



# PowerVM Lx86 for x86 Linux Applications Administration Guide





# PowerVM Lx86 for x86 Linux Applications Administration Guide

**Note**

Before using this information and the product it supports, read the information in “Notices” on page 141.

**Fourth Edition (April 2009)**

This edition applies to the version 1.3.1.0 of IBM PowerVM Lx86 for x86 Linux Applications and to all subsequent releases and modifications until otherwise indicated in new editions.

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## About this publication

This guide explains how to install and configure the PowerVM Lx86 for x86 Linux<sup>®</sup> Applications (PowerVM Lx86) product on a Linux on POWER<sup>®</sup> system.

For information about the accessibility features of this product, see “Accessibility features” on page 139.

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## Typographical conventions

The following typographical highlighting conventions are used in this book:

Font	Usage
<b>Bold</b>	Identifies commands and graphical objects such as buttons, labels, and icons that you select.
<i>Italics</i>	Identifies parameters whose actual names or values you are to supply.
Monospace	Identifies examples of text similar to what you might see displayed, examples of portions of program code similar to what you might enter, messages from the system, or information you should literally type.
%	Identifies information you should type on the command line of a Power shell.
\$	Identifies information you should type on the command line of a translated x86 shell.



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## Part 1. Introduction to PowerVM Lx86

This guide explains how to install and configure the PowerVM Lx86 for x86 Linux Applications (PowerVM Lx86) product on a Linux on POWER system.

The guide has the following parts:

- **Introduction to PowerVM Lx86.** Gives an overview of the product, the new features in the product and includes explanations of some of the terms and concepts unique to PowerVM Lx86.
- **Installing and uninstalling PowerVM Lx86.** Explains how to install PowerVM Lx86, the system requirements needed to run the product, and how to obtain additional installation media. A detailed installation reference is also provided as well as details of how to uninstall the product.
- **Running and installing x86 applications.** Overviews and examples show you how to use PowerVM Lx86 to install and run your Linux on x86 applications on Linux on POWER.
- **Configuring x86 World and PowerVM Lx86.** Explains how to upgrade PowerVM Lx86, configure the product for your specific needs and how to install and update the packages in the x86 World. Details of how to start x86 daemons and how to use SE Linux are also provided.
- **Advanced PowerVM Lx86 installation features.** Explains how to use the more advanced archiving and automated installation features of PowerVM Lx86.
- **Managing remote and local users with PowerVM Lx86.** Explains how the system deals with two definitions of local users, groups, and passwords on the system because the x86 World and the POWER system both have their own set of own set of local password files and also how to configure the x86 World to use remote users with NIS, LDAP and other remote user mechanisms.
- **PowerVM Lx86 error messages and resolutions.** Shows errors that can be reported on the terminal by the components of PowerVM Lx86 and details of how to resolve each problem.

At the end of the guide there are also appendices detailing known issues with PowerVM Lx86, a description of the translation process used by PowerVM Lx86 and a glossary of terms. This document should be used in conjunction with the PowerVM Lx86 Release Notes, which provide additional information specific to a particular release. This includes known limitations and any additional installation instructions.



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## Chapter 1. New features in PowerVM Lx86 1.3

The 1.3 release of PowerVM Lx86 adds major new features and a range of improvements to the existing product.

The 1.3 release adds the following major new features to PowerVM Lx86:

- Enhanced installer that supports archiving x86 Worlds, automating the install process and IBM Installation Toolkit for Linux on Power integration.
- SE Linux support on RHEL 4.

The 1.3 release has the following improvements to PowerVM Lx86:

- General performance enhancements.
- General bug fixes.
- gdb improvements.
- Support for SLES 10 SP2 and RHEL 4.7.
- The ability to run PowerVM Lx86 in a more accurate x87 80-bit floating-point mode.
- Improved usability of runx86, particularly improving the handling of the current working directory.
- man pages for runx86, linkx86 and powervm-lx86-world-sync scripts.
- An updated Administration Guide, including details of the new features in this release.

The 1.3.1 update release has the following improvements to PowerVM Lx86:

- Support for SLES 11 and RHEL 5.3.
- SE Linux support on RHEL 5.3. See Chapter 17, “SE Linux support with PowerVM Lx86,” on page 73.
- Ability to restrict the virtual memory usage of Lx86. See Chapter 14, “PowerVM Lx86 configuration settings,” on page 59.
- Administration Guide updates for SLES 11 and RHEL 5.3.
- Additional bug fixes.

The 1.3.1 update release removes the following features from PowerVM Lx86:

- Support for SLES 9 SP3 and SP4. Customers wanting to use SLES 9 will need to use PowerVM Lx86 version 1.3 or earlier.



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## Chapter 2. PowerVM Lx86 overview

PowerVM Lx86 enables POWER machines to run Linux x86 applications alongside native Linux on POWER applications.

The Linux x86 applications run on Novell or Red Hat Linux x86 distributions within a Virtual x86 Environment (VxE). No modification or recompilation of the x86 Linux applications are needed. The x86 operating system and applications only need to be installed on or copied to a Linux on POWER machine that has PowerVM Lx86 installed on it.

Installing PowerVM Lx86 on a POWER system makes the system compatible with x86 applications. This extends the application support for Linux on POWER, allowing applications that are available on x86 but not on POWER to be run on the system.

### How it works

PowerVM Lx86 creates a VxE within which x86 applications can run. The VxE is created solely within user-space; no modifications to the POWER kernel are required. PowerVM Lx86 does not run the x86 kernel on the POWER machine. Instead, it dynamically translates and maps all requests made from within the VxE to the underlying Linux operating system and POWER processor. The VxE is not a virtual machine; rather, x86 applications are encapsulated so the operating environment appears to be Linux on x86, even though the underlying system is Linux on POWER.

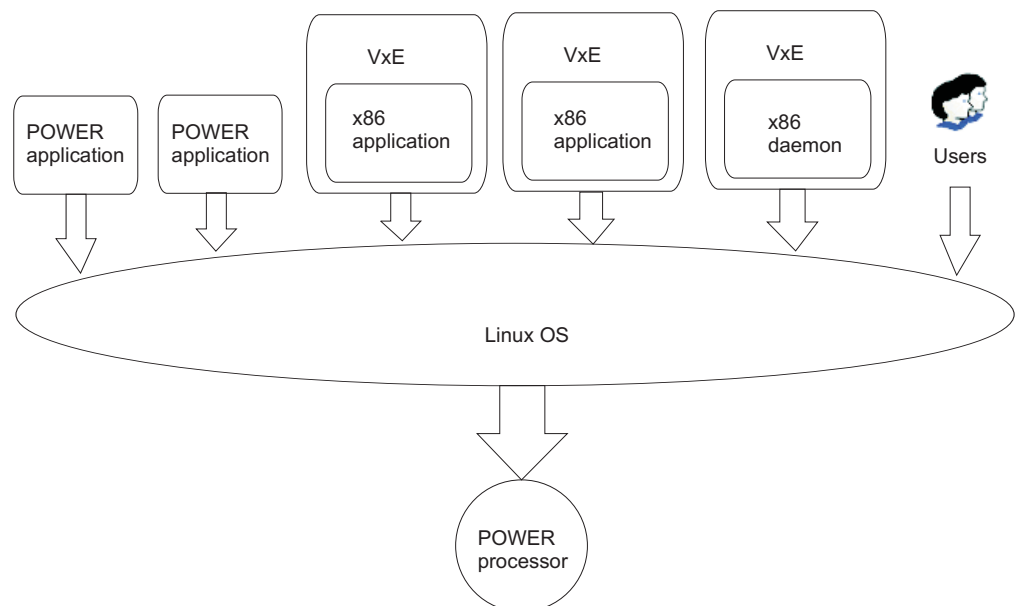


Figure 1. How it works

See “PowerVM Lx86 translation process” on page 137 in this guide for a detailed description about how requests made from within a VxE are dynamically translated and mapped to the underlying Linux operating system and POWER processor.

