Novell® Open Enterprise Server 2: Deploying Virtualized NetWare® on Linux®
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Taking Advantage of NetWare® Virtualization

By virtualizing NetWare on Linux, you can take advantage of an open, contemporary platform for mission-critical computing without losing essential NetWare functionality and skill sets. Virtual machine technology has been available for many years. It appeared first on mainframe systems, and then gradually made its way onto personal computers. Today, virtualization has transitioned into mainstream operating systems such as Linux® and Windows® and has made significant inroads into the data center.

Over the past year, enterprise IT managers have become increasingly excited about SUSE® Linux Enterprise Server 10 from Novell, and the many benefits provided by its included Xen® virtualization technology. Among these benefits are server consolidation, workload isolation and disaster recovery through dynamic server migration—all of which are motivating more organizations to migrate to Linux. Many such enterprises, especially those that want a gradual migration, are choosing Novell Open Enterprise Server 2. It’s a Novell solution that includes SUSE Linux Enterprise Server 10, inherits its virtualization capabilities, and for the first time makes virtualization natively available for NetWare on Linux.

Why is this feature so important? There are many reasons. By virtualizing NetWare on Linux, you can take advantage of an open, contemporary platform for mission-critical computing without losing essential NetWare applications and skill sets. If you want to migrate to Linux gradually, you can leverage your existing applications throughout the process. And, you can continue running NetWare while consolidating systems or taking advantage of the most up-to-date and innovative hardware available. Novell Open Enterprise Server 2 makes NetWare virtualization on Linux feasible and profitable while simplifying the process of wide-scale Linux migration.

Virtualization Basics

Xen Technology

With Novell Open Enterprise Server 2, you have the choice to deploy NetWare 6.5 SP7 on a physical machine or in a virtual machine using the Xen 3.0 technology included with SUSE Linux Enterprise Server 10. The Xen software layer is developed and maintained by the Xen open source community.

Like most virtual machine technologies, Xen 3.0 consists of a host (also known as DOMAIN 0) and multiple guests (also known as DOMAIN Us). The host is responsible for partitioning a physical server and, as guest virtual machines start and boot their operating systems, it assigns physical resources to each guest.

Some resources, such as memory, are dedicated to the guest and cannot be shared among guest operating systems. Other resources, such as network cards, can be either shared among guest operating systems or dedicated to a specific guest.

Paravirtualization

Xen 3.0 has an advantage over many competing virtualization technologies because it includes a hypervisor, also known as a virtual machine monitor, as part of the core virtualization layer. The hypervisor allows specially modified guest operating systems to interact more efficiently with the physical server. This is known as paravirtualization.

While the host controls memory resources and which physical or virtual devices the virtual machines can access, the hypervisor allocates and schedules the central processing unit (CPU) resources during runtime for...
the different virtualized guest operating systems. It also enforces the proper level of protection between virtual machines. The hypervisor presents the guest operating systems with virtual machines that perform very much like the guest servers’ native architectures. With the hypervisor, then, a para-virtualized operating system can leverage virtualized drivers rather than physical drivers.

A fully virtualized operating system has to “trap” information from the executing instruction stream; however, a paravirtualized operating system does not require information trapping and provides performance gains as a result. In addition, with paravirtualization, the virtualized platform is not required to emulate the actual hardware platform. This leads to additional efficiencies in circumstances such as accessing page tables that control memory. Non-modified guest operating systems that operate in full virtualization mode do not deliver these benefits.

**Enhanced for Virtualization**

The NetWare 6.5 operating system in Novell Open Enterprise Server 2 has been enhanced to recognize when it is running in a virtualized environment, allowing it to run as a paravirtualized guest operating system inside a virtual machine. As a result, virtualized NetWare users can enjoy all of the performance and efficiency benefits that paravirtualization provides.

Virtualized NetWare also lets you take advantage of the latest advances in hardware technologies. Some users have struggled to find NetWare driver support on certain new technologies, but since NetWare can run as a paravirtualized guest operating system (OS) that loads virtual drivers, physical driver support is no longer an issue. Instead, the host OS dictates the physical driver requirements. Because the host OS is Linux, which has comprehensive and constantly growing driver support, paravirtualized NetWare automatically inherits that entire driver base.

