Deploying Citrix Application Delivery solutions on HP hardware and software

Executive summary

Enterprises face a growing need to provide access to business applications across large geographic areas and a variety of organizations. However, accessing information across long network connections may slow down response times, resulting in a poor user experience. Furthermore, having information maintained on individual PCs can expose the enterprise to security threats and may make it difficult to comply with regulatory requirements. Providing and managing access to mobile users can also be challenging given the wide ranges of devices and operating environments that may be used.

Transforming access necessitates a fresh look at how you deploy, manage, and support your business applications. You should consider the following:

- A systematic approach to access is the key to bridging the gap between users and enterprise resources. It can help you enhance the efficiency and consistency of the user experience – wherever your applications reside.
- Transforming access is more than just providing network connections; you should also virtualize your applications to provide access from any type of client device and secure, local storage for business data.
- Transforming access is also more than just providing software and servers. You need a complete solution that includes storage, client devices, printers, and management software, all of which are designed to work together.
- HP provides a complete line of hardware and software solutions designed to support Citrix Application Delivery infrastructure.
- HP and Citrix have a proven record of success, with over 75,000 mutual customers. This collaborative relationship ensures that our products work together seamlessly and deliver rapid time-to-value.

The paper begins by accenting the HP Adaptive Infrastructure, within which Citrix Application Delivery solutions can be used to create an integral part of the IT supply chain, and HP Server Based Computing. More information is provided on the features and scalability of recommended HP ProLiant servers.

Various aspects of Citrix Application Delivery infrastructure are discussed, including enhancements made to the Citrix printing subsystem and the benefits of using HP StorageWorks storage solutions in this environment. The paper concludes by detailing HP and Citrix management solutions for provisioning, maintaining platform health, change and configuration management, identity access management, and validation and optimization.

Intended audience: This white paper is intended for business and IT professionals interested in application delivery.

Introduction

IT organizations are under pressure to reduce both operating costs and capital expenses; even though budgets are stagnant, the expectations of management and the business continue to grow, placing still greater demands on IT. As a result, IT managers are constantly looking for effective ways to simplify operations and do more with existing resources, giving them better control over costs while allowing them to meet the needs of the business.

Simplifying the application delivery and management infrastructure can help an IT department operate efficiently within a tightly-controlled budget while still meeting increasing demands from users for wider, faster access with more functionality.

The powerful, mutually-supportive combination of Citrix Application Delivery solutions and an HP Adaptive Infrastructure helps integrate and synchronize IT with business processes, while sustaining the rapid deployment of resources. This is a balanced infrastructure that emphasizes agility and accepts change as a normal operating condition.

HP provides a complete line of hardware and software solutions to support Citrix Application Delivery. From leading-edge HP ProLiant servers, storage, printers and thin clients to the HP Software portfolio with offerings such as HP Business Technology Optimization (BTO) Software, HP Systems Insight Manager (HP SIM), HP ProLiant Essentials Rapid Deployment Pack (RDP), HP Configuration Management software, and HP LoadRunner, HP provides innovative solutions that improve operational efficiency while minimizing complexity and risk.

HP and Citrix provide joint, industry-leading solutions that help make change an opportunity rather than an obstacle; furthermore, these solutions can reduce the total cost of ownership, creating savings that can be used to pursue business growth.

Value of the HP and Citrix partnership

Citrix and HP have been working together since 1995, creating a partnership that provides end-to-end access solutions that enable IT organizations to reduce risk, control costs, and equip users to become more productive.

The benefits of deploying Citrix Application Delivery infrastructure on HP hardware and software include:

- **Integrated**

  Citrix and HP work together to provide the processes, methodologies and tools needed to implement global application server solutions. This partnership is distinguished by knowledge-sharing and integrated product development; for example:

  – HP is a Strategic Partner within the Citrix Global Alliance Partner Program and maintains a full-time engineer onsite at Citrix, working with Citrix test engineers to help ensure compatibility between HP and Citrix products

  – HP validates the installation of Citrix Presentation Server on select HP ProLiant servers prior to product announcements

  – There is a sizer for Citrix Presentation Server deployments on the HP website.

  – Citrix is a member of the HP BladeSystem Solution Builder Program and works with HP to build the industry's broadest offering of blade-based customer solutions

  – HP and Citrix have signed agreements for On-Site Engineering, Cooperative Support, and Global Systems Integration and Professional Services

- **Preferred**
  Over half of all Citrix implementations worldwide run on HP technologies.

- **Validated**
  Citrix on HP access solutions have been proven in production deployments at more than 75,000 mutual customers.
- **Field-proven**
  There are more than 150 public case studies attesting to the value of Citrix on HP access solutions in addressing real-world business challenges.
- **Enterprise-optimized**
  Because HP and Citrix have partnerships with industry leaders such as SAP, Cisco, Microsoft®, and Oracle®, Citrix on HP access solutions can integrate seamlessly with almost any enterprise IT environment.

As a result, Citrix Application Delivery solutions can be deployed with confidence on HP hardware and software; no other vendor has as long a history with Citrix solutions.

The next section describes the HP Adaptive Infrastructure, within which Citrix Application Delivery solutions can be used to create an integral part of the IT supply chain.

Adaptive Infrastructure

In the past, technology supported business activities; today, however, IT powers the business and is increasingly evaluated through business metrics. It is not just performance and manageability that matter in today's environment; technology is also required to deliver positive business outcomes: reduce cost, mitigate risk and drive growth.

The HP Adaptive Infrastructure initiative has been designed to help achieve these goals by supporting the evolution from a conventional IT environment to a next-generation data center that optimizes the IT infrastructure and automates service delivery.

Key features

This section outlines key features of the HP Adaptive infrastructure.

Standardization

In the evolving next-generation data center, systems – including servers and storage – will be standardized and simplified around pre-set configurations designed to accommodate key service requirements. For example, one configuration might be tuned to support a high volume of interactive transactions; another for high-performance computing services; and a third to provide wide access and high-volume application presentation. In addition, the data center must always meet required levels for security and availability.

The output of the data center will become a catalog of standard IT services that have been pre-defined in conjunction with the business. These services can be categorized as follows:

- Infrastructure services – such as computing and directory services
- Application services – such as enterprise resource planning (ERP) and messaging services
- Information services – such as customer information and business reporting services

Management

Effective management – especially in a shared infrastructure – is critical. Tools, such as HP ProLiant Essentials products, will be used in the next-generation data center to help you design, implement and integrate processes, allowing you to proactively manage and operate your infrastructure and applications to meet given service levels. In turn, this will help you better meet the needs of the business while reducing costs and improving utilization through resource sharing and automation.

A single-view control room will make it possible for IT services to be delivered by a small number of IT staff performing standard processes, in much the same way as workers in a factory assembly line. These processes include configuring a service, ordering a service, provisioning a service, monitoring the service against established service levels, changing the service in response to changing requirements, and remote infrastructure management.

Virtualization and automation

Virtualization and automation will be key components of the next-generation data center.

Virtualization effectively separates the hardware owner from the application owner, allowing operations – configurations, monitoring operations and tool sets – to be homogenized. As result, the management of virtual resources can be achieved using a low maintenance/high volume set of operations, such as those delivered by HP StorageWorks products.

Since virtual resources can be created and redeployed through software, separate ownership allows hardware owners to automate their now homogenous operations on these resources.

Energy efficiency

The cost of energy continues to rise and is becoming the single largest operating cost in a data center; as a result, energy efficiency will be a fundamental requirement in next-generation data centers. Moreover, enterprises are becoming increasingly concerned with the environmental impact of their data centers, making energy efficiency an even larger issue. At the same time, today's data centers are being driven by the demand for higher performance and greater computing density. Thus, limited by last-generation data center design and by the need to become more energy efficient, data centers are approaching their computing capacity limits.