## **PowerVM Lx86 does not affect Linux on POWER applications**

An x86 application running within a VxE appears to be just another user-space POWER process. It has no direct effect on any POWER applications that run natively on the host system.

### **As an end user**

If you want to run x86 applications, you can log on to the POWER system and run the x86 applications within a VxE using PowerVM Lx86. See the Chapter 9, “Running x86 applications,” on page 37 section in this guide.

### **PowerVM Lx86 installation**

IBM® supplies a semi-automated installation script and RPM packages.

See Part 2, “Installing and uninstalling PowerVM Lx86,” on page 11 in this guide for full installation instructions.

### **Installation of x86 applications**

You can install x86 applications using their original installation scripts from within a VxE. Alternatively, you can copy x86 applications onto the POWER machine. See the “Installing x86 applications” on page 46 section in this guide for details.



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## Chapter 3. PowerVM Lx86 concepts

PowerVM Lx86 concepts include the VxE, the x86 World, jailing, and escapes.

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### VxE for PowerVM Lx86

PowerVM Lx86 creates a VxE within which x86 applications can run.

The PowerVM Lx86 software creates a VxE using the following:

- A set of x86 Linux libraries, commands, applications, and other system files that are installed in a directory, known as x86 World, on the POWER system.
- A program, known as the translator, that handles the mapping of instructions and requests from the VxE onto the underlying POWER system.
- Selective integration between the VxE and the POWER environment. For example, a subset of the Linux on POWER file system can be made visible to applications from within the VxE.

Use the **runx86** command to run x86 binaries. For example, to run the x86 binary `myx86Binary` within a VxE, you enter the following command from a native POWER shell on the host system:

```
% runx86 ./myx86Binary
```

In this example, when `myx86Binary` finishes executing, the **runx86** command also exits, and the VxE no longer exists.

If you enter the **runx86** command without providing an argument, then **runx86** starts an x86 shell within a new VxE. You then interact with the x86 shell as though you are on an x86 machine. Any commands entered from the x86 shell are then automatically run within a VxE.

Following is an example using the **runx86** command:

```
% uname -srmpi
Linux 2.6.9 ppc64 ppc64 ppc64
% runx86
$ uname -srmpi
Linux 2.6.9 i686 i686 i386
$ exit
%
```

After you finish working with the x86 shell, use the **exit** command as if you were using a native x86 shell on an x86 machine. After you exit, the VxE that ran the x86 shell no longer exists, and you return to the POWER shell.

#### Notes:

- It is not possible to run an x86 binary directly from a native POWER shell. To ensure that the x86 binary is run within a VxE, the **runx86** command must always be used, either with the x86 binary as an argument, or without any arguments to start an x86 shell. From the shell you can then directly run the x86 binary.

- Not all commands can be run in a VxE. For example, you should do system administration work from a native POWER shell. However, software management of the x86 applications and environment in the x86 World should be done in the VxE.

For more information about using **runx86**, see Chapter 9, “Running x86 applications,” on page 37.

## x86 World for PowerVM Lx86

The x86 World directory contains the x86 binaries, common x86 libraries, and infrastructure files. x86 applications should also be installed in this directory. This directory is configurable and is specified during the installation process. The default location for x86 World is the `/i386` directory. The convention `X86WORLD_ROOT` is used in this document to represent the directory where the x86 files are installed.

An x86 World can be created using x86 libraries and binaries obtained from an existing x86 Linux operating system distribution.

As described previously, you run x86 binaries within a VxE with the **runx86** command. For an x86 application or shell running within a VxE, the accessible part of the file system is restricted to x86 World. This is shown in the following example. The area ringed with a dashed line is x86 World.

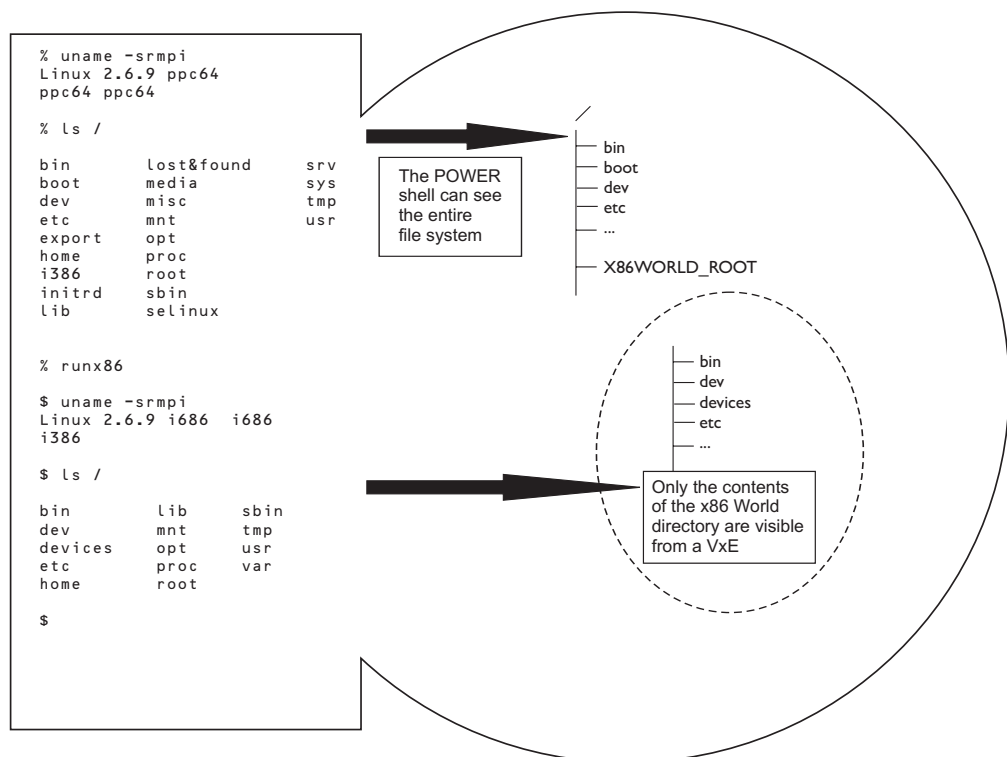


Figure 2. x86 World

In this example, when the `ls` command is issued from within the x86 shell, the x86 `/bin/ls` binary is run within a VxE, and it displays the contents of the root of the x86 World filesystem. That is `/i386` by default.