Even though NetWare virtual machines can automatically load virtual drivers, administrators still have the option to load physical drivers. Utilizing physical drivers lets a virtual machine interact directly with the physical hardware. One reason you might consider loading a physical driver is that your system could gain a small amount of extra performance from the physical server’s network card. However, a more likely reason to load a physical driver would be to allow direct interaction with a tape backup device to reduce input/output (I/O) overhead. Regardless of the reason for using physical drivers, administrators should be aware that utilizing physical drivers can impact some virtualization operations, such as migrating a virtual machine from one physical server to another.
NetWare has been enhanced to recognize that it is running as a virtual server, but it is still the same NetWare that your organization has known and trusted for years—it’s simply operating in a new environment that presents advanced opportunities and capabilities.

Figure 1. Virtualized NetWare utilizes virtual drivers, eliminating the need for physical drivers.

The Same NetWare, New Opportunities

NetWare has been enhanced to recognize that it is running as a virtual server, but it is still the same NetWare that your organization has known and trusted for years—it’s simply operating in a new environment that presents advanced opportunities and capabilities. In fact, paravirtualized NetWare utilizes the same binary code that runs on bare metal machines with just a few exceptions.

1. **Loader file**—Physical NetWare utilizes either DOS or NWLOADER.SYS, while virtualized NetWare uses XNLOADER.SYS to alert the server that it’s running in a virtual environment.

2. **Pre-loaded drivers**—In a virtual NetWare environment, you will typically load virtual drivers that interact with Xen rather than discrete drivers that interact with actual physical components. These virtual drivers are primarily contained in the files XENBLK.HAM, XENNET.CAD and XENMPP.SPM.

According to Novell engineering, more than 95 percent of the NetWare loadable modules (NLMs) in NetWare required no changes to run on a NetWare virtual machine. When changes were needed, it was typically because the NLMs contained privileged or sensitive CPU instructions, accessed hardware directly or expected to run at ring zero. This was the case with the SERVER.EXE file, which required the most changes. This means that you shouldn’t have problems running your third-party NLMs unless they fall into one of these categories. Novell is also working closely with backup and antivirus vendors to ensure that their NLMs will run without problems in a virtual environment.

From a management standpoint, your administrators can manage NetWare in a virtual machine just as they would manage NetWare on a physical machine. Traditional tools such as Novell ConsoleOne®, Novell iManager and Novell Remote Manager (NRM) are still effective, but Novell Open Enterprise Server 2 gives your administrators
additional management options. They can now take advantage of Linux management utilities and console commands because the virtual machine is running in a Linux environment.

**Getting the Most Out of Hardware**

One of the major benefits of running NetWare as a virtual machine in Novell Open Enterprise Server 2 is that it allows you to fully utilize your existing hardware investments. Unlike some virtualization solutions, virtual NetWare doesn’t have to be deployed on servers with chipsets specifically enabled for virtualization. In fact, organizations with current NetWare servers and low CPU utilization might be able to host multiple NetWare virtual machines on an existing server to leverage the benefits of server consolidation.

By running NetWare as a virtual machine, you can also choose to integrate high-performing hardware into your environment. This further enhances your ability to consolidate servers and to take greater advantage of 64-bit processors. When NetWare servers run as virtual machines in Novell Open Enterprise Server 2, they are no longer bound by 32-bit constraints. They can take full advantage of the extra processing power, added memory capabilities and improved heat and energy savings offered by 64-bit dual-core and multi-core processors.

In addition to allowing you to preserve your NetWare services on today’s high-end hardware platforms, server consolidation is one of the main reasons for employing virtualized NetWare. For example, with NetWare virtual machines in a Novell Open Enterprise Server environment, you might consolidate three or more physical NetWare servers into guest virtual machines that run on a single physical box. Additionally, Linux virtual machines can be hosted on that same hardware.

![Before and after server consolidation](image)

**Figure 2.** Before and after server consolidation.

Hosting both Linux and NetWare as virtual machines on a single box can facilitate migration efforts. Specifically, you can preserve applications and services dependent on NetWare while transitioning your IT environment and skill sets to Linux. To help with these consolidation efforts, you can leverage the included Novell Open Enterprise Server Migration Tools. Additional migration resources are available online at: [www.novell.com/oesmigrate](http://www.novell.com/oesmigrate)
Deployment Considerations
Before implementing any changes to an IT infrastructure, research is very important. When considering virtualization, you should carefully analyze your options and identify the servers and workloads that represent the best candidates for a virtual environment.

When to Virtualize
In environments where any of the following conditions exist, it makes sense to begin considering a virtualization strategy:

- Space is at a premium in the data center and more servers need to be deployed.
- Overall power and cooling costs for the data center are running very high and need to be reduced.
- A number of servers are reaching the end of their lives and need to be moved to a data center.
- Rolling out a new server operating system will take a long time from test to production.
- Server maintenance costs are high and need to be reduced.
- Pre-deployment test cycles are needed.