In response, some vendors have chosen to focus on individual aspects of the overall power and cooling challenge, such as chip efficiency or data center cooling. HP, meanwhile, is taking a broader, holistic approach and can help you execute comprehensive energy and environmental strategies for your entire IT infrastructure, driving significant overall energy cost savings and reducing your global carbon footprint through sustainable business practices.

HP Server Based Computing

HP, in partnership with Microsoft and Citrix, provides one of the most complete solutions for the server-based computing environment.

As a leader in server-based computing, HP has already deployed thousands of solutions for large enterprises, such as financial and telecommunications services, government, education and healthcare agencies. HP Server Based Computing (SBC) experts can provide the knowledge, hardware, software and services needed to deliver benefits like rapid return on investment, unmatched simplicity, unprecedented scale-out, lower total cost of ownership, and faster time-to-solution.

This section provides more information on HP ProLiant servers and HP BladeSystem, which can be key components of an HP SBC environment. Information is also provided on improving server performance in this environment through the use of Battery Backed Write Cache (BBWC).

HP ProLiant servers

Deploying HP ProLiant servers in an HP SBC environment (such as the Citrix Application Delivery platform) offers many benefits to the customer over conventional client/server computing:

- Lower application ownership costs
- Enhanced security
- Elimination of additional development, testing or deployment procedures for individual applications

- Improved data backup and recovery
- Improved end-user support
- Uniform desktop experience from any network
- Accelerated application deployment access point
- Extended application availability

Tested servers

HP offers a broad range of HP ProLiant servers that are ideal for HP SBC environments. Table 1 lists the servers recommended for 64- and 32-bit HP SBC environments and provides a brief description of each.

Note:
Previous generations of the same model are omitted; retired models are included for completeness.
Descriptions are valid as of November, 2007.

Table 1. Tested servers

Server	Description
BL460c	With features comparable to a standard 1U rack-mount server, the 2P multi-core HP ProLiant BL460c server blade combines power-efficient computing power with high density, allowing memory and I/O to be expanded to maximize performance. Quad- or Dual-Core Intel® Xeon® processors, fully-buffered DDR2 dual inline memory modules (DIMMs), Serial Attached SCSI (SAS) or Serial ATA (SATA) hard drives, as well as support for multi-function Gigabit server adapters and a range of I/O options combine to create a performance system that is ideal for scale-out applications. The HP ProLiant BL460c server blade provides multiple high-availability features, including hot plug hard drives, mirrored memory, online spare memory, memory interleaving, embedded RAID capability, and enhanced remote Lights-Out management.
BL465c	With features equaling a standard 1U rack-mount server, the 2P/4C[1] HP ProLiant BL465c server blade blends power-efficient computing power and high density with expanded memory and I/O for maximum performance. Next-generation AMD Opteron™ processors with DDR2 memory, SAS or SATA hard drives, and support for multifunction Gigabit server adapters and multiple I/O cards combine to create a performance system that is ideal for the full range of scale-out applications.
BL480c	The 2P multi-core HP ProLiant BL480c server blade offers an outstanding combination of processing power and expansion, with 12 DIMM slots, four hot plug drive bays, and three I/O expansion slots. Power to handle the most challenging applications is delivered by Quad- or Dual-Core Intel Xeon processors, up to 48 GB of fully-buffered 667 MHz DDR2 memory, four server adapters, and a choice of four hot plug SAS or SATA hard drives.

---

[1] Denoting a total of two processors (P) and four cores (C) deployed in the tested server

Table 1. Tested servers (continued)

Server	Description
BL680c G5	The HP ProLiant BL680c G5 server blade delivers no-compromise performance and expansion in the first 4P/16C server for HP BladeSystem. With up to four Quad-Core Intel Xeon processors, 128GB of fully-buffered memory, two hot plug SAS or SATA hard drives, four embedded Gigabit server adapters and three I/O expansion slots, this server blade delivers the density and performance needed to handle the most demanding enterprise-class applications.
BL685c	The dense HP ProLiant BL685c server blade delivers no-compromise performance and expansion capabilities. With up to four AMD Opteron 8000 Series processors, 64 GB of DDR2 memory, two hot plug SAS or SATA hard drives, four embedded Gigabit server adapters, and three I/O expansion slots, this blade delivers the density and performance needed to handle the most demanding enterprise-class applications.
DL360 G5	With concentrated 1U computing power and essential fault tolerance, the Dual- or Quad-Core Intel Xeon-powered HP ProLiant DL360 G5 server is ideal for space-constrained environments.
DL365	Delivering concentrated 1U computing power, HP Integrated Lights-Out management, and essential fault tolerance, the 2P/4C HP ProLiant DL365 server is optimized for space-constrained installations. Dual-Core AMD Opteron processors, DDR2 memory, SAS and PCI Express technology combine to provide a high-performance system that is ideal for the full range of scale-out applications. To support mission-critical applications, the ultra-dense HP ProLiant DL365 server provides fault tolerance with redundant power, redundant fans, and embedded RAID capability, along with full-featured remote Lights-Out management.
DL380 G5	The 2P HP ProLiant DL380 G5 server with Dual- or Quad-core Intel Xeon processors continues to deliver on its history of design excellence with enterprise-class uptime and manageability, providing a reliable, versatile platform for demanding scale-out applications and virtualization projects. Its 2U form factor makes the HP ProLiant DL380 G5 server ideal for a wide range of rack deployments.
DL385 G2	The 2P HP ProLiant DL385 server builds on the HP ProLiant DL380 server's history of design excellence, enterprise-class uptime, and manageability, delivering proven 2P performance with 2U density for a variety of rack deployments and applications. This server features AMD Opteron 2000 Series processors.
DL580 G5	The four-socket HP ProLiant DL580 G5 server delivers outstanding performance for demanding scale-up and scale-out applications, along with enterprise-class high-availability features and exceptional flexibility and serviceability. Based on the latest industry-standard processing, memory, I/O and networking technologies, this server provides enterprise-class high-availability features (such as hot plug and redundant components) to help guarantee maximum uptime, while HP iLO 2 technology supports remote administration. Its dense, highly expandable architecture maximizes application deployment flexibility, providing support for PCI Express, PCI-X or battery backed write cache (BBWC) options.

Continued

Table 1. Tested servers (continued)

Server	Description
DL585 G2	The 4P/8C HP ProLiant DL585 G2 server delivers outstanding price/performance in an x86 four-socket rack server. A combination of Dual-Core AMD Opteron processor technology, excellent availability features, and unsurpassed flexibility makes this system ideal for mission-critical data center deployments.

Server scalability

Tables 2 and 3 summarize the optimal numbers of Heavy Users supported by HP ProLiant servers tested by HP in 64- and 32-bit HP SBC environments, respectively.

Note:
Test results are valid as of November, 2007.
As with any laboratory benchmarks, the performance metrics quoted in Tables 2 and 3 are idealized. In a production environment, performance metrics may be impacted by a variety of factors.
For more information on the particular server configurations tested, refer to the HP white paper, "Scalability and performance of HP ProLiant servers in 32-bit and 64-bit HP Server Based Computing environments."

64-bit HP SBC environment

Note:
The 64-bit HP SBC environment utilized a Microsoft Office 2003 workload; results obtained in this environment cannot be compared directly with those obtained in the 32-bit HP SBC environment, which utilized an Office XP workload.

