



VMware Helps Lockheed Martin Space Operations Provide Low-Cost, Efficient Support to NASA

VMware Workstation and VMware GSX Server Assist Lockheed in Lowering Costs, Maintaining Security

KEY SUCCESSES

- Cut storefront start-up hardware costs in half
- Maximized hardware utilization
- Enabled set-up of complex three-tier security system on a single desktop
- Establish three different configurations per machine
- Enabled developers to work remotely and securely

Lockheed Martin Commits to Contain Costs for NASA Contract

When Lockheed Martin Space Operations was awarded NASA's \$3 billion+ Consolidated Space Operations Contract (CSOC), the contractor took on the responsibility of providing end-to-end space operations support for NASA missions, including the Space Shuttle and International Space Station mission operations and planning systems design, development, and integration. CSOC-sponsored "storefronts" are a key component in meeting these obligations in a cost-effective manner. The storefront program involves setting up a facility on or near selected university campuses, where students are hired to perform software engineering and other related work under the supervision of CSOC.

The first of these storefronts, located at Prairie View A&M University (PVAMU) in Prairie View, Texas, opened on September 6, 2001. The Prairie View storefront provides support to the maintenance of approximately 6.5 million lines of code currently being sustained for Johnson Space Center by the CSOC Software Engineering organization in Houston.

Security Requirements Complicate the Picture

"When Lockheed Martin was awarded this contract, our primary goal was to minimize costs while providing premier space operations support," said Bill Smith, Project Engineer at CSOC. "In doing so, we of course had to maintain NASA's high security standards, which required a setup to handle unclassified sensitive and unclassified activities. VMware products allowed us to do this and assisted us in getting the storefront up and running rapidly and in a cost-effective manner." Using VMware™ Workstation, CSOC is able to run three configuration types on each workstation in the storefront facility, resulting in:

- **Significant cost savings.** Smith estimates that, without VMware, the cost of the user workstation equipment for the storefront would probably have been double what it was, simply because the architecture would have required twice the number of workstations and network infrastructure components.
- **Worry-free management of security requirements.** The storefront's security requirements are easily handled with the isolation provided by virtual machines. Each workstation runs three virtual machines simultaneously, and each virtual machine is configured with a different operating system and security setup.
- **Rapid start-up.** With VMware products, the storefront team was able to get the facility up and running rapidly and efficiently – within a couple of months

"VMware offered an effective solution to minimize hardware and infrastructure costs: not only could we buy fewer machines, we could also minimize physical network connections while managing our complicated security requirements."

*Nancy Patterson
Engineering Director, CSOC Johnson Space Center*



VMWARE WORKSTATION 3.0 AND VMWARE GSX SERVER AT WORK

- 16 Intel-architecture workstations
- 2 Intel-architecture servers
- Red Hat Linux 7.2
- Microsoft® Windows® NT® 4.0;
Red Hat Linux 7.2
- Web Browser, e-mail, VPN Interface,
proprietary mission control and
planning software
- Fast Ethernet; VPN

VMware Software Minimizes Equipment Costs, Maximize Security

"We needed to run some applications on Windows NT 4.0, and some on Linux; some communications would use a T-1 line; some would require a VPN layered on top of that," said Smith. "VMware offered the technology necessary for us to run these applications while maintaining the highest security level."

The sixteen PCs and two servers at the PVAMU storefront are connected to CSOC's Houston Operations via a T-1 line. Each PC is configured with Red Hat Linux 7.1 as the host operating system, and runs three guest operating system environments simultaneously in virtual machines, with the help of VMware Workstation:

1. The Microsoft Windows NT 4.0 guest operating system gives storefront workers access to CSOC Online at the "business and restricted technology security level," which is used for e-mail, office applications, and Internet access.
2. One Red Hat Linux 7.2 guest operating system provides a secure connection, via a Virtual Private Network (VPN), to the Houston R&D facility. Workers use this virtual machine to do evaluations of commercial off-the-shelf products and train on the operational software.
3. A second Red Hat Linux 7.2 guest operating system runs at the highest security level so employees can access the mission control and planning software to do maintenance, updates, and fixes. In this configuration, cut and paste between sessions is disabled, preventing migration of data or information without the use of secure procedures.

In addition, one of the servers in the storefront uses VMware GSX Server™ to maintain user rights configuration and tools configurations. The server provides read-write capabilities for each virtual session separately on the server. In the unlikely event that the T-1 communications link fails, the users still have access at the local PVAMU StoreFront network to save work and files. The server has a backup and restoration capability to ensure no work is lost.

Lockheed Martin's use of VMware Workstation and VMware GSX Server software is another example of VMware's ability to help companies optimize resources and complete projects quickly.

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