In terms of power, space and cooling, virtualization can save a data center significant amounts of money. For example, a business might have eight physical servers deployed in its data center, with four servers acting as a primary service and four servers acting as a backup. In this scenario, the four backup servers could easily be moved to a virtualized environment on a single physical server.

When Not to Virtualize
When laying out a virtualization strategy, an often-overlooked question is “what should not be virtualized?” Because of unpredictable utilization patterns, including servers that run at or near maximum capacity, the following scenarios might not be the best candidates for moving to a virtual machine environment:

- A new generation multi-core server is being installed to increase the performance of a database.
- Current megabit switches are no longer fast enough to handle the network traffic to a server.
- More storage needs to be purchased as a result of a new application generating files that are hundreds of megabytes in size.

While servers in these scenarios can be virtualized, the inherent differences in performance or scalability between the physical and virtual world might mean that you should look elsewhere for viable virtualization candidates.

Workload Analysis
If you are hosting multiple virtual machines on the same physical server, you need to pay attention to their workload types. A physical server that is overloaded with multiple virtual machines with the same type of workload could run out of CPU power, memory or I/O bandwidth. For example, if all of the virtual machines perform disk-intensive operations, they could use the entire bandwidth of the server’s disk array.

To determine a good candidate for virtualization, it is important to analyze the actual workload of the server itself. To determine this workload, the following factors must be observed:

- Average CPU utilization as a percentage of available CPU resources
- Maximum CPU utilization, including peak duration
- Average network utilization as a percentage of available bandwidth
- Maximum network utilization, including peak duration
- Average memory utilization as a percentage of available memory
- Peak memory utilization, including peak duration
Disk channel utilization, as a composite of points

Note: Disk channel utilization should be a composite of data points that include the number of reads and writes performed, overall data throughput and numbers of files read and written to the disk.

Ideally, a workload analysis would be performed over a period of several days or weeks, with the data averaged over that period. When averaging the data, pay attention not only to the data points collected, but also to the times of day during which data was collected.

During data analysis, you should ensure that the statistics for each server are kept separate. If results are blended, it is very difficult to determine which of the servers actually make good candidates.

Choosing the Right Workload

By the time a workload analysis is finished, you will have a solid set of data to work with and a greater understanding of what your servers are doing and when. Still, you will need to be able to make sense of that information before you can start virtualizing workloads.

The easiest way to start this process is by excluding servers that show high utilization in one or more of the observed subsystems. A server that consistently shows high CPU utilization or frequent peaks should be discounted, especially if these peaks fall during normal working hours. Servers with peaks that coincide with backup and antivirus activities or other types of housekeeping might still be considered for virtualization.

A server that averages between 2- and 7-percent CPU utilization with an occasional peak could work well in a virtual machine environment. Of course, if the plan is to migrate from an older system with a single core CPU ranging between 1.8 and 2.0 GHz to a newer dual- or multi-core system running at 2.2 GHz or higher, the CPU percentages will be somewhat skewed. The new system will likely be able to handle several virtual machines with low utilization workloads.

In addition to evaluating CPU utilization, you should check the network bandwidth and how it is being used. Virtualization plans that require all of a server’s virtual machines to use a single network card will result in an overall decrease in available bandwidth for each of the virtual machines. Similarly, a server that handles a fairly high load on its network card might be best left as a physical server.

One aspect of virtualization that is often overlooked is the amount of memory required. Simply because a server has moved to a virtual machine doesn’t mean that it needs less memory.

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convenient to configure and maintain when hosting multiple virtual machines. Virtual disk files are the most convenient; however, they will generally be slower. Network attached storage provides the most flexibility.

Any disks attached over an Internet small computer system interface (iSCSI) or via a remote mount point will work in a virtual environment exactly as they do in a physical environment. Still, pay particular attention to utilizing the network interface card. If it has a very busy iSCSI connection, it would be wise to consider optimizing the virtual machine to handle the heavy traffic.

Note: Using a local disk on the physical server for a virtual machine’s storage prevents on-the-fly migration of the virtual machine from one physical server to another.

Scalability Considerations

Although some workloads do not lend themselves to virtualization, buying the right server configuration and tuning a virtual machine can pay dividends.

One of the simplest things you can do to ensure good performance is to buy servers with high-performing CPUs.

