VMware Mirage Implementation Case Study for a Large, Public-Sector Organization

Architecture for 10,000 Users Across 400 Offices with Low-Bandwidth Connectivity to the Data Center

TECHNICAL WHITE PAPER

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Introduction

This document describes an implementation of a VMware Mirage™ solution at a large, public-sector organization in the United States. It addresses

- The objectives and challenges faced
- How and why the Mirage solution was successful in meeting the objectives
- How VMware Professional Services utilized Mirage to overcome the technical challenges discovered within the environment

This case study is intended to help customers, IT architects, consultants, and administrators involved in the early phases of planning, designing, and deploying Mirage-based solutions. It provides an example of a successful architecture and deployment method that meets specific industry-vertical challenges and the benefits gained.

About the Organization

The public-sector organization provides various services to 17 million people across 500,000 square kilometers (km^2). It employs nearly 10,000 staff members across more than 400 locations. Approximately 3,000 employees work in the central office, and 7,000 are distributed across the 400 sites.

The organization's IT infrastructure is based on low-bandwidth connectivity. The central office's LAN and data center connection is only 100 Mbps, much slower than expected in today's technology-driven organizations. Remote sites and field offices are connected to the data center via slow T1 network connections of 1.5 Mbps, with no network quality of service (QoS) capability.

Over 10 different HP desktop and laptop models of various generations connect to the network. Microsoft Windows XP is installed on each end-user device. Symantec Altiris 6.9 supports the management lifecycle of all 10,000 devices.

Business Objectives and Challenges

The primary objective was to move all end users off the Windows XP endpoints by April 8, 2014, when Microsoft support was due to expire. If the organization were to continue to use Windows XP, the cost of extended support was estimated to be about $200 per device, per year. With at least 10,000 devices in the environment, the maintenance fee would be $2 million per year in addition to the current operational expenses.

About 2,000 devices were also due for a hardware refresh. The cost of extending the hardware support contracts and the increasing calls to support teams contributed to the value of the migration.

In addition, a high portion of IT operational expenses was attributed to the travel costs involved to locally support the 400 sites. The goal was to significantly reduce these costs while still being able to provide similar services remotely.

VMware was asked to assist in the following objectives while causing little to no disruption to staff during work hours and not impacting an already slow and highly utilized network:

- Avoid the upcoming $2 million expenditure by moving all devices from Windows XP to Windows 7 by April 8, 2014
- Deliver 2,000 new devices to the field
- Significantly reduce IT travel costs

About Mirage

Mirage is an endpoint management solution that enables lifecycle management of end-user devices. Some of its key capabilities are seamless, nondisruptive software deployment and optimized user backup. The Mirage centralized image management system uses simple concepts, such as network bandwidth throttling, network compression, and single-instance storage to deliver high-impact results across a highly distributed infrastructure, qualities that make it a tailor-made solution for this organization's environment.

The Mirage branch reflectors are placed in remote offices and stored with corporate images. This setup localizes software updates or provisioning to local endpoints, avoiding having to transfer the images across the WAN. The images can also be synchronized between branch reflectors and the central management system on a customized schedule. Creating branch reflectors also requires minimal effort and time.

Single-instance storage reduces the network bandwidth requirements even further by backing up only a single version of files that are shared among multiple colleagues. For example, if a Word document or spreadsheet has been saved by 10 employees on their desktop or laptop, only one instance of the file is backed up. Eliminating data duplication reduces storage needs and makes the network more efficient.

For more information, visit http://www.vmware.com/products/horizon-mirage.

Project Overview

In 2013, the end-user desktop operating system upgrade was initiated with a clear understanding of the upside to moving off Windows XP. In any large migration, the difficulties lie in the small details and logistics. The organization presented VMware three scenarios that needed to meet the overall objectives.