Table 2. Optimal number of Heavy Users supported in a 64-bit HP SBC environment (Microsoft Office 2003 workload)

Server	Configuration	Optimal Heavy User support
BL460c	2P/8C	196
BL480c	2P/8C	200
BL680c G5	4P/16C	278
BL685c	4P/8C	166
DL360 G5	2P/8C	181
DL380 G5	2P/8C	181

<div align="right">Continued</div>

Table 2. Optimal number of Heavy Users supported in a 64-bit HP SBC environment (continued)

Server	Configuration	Optimal Heavy User support
DL580 G5	4P/16C	303
DL585 G2	4P/8C	155

32-bit HP SBC environment

Table 3. Optimal number of Heavy Users supported in a 32-bit HP SBC environment (Office XP workload)

Server	Configuration	Optimal Heavy User support
BL460c	2P/8C	197
BL465c	2P/4C	181
BL480c	2P/8C	194
DL360 G5	2P/4C	178
DL365	2P/4C	184
DL380 G5	2P/4C	191
DL385	2P/2C	148
	2P/4C	181
DL580 G5	4P/16C	233

HP SBC online sizer

To minimize customer risk, HP offers automated, online tools that can help the customer size an HP SBC solution. The algorithms and methodology used by the sizer are the result of customer surveys and through testing.

Figure 1 shows a typical HP SBC sizer screen.

Figure 1: An HP SBC sizer screen
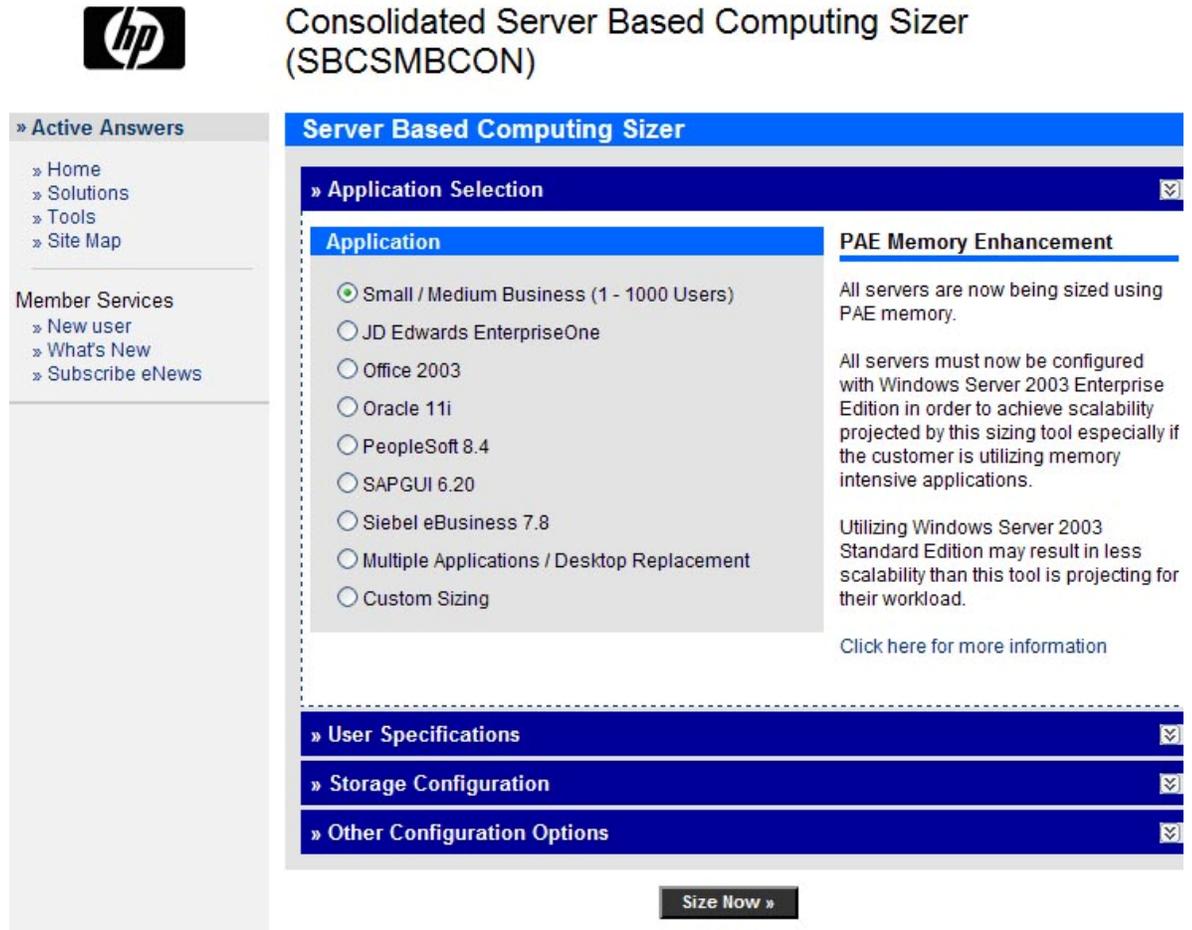
HP BladeSystem

The powerful, mutually-supportive combination of Citrix Application Delivery solutions on a modular infrastructure featuring HP BladeSystem c-Class products can rapidly deploy the resources needed to integrate and synchronize IT with the business. This infrastructure emphasizes agility and accepts change as a normal operating condition.

Out of the box, HP BladeSystem removes constraints imposed by conventional IT infrastructures, unifying server, storage, networking, power, and management capabilities in a change-ready, energy-thrifty, and cost-effective system. HP BladeSystem helps customers of all sizes – from large enterprises to small and medium businesses (SMBs) – make an easy transition to an Adaptive Infrastructure by enabling tighter and more dynamic connections between IT and the business process. With its simplified, flexible infrastructure, HP BladeSystem is prepared for change.

The c-Class infrastructure is made up of the following components:

- HP ProLiant and/or HP Integrity server blades for Microsoft Windows®, Linux, and HP-UX
- A choice of Intel or AMD™ processors, including the latest quad- and dual-core devices, for 32- and 64-bit applications

- An enclosure that has been designed for full redundancy and high availability, and provides options for connectivity, power, cooling, and management
- HP BladeSystem Onboard Administrator, which provides a single point of control for the intelligent management of the entire enclosure
- HP Insight Display, which supports local management through an LCD display conveniently sited on the front of the system
- HP Virtual Connect, Ethernet, Fibre Channel, InfiniBand (IB), iSCSI, and other interconnect choices
- A power subsystem that supports redundant or non-redundant power modes; in addition, dynamic power-saving mode requires up to 30% less power than traditional rack-mounted and tower servers
- Parallel, redundant, scalable enclosure-cooling (PARSEC) architecture, which maximizes cooling while consuming less power and working more quietly than previous HP designs.
- Direct-attach and shared storage blades that can provide file- or block-based storage capacity for the servers within the enclosure

Two HP BladeSystem enclosures are offered, the c7000 and c3000.

**c7000 enclosure – for enterprise and high-performance computing environments**

The HP BladeSystem c7000 enclosure provides all the power, cooling, and I/O infrastructure needed to support modular server, interconnect, and storage components – to meet today's needs and to support change over the next few years. This enclosure is 10U high and holds up to 16 server and/or storage blades plus optional redundant network and storage interconnect modules. It includes a shared, 5 Tb/second high-speed NonStop midplane for wire-once connectivity of server blades to network and shared storage. Power is delivered through a pooled-power backplane that ensures the full capacity of the power supplies is available to all server blades for maximum flexibility and redundancy. All server blades feature hot plug drives, large memory capacity and significant expansion capabilities.

While Citrix solutions can virtualize applications and the operating system, HP BladeSystem can virtualize the modular hardware infrastructure. When these two solutions are integrated together, the resulting environment can provide rapid application support and access management to meet evolving business needs.

Increased density along with improved power and cooling efficiency combine to enhance data center resource utilization.