This restriction of the view of the Linux file system is called *jailing*, and is similar in concept to UNIX® **chroot**.

---

## Jailing and escapes for PowerVM Lx86

Jailing an application ensures that it accesses x86 libraries and infrastructure files, just as if the application is running natively on an x86 machine.

Any application running within a VxE sees the directory structure under *X86WORLD\_ROOT* as its root file system. The VxE replaces references to */* at the start of a file path with *X86WORLD\_ROOT*.

Following is an example of a jail:

Assume the x86 application tries to open the */lib/libc.so.6* library.

If this path is left unmodified and passed through to the POWER kernel, then the application incorrectly opens the POWER version of the C runtime library, which is incompatible with x86.

So, the path is jailed, and the jailed path is passed through to the POWER kernel as *X86WORLD\_ROOT/lib/libc.so.6*.

This causes the x86 C runtime library to be opened, and subsequently loaded, allowing the x86 application to run.

### Escapes (access to files outside of x86 World)

Sometimes it is necessary for an x86 application to access files that are located outside of x86 World. For example, the application might need to access data stored on a remote shared filesystem, or it might need to access data that is stored locally but not within x86 World. To allow access to files stored locally that are external to x86 World, a mechanism known as an *escape* is used.

An escape links a path inside x86 World with a path outside x86 World. You create escapes with the **linkx86** command supplied with PowerVM Lx86. The **linkx86** command enables PowerVM Lx86 to recognise escapes. The escape is then transparent to an x86 application running within a VxE, similarly to the way a mounted file or directory in Linux is transparent to a Linux application. Escapes persist across reboots of the host POWER system, and they are visible to all x86 applications.

**Note:** An escape is implemented as a symbolic link that follows a specific naming convention to ensure that access from the VxE functions correctly. It is not recommended to use the **ln** command directly to create escapes. This can cause x86 applications running within a VxE to fail. Due to the nature of its implementation, an escape can be safely removed from the system by deleting the link using a POWER shell.

## Example Escape

An x86 application needs access to files in /var/mail

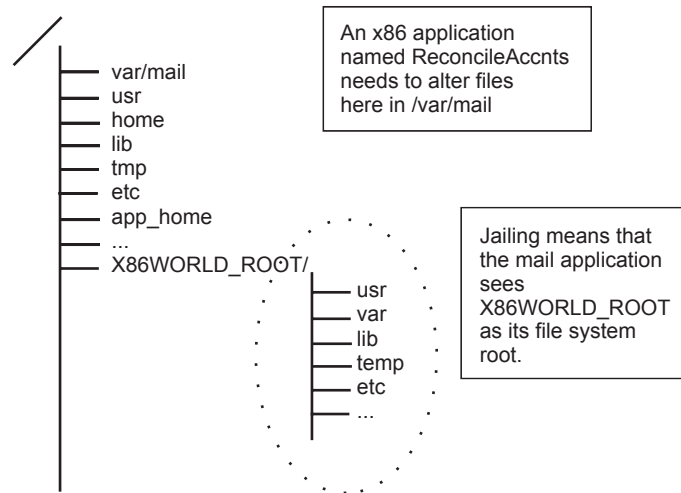


Figure 3. Example escape

You can use the **linkx86** command to create an escape to the /var/mail directory, as the following example demonstrates, starting in a POWER shell:

```
% runx86

$ ls /var
cache lib log
$ exit

% linkx86 /var/mail
% runx86

$ ls /var
cache lib log mail
$
```

The x86 application now sees the /var/mail directory. This is the file system as seen from the VxE:

```
/
var/mail
usr
X86WORLD_ROOT
home
lib
tmp
etc
apphome
...
```

If access is needed to a remote filesystem from within a VxE, then the remote filesystem can be mounted to a mount point under the x86 World root or mounted in a native POWER shell with an escape created from the x86 World. The **mount** command and the **linkx86** command should both be issued from a native POWER shell, and not from an x86 shell.

See section “Creating mountpoints or access to devices” on page 47 for details of how to create a mount point accessible to x86 World.

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## Part 2. Installing and uninstalling PowerVM Lx86

This section describes how to install and uninstall PowerVM Lx86. The scripts are for installing and uninstalling PowerVM Lx86, and can optionally install or uninstall x86 World. The `installer.pl` script installs the required PowerVM Lx86 RPM package. With the `installer.pl` script you can install an x86 World instance using an x86 distribution from CD, DVD or ISO images. The PowerVM Lx86 translator RPM package and binaries are named `powervm-lx86`.

This reference includes:

- System and installation requirements.
- Downloading Linux x86 distribution media.
- Running the PowerVM Lx86 installation script.
- Information about uninstalling PowerVM Lx86.
- Details of where the PowerVM Lx86 and x86 World files are installed on the host system.

### Release contents

A PowerVM Lx86 release can be provided on a CD or downloaded from IBM's Web site.

A typical release contains the following files:

- `powervm-lx86-1.3.0.0-1.tgz`: the product package containing the PowerVM Lx86 binaries, documentation and installer script.
- `powervm-lx86-release-notes-1.3.0.0.txt`: the latest Release Notes for the product containing amendments to the Administration Guide in text format.
- `powervm-lx86-release-notes-1.3.0.0.pdf`: the latest Release Notes for the product containing amendments to the Administration Guide in PDF format.

The PowerVM Lx86 product package has the following directory structure within the `tgz` file:

- `powervm-lx86-installer-1.3.0.0-1/installer.pl`
- `powervm-lx86-installer-1.3.0.0-1/lib/`
- `powervm-lx86-installer-1.3.0.0-1/resources/`
- `powervm-lx86-installer-1.3.0.0-1/doc/`

In summary, to install PowerVM Lx86, copy the product package, `powervm-lx86-1.3.0.0-1.tgz`, to the local machine. Extract the file and then, as root, run the `powervm-lx86-installer-1.3.0.0-1/installer.pl` script.

For a detailed installation guide, please see Chapter 6, "Running the PowerVM Lx86 installation script," on page 23.



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## Chapter 4. System and installation requirements for PowerVM Lx86

Requirements include the necessary access levels, hardware, and software requirements for the installation.

### Prerequisites

Root access when installing the PowerVM Lx86 RPM package and x86 World is necessary.