Scenario 1: Hardware Refresh of 2,000 Endpoints

Coinciding with the migration, 2,000 new machines were delivered to the central office. The organization employed the existing tried-and-trusted desktop management platform Altiris to refresh the hardware. Unfortunately, imaging just four machines on the 100 Mb network caused an outage for all users in the central office.

The challenge was to build 2,000 machines as quickly as possible on a network of only 100 Mb with minimal effort.

Scenario 2: OS Migration of 8,000 Widely Distributed Machines

Approximately 8,000 machines with low network connectivity to the data center are dispersed over 400 locations across the 500,000 km^2. Deploying onto the fastest network within the public-sector organization had already caused problems. It was not going to be possible to use the same approach for machines dispersed over slower networks.

Scenario 3: Reducing Operational Expenditures

The organization needed to reduce the amount of time spent managing the desktop environment and the tools to support management.

A large number of images were used to cover all hardware specifications and the variance in software required for each department. Periodic updates to the operating system, applications, and patches required extensive resources to update each image.

Mirage High-Level Architecture

The Mirage solution consists of several components. Some components are centralized for ease of deployment and manageability, while others are distributed to optimize data transfer from the centralized components to the end-user device.

Figure 1 illustrates the VMware Mirage solution architecture designed for the large public-sector organization to enable

- Migration to Windows 7
- An optimal, longer-term desktop management solution tailor-made for this type of infrastructure

