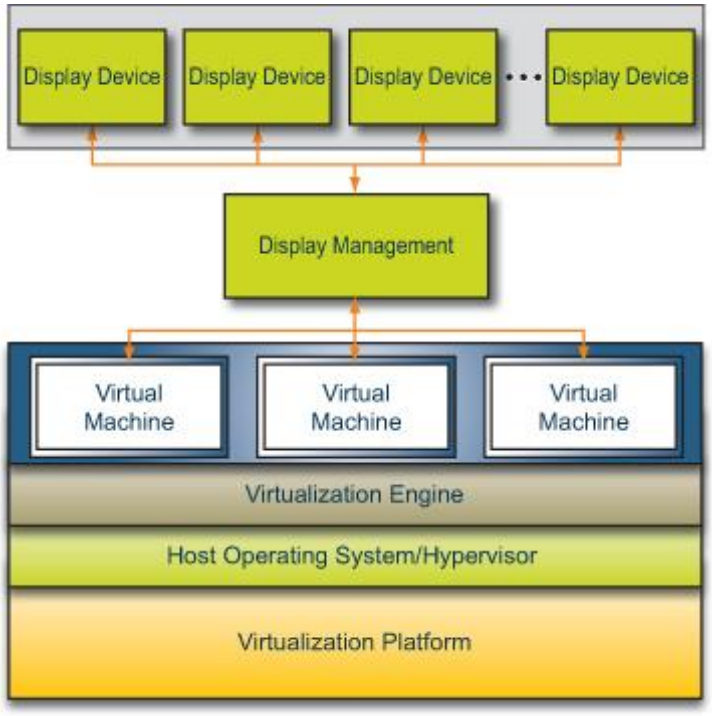

Figure 4 Overview of the solution architecture

Figure 4 depicts a generalized abstraction of the solution architecture, which combines underlying core components typical in a virtualization solution and in a thin-client deployment. The virtualization server supports a “host” operating system or a hypervisor that runs natively on the physical hardware, as well as several “guest” OS instances that execute within the virtualization engine. Usually the virtualization software includes specific tools to simplify the management of different virtual machines, making it easy for program managers to create, duplicate, maintain, and deploy a variety of OS instances. Of the many virtualization packages available today, the EEC is deploying Microsoft Hyper-V, but the overall solution is flexible enough to allow the use of other virtualization technologies.

To support the implementation of Sun Ray thin clients, the display management layer runs the necessary software to maintain session state and format the thin client displays. This layer is responsible for directing, in a secure fashion, display information to the user's Sun Ray thin client. Centralizing client session state via this layer eliminates administration and facilitates mobility, allowing the correct display to follow the user to a different Sun Ray thin client.

Deployed Solution

Figure 5 depicts the solution implemented at the EEC. Specific solution components are listed below and described in more detail in the following pages.

- Virtualization platforms — Sun x64 servers (specifically, Sun Fire X4450 servers)
- Virtualization server operating system — Microsoft Windows Server 2008
- Virtualization engine — Microsoft Hyper-V
- Display management layer — Sun Ray Servers (specifically, Sun Fire X4150 servers), which run the Sun Ray Server Software and Sun Ray Connector for Windows
- Display devices — Sun Ray thin clients