Figure 2 shows a typical architectural diagram of a Citrix Application Delivery platform deployed within a single HP BladeSystem c7000 enclosure.

Figure 2: Citrix Application Delivery infrastructure can readily be deployed within a single HP BladeSystem enclosure
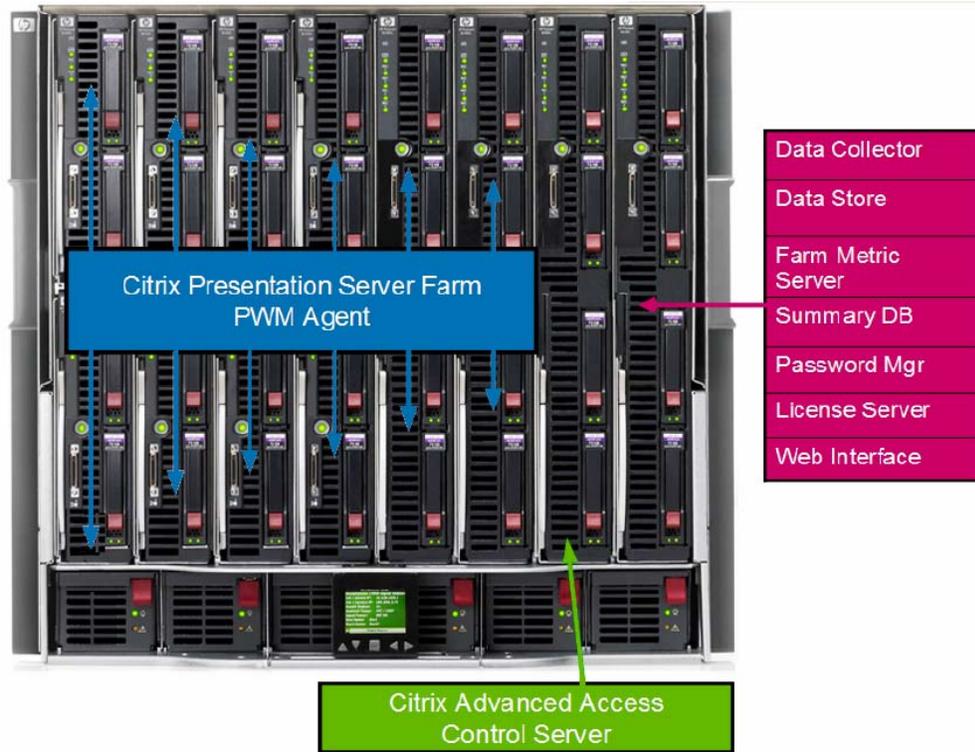
c3000 enclosure – for remote sites and small- to medium-sized businesses

The HP BladeSystem c3000 is a versatile, all-in-one enclosure that allows smaller sites to deliver big business results. This enclosure consolidates server, storage (NAS or iSCSI), and network, power, and management capabilities into a single, affordable infrastructure that can help you secure and grow your business.

The HP BladeSystem c3000 enclosure has the flexibility to scale from a single enclosure that holds as many as eight blades to a rack with seven enclosures that can support up to 56 blades. Citrix Application Delivery infrastructure can be deployed within a single enclosure, providing the flexibility to support expansion as the organization grows.

This enclosure has been designed for the following applications:

- Remote sites or branch offices with three to eight servers
- Retail stores, branch offices, manufacturing sites, and wiring closets
- Harsh environments not typically found in modern data centers (high ambient temperatures, dusty environments, and in ships, airplanes, platforms, and vehicles)
- Small- to medium-sized businesses with between three and 100 servers.
- Data centers with special power and cooling constraints, such as those needing DC-powered racks or those with low power and cooling capacities (under 3000 watts per rack)
- High performance computing (HPC) clusters featuring IB interconnection, where applications need a one-to-one IB network subscription ratio between the physical cluster nodes

Enhancing server performance with BBWC

IT managers are constantly looking for effective ways to simplify operations and do more with existing resources, giving them better control over costs while allowing them to better meet the needs of the business. One option for improving the performance of existing servers in an HP SBC environment is the use of BBWC, a low-cost feature that is only available from HP.

HP Smart Array controllers include an allocation of RAM that can be utilized to temporarily buffer data being written to or read from disk. Since access to this RAM is significantly faster than disk access, this cache can enhance overall server performance.

Data being written to disk are temporarily buffered in cache before being written to disk. After the cache has received all the data associated with a particular write command, the controller indicates to the server that the data transfer is complete – even though data are still being written to disk (a process known as cache synchronization).

By buffering write data, disk throughput can be improved significantly; indeed, testing carried out by HP has indicated that, with the optimal number of users logged on, disk response times can be as much as 70% faster with write cache enabled.

Note:
For more information on BBWC features and performance testing, refer to the HP white paper, "Improving performance with the Battery Backed Write Cache on HP Smart Array controllers."

While faster access times can translate directly to enhanced system performance, this improvement comes with a potential penalty: if a system or utility failure were to occur during cache synchronization, data may be lost unless the write cache is battery-backed.

Because of the potential for data loss, HP automatically disables write cache unless an optional BBWC enabler is installed and fully-charged. With BBWC enabled, you can safely allow write data to be cached, knowing that the data would be protected by the battery in the event of a system or utility failure.

Testing BBWC in a real-world application

HP has tested the value of enabling write cache in a real-world application – a call center. In this example, the call center deployed an HP ProLiant server with three different write array configurations:

- HP Smart Array 5304 controller with 256 MB write cache
- HP Smart Array 5i Plus controller with 64 MB write cache[2]
- HP Smart Array 5i controller with write cache disabled

Test results indicated that, in this particular environment, the maximum numbers of users supported were as follows:

- HP Smart Array 5i controller with no write cache – 39 users
- HP Smart Array 5i Plus controller with 64 MB write cache – 51 users
- HP Smart Array 5304 controller with 256 MB write cache – 96 users

[2] Although the HP Smart Array 5i controller family is retired, the concept and expected performance gain applies to new Smart Array controllers as well

Thus, the deployment of 64 MB write cache translated to support for up to 31% more users. Increasing the size of the write cache to 256 MB led to an even more significant improvement – up to 246% more users.

Printing

This section describes improvements made to the Citrix printing subsystem and explains how HP printers and print drivers are validated for Citrix Application Delivery infrastructure.

Citrix printing subsystem

While printer support has traditionally been one of the biggest challenges in a Citrix environment, Citrix Presentation Server 4.0 delivered a completely redesigned – from the ground up – printing subsystem architecture with enhancements that include a new Advanced Universal Printing feature and new printing policies with support for proximity printing (which gives users the ability to print to the nearest printer). The new printing subsystem is intended to be more robust, scalable, and extensible.

Note:
More information is available on the Citrix website; refer to, "Citrix Presentation Server 4.0 – NEW Printing Subsystem."

The Citrix printing subsystem includes these key components:

- **Server-side printers**
  Includes print drivers that are installed on the presentation server
- **Client-side printers**
  These are the printers defined on each client workstation; they may be locally- and/or network-attached
- **Management console settings**
  Configurations (including printing policies and driver mappings) are created in Presentation Server's Java™ console
- **Universal Printer Driver**
  This printing subsystem employs a Citrix-developed Universal Printer Driver (UPD) along with the underlying network infrastructure that allows this driver to remotely manipulate most of the settings of a client-side printer. The Citrix UPD is automatically installed on all Presentation Server 4.0 systems.

The following section describes how Presentation Server 4.0 has fundamentally changed the way that client-side printers are managed within the Citrix architecture and how print data is streamed back to the client.