### Supported POWER operating systems summary

- Red Hat 4 AS (RHEL 4 AS) Linux Update 4, Update 5, Update 6, and Update 7
- Red Hat 5 AS (RHEL 5 AS) Linux Update 3
- Novell SUSE Linux Enterprise Server 10 (SLES 10)
- Novell SUSE Linux Enterprise Server 10 (SLES 10) Service Pack 1 and Service Pack 2
- Novell SUSE Linux Enterprise Server 11 (SLES 11)

### Supported x86 and POWER operating system combinations

The officially supported OS combinations for the 1.3.0.0 release are:

*Table 2. Officially supported OS combinations*

Power OS distribution	Supported x86 World OS distribution
RHEL 4.4	RHEL 4.3
	RHEL 4.4
RHEL 4.5	RHEL 4.3
	RHEL 4.4
	RHEL 4.5
RHEL 4.6	RHEL 4.3
	RHEL 4.4
	RHEL 4.5
	RHEL 4.6
RHEL 4.7	RHEL 4.3
	RHEL 4.4
	RHEL 4.5
	RHEL 4.6
	RHEL 4.7
RHEL 5.3	RHEL 5.3
SLES 10	SLES 10

SLES 10 SP1	SLES 10 SLES 10 SP1
SLES 10 SP2	SLES 10 SLES 10 SP1 SLES 10 SP2
SLES 11	SLES 11

**Note:**

- Only x86 RHEL Application Server (AS), not ES or WS is supported by the installer. RHEL 4.3 on Power is not supported by PowerVM Lx86, however RHEL 4.3 is supported as an x86 World OS on RHEL 4.x for Power.

---

## Minimum hardware requirements for PowerVM Lx86

Hardware requirements for PowerVM Lx86.

PowerVM Lx86 runs on the following hardware platforms:

- System p<sup>®</sup> server with POWER5<sup>™</sup>, POWER6<sup>™</sup> or Power PC-compatible processor (for example, OpenPower<sup>®</sup>, JS20, JS21, p505, p510, p520, p550, or p570)

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## Disk space requirements for the x86 World

Requirements for disk space when installing the x86 World.

### Disk space for SLES10, Service Pack 1, and Service Pack 2

- 3.2 GB disk space for software for a full installation; 1GB disk space for software for a minimal installation
- 1 GB disk space for the /tmp directory for a full installation; 300 MB disk space for the /tmp directory for a minimal installation

### Disk space for SLES11

- 4 GB disk space for software for a full installation; 1GB disk space for software for a minimal installation
- 1 GB disk space for the /tmp directory for a full installation; 300 MB disk space for the /tmp directory for a minimal installation

### Disk space for RHEL 4 Update 4, Update 5, Update 6, and Update 7

- 10 GB disk space for software for a full installation; 1.2 GB disk space for software for a minimal installation
- 2.4 GB disk space in the /tmp directory for a full installation; 400 MB for a minimal installation

### Disk space for RHEL 5 Update 3

- 6 GB disk space for software for a full installation; 900 MB disk space for software for a minimal installation
- 2 GB disk space in the /tmp directory for a full installation; 300MB for a minimal installation



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## Other required POWER software

Other POWER software required for the installation of PowerVM Lx86.

PowerVM Lx86 requires that the following software components be installed. The installation script checks for these components, and notifies you if they are not present.

- The **star** package must be installed on the system before an archive can be created or installed by the non-interactive mode of the PowerVM Lx86 installer. The PowerVM Lx86 installer script will inform you if the **star** package is not installed.
- **Perl 5.8** must be installed on the POWER system for the PowerVM Lx86 installer to function. You can check the Perl version with the **perl --version** command or run:

You can check the versions of your installed Perl RPM packages with the following command:

```
% rpm -qa | grep perl
```

If you do a full installation of the particular distribution, it will be installed by default. If Perl is not installed on your system, install the version of Perl that is provided with your distribution.

*Table 1. Perl requirements for PowerVM Lx86 installer*

Power OS	Perl version required
RHEL 4 Update 4	perl-5.8.5-36.RHEL4
RHEL 4 Update 5	perl-5.8.5-36.RHEL4
RHEL 4 Update 6	perl-5.8.5-36.RHEL4
RHEL 4 Update 7	perl-5.8.5-36.RHEL4
RHEL 5 Update 3	perl-5.8.8-18
SLES 10	perl-5.8.8-14.2
SLES 10 SP1	perl-5.8.8-14.2
SLES 10 SP2	perl-5.8.8-14.7
SLES 11	perl-5.10.0

- The 64-bit version of **libstdc++.so.6** must be installed on the POWER system for PowerVM Lx86 to function. Each of the supported distributions has its own version of the library, which must be installed. You can check that the library is installed on your system, by checking that **/usr/lib64/libstdc++.so.6** exists.

*Table 2. libstdc++.so.6 version required for PowerVM Lx86*

Power OS libstdc	package required
RHEL 4 Update 4	libstdc++-3.4.6-3
RHEL 4 Update 5	libstdc++-3.4.6-8
RHEL 4 Update 6	libstdc++-3.4.6-9
RHEL 4 Update 7	libstdc++-3.4.6-9
RHEL 5 Update 3	libstdc++-4.1.2-44
SLES 10	libstdc++-64bit
SLES 10 SP1	libstdc++-64bit
SLES 10 SP2	libstdc++-64bit

Table 2. *libstdc++.so.6* version required for PowerVM Lx86 (continued)

Power OS libstdc	package required
SLES 11	libstdc++43

You can check the versions of your installed `libstdc++.so.6` RPM packages with the following command:

```
% rpm -qa | grep libstdc
```

## Installation media requirements

PowerVM Lx86 requires x86 media to install the x86 World. This section details the exact media required for installation of the x86 World.

- For SUSE Linux Enterprise Server (SLES) 10, the installation requires the following CDs, DVDs, or ISO images:
  - SLES Version 10 for x86 CDs 1 - 4; an example is SLES-10-CD-i386-GM-CD{1-4}.iso
  - or
  - SLES Version 10 for x86 DVDs 1 - 2; an example is SLES-10-DVD-i386-GM-DVD{1-2}.iso
- For SUSE Linux Enterprise Server (SLES) 10 SP1, the installation requires the following CDs, DVDs, or ISO images:
  - SLES Version 10 SP1 for x86 CDs 1 - 4; an example is SLES-10-SP1-CD-i386-GM-CD{1-4}.iso
  - or
  - SLES Version 10 SP1 for x86 DVDs 1 - 2; an example is SLES-10-SP1-DVD-i386-GM-DVD{1-2}.iso
- For SUSE Linux Enterprise Server (SLES) 10 SP2, the installation requires the following CDs, DVDs, or ISO images:
  - SLES Version 10 SP2 for x86 CDs 1 - 4; an example is SLES-10-SP2-CD-i386-GM-CD{1-4}.iso
  - or
  - SLES Version 10 SP2 for x86 DVDs 1 - 2; an example is SLES-10-SP2-DVD-i386-GM-DVD{1-2}.iso
- For SUSE Linux Enterprise Server (SLES) 11, the installation requires the following DVDs or ISO images:
  - SLES Version 11 for x86 DVDs 1 - 3; an example is SLES-11-DVD-i586-GM-DVD{1-3}.iso
- For Red Hat Enterprise Linux (RHEL) 4.4 AS, the installation requires the following CDs or ISO images:
  - RHEL 4.4 AS CDs 1 - 4; an example is RHEL4-U4-i386-ES-disc{1-4}.iso
- For Red Hat Enterprise Linux (RHEL) 4.5 AS, the installation requires the following CDs or ISO images:
  - RHEL 4.5 AS CDs 1 - 4; an example is RHEL4-U5-i386-ES-disc{1-4}.iso
- For Red Hat Enterprise Linux (RHEL) 4.6, the installation requires the following CDs, DVDs, or ISO images:
  - RHEL version 4.6 for x86 CDs 1 - 5; an example is RHEL4.6-i386-AS-disc{1-5}.iso
  - or
  - RHEL Version 4.6 for x86 DVD; an example is RHEL4.6-i386-AS-DVD.iso