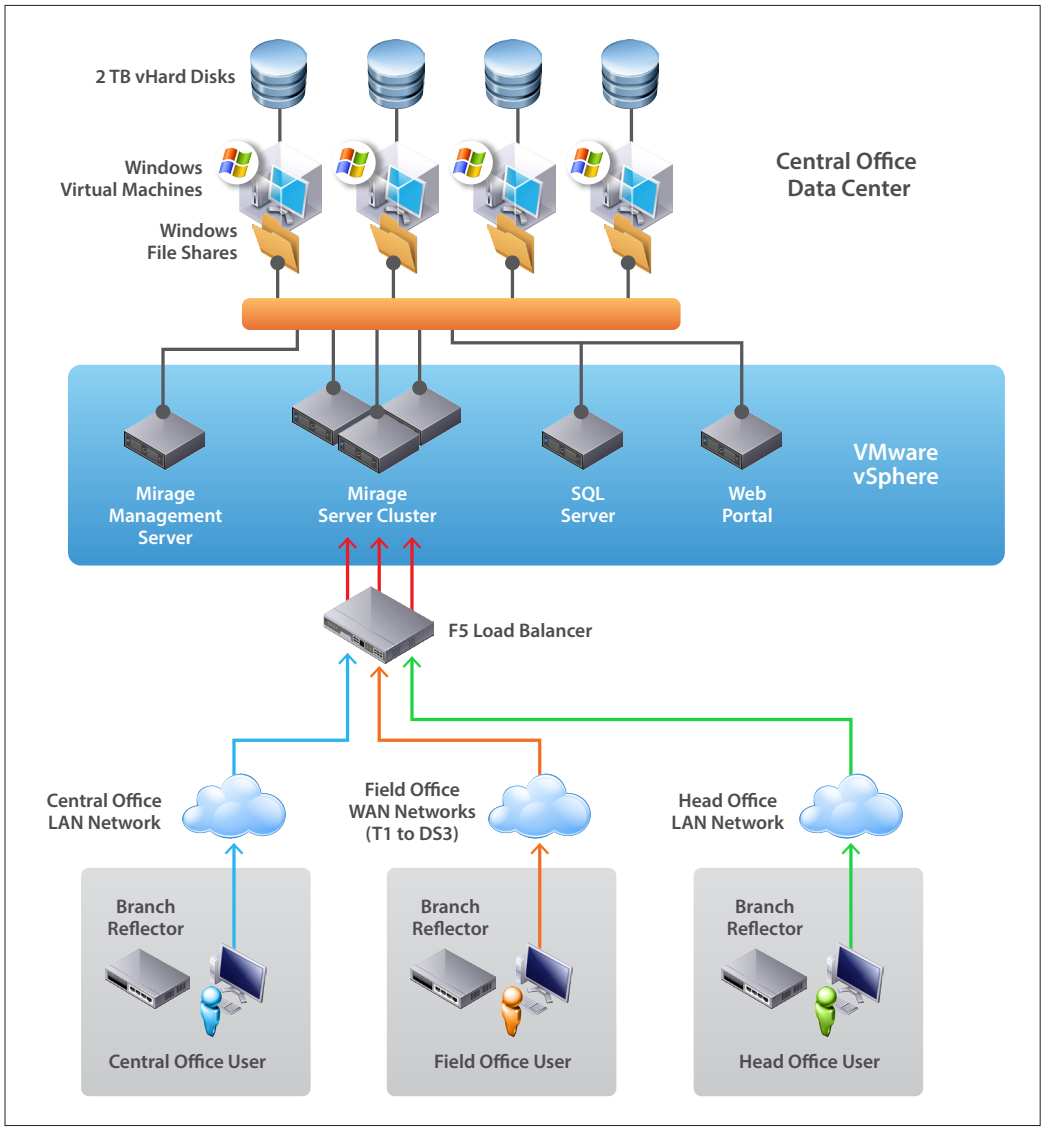

Figure 1: Mirage Architecture

The central office data center, with 100 Mb network, hosts the centralized Mirage solution components:

- Mirage Management server
- Mirage server cluster
- Mirage storage (Windows file shares)
- Web Portal
- Load balancer
- Database

Each branch office is provided a branch reflector, a distributed component. A load balancer brokers all end-user device connections to the Mirage servers, regardless of office location.

Note: A Mirage Gateway server allows end users with an installed Mirage client to communicate securely with the Mirage servers over the Internet. This capability was not required for this project, so a Mirage Gateway server was not deployed.

Management Server

A single Mirage Management server controls and manages the Mirage server cluster. It is used extensively to coordinate and manage the provisioning of operating systems to the 2,000 new devices and migrating 8,000 Windows XP instances to Windows 7.

Web Portal

A single Mirage Web Portal server enables the service desk personnel to respond to queries and requests.

Mirage Server Cluster

A Mirage server synchronizes the data between the end-user devices and the Mirage repository. It manages the storage of base layers (typically OS images), application layers, centralized virtual desktops (CVDs), and deploying software layers to end-user devices.

A best practice is to deploy a Mirage server node for every 1,500 end-user devices that are fully managed. With 10,000 endpoints, the number of nodes is: 10,000 ÷ 1,500 = 6.66.

So for this project, the Mirage server cluster consists of seven nodes, each with the same virtual machine specification detailed in Appendix A. As the number of end-user devices increases, it is recommended to further scale out the cluster with additional nodes. Adding Mirage server nodes is a nondisruptive activity.

High availability for the Mirage Server cluster is adequately provided for by VMware vSphere® High Availability.

Mirage Storage

The Mirage storage repository contains all base layers, applications layers, CVDs, end-user device information, user profiles, and user data.

VMware best practices recommend using network-attached storage (NAS) with a CIFS share as the repository for Mirage server clusters. Enterprise NAS solutions provide scalability and performance for data transfer between endpoints and Mirage servers.

For this project, the only requirement for backing up user data was for 400 VIP users—if the OS migration failed because of a blue screen of death, user data could be rapidly restored. Other design considerations included image management of 10,000 CVDs and no existing Enterprise NAS solution.

The solution had four virtual machines deployed as Windows file servers, each with a 2 TB virtual disk providing a CIFS share to the Mirage server cluster. The Mirage server cluster uses an algorithm to divide data across volumes based on the most available space.