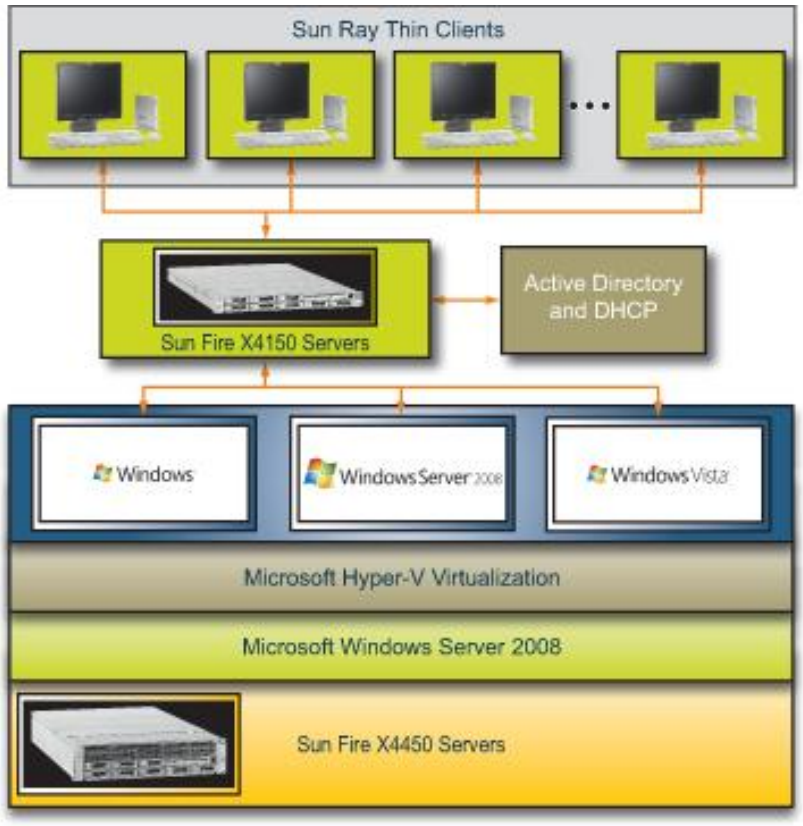

Figure 5 EEC solution architecture

Virtualization Platforms

For the new EEC test environment, the back-end virtualization platforms are Sun Fire X4450 servers, which are dense x64 platforms from Sun that incorporate Intel® Xeon® processors that feature low power envelopes. As shown in Figure 5, these servers host the native operating environment and a set of virtual machines. Each Sun Fire X4450 server is a compact, energy-efficient for-socket system that occupies only two rack units. Because of its high compute density and low energy footprint, the Sun Fire X4450 server is an ideal solution for virtualization initiatives since it provides significant space and power savings.

Like other Sun Intel Xeon and AMD Opteron servers, Sun Fire X4450 servers are certified for Windows Server 2008 and Hyper-V, and are installed using native Windows 2008 drivers. Sun also provides a Tools and Drivers CD to update drivers to more current versions after the initial Windows installation.

There are six Sun Fire X4450 servers used in the EEC, each configured as follows:

- 4 Intel Xeon L7345 processors
- 64GB memory
- Sun StorageTek RAID host bus adapter
- Four internal 146GB 10,000 RPM drives

Sun's portfolio of x64 servers allows customers to scale from one to eight processors and up to 32 cores. At the same time, Sun x64 servers share many common components and support a variety of OS environments, including Windows Server 2008, the Solaris OS, Linux, and VMware. Like other Sun servers, the Sun Fire X4450 server includes an integrated service processor and preinstalled support for Sun ILOM (Integrated Lights Out Manager). Included at no additional charge, ILOM is a effective management tool for Sun systems — one that relies on standard management protocols and integrates with industry-leading data center management systems. ILOM includes KVM over IP support, which can redirect video, keyboard, and mouse communication between the server and a remote administrative workstation. This capability simplifies remote server monitoring and troubleshooting in the EEC data center.

Virtualization Operating System and Virtualization Engine

To host virtual machines on the Sun Fire X4450 servers, Microsoft Server 2008 and Hyper-V technology provide the native host operating system and virtualization engine, respectively.

Windows Server 2008

An advanced operating system, Windows Server 2008 is designed to drive the next generation of networks, applications, and Web services. It is engineered to support applications that deliver rich user experiences and can provide a highly secure network infrastructure. Building on the success of previous generations of Windows Server software, Windows Server 2008 includes significant new capabilities, including the Hyper-V virtualization technology. In addition, this release features new security enhancements and management tools designed to streamline deployment, simplify administration, lower costs, and provide a solid foundation for demanding application workloads.