- For Red Hat Enterprise Linux (RHEL) 4.7, the installation requires the following CDs, DVDs, or ISO images:
  - RHEL version 4.7 for x86 CDs 1 - 5; an example is RHEL4.7-i386-AS-disc{1-5}.iso
  - or
  - RHEL Version 4.7 for x86 DVD; an example is RHEL4.7-i386-AS-DVD.iso
- For Red Hat Enterprise Linux (RHEL) 5.3, the installation requires the following CDs, DVDs, or ISO images:
  - RHEL version 5.3 for x86 CDs 1 - 5; an example is rhel-server-5.3-i386-disc{1-5}.iso
  - or
  - RHEL Version 5.3 for x86 DVD; an example is rhel-server-5.3-i386-dvd.iso



---

## Chapter 5. Downloading ISOs for PowerVM Lx86

Before you proceed with the installation, you must make sure that the x86 CDs, DVDs, or ISO images required by PowerVM Lx86 are available to the installer script.

The Virtual x86 Environment uses a set of x86 libraries, commands, applications and other system files. See Chapter 4, “System and installation requirements for PowerVM Lx86,” on page 13 for the specific CDs, DVDs, or ISOs you need. If you do not already have the CDs, DVDs, or ISOs, you can download the ISO images from the Red Hat or Novell Web sites.

The best method for installation is to download all ISOs to one directory and provide the name of that directory to the installer.

---

### Red Hat 4 procedure for downloading Linux x86 ISO images

The requirements and procedures for downloading Red Hat ISO images can be found on the Red Hat Network (RHN) Web site. Note that these procedures have been verified, but may have changed slightly since the writing of this manual.

#### Prerequisites

To download ISO images from the RHN Web site, you must have the following items. You can skip this if you already have the ISOs.

- A valid login account for the RHN Web site. If you do not have an RHN account, you can create one on the <https://www.redhat.com/rhn> Web site.
- A system that is registered under your login account. If you need to register a system, follow these steps:
  1. Log in to your system as root, and type the following at the command prompt: `up2date --register`. A window then opens, and you are led through the registration process.
  2. Read the Red Hat privacy statement, and provide your RHN login ID and password. If you do not have an RHN ID, you can create one using this window.
  3. When asked, provide the information you want to have accessible on your system profile.

Once completed, your chosen system profile information is sent to RHN, and you will be able to view this information on the RHN Web site under your account.

- A system with the proper Red Hat entitlement assigned to it.

If you do not have an entitlement, the first entitlement is free for your first registered system. Thereafter you must purchase additional entitlements to be used for any additional systems. You can use the same entitlement for different systems with different architectures, so long as only one system is assigned to that entitlement at any given time.
- A system with the proper Red Hat subscription assigned to it.

You must purchase a subscription for a particular system to obtain ISOs for it. Red Hat allows you to have a 30-day free trial period, during which you can

download ISO images. After this period ends, you still have access to the ISO images, but you are no longer able to download updates or to receive support. The software subscription is system and architecture specific. Regular customers need to purchase one subscription to cover ISO images for the x86 architecture and a second subscription to cover the ISO images for the POWER architecture. However, you are not asked to pay for two subscriptions with PowerVM Lx86. The PowerVM Lx86 installation collects the data needed for Red Hat to upgrade the Linux POWER entitlement to include an entitlement for Linux on x86 as well. This additional x86 entitlement is only to be used with PowerVM Lx86 on a POWER system.

## Downloading ISO images from the Red Hat Network

It is simpler to download the RHEL ISO images onto a RHEL system than onto a non-RHEL system. The procedure to download onto a non-RHEL system follows this one, if you need to do so for some reason.

To download ISO images from the RHN onto a RHEL 4 system, complete the following steps:

1. Log in to the Red Hat Network site. As stated previously, if you do not have a login, you can create one at <https://www.redhat.com/rhn>.
2. Click **Downloads** on the top menu.
3. Click **Download your software here** in the Red Hat Enterprise Linux section.
4. Choose the system you want to download the ISO for. The window that opens shows the various ISO installation and source disk images, with their corresponding MD5 checksum values.

To download ISO images from the RHN on to a non-Red Hat system, complete the following steps.

1. Log in to the Red Hat Network site. As stated previously, if you don't have a login, you can create one at <https://www.redhat.com/rhn>.
2. Click **Systems** on the top right corner.
3. Choose the system you want to download the ISO for.
4. Click the **Software** tab located below the system name at the top.
5. Click the **Software Channels** tab. This shows the base channel that your system is subscribed to, along with any other additional channels beneath it.
6. Click the desired channel subscription that you want the ISO image from. The next window that opens shows further details of that subscription.
7. Click the **Downloads** tab. The window that opens shows the various ISO installation and source disk images, with their corresponding MD5 checksum values.

---

## Novell procedure for downloading Linux x86 ISO images

The requirements and procedures for downloading Novell SLES ISO images can be found on the Novell Customer Center Account Web site. Note that these procedures have been verified, but may have changed slightly since the writing of this manual.

### Prerequisites

To download images from the Novell Web site, you must have the following items:

- A valid login account for the Novell Customer Center Account Web site.

If you do not have an existing Novell Customer Center account, you can create one at <http://www.novell.com>. Click **Customer Center** under **Support**.

- Select the proper subscription for the SLES distribution version you want to download. To download the distribution version ISOs, you must have purchased the subscription for that particular version. You can obtain an evaluation version that gives you access to the distribution ISO images for a 30-day free trial period on SLES 9 distributions and a 60-day free trial period on SLES 10 distributions. You can use one subscription on varying system architectures, so you can use the same subscription for both x86 and POWER systems.

To get the subscription, follow these steps:

1. Go to <http://www.novell.com/products/server/>.
2. Click **Download Eval**.
3. Click the download that is appropriate for your platform. You get an activation code and a link to download the ISOs.

## Downloading ISO images from the Novell Customer Center

To download ISO images from the Novell Customer Center, complete the following steps.

1. Log in to your account on the Novell Customer Center Web site located at <http://www.novell.com>.
2. Click **Customer Center** under **Support**.
3. Click **List of Products and Subscriptions** under **Products and Subscriptions** on the left panel. A window opens with a table of the software subscriptions you currently own.
4. Click **Activate Product/Subscription** under **Products and Subscriptions** on the left panel.
5. Enter the activation code, which is on the registration card you receive when you purchase the subscription. You also receive an activation code if you request an evaluation copy.
6. Double-click the distribution version you want to download.
7. Under **Overview**, scroll down to the **Downloads** section, and click **Media**. There is a list of ISO images that are available for the selected distribution version.
8. Click **proceed to download** on the upper right corner.
9. A page opens with the distribution images, which you can download.