Citrix UPD

The Citrix UPD provided with Presentation Server 4.0 supports the use of Windows Enhanced MetaFiles Format (EMF) for transferring print jobs from client to server. EMF significantly improves printing performance, especially time to print.

When users log on to a presentation server, local and network printers available to them are automatically created within the session. As a result, users can utilize their regular printers from applications running on presentation servers without having to set up these printers each time they log on.

Auto-creation of client printers requires the drivers for these printers to be available on the server side of the presentation server architecture. While the driver replication feature of Presentation Server makes it easier to manage printer drivers within the farm, maintaining a large number of printer drivers can be problematic. However, universal printing helps relieve this burden and avoid some of the other problems that can occur in a diverse environment.

The following section outlines the capabilities of the HP UPD.

HP UPD

The HP UPD is intended to provide a single driver solution to be used with multiple printer models in a managed Windows environment, such a Citrix Application Delivery platform.

HP has validated the HP UPD on Presentation Server 4.0 for Windows Server 2003 x64 Edition platforms and now supports the UPD in this environment.

To help the customer determine which UPD to use in a particular environment, HP makes the following recommendations:

- Use the Citrix UPD for Presentation Server 4.0 environments and when using 32-bit Windows clients
- Use the HP UPD for Citrix platforms prior to Presentation Server 4.0 or when using non-32-bit clients
- In an enterprise or managed print server environment, use the HP UPD when printing to multiple HP printer models

The following section describes how HP printers and drivers are validated for use in a Presentation Server environment.

Printer and driver testing

Citrix collaborates with HP to test HP printers and their associated HP print drivers, and the HP UPD in Presentation Server and Presentation Server for Windows Server 2003 x64 Edition environments. Presentation Server 4.5 has been tested on Windows 2000 Advanced Server, Windows Server 2003, and Windows Server 2003 x64 Edition platforms.

Citrix characterizes the performance of HP printers and printer drivers using the standard printer and printer-related feature tests designed to test Presentation Server and Presentation Server client software. HP provides a selection of LaserJet, Business Inkjet, and DeskJet printers to be tested by Citrix; however, since base printer driver code is common among members of the HP printer family, the combination of printers selected by HP serves as a representative sample of this entire family.

The HP white paper, "HP printers supported in Citrix Presentation Server environments," lists the printers tested, explains the printer tests, identifies the printer driver versions used, and describes any issues that occurred during testing.

Important:
All HP printers and associated printer drivers listed in the above-referenced white paper are supported by HP in Citrix environments.

HP tests all printer drivers on Windows Server 2003/Citrix Presentation Server and Windows 2000 Terminal Server/Citrix MetaFrame XP 1.0 platforms and is confident of the functionality and stability of the driver versions referred to in the above-mentioned white paper. HP also screens all driver releases to verify that the drivers are free of memory leaks and memory allocation issues.

Other devices tested

Citrix has also collaborated with HP to test select HP scanners and All-in-One printers and their associated HP TWAIN drivers in a Presentation Server environment.

Performance characterizations of these devices and their associated drivers are carried out using the standard scan-related feature tests used by Citrix to test Presentation Server and Presentation Server client software.

The following section outlines the use of HP Thin Clients with the Citrix Application delivery platform.
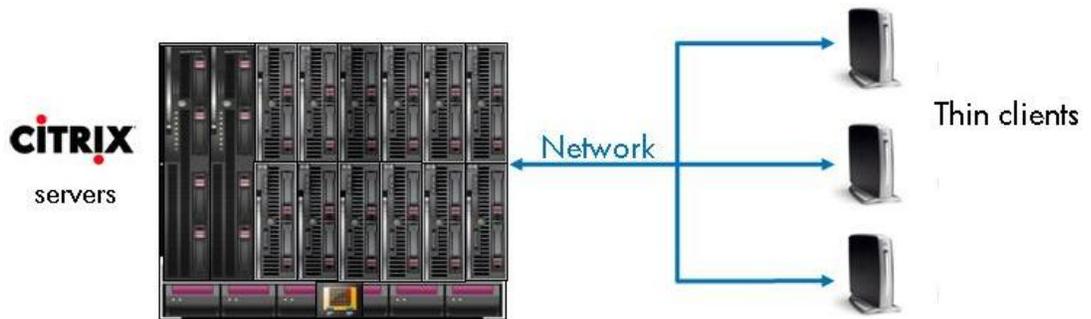
HP Thin Clients as access devices

Easy to buy, deploy and manage, HP Thin Clients can be ideal access devices for an HP SBC environment and are optimized for the Citrix Application Delivery platform. For example, out of the box, HP Thin Clients provide support for Citrix ICA Program Neighborhood and Citrix Desktop Broker for Virtual Desktop Infrastructure.

As key applications are delivered to more users in more places, HP Thin Clients can help increase security and reliability across the Citrix environment, while providing users with the familiar look and feel of a desktop PC experience.

As part of a rigorous testing program, HP and Citrix work closely together to help optimize HP Thin Clients with Citrix Application Delivery solutions right out of the box. Initial deployment is easier, thanks to automated HP setup and configuration technologies. For example, running in 'stateless' mode, as soon as an HP Thin Client is connected to the network, its settings are automatically downloaded. Further, with HP ProLiant Essentials Rapid Deployment Pack (RDP) or Altiris Deployment Solution software, IT staff can deploy, administer and configure all data, users and applications from a central location.

Figure 3 shows how HP Thin Clients can be used in conjunction with HP BladeSystem to support Citrix Application Delivery infrastructure.

Storage solutions

Driven by obligations to support disaster recovery and regulatory compliance solutions, and provide storage for new sources of information (such as digital images, sound and video), it is reasonable to expect that enterprise data storage requirements will continue to increase. Similarly, storage requirements for the HP SBC environment and the Citrix Application Delivery architecture can also be expected to increase.

To meet these increased storage requirements, HP StorageWorks data storage products can be used for a range of applications in the Citrix environment, including but not limited to the following:

- Application and user file storage
- Storage mirroring
- Boot from SAN capability for presentation servers
- Hosting a Citrix Data Store cluster
- Hosting a Citrix License Server cluster

The following sections provide more information on the use of HP storage solutions with Citrix Application Delivery infrastructure: using storage blades and SANs, and the performance impact of booting from each; implementing Citrix Data Store and License Server clusters; and optimizing and protecting applications with HP StorageWorks Storage Mirroring and Citrix WANScaler.

Using storage blades

The HP StorageWorks SB40c storage blade is a half-height HP BladeSystem c-Class storage device that can support up to six hot plug SAS or SATA hard disk drives. Using an onboard HP Smart Array P400 controller, the SB40c provides outstanding performance, availability, and storage density, helping meet the growing need for enterprise storage.

The SB40c provides directly-attached storage for HP BladeSystem c-Class servers; if desired, you can boot these servers from storage blades.

Performance testing

HP tested the SB40c storage blade with a 2P HP ProLiant BL480c server blade in an HP SBC environment to determine the impact on server scalability of booting from a storage blade.

Figure 4 shows that booting from a storage blade led to a 4% increase in supported users.

Figure 4: Nearly 4% more users were supported when booting from a BL480c storage blade
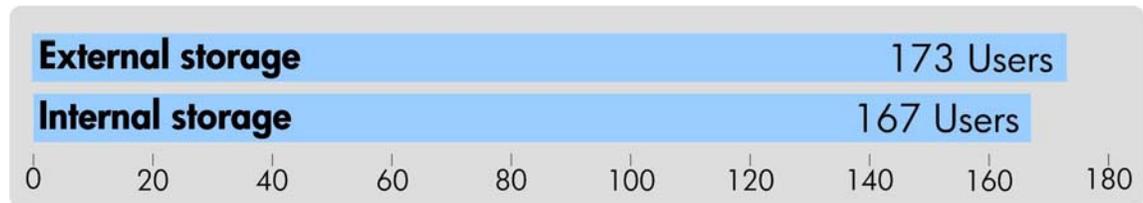
Note:
For more information on this testing, refer to the HP white paper, "Performance report of HP ProLiant BL480c server blade with HP StorageWorks SB40c storage blade in a Server Based Computing environment."