Storage capacity used the best practice calculation for the following scenarios:

- Image management scenario: Each CVD uses approximately 100 MB (10,000 endpoints x 100 MB = 1 TB)
- Backup and recovery of the 400 VIP endpoints using the Mirage Disaster Recovery capability: Each CVD requires about 15 GB of storage (400 x 15 GB = 6 TB)

The total can be rounded up to 8 TB to allow for growth and standardization, with a 2 TB VMDK file on each Windows virtual file server.

SQL Server

A dedicated SQL Server was deployed as a repository for the Mirage configuration with the specification of the virtual machine detailed in Appendix A. The standard Mirage database sizing guidelines in the VMware Mirage Installation Guide were followed.

Deployment Method

This section describes the methods VMware used to address the organization's three scenarios of migrating Windows XP.

Scenario 1: Hardware Refresh of 2,000 Endpoints

The organization needed to load 2,000 endpoints with the standard OS as well as the applications that each user required. Previous attempts at executing the rollout of images had caused network outages that affected the central office.

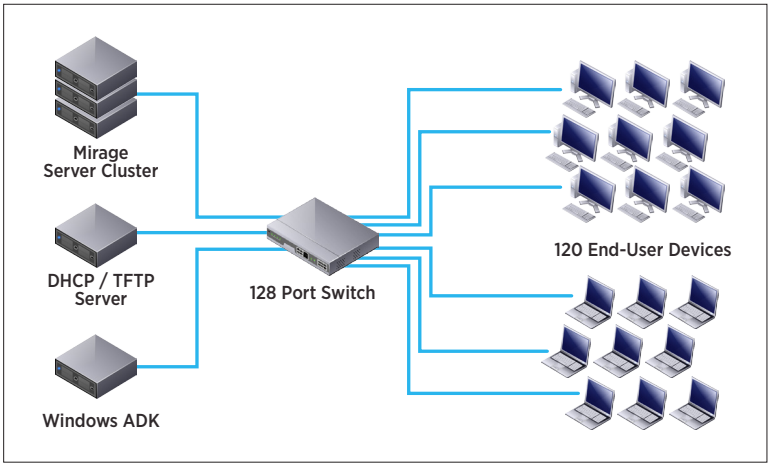

Figure 2: VMware Mirage Deployment Network

Mirage 5.0 was the latest version at the time of the implementation. Mirage 5.0 had no bare metal capability, so a custom solution was deployed, consisting of a Mirage client in a dedicated deployment environment, along with Dynamic Host Configuration Protocol (DHCP), Trivial File Transfer Protocol (TFTP), and Windows Assessment and Deployment Kit (ADK) services.

A Windows-based, free TFTP server was deployed. A DHCP server was configured with the following options:

• 066 Boot server host name – Hostname / IP address of the Windows Deployment Services server

• 067 Boot file name

Windows ADK was downloaded from Microsoft to enable building a Windows PE boot image. The Windows PE version must match the characteristics of the processor—32-bit or 64-bit. Windows PE contains a Mirage client to connect directly to a Mirage cluster and download base layers and application layers as needed.

Each day the process involved the following steps:

1. 120 endpoints plugged in to the lab network switch
2. Each endpoint booted into the Preboot Execution Environment (PXE)
3. Downloading the Windows PE image and Mirage client
4. Connecting to the Mirage server to download and install the base and application layers

In just over 16 working days, all 2,000 machines were successfully built and handed out to the central office users.

Mirage version 5.3 provides bare metal deployment instructions in the administrator's guide.

Scenario 2: OS Migration of 8,000 Widely Distributed Machines

Migrating 8,000 machines distributed across 500,000 km^2 from Windows XP to Windows 7 without impacting the WAN is a challenging paradigm. Solutions available on the market, such as SCCM, allow for distribution and remote servers but have high administrative overhead in setup and lifecycle management.