Installing Virtualized NetWare

The SUSE Linux Enterprise Server 10 SP1 host server will need to have at least 512 MB of RAM for the VM host server and 512 MB of RAM for the NetWare virtual machine. However, for better performance, you should use a server with 2 GB of RAM or more.

SUSE Linux Enterprise Server 10 SP1 will need to be installed and configured as the virtual machine host server, selecting Xen Virtual Machine Host Server from the Primary Functions software selection category. To optimize the host server to manage the virtual machines, it should be configured without any Open Enterprise Server services. These should be installed on an Open Enterprise Server virtual guest OS or a physical NetWare installation.

To avoid running additional services on a host server, the Print Server from the Primary Functions category should be deselected. Furthermore, Novell eDirectory™ should not be running on the host server.

After the host server installation and configuration finishes and the system reboots, perform the following steps to finalize the host server configuration:

1. Log in as root and change the default boot loader to the Xen kernel.
2. Reboot the system.
3. Configure the network time protocol (NTP) on the host server.
4. Disable the Alt-Escape desktop shortcut if using GNOME.*

After the host server is running, a virtual machine for NetWare can be created using one of three installation methods—each with an icon in YaST.
Virtual Machine Manager

The “Virtual Machine Manager” option launches a program called virt-manager. To create a NetWare virtual machine using virt-manager, click Virtual Machine Manager in YaST and select New. This will launch a program called vm-install that will guide administrators through the creation of a NetWare virtual machine. Virt-manager provides a console that is VM-specific and doesn’t allow most keyboard commands to be intercepted by the Linux desktop. In other words, most of the keyboard commands familiar to NetWare administrators will work as they always have.

Create Virtual Machines

The second option in YaST is “Create Virtual Machines,” which launches the vm-install program directly. One advantage of using the Create Virtual Machines option directly is that it allows administrators to run vm-install in either pure text or graphical user interface (GUI) mode, while virt-manager requires a GUI. However, launching vm-install with this icon bypasses virt-manager and will not result in NetWare keyboard control. This is the reason for the instruction to disable certain shortcuts in the GNOME desktop.

Figure 3. Create Virtual Machines is one of three installation methods in YaST for creating a NetWare virtual machine.
**Response File Utility**

The last installation option, which simplifies the creation of multiple NetWare virtual machines by enabling unattended installations, is the "Response File Utility." A response file is created in YaST by completing the following steps:

1. Select Open Enterprise Server from the menu and then select the *NetWare Response File Utility.* (This utility is installed automatically on every Novell Open Enterprise Server 2 Linux server.)

2. On the *Select Install Type* page, set the hardware type to *Virtual.*

3. Select the type of server installation you are creating the response file for: new server install, server upgrade or two-part factory installation.

4. The Response File Generator will ask for information about the NetWare server that will be created as a virtual machine. The questions should be answered the same way they would be if a physical NetWare installation were being performed. If a response file for NetWare 6.5 is already available, this can also be used to generate a virtual NetWare server.

If a response file is used, the install can be initiated by:

1. Selecting *Virtual Machine Manager* in YaST.
2. Selecting *Find* from the *Operating System Installation* menu option.
3. Browsing to the location of the response file.

After it is opened and applied, YaST will proceed with the creation of the virtual machine and the installation of the virtual NetWare server. If a required parameter is missing in the response file, the administrator will be prompted to enter the desired values during the installation. If a response file is not specified, all of the installation information will need to be entered just as if a physical NetWare installation were being performed.

For complete details on installing NetWare virtual machines, refer to the online documentation for Novell Open Enterprise Server 2 at: [www.novell.com/documentation/oes2](http://www.novell.com/documentation/oes2)
After you create the virtual machines, you can manage them using the Virtual Machine Manager utility, which allows operations such as Add, View, Start, Shut Down and Terminate Virtual Machines. Virtual machines can also be managed from a terminal using xm commands.

**Strategic Deployment, Greater Savings**

Running NetWare as a virtual machine in a Novell Open Enterprise Server 2 environment provides you with a variety of benefits. You can preserve NetWare services and skill sets; leverage the latest hardware technologies; facilitate migration to Linux; and consolidate servers for power, cooling and space savings. With a detailed deployment strategy, you can fully optimize and leverage your virtual NetWare environment, using it to reduce costs and complexity across the enterprise.
Running NetWare as a virtual machine in a Novell Open Enterprise Server 2 environment provides you with a variety of benefits, including the ability to preserve NetWare services and skill sets; leverage the latest hardware technologies; facilitate migration to Linux; and consolidate servers for power, cooling and space savings.