---

## Chapter 6. Running the PowerVM Lx86 installation script

The PowerVM Lx86 installation script installs the software in the standard configuration.

---

### Installing PowerVM Lx86 and x86 World

Use this procedure to install PowerVM Lx86 and x86 World.

The following procedure assumes that you are installing onto a system for the first time or that any previous installations of PowerVM Lx86 have been uninstalled. If the default locations are accepted, then the PowerVM Lx86 translation software is installed in the `/opt/powervm-lx86` directory. You can install it in an alternative location if necessary.

The default location for the x86 World libraries and binaries is the `/i386` directory, which is frequently referred to as `X86WORLD_ROOT` in this document.

Also note that this procedure uses RHEL as an example, but the SLES installation follows the same process.

1. Download the PowerVM Lx86 package on to your system from the IBM website or copy the PowerVM Lx86 files from the CD.
2. Become root on the POWER system.
3. Extract the PowerVM Lx86 installer. For example:  

```
% tar -xvzf powervm-lx86-1.3.0.0-1.tgz
```
4. Run the PowerVM Lx86 installation script:  

```
% powervm-lx86-installer-1.3.0.0-1/installer.pl
```

You are asked to read through and agree to the license agreement before continuing with the installation. The following prompt is displayed:

```
Host OS detected as Red Hat Enterprise Linux release 4 (RHEL4U6)
```

```
Welcome to the PowerVM Lx86 Installer
```

```
To run Linux/x86 applications the installation will require Linux/x86
application binaries, libraries and infrastructure files as well as the
PowerVM Lx86 software.
```

```
Please refer to the PowerVM Lx86 Administration Guide and Release Notes
for further details of the installation requirements.
```

```
You must agree to the following license to install PowerVM Lx86.
```

```
If you do not accept the license terms, the installation will abort.
```

```
Page through the license with SPACE.
```

```
If you want to quit before you reach the end of the license, press q.
```

```
Press ENTER to view the license.
```

5. Press Enter to view the license, and press Enter again to scroll to the next page. The following prompt is displayed:  

```
Do you want to view the license again? [y/N]
```

6. If you want to view the license again, press y and Enter, or to continue just press Enter. The following prompt is displayed:  
Do you accept the license terms? [y/N]
7. If you do not agree to the license terms and enter n, the installation will abort. If you agree to the license terms, enter y and press Enter. The license text is saved to disk. You can print this file for your records. You will be asked for information that will be sent by e-mail to activate the product. The following prompt is displayed:  
Registration with IBM  
  
You must provide some information to IBM before starting the installation process. This Activation information will be sent to IBM as an email.  
  
Note: You must provide your company name for the installation to proceed. All other details are optional. The Activation email will also include some details about this system. Once you have entered this information it will be presented to you to review. You will have the option to send the information to IBM via email or abort the installation.  
  
Please enter the name of your company:
8. You must enter the name of your company. You are also prompted for your name, address, phone number, and e-mail address; these fields are optional.
9. Enter the requested information, or, to skip any of the questions, press Enter at the prompt. The system model number, serial number, and current time and date information are collected automatically from your system. All the information collected is displayed on the screen, and is similar to the following:  
The following is about to be sent to IBM:  
  

Date:	Mon Jul 14 15:00:00 GMT 2008
System:	IBM,nnnn-nnn
Serial:	IBM,nnnnnnnnn
Company:	Your company
Name:	Your name
Address:	Your address
Phone Number:	555-5555
Email:	yourname@example.com

  
Is the above information correct? [y/N]
10. If this information is correct, enter y. The following prompt is displayed:  
Send the above information to IBM?  
(If you answer 'no' here, the installation will be aborted.) [Y/n]
11. If you agree with sending the information to IBM, press Enter, and you then see this output:  
Email sent successfully.
12. (RHEL systems only) The following prompt is displayed:  
Registration with Red Hat Inc.  
Would you like to Register? [y/N]  
  
If you would like to register with Red Hat to upgrade your system to support both Linux on x86 and Linux on POWER, then enter y and go to the next step. If you do not want to register now, you can register after installation.
13. (RHEL systems only) The following prompt is displayed:  
The Linux/x86 binaries and libraries in the x86 World can be kept up to date using the Red Hat Network. To receive this support, you must upgrade your current Red Hat subscription to support both

Linux/x86 and Linux/POWER. This upgrade is at no additional charge.

To upgrade the subscription on this system, you need to provide some information that will be emailed to Red Hat Inc. Once this has been sent, you will receive an acknowledgement email from Red Hat within approximately the next 24 hours (1 business day). You will then receive another email confirming that the subscription has been upgraded within approximately the next 48 hours (2 business days).

Please enter the name of your company [Your Company]:

To receive an upgraded Red Hat Network Subscription, you must provide your name, your company name, and an e-mail address, and, optionally, your Red Hat login name and your Red Hat account number. Your name, your company name, and an e-mail address are provided as default from the IBM Registration process you entered above.

14. (RHEL systems only) If you are satisfied with the defaults, press Enter for each prompt, and then, optionally, answer the login and account number prompts. To skip these last two questions, press Enter at the prompt. The system model number, serial number, and current time and date information are now collected automatically from your system. All the information collected is displayed on the screen. The following prompt is displayed:

```
Date:          Mon Jul 14 15:00:00 GMT 2008
Company:       Your company
RHN Login:
Account No:
Name:         Your name
Email:        yourname@example.com
```

Is the above information correct? [y/N]

15. (RHEL systems only) If the information is correct, enter y. The following prompt is displayed:

```
Send the above information to Red Hat Inc. (pave@redhat.com)?
(If you answer 'no' here, the installation will be aborted.) [Y/n]
```

If you agree with sending the information to Red Hat to upgrade your subscription, press Enter, and you see this output:

Email sent successfully.

16. The following menu is displayed:

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

17. Enter 1 to begin the installation. The following menu is displayed:

1. Install powervm-lx86 + x86 World.
2. Install powervm-lx86.
3. Install x86 World.
4. Install x86 World from a pregenerated archive.
5. Go back to the Main Menu.
6. Quit.

Please select the type of operation you would like to perform:

18. Enter 1 to begin the installation of the PowerVM Lx86 package and x86 World. The following prompt is displayed:

Install powervm-lx86 to: [/opt/powervm-lx86]

19. Press Enter to accept the default installation location, or enter an alternative location. The following prompt is displayed:  
Log files created by powervm-lx86 will be stored in:  
[/var/opt/powervm-lx86/log]
20. Press Enter to accept the default log file location, or enter an alternative location. The following prompt is displayed:  
Install x86 World to: [/i386]
21. Press Enter to install x86 World in the recommended default location, or enter an alternative location. The following prompt is displayed:
  1. powervm-lx86-<version>
  2. Go back to the Main Menu.