Hyper-V Technology

New in Windows Server 2008, Hyper-V is a hypervisor-based virtualization technology. The hypervisor software runs directly on the hardware platform and beneath all operating systems running on the computer — the kernel interfaces with the hypervisor to optimize performance and scalability. In many ways the hypervisor resembles a kernel: it manages memory, schedules threads (virtual processors), and handles basic functionality of the system.

Hyper-V provides secure isolation of virtual machines using partitions in which specific operating system instances execute. As Figure 6 shows, the parent partition runs an instance of Windows Server 2008. Also running in the parent partition is the virtualization stack, which is a collection of software components that support the virtual machines and can access the underlying physical hardware. The administrator creates child partitions that can each run different virtual machines that include hypervisor-aware operating systems or earlier generation operating systems. Unlike the parent partition, the child partition does not access hardware resources directly. Instead, requests for hardware access from a child partition are redirected through the virtualization stack in the parent partition.

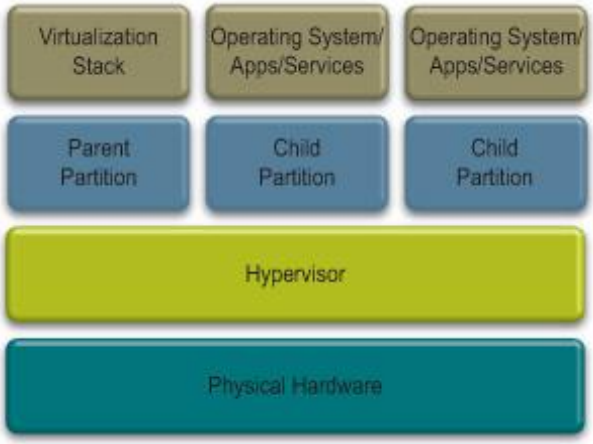

Figure 6 Architecture of Hyper-V virtualization technology

Microsoft's System Center Virtual Machine Manager (SCVMM) 2008 makes it easy for program managers to duplicate a virtual machine and move it quickly from one physical host system to another. Using SCVMM 2008 and its powerful scripting capabilities, EEC program managers can rapidly provision new virtual machines and quickly create new test environments for customer engagements.

Virtual Machines

Using the Hyper-V virtualization technology and SCVMM 2008 tools, program managers can create and manage a series of virtual machines. The virtual machines span the range of operating environments that the EEC makes available for customer use — they can be currently released products (Windows 7, Windows Vista, Windows XP, or Windows Server 200X) or releases that are still under development. In the Microsoft EEC, each customer's landing pad is a virtual machine of either Windows 7 or Windows Vista, which provides the ability to connect to other EEC data center resources.

Within the EEC architecture, there are also several virtual machines running Windows Server 2008 to provide Windows Active Directory and DHCP services. All customers using EEC systems are given an Active Directory entry that defines the customer's landing pad, the customer's user id and password, and the customer's smart card identifier.

Display Management

To provide display management, a set of Sun Ray Servers manages display states and content for the Sun Ray thin clients. In the EEC, there are three Sun Ray Servers implemented on three Sun x64 platforms — specifically on three Sun Fire X4150 servers. Powered by Intel Xeon processors, the Sun Fire X4150 server is a two-socket, enterprise-

class x64 system that packs high performance and expansion headroom into a compact 1 rack-unit footprint.

To function effectively as Sun Ray Servers, each of the three Sun Fire X4150 servers is configured with:

- Two Intel Xeon L5420 processors
- 8GB memory
- Sun StorageTek RAID host bus adapter
- Two internal 146GB 10,000 RPM drives

The Sun Ray Servers features two core software components: the Sun Ray Server Software and the Sun Ray Connector for Windows.