In contrast, the Mirage branch reflectors are easy to set up, in less than 5 minutes. Branch reflectors do not need specialized hardware. In fact, this project used standard PCs and laptops, making it easy to transport branch reflectors to the various locations. To ensure that the WAN was not impacted, all branch reflectors were warmed up by transferring the base and application layers before transporting to the remote offices.

When at the remote office, the branch reflector can use peering services to distribute base layers and application layers to all adjacent end-user devices. Each branch reflector can serve 30–40 concurrent endpoints. More branch reflectors can be added to each site for further scaling. In addition to reducing WAN traffic by acting as a proxy, the branch reflectors can also reduce network outages during the OS migration.

When given the green light, each end-user device was configured with the Mirage client and pre-cached with the new OS. This work is done in the background without disrupting the user. After the endpoint is ready, a reboot initiates the *pivot*—the key feature of the Mirage solution—by swapping out all Windows XP files for Windows 7 without impacting any application or user data, unlike traditional, block-based end-user device management solutions.

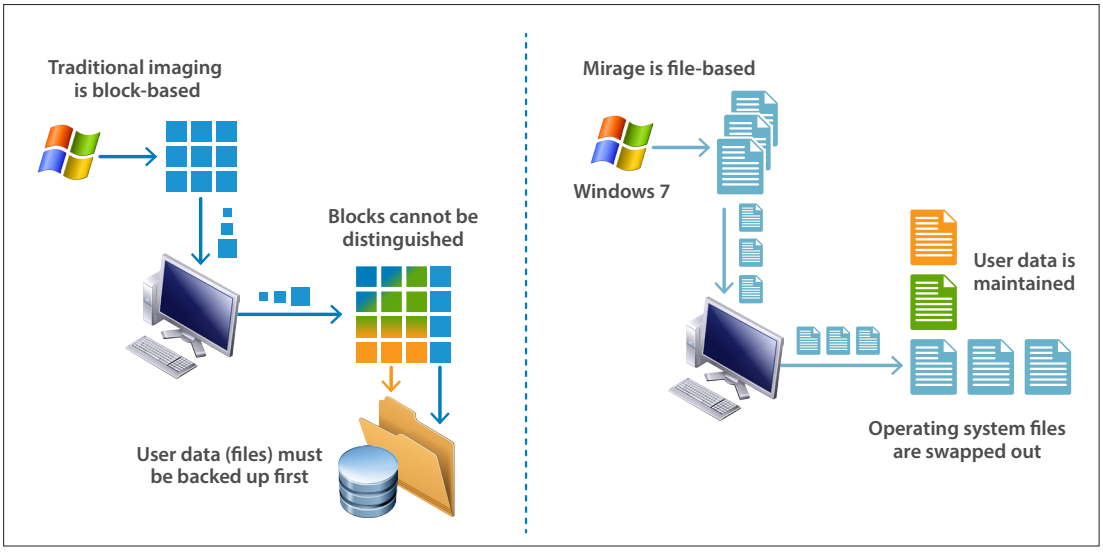

Figure 3: Traditional Migration Method vs. Mirage

The amount of time, effort, and storage capacity cost saved by not having to back up user data beforehand has not been validated, but it is not difficult to comprehend the overall savings with the fact that each user was upgraded to a new supported operating system with zero data loss in less than 2 hours.

Validated performance characteristics are presented in the VMware Mirage Large-Scale Reference Architecture guide.

Scenario 3: Reducing Operational Expenditures

Base images were traditionally required to be unique to each hardware profile, and in many cases, each release date of the same hardware profile, thereby creating a proliferation of images that required lifecycle management. In contrast, Mirage can consolidate all this information into one base image.

The public-sector organization has a variety of 12 different HP desktops and laptops of different generations and release dates. Mirage uses one image for all HP devices by separating the different drivers into discrete driver libraries that can be independently managed. Drivers can be updated, modified, and grouped into a driver profile based on a hardware device model. As the image is deployed, along with the drivers, the Windows Plug and Play mechanism determines the optimum driver for the hardware specification.