Please select the version of powervm-lx86 you would like to install:

22. Select the version of PowerVM Lx86 to install by entering 1. The following prompt is displayed:  
Which Linux/x86 OS distribution will you be installing for your x86 World?
  1. Red Hat Enterprise Linux AS release 4 (full)
  2. Red Hat Enterprise Linux AS release 4 (minimal)
  3. Red Hat Enterprise Linux AS release 4, Update 6 (full)
  4. Red Hat Enterprise Linux AS release 4, Update 6 (minimal)

Please select a distribution from the list above:

For details of the supported x86 and POWER operating system combinations, see Chapter 4, “System and installation requirements for PowerVM Lx86,” on page 13.

23. Enter the number of the appropriate distribution. The following prompt is displayed:  
Where are the home directories located on this system (type 'skip' if you don't want the x86 World to share your home directories)? [/home]
24. This step *escapes* the x86 World home directory. Press Enter to accept the default home directory location, or enter an alternative location. If you do not want to escape the home directories, enter skip. If your environment uses multiple locations for home directories, such as the /home1 directory and the /home2 directory, then you need to use the **linkx86** script to configure additional escapes after the installation script has finished. The following prompt is displayed:

To create the x86 World the powervm-lx86 installer will need the appropriate set of x86 RPMs. This set of RPMs is generated from the Red Hat Enterprise Linux AS release 4, Update 6 (full) x86 install media (ISO or CD/DVD-ROM).

Please enter the directory or files containing Red Hat Enterprise Linux AS release 4, Update 6 (full).

- ISO9660 images are accepted (if they end with .iso)
- RPM files are accepted (if they end with .rpm)
- If you have a CD/DVD-ROM, please mount it and enter the mount path

You can enter each file or mount path individually or provide a pattern to select multiple files at once,  
e.g. /files/rhel/RHEL4-U4-i386-AS-disc\*.iso.

To view a list of missing RPM files, type 'list'  
To return to the main menu, type 'skip'

Enter directory or file:

25. To view the list of outstanding RPMs, enter `list`. You can source the RPMs from CD, DVD, ISO images, or a directory of RPMs. You can add RPMs from multiple media sources one at a time. For CD and DVD installation, you can mount the disks individually.
26. If mounting CDs or DVDs, mount the first disk, and then enter the mount location. After the RPMs are copied from that disk, unmount the disk and mount the next disk. Type in the new mount location and continue until all of the RPMs are copied across.

If you are installing from ISO images, you can use a pattern match if the ISOs have similar names. For example, you can add `RHEL4-U4-i386-AS-disc1.iso` and `RHEL4-U4-i386-AS-disc2.iso` by typing in the pattern `RHEL4-U4-i386-AS-disc*.iso`.

27. For each media source, the installer prints the following message:

```
nnn required RPMs found. Copying...
```

After all of the required RPMs are copied onto the local system, the RPMs are installed into x86 World, and the following output is displayed:

```
All RPMs found successfully.
```

```
About to proceed with the following:
```

- Install `powervm-lx86` to `/opt/powervm-lx86`
- Log files will be stored in `/var/opt/powervm-lx86/log`
- Install x86 World to `/i386`
- Selected distribution is Red Hat Enterprise Linux AS release 4, Update 6 (full)
- Home directories are in `/home`

1. Continue.
2. Change settings.
3. Go back to the Main Menu.

```
Please select the type of operation you would like to perform:
```

28. If the settings are correct, Enter 1 to continue.

```
powervm-lx86 installed successfully.
```

```
Installing x86 World...
```

```
Step 1/2: Installing base RPMs...
```

```
100% [=====>]
```

```
Step 2/2: Installing x86 World...
```

```
100% [=====>]
```

```
Finalizing x86 World installation. Please wait...
```

```
Removing /tmp/x86rpms...
```

```
x86 World installed successfully.
```

```
powervm-lx86 and x86 World are now installed.
```

```
Binding them together and creating runx86 script.
```

```
Installation Summary
```

```
Installed powervm-lx86:
```

- From RPM: `powervm-lx86-<version>`
- Installation directory: `/opt/powervm-lx86`
- Log files created by `powervm-lx86` will be stored in `/var/opt/powervm-lx86/log`

```
Installed x86 World
```

- Distribution: Red Hat Enterprise Linux AS release 4, Update 6 (full)
- Installed at: /i386
- Home directories are in /home

To start a translated x86 World shell, run `/usr/local/bin/runx86`

Note: SELinux is not enabled by default for PowerVM Lx86 after installation. If SELinux is enabled on your Power system, you can enable SELinux for x86 applications by enabling the SELinux configuration switches in the PowerVM Lx86 configuration file. Please see the Administration Guide for details.

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

29. Enter 6 to quit the installation. The installation exits, with the following summary of the installation process and details of where the installation log and activation e-mails are stored:

The Activation email data is stored on the system in  
activation-detail.

If this system is not set up to send email, please email  
this data file to IBM at <pave@us.ibm.com>.

Thank you for using the PowerVM Lx86 Installer

Today you performed the following transactions:

Accepted license agreement  
Registered with IBM  
Registered with Red Hat Inc.  
Installed PowerVM Lx86  
Installed installer into /opt/powervm-lx86/installer  
Installed x86 World (Red Hat Enterprise Linux AS release 5, Update 1 (full))

End of Transaction log.

To start a translated x86 World shell, run `/usr/local/bin/runx86`

The full log of your session is in `/tmp/powervm-lx86_install_XXXXXX.log`

Installation of PowerVM Lx86 and x86 World is now complete. For further details about how to configure PowerVM Lx86 and x86 World, see Part 4, "Configuring and maintaining the x86 World and PowerVM Lx86," on page 51.

To start running x86 applications, see Chapter 9, "Running x86 applications," on page 37.

---

## Chapter 7. PowerVM Lx86 installation reference

This section includes the details of a PowerVM Lx86 installation including PowerVM Lx86 directories and files.

### PowerVM Lx86 directory structure

The PowerVM Lx86 installer will install the software, by default, into the directory structure as shown in this chart:

Directory	File or sub-directory	Description
/opt/powervm-lx86/bin/	powervm-lx86 powervm-lx86-daemon i386-router dependency_checker.pl powervm-lx86-rcmonitor	The PowerVM Lx86 translator application.  PowerVM Lx86 translator daemon.  PowerVM Lx86 router.  /etc/init.d dependency checker (SLES systems only).  /etc/init.d directory monitor application (SLES systems only).
/opt/powervm-lx86/lib/perl5	powervm_lx86_scripts/	PowerVM Lx86 globalization support files.
/opt/powervm-lx86/locale	<i>locale directories</i>	PowerVM Lx86 globalization files.
/opt/powervm-lx86/selinux	<i>selinux files</i>	SE Linux support files (RHEL systems only).
/etc/init.d	powervm-lx86 powervm-lx86-rc1 powervm-lx86-rc2 powervm-lx86-rc3 powervm-lx86-rc4 powervm-lx86-rc5 powervm-lx86-rc6 powervm-lx86-rcommon powervm-lx86-rcmonitor	Start-up script to start PowerVM Lx86 daemon.  x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script. x86 init.d runlevel script.  /etc/init.d directory monitor script (SLES systems only).
/etc/opt/powervm-lx86	config	Configuration file, created if PowerVM Lx86 or x86 World are installed into non-default locations.