Sun Ray Server Software

Sun Ray Server Software hosts the user sessions for the Sun Ray thin clients. The software (which currently runs under the Solaris OS or under Linux) provides these core capabilities:

- **Hot desk mobility.** Because Sun Ray thin clients are totally stateless, the user can access their application state from any thin client on the network. When the user inserts their smart card and is authenticated, the user's current session is directed to that particular Sun Ray thin client. If the user pulls the card, inserts it in a different Sun Ray thin client, and reauthenticates, all running applications and session data follows the user to the new thin client.
- **Load balancing.** The Sun Ray Server Software provides static load distribution. When a new thin client session is initiated, the session can be placed on any one of the servers in the group based on the availability of server resources. The load balancing algorithm takes into account each server's load and capacity (the number and speed of its CPUs) so that larger or less heavily loaded servers can host more Sun Ray thin client sessions.
- **Session failover.** The Sun Ray Server Software provides support for multiple servers to manage a group of Sun Ray thin clients. Defining a set of servers as a "failover group" provides for automatic user re-authentication on another Sun Ray Session Server if one server in the failover group becomes unavailable.
- **Encryption.** Sun Ray Server Software enables encryption of network traffic between Sun Ray Servers and Sun Ray desktop units.

To size the Sun Ray Servers, EEC system architects used publicly available guidelines from the Sun web site (www.sun.com/software/sunray/sunray_serversizing.pdf). Generally, a conservative rule-of-thumb is 20-50 users per processor core. Since the EEC deployment is mission-critical in its daily operations, the Sun Ray Software Servers are configured as a failover group. In such a configuration, the thin client desktops still exhibit acceptable performance even if there is only one active server available. A failover configuration such as this protects against server failure and helps to simplify routine maintenance of servers and software.

Sun Ray Connector for Windows

The Sun Ray Connector for Windows software extends Sun Ray Server Software functionality, allowing it to broadcast Windows XP Professional, Windows Vista, Windows Server 2003 or Windows Server 2008 in a Windows Terminal Services configuration or in a virtualized environment with Hyper-V. Using the connector capability, program managers can provide full-screen, Microsoft Windows desktops on Sun Ray thin clients, with all the security, mobility, and zero-administration benefits inherent in a Sun Ray thin client architecture.

From a user point of view, the Sun Ray Connector for Windows mediates between the Sun Ray desktop and Windows Terminal Server or Hyper-V. Running on the Sun Ray server, it uses Microsoft Remote Desktop Protocol (RDP) to communicate with the Windows software and the Appliance Link Protocol (ALP), which is the native communications protocol used between Sun Ray thin clients and Sun Ray Servers. In the EEC solution, the Sun Ray Connector for Windows connects to Windows Server 2008's Hyper-V to access the user's landing pad and display the configured Windows environment.

Sun Ray Thin Clients

Sun Ray thin clients form the display component in the new EEC test environment. These devices are low-power, low-cost units that require no annual desktop refresh costs but provide a familiar user experience, especially when combined with virtualization technology and the Sun Ray Connector for Windows. There are three different types of Sun Ray thin clients currently available from Sun:

- **The Sun Ray 2 Client.** At the lowest price point, this small footprint device is packed with traditional Sun Ray functionality. It is an extremely eco-friendly device, with an unbelievably low power consumption of only 4 watts — less than a typical night light! It can be used with existing monitors, keyboard, and mouse devices, and is particularly well-suited for cost-sensitive environments such as call centers, education facilities, healthcare applications, service providers, and financial centers.

- **The Sun Ray 2FS Client.** In addition to low power consumption, the Sun Ray 2FS client includes an integrated fiber optic port and built-in dual-display capabilities. These thin client models are ideal for government and electronic design automation applications where screen real estate is important and dual display screens are often deployed.
- **Sun Ray 270 Client.** The Sun Ray 270 virtual display client is an “all-in-one” unit that includes a brilliant, 17-inch flat panel monitor. Its compact design and flexible Video Electronics Standards Association (VESA) mounting options make it particularly well-suited for space-constrained environments.

Figure 7 The Sun Ray 270, 2FS, and 2 thin clients (from left to right)

Since Sun Ray thin clients have no local disk, applications, or operating system, a single administrator can easily manage well over 1,000 clients. When new OS instances or applications are introduced or more computing power is required, program managers modify

the centralized back-end software components — no changes are required on the thin clients themselves.