Using a SAN and implementing boot from SAN

A SAN is a dedicated, high-speed network that delivers shared storage through an external disk storage pool. The SAN only carries I/O traffic between servers and the storage pool and is separate and distinct from the LAN.

Note:
For more information on booting from SAN, refer to the HP white paper, "Managing Citrix Presentation Server 4.0 with HP ProLiant Servers and HP StorageWorks MSA1500 SAN Array."

As part of the Adaptive Infrastructure strategy to help customers better synchronize IT with business processes, HP offers a family of open, modular StorageWorks storage solutions – industry-standard platforms for deploying, managing, and operating today's demanding network storage environments. The solutions range from a basic SAN to a global enterprise SAN. HP Storage Networking Solutions deliver scalability, performance, and broad interoperability required for critical data and applications.

SAN storage arrays can significantly impact the customer's competitive advantage by improving business agility, making it possible to react quickly to changes in the marketplace. StorageWorks solutions make storage arrays more affordable, significantly reducing the total cost of ownership while maintaining a high return on investment.

Business case

As server farms grow, the costs associated with managing directly-attached storage can quickly escalate, often making it impractical to manage data storage needs proactively. A SAN implementation, on the other hand, allows the customer to manage all storage needs virtually and proactively while maintaining the high availability required by the farm.

Another huge benefit delivered by a SAN deployment is the ability to manage the SAN without interruption. Since drives are added to the SAN physically but managed logically, IT staff can dynamically allocate additional storage to a storage pool, add storage to the SAN, or reallocate storage – with no need to reboot the associated servers.

A further benefit is the capability to boot servers from the SAN rather than locally, providing the following benefits:

- Redundant storage paths
- Enhanced disaster recovery capabilities
- Improved security
- Minimized server maintenance
- Reduced impact of a failure on production
- Reduced backup window time

Performance testing

HP tested the impact of boot from SAN capability on the performance and scalability of a 2P HP ProLiant BL30p server blade using both internal and SAN storage. Figure 5 provides test results.

Figure 5: The optimum[3] number of users supported by this server blade increased significantly when boot from SAN was configured
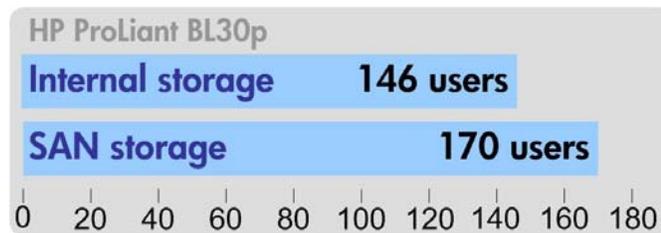
Hosting a Citrix Data Store cluster

Part of Citrix Presentation Server farm deployment is the Citrix Data Store, an Open Database Connectivity (ODBC)-compliant database (such as IBM DB2, Microsoft SQL Server, Oracle Database, or Microsoft Office Access) that contains persistent information relating to the Citrix Presentation Server environment, including farm configuration information, published applications, server and printer configurations, and security details.

Note:
For more information on the Citrix Data Store, refer to the Citrix document, "Advanced Concepts Guide Citrix Presentation Server for Windows Version 4.0."

---

[3] By definition, a server is supporting the optimum number of users when its ICAMark test score reaches 80.

In an enterprise environment, it is important for the data store to be available at all times. For maximum availability, Citrix recommends placing the data store in a clustered database environment with a SAN backbone. Hardware redundancy allows the SAN to recover from most component failures; in addition, software such as Oracle Real Application Clusters (RAC) or SQL Server with Microsoft Cluster Services (MSCS) provides failover in the event of a catastrophic software failure.

Figure 6 outlines a typical Citrix Presentation Server farm implementation that is using an HP StorageWorks 1500cs Modular Smart Array (MSA1500) array to host storage, including the data store.

Figure 6: A typical server farm, with storage for the data store deployed on an HP StorageWorks MSA1500 array
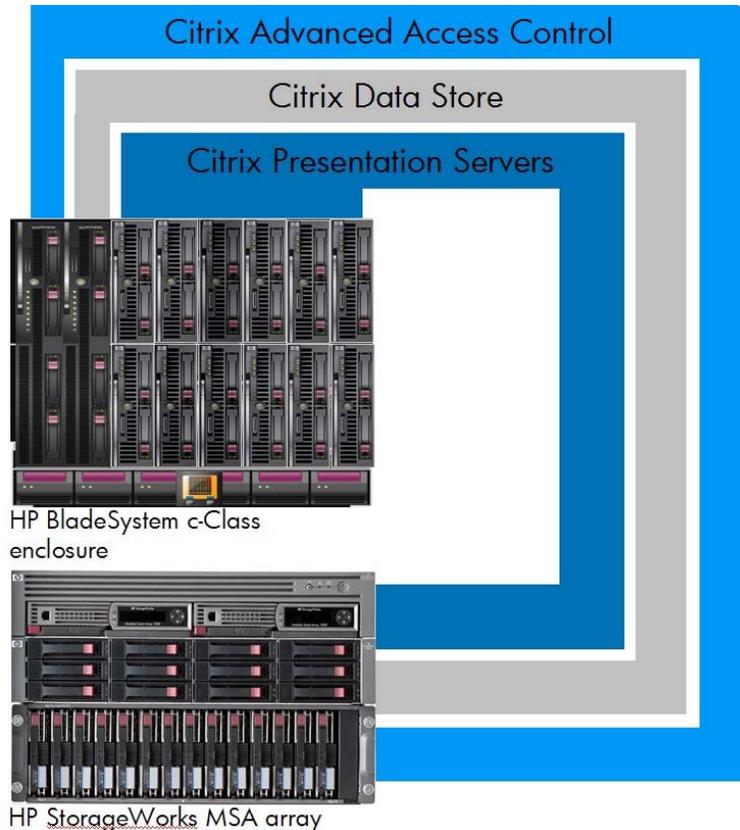
Hosting a Citrix License Server cluster

Every Citrix environment must have at least one shared or stand-alone licensing server that is dedicated to storing and managing product licenses for the server farm.

Whenever a user connects to a Citrix product, the product requests a license from the licensing server on behalf of the user. When the license is successfully checked out from the licensing server, the user can run the product.

Citrix products maintain continuous connections to the licensing server. Should a connection be broken, there is a grace period during which a local record of the license allows the product to keep running; this record is updated hourly.

Citrix License Servers can utilize MSCS with an HP SAN to maintain high availability and redundancy. Citrix provides specific instructions for installing the license server in a clustered environment.

Optimizing and protecting applications with HP StorageWorks Storage Mirroring and Citrix WANScaler

Slow application response over a wide area network (WAN) can be a problem for branch office backups. Combining HP StorageWorks Storage Mirroring and Citrix WANScaler enables continuous real-time backup and automatic failover for remote offices are fast, effective, and foolproof, even over the WAN.

Storage Mirroring

Storage Mirroring extends the capabilities of a periodic backup to provide accessible, affordable data protection, ensure minimal data loss, and enable rapid recovery from a disaster or system outage.

Storage Mirroring includes patented replication and failover technology that continuously captures byte-level changes as they happen and replicates these changes to one or more target servers at any location – locally or at a remote recovery site. In the event of a disaster, Storage Mirroring lets you recover from your target servers in minutes, if not seconds.