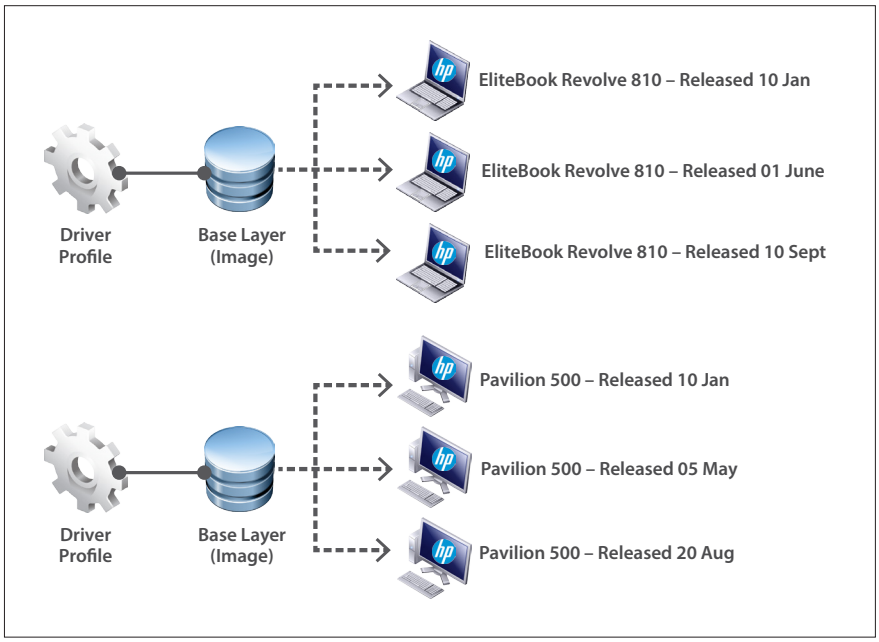

Figure 4: Mirage Driver Profile

For more information on configuring the driver library, see the VMware Mirage Administrator's Guide.

Specific applications for departmental usage or required applications for hardware profiles, such as laptops, are placed in application layers. An application layer can contain one or many applications and be deployed individually or in a combination.

Conclusion

To summarize, this project

- Delivered 2,000 new machines to users with obsolete hardware within 4 weeks
- Migrated all machines off Windows XP within the allocated time, avoiding additional support costs of $2 million
- Executed migrations with minimal disruption to users because updates were cached on each individual machine and updated only when initiated by the user
- Rolled out new OS with zero impact on the WAN and minimal consumption of the corporate network
- Eliminated the need for extra transportation or setup at the remote sites by using Mirage branch reflectors
- Dramatically reduced travel for IT support staff by centralizing endpoint management

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References

VMware Mirage Large-Scale Reference Architecture

VMware Horizon Mirage Branch Office Reference Architecture

VMware Mirage Installation Guide

VMware Mirage Administrator's Guide

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Appendix A: Reference Architecture Detail

The following table lists the server specifications of the Mirage deployment.

COMPONENT	DESCRIPTION
Mirage Management server	• 8 vCPUs • 16 GB of RAM • 40 GB of hard disk • Mirage 5.0 • Windows Server 2008 R2 SP1
Mirage server cluster nodes	• 8 vCPUs • 16 GB of RAM • 40 GB of hard disk for OS • 8 TB for local cache • Mirage 5.0 • Windows Server 2008 R2 SP1
SQL Server	• Dual vCPUs • 8 GB of RAM • 40 GB of hard disk for OS • Windows Server 2008 R2 SP1 • MS SQL Server 2008 R2 – Enterprise Edition
Branch reflectors	• 2 vCPUs • 4 GB of RAM • 40 GB of hard disk for OS • 103 GB for local cache • Mirage 5.0 • Windows Server 2008 R2 SP1

Table 1: Mirage Deployment Specifications

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