From the point-of-view of the network, Sun Ray appliances are identical except for their Ethernet address, which greatly simplifies replacement. They have no moving parts, virtually eliminating desktop repairs — if a unit fails, it can be simply swapped for another. The devices are highly reliable, with a typical life expectancy of about 22 years.

When a Sun Ray thin client is connected to the network and booted, it is assigned an IP address via DHCP, and a thin client session is initialized on the Sun Ray Server. Users can then access their session from any Sun Ray client on the local area network (LAN) or the wide area network (WAN).

In the EEC implementation, Microsoft is initially allocating about one hundred Sun Ray thin clients among seven customer labs. As described previously, a user gains access to their Sun Ray thin client session using an assigned smart card. At Microsoft, smart cards are issued as employee badges, so EEC and Sun engineers worked together to verify that these particular cards would work properly with Sun Ray thin clients. By establishing card profile and configuration files on the Sun Ray Server, the server software properly interrogates the smart card for a unique identifier, which allows these cards to support Sun Ray hot-desking correctly. Taking advantage of Microsoft's existing smart card technology allows the Sun Ray thin client solution to integrate more easily into the EEC infrastructure.

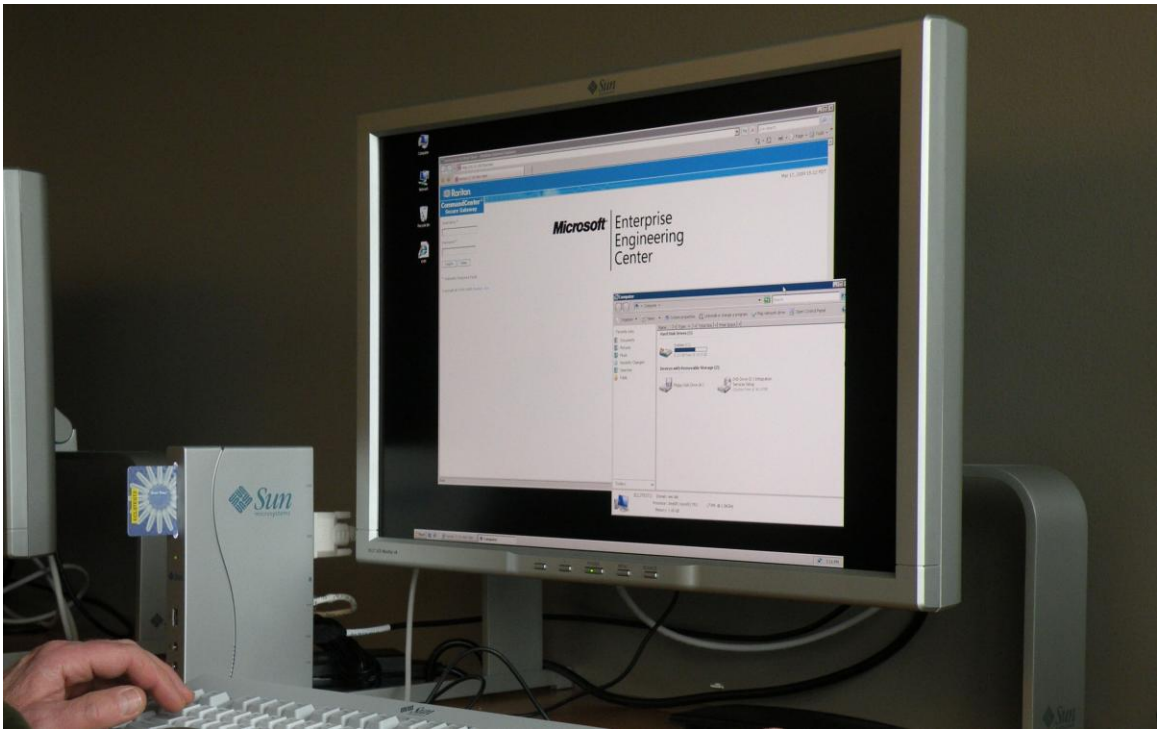

Figure 8 A Sun Ray thin client in an EEC lab

EEC Deployment Plan

The EEC has followed a multi-phased implementation plan that concluded in June 2009, at the same time as the completion of the facility reconstruction project. The project timeline called for thorough testing of the installed environment and the completion of the pre-production phases. Some of the key accomplishments for this deployment include:

- Integration of the solution with existing DHCP and Active Directory services.
- Verification of Sun Ray hot-desking capabilities over multiple virtual LANs (there are 20 VLANs configured).
- Transparent failover to a secondary Active Directory instance in the event the primary instance is off-line.
- Ability to search various branches of the Active Directory namespace.
- Implementation and verification of high availability of the three servers in the Sun Ray Server failover group.
- Minimize the administration duties associated the Sun Ray environment.

The joint Microsoft and Sun implementation teams are excited by the project's progress to date and its success thus far.

One of the advantages in combining virtualization and Sun Ray thin client technology for the EEC has been how well these technologies complement the existing EEC test environment. Although the solution provides a level of agility that is “revolutionary”, integration of these new technologies has been “evolutionary”, allowing the EEC to reuse many existing components from its data center and labs, including servers, storage devices, displays, KVM switches, and .NET smart cards.

Conclusion

On its own, virtualization is a powerful technology that can help to centralize administrative tasks, improve security, and increase utilization of valuable server resources. Combined with Sun Ray thin client technology, virtualization is allowing the EEC to reach new levels of agility in its operations.

Specifically, the EEC is realizing these benefits:

- **Faster provisioning of customer environments.** The administrative workload focuses more on cloning and customizing virtual machines for customer use, instead of physically rewiring and reinstalling hardware. To expedite the provisioning process, SCVMM 2008 enables rapid provisioning of virtual machines, allowing environments to be quickly duplicated. Using virtualization technology, it is easier to create, maintain, and personalize the required customer test environments.
- **Improved security to protect Microsoft intellectual property and customer assets.** Sun Ray thin clients are designed for secure operation from the ground up (which is one reason they are so widely deployed in government and military agencies). In the EEC test environment, the Hyper-V virtualization engine securely isolates running virtual machines and centralizes all data, applications, and OS instances on physically secured servers.
- **High reliability desktops.** Sun Ray thin clients are highly reliable, proven by their exceptionally long life expectancy. These units require no ongoing maintenance since all data and applications are maintained on centralized servers, and Sun Ray Servers keep track of the user's session state.
- **A “green” data center footprint.** With Intel processors that feature extremely low power requirements, Sun x64 servers are eco-friendly choices to power the combination of virtualization and Sun Ray thin client technology. Sun Ray thin clients are also low-power devices, requiring only 4 or 12 watts for operation (for the Sun Ray 2 and Sun Ray 2FS thin clients, respectively) — significantly less than many other desktop options.
- **User mobility.** Since Sun Ray thin clients are totally stateless devices, it is now possible for users to move between labs, conference rooms, and offices securely and effortlessly. Through the use of a smart card, a user can transparently access their current session and applications from any Sun Ray thin client in the EEC, enhancing opportunities for collaboration between Microsoft product groups and visiting customers during engagements.

In the EEC test environment, Microsoft and Sun are aligned closely and collaborating to merge the strengths of virtualization and Sun Ray thin clients. In doing so, they are able to highlight the power of Windows software technologies and deliver a Windows desktop quickly and securely to satisfy the constant influx of visiting EEC customers.

Related Links

For more information on the Microsoft EEC, see:

http://www.microsoft.com/eec/

For more information on Sun Ray thin client technology, see:

http://www.sun.com/software/sunray/

For more information about Windows Server Hyper-V, see:

http://www.microsoft.com/windowsserver2008/virtualization/

For more information about System Center Virtual Machine Manager 2008, see:

http://www.microsoft.com/systemcenter/virtualmachinemanager

For more information on compatibility of Sun x64 systems and Microsoft Windows Server 2008, see:

http://www.sun.com/windows