The Application Manager feature of Storage Mirroring is designed to configure and manage protection for business-critical applications. This feature automates the setup and configuration of real-time protection and availability management for Microsoft Exchange, SQL Server, or Windows Server 2003 File Services.

Citrix WANScaler

Citrix WANScaler can accelerate the application performance experienced by branch-office users, delivering LAN-like performance over any WAN.

By significantly improving the performance of enterprise applications such as Windows file sharing, WANScaler can enhance user productivity, postpone expensive bandwidth upgrades, and enable the consolidation of application resources.

Benefits include the following:

- **Extend collaborative workflows and improve global productivity** – WANScaler accelerates files and application data over the WAN between branch offices so that users spend less time waiting.
- **Capitalize on cost savings through IT resource consolidation** – WANScaler enables applications and data storage to be consolidated, reducing the number of data centers and simplifying the application infrastructure.
- **Protect data centrally** – WANScaler speeds the delivery of data to branches, allowing data to be stored and replicated in a protected facility to meet regulatory or corporate mandates for data security and disaster recovery.

Performance testing

Storage Mirroring and WANScaler were tested on a simulated T1 connection configured with 25 ms of latency and 1% packet loss each direction, for a total round-trip latency of 50 ms with 2% packet loss.

Table 4 outlines the test results.

Table 4: Test results for various scenarios, showing the percentage improvement when WANScaler is used in conjunction with Storage Mirroring

Scenario	Storage Mirroring	Storage Mirroring and WANScaler (First pass)		Storage Mirroring and WANScaler (Second pass)	
File data mirror test 3.15 GB of file data representing a variety of file types and sizes, as in a typical file server	29,197 seconds	3,374 seconds	+765%	1,578 seconds	+1,750%
Exchange data mirror test 2.72 GB of Exchange data, containing both database and log files	25,086 seconds	964 seconds	+2,502%	637 seconds	+3,838%
Exchange replication test Performed using Exchange LoadSim 2003 on Exchange Server 2003, Enterprise Edition; replication was measured for a 60-minute period	403,083,518 bytes received by the target server	7,376,330,537 bytes	+1,729%	N/A	N/A

Management

This section describes how HP and Citrix solutions can be used together to manage the Citrix Application Delivery platform. Information is provided on the following topics:

- **Automated server software provisioning** – Provides an example of the use of HP Insight Control management software (HP intelligent embedded technologies, HP SIM, and core HP ProLiant Essentials offerings) for automated server provisioning through RDP

- **Maintaining platform health** – Shows how HP Software Windows Management can be used with Citrix Presentation Server to proactively manage events and maintain service levels. HP BTO Software solutions, in conjunction with the Hermes SoftLab Citrix Presentation Server SMART Plug-in, provide advanced functionality for detecting and resolving critical issues.

- **Change and configuration management** – Shows how the policy-based change and configuration management software delivered by HP Configuration Manager (CM) suite allows IT staff to inventory, provision and maintain authorized software in a heterogeneous environment.

- **Identity access management** – Shows how the combination of HP BTO Software and Citrix Password Manager can be used to ensure that any user, whether internal or external, can only access the resources to which that user is entitled.

- **Validation and optimization** – Shows how HP LoadRunner, an industry-standard load testing and performance validation solution can be used to help predict system behavior and isolate potential performance bottlenecks. As a result, the performance of an application can be optimized before it goes into production.

Automated server software provisioning

HP Insight Control management software addresses all aspects of HP ProLiant and HP BladeSystem server management by bringing together HP intelligent embedded technologies, HP SIM, and core HP ProLiant Essentials software offerings (such as RDP) in simple, integrated packages with streamlined licensing.

Using RDP

RDP is an integrated HP and Altiris solution that automates server software provisioning, allowing businesses to quickly and easily deploy Citrix Presentation Server 4.5 on the latest HP ProLiant BL and DL series servers in a Citrix server farm. Using state-of-the-art RDP technology, IT staff can readily deploy server images, scripts, and applications to meet the needs of an ever-changing business environment. This technology helps guarantee consistency across the server farm – quickly and with little administrative effort.

Note:
For more information, refer to the HP white paper, "Using HP ProLiant Essentials Rapid Deployment Pack 3.5 to deploy Citrix Presentation Server 4.5."

Combining RDP with Citrix Presentation Server allows operating systems, configurations, and published applications to be deployed to specified presentation servers from the RDP console by means of scripts or images. As business needs change – even temporarily – RDP can facilitate the redeployment of servers and applications to the server farm.

Ultimately, using RDP with the latest HP ProLiant servers and Citrix Presentation Server 4.5 translates into cost savings and customer satisfaction as users receive their applications and data when, where, and on whichever device required.

The current release, RDP 3.7, includes Altiris Deployment Solution 6.8 Service Pack 2 and delivers support for HP SIM 5.1.

Maintaining platform health

The combination of Citrix Presentation Server and HP Software Windows Management allows you to maintain the health of your Citrix Application Delivery platform, monitoring availability within your infrastructure so that you can understand end-user performance issues, identify problems and manage events. You can identify the root causes of problems within your infrastructure before users are impacted, maintaining the desired service levels. Because you gain more exposure to your systems, you are able to be proactive rather than reactive, thus lowering the overall cost of managing the infrastructure.

This management solution includes the following components:

- Citrix Presentation Server
- HP Operations Manager for Windows
- HP Internet Services software
- Hermes SoftLab Citrix Presentation Server SMART Plug-in (SPI) for HP Software
- HP Network Node Manager (NNM) software

In conjunction with the Citrix Presentation Server SPI, HP Operations Manager software provides advanced functionality for detecting and resolving critical issues on a Citrix Application Delivery platform. You can define complex rules and instructions for monitoring systems and services; if an issue is detected, a message is sent to the HP Operations Manager console. In addition, you can define automated actions to be performed whenever a particular issue is detected or provide instructions for IT staff. You can check which actions were launched when issue was detected and review the outcomes.

Functionality provided by the Citrix Presentation Server SPI includes:

- **Citrix Presentation Server**
  - Monitor both mandatory and optional Citrix Presentation Server and Windows services, with advanced monitoring (probing) of Independent Management Architecture (IMA) service
  - Forward Citrix-related system and application event log messages
  - Monitor average and current latency and latency deviation for a session
  - Monitor the number of sessions in a specific state (such as Active, Listener, Down, Shadowing)
  - Monitor and collect session resource consumption (such as CPU, memory, handle, thread)
  - Monitor and collect session network traffic for errors/timeouts
  - Automatically disconnect lengthy inactive sessions
  - Utilize a logon throttler to protect servers from being overloaded during intensive login activity
  - Monitor changes in the data collector
  - Monitor the consistency of the Data Store
  - Monitor and collect user logon process (user profile loading, applying group policy objects, user initialization, logon script execution, Citrix-specific initialization)
  - Monitor and collect profile full/roaming size, number of executables and media files
  - Monitor and collect profile contents (presence and amount of executable files, media files, custom files)
  - Monitor and apply changes to server/published application configuration
  - Monitor to determine if logons are enabled

- **Citrix Presentation Server Web Interface**
  - Monitor for repeated user logon failures
  - Monitor logon process duration

- **Citrix License Server**
  - Monitor for repeated user logon failures
  - Monitor logon process duration

- **Citrix Presentation Server Secure Gateway**
  - Monitor Secure Gateway service and the event log
  - Monitor session connectivity issues

Figure 7 shows a Citrix Presentation Server farm topology as viewed through HP Operations Manager for Windows and the Hermes Presentation Server SPI.

Figure 7: Displaying a typical server farm topology
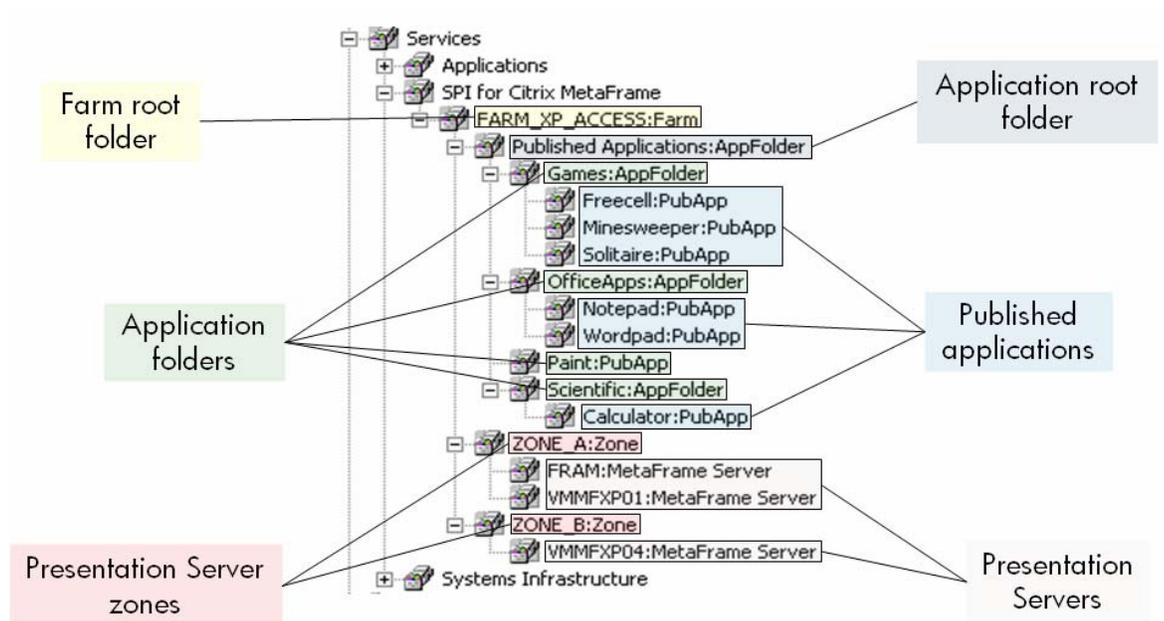
Change and configuration management

HP Configuration Management (CM) suite is policy-based change and configuration management software that allows your IT staff to efficiently inventory, provision and maintain authorized software across heterogeneous server platforms. CM facilitates data center consolidation and can help you enforce compliance requirements and meet the requirements of service level agreements.

Key features of CM include the following:

- Provision and manage operating systems, applications, patches and content
- Prepare an application package and conduct impact analysis prior to distribution

- Target individual or groups of servers for Citrix Presentation Server deployment and maintenance based on business policies
- Leverage powerful templates to facilitate the deployment of complex server applications
- Scale your Citrix Application Delivery infrastructure to meet the needs of the enterprise

Identity access management

It has always been prudent for an organization with hundreds or thousands of employees to identify those who are permitted to access information resources and to control their access. Today, large enterprises have additional reasons for strengthening the oversight of information access, including regulatory compliance, security, productivity and cost concerns. Add an expanding user base that may include partners, customers and vendors, as well as remote and mobile employees, all requiring access to various password-protected applications, and it becomes clear why many large businesses are searching for a complete, integrated product and services solution that can effectively manage user identity and access.

In contrast to other identity access management (IAM) solutions, the combined HP Select Identity software and Citrix Password Manager IAM solution is based on a service-oriented model that ensures that all users, whether internal or external, can access the resources to which they are entitled – and nothing more. Access is easily revoked when user roles or status change.

Table 5 outlines the products form the basis of this IAM solution.

Table 5: The combined HP Select Identity software and Citrix Password Manager IAM solution

Product	Contribution
Citrix Access Suite	Citrix Access Suite unifies key access points, capabilities and technologies in a single solution to provide secure, on-demand access to any business information resource – from anywhere, with any device, over any network. Citrix Password Manager is a key Access Suite component.
HP Select Access	Through its highly scalable, standards-based architecture, Select Access software provides complete web-based single sign-on, automated network and resource discovery, and flexible delegated administration.
HP Select Federation	Select Federation software enables web-based single sign-on and cross-domain identity management without requiring a centralized data repository or repository synchronization.
HP Select Identity	The service-oriented approach of Select Identity software delivers centralized management of users' identities and access rights over their complete life cycle, from initial registration through approval, provisioning, ongoing maintenance, termination, and auditing.

Validation and optimization

IT staff must be able to support a wide range of application environments and user scenarios, both new and old, while still addressing today's dynamic application delivery challenges. An innovative, integrated approach to application delivery and application performance testing is required.

Like any application environment, Citrix Application Delivery infrastructure can benefit from performance tuning to ensure that it has been optimally configured to meet expected workloads. HP and Citrix have joined together to provide a performance validation and optimization solution that leverages the key capabilities of HP LoadRunner 9.0 software to conduct performance testing in a Citrix Presentation Server 4.5 environment. HP LoadRunner is an industry-standard load testing and performance validation solution that helps predict system behavior and isolate potential performance bottlenecks, allowing you to optimize application performance before going into production.

The combination of Citrix Presentation Server and HP LoadRunner software can streamline application delivery for Windows applications, while mitigating risk and simplifying application performance validation.

Summary

HP and Citrix have collaborated to provide a solution with the following benefits:

- **Accelerate business growth**
  Extend your business to reach more locations and more users, provide support for a more dynamic work style, and scale quickly to incorporate new users and uses

- **Reduce costs**
  Reduce the expense associated with delivering and securing applications, speed up the distribution of and access to data, and support the dynamic scaling of application resources to meet changing business needs

- **Mitigate risk**
  Secure your critical data in a centralized location, facilitating compliance and ensuring that only authorized users can access applications and data; provide secure access to remote and mobile users

For more information

HP ActiveAnswers for Server Based Computing	http://h71019.www7.hp.com/ActiveAnswers/cache/70283-0-0-0-121.aspx
Consolidated HP SBC online sizer tool	http://h71019.www7.hp.com/activeanswers/Secure/70245-0-0-0-121.aspx
HP ProLiant servers	http://www.hp.com/go/proliant
HP Thin Clients	http://h20334.www2.hp.com/Hpsub/cache/41207-0-0-225-121.html
Storage from HP	http://www.hp.com/go/storage
HP Adaptive Infrastructure	http://www.hp.com/go/adaptiveinfrastructure
HP Software Windows Management	http://www.openview.hp.com/solutions/winm/index.html
HP Configuration Management for Servers Solution suite	http://h20229.www2.hp.com/solutions/ascm/index.html?jumpid=reg_R1002_USEN
HP LoadRunner	https://h10078.www1.hp.com/cda/hpms/display/main/hpms_content.jsp?zn=bto&cp=1-11-126-17%5E8_4000_100__
HP ProLiant Essentials Rapid Deployment Pack (RDP)	http://www.hp.com/go/rdp
Citrix Presentation Server	http://www.citrix.com/English/ps2/products/product.asp?contentID=186
Citrix WANScaler	http://www.citrix.com/English/ps2/products/product.asp?contentID=33886
Citrix Password Manager	http://www.citrix.com/English/ps2/products/product.asp?contentID=7181
Hermes SoftLab CPS SMART Plug-in for HP OpenView	http://www.hermes-softlab.com/products/SPI/citrix.html

To help us improve our documents, please provide feedback at www.hp.com/solutions/feedback.