Directory	File or sub-directory	Description
/etc/opt/powervm-lx86	activation-detail	Contents of IBM activation e-mail created during installation.
/etc/opt/powervm-lx86	exec_types	SE Linux support file.
/etc/opt/powervm-lx86/ license	license	Copy of license agreed to during installation.
/usr/sbin/	powervm-lx86-world-sync	Script to manage local user files.
/var/opt/powervm-lx86/log	<i>powervm-lx86.log.xx.yyyy.zzzzzz</i>	PowerVM Lx86 debug log files.
/var/opt/powervm-lx86/ daemon	powervm-lx86-daemon.log powervm-lx86-daemon.lock cache	Contains event logs for the PowerVM Lx86 daemon.  The PowerVM Lx86 daemon execution lock.  The PowerVM Lx86 daemon cache.
/var/opt/powervm-lx86/ selinux	<i>selinux files</i>	SE Linux support scripts, created when SE Linux enabled for PowerVM Lx86 (RHEL systems only).
/i386	<i>x86 World files</i>	The default directory for the x86 World files. When x86 applications are run, they see this directory as root (/).
/usr/local/bin	linkx86 runx86	Script to creates x86 World escapes.  Script to invoke PowerVM Lx86.
/opt/powervm-lx86/ installer	installer.pl lib/ resources/ doc/	Local copy of PowerVM Lx86 installer.  Auxiliary installer files and installer globalization text.  Installer RPMs and license files.  Release Notes and PowerVM Lx86 Administration Guide.
/opt/powervm-lx86/doc	<i>Release notes</i> <i>Administration Guide</i>	Symlink to the Release Notes and the PowerVM Lx86 Administration Guide (all locales)



---

## Chapter 8. Uninstalling PowerVM Lx86 and x86 World

The semi-automated installer.pl script is used to uninstall PowerVM Lx86 and x86 World from your system.

You can use the script to remove the following:

- PowerVM Lx86 software and configuration (optional)
- x86 World and any applications or user files installed or modified since the original installation (optional)

### Notes:

- The **rpm -e** command cannot remove PowerVM Lx86. **rpm** cannot remove any files added to the installation directories, including any applications that have been installed within x86 World. The installer.pl script can, if you so choose, completely remove the installation directories and contents.
- You must run the installer.pl script from a POWER shell and not an x86 shell.
- Before uninstalling PowerVM Lx86 and the x86 World, please quit all running x86 applications. If any x86 applications are still running during the uninstall, you will be prompted to let the uninstall script kill these processes. You must kill the running processes for the uninstall to proceed.
- Back up any critical data (either applications or user files) from the x86 World before removing the x86 World.

To uninstall PowerVM Lx86 and x86 World, follow these steps:

1. Run the PowerVM Lx86 uninstall script with the following command:

```
% ./installer.pl
```

The script shows a message similar to the following:

```
Welcome to the PowerVM Lx86 Installer
```

```
To run Linux/x86 applications the installation will require Linux/x86
application binaries, libraries and infrastructure files as well as the
PowerVM Lx86 software.
```

```
Please refer to the PowerVM Lx86 Administration Guide and Release Notes
for further details of the installation requirements.
```

```
License file found
```

```
Registration with IBM
Existing registration with IBM has been found
in /etc/opt/powervm-lx86/activation-detail.
Would you like to re-register? [y/N]
```

2. If you want to register again, enter y. If not, enter n or press the Enter key to accept the default n. If you choose to skip reregistration, the system displays the following installation menu:

```
Registration with Red Hat Inc.
Would you like to register? [y/N]
```
3. If you want to register again with Red Hat, enter y. If not, enter n or press the Enter key to accept the default n. If you choose to skip the Red Hat reregistration, the system displays the following installation menu:

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

4. Select option **3. Uninstall Software** from the menu.

The following menu is displayed:

1. Uninstall powervm-lx86 + x86 World.
2. Uninstall powervm-lx86.
3. Uninstall x86 World.
4. Go back to the Main Menu.
5. Quit.

Please select the type of operation you would like to perform.

5. Select option **1. Uninstall powervm-lx86 + x86 World** from the menu.

If any x86 applications are still running, the system prompts you with the following message:

The following translated processes (pids) are running:  
xxxxx xxxxx xxxxx

You cannot uninstall while there are still translated processes running.  
Kill these processes to continue.

Do you want to kill these processes now? [y/N]

6. Enter y followed by the Enter key to kill the running x86 applications.

The system prompts you with the following message:

Are you sure you want to uninstall powervm-lx86? [Y/n]

7. Press Enter to accept the default yes, or enter y.

The system prompts you to remove the log file directory:

Remove log file directory (/var/opt/powervm-lx86/log)? [y/N]

8. Enter y followed by the Enter key. Note that by default, the log file directory is not deleted so that any log files contained in the directory are saved for future reference.

The system prompts you to remove the x86 World:

Delete x86 World (installed at /i386) from the filesystem?

You will lose all custom config and installed applications. [y/N]

9. Enter y to remove the x86 World. All the files stored in the `X86WORLD_ROOT` are deleted. Back up any critical data before carrying out this step.

The system prompts you to remove the configuration files for PowerVM Lx86:

Remove the installation config directory (/etc/opt/powervm-lx86)? [y/N]

10. Enter y to remove the configuration directory and its contents.

The system shows the following:

```
Uninstalling powervm-lx86. Please wait...
powervm-lx86 installation directory (/opt/powervm-lx86) deleted.
Log file directory (/var/opt/powervm-lx86/log) deleted.
Uninstalling x86 World. Please wait...
Config directory (/etc/opt/powervm-lx86) deleted.
```

Exiting program after successful uninstall.

Thank you for using the PowerVM Lx86 Installer

Today you performed the following transactions:

```
Uninstalled powervm-lx86
Uninstalled x86 World
```

End of Transaction log.

The full log of your session is in /tmp/powervm-lx86\_install\_XXXXXX.log

The uninstall of PowerVM Lx86 and the x86 World is now complete.



---

## **Part 3. Running and installing x86 applications**

This section describes how to run x86 applications using PowerVM Lx86 and also how to install additional x86 applications into the x86 World.



---

## Chapter 9. Running x86 applications

You must use the **runx86** command from a native POWER shell.

All x86 applications must be run within a VxE. The **runx86** command must always be used to ensure that an application, command, or utility is run within a VxE. Applications can be run in a VxE in either of the following ways:

- Use the **runx86** command to start an x86 shell. From within the x86 shell, run the x86 application as you normally would on an x86 system.
- Run x86 applications from a native POWER shell by using the **runx86** command with the x86 application as an argument to the command.

### Notes:

- When invoking an x86 application, the current working directory must be accessible from the x86 World (for example, the *X86\_WORLDROOT* itself, */i386*). Either the application must be installed within the x86 World or be visible from the x86 World. You can make the application visible from the x86 World by either mounting the application directly to a mountpoint within x86 World, or to a mountpoint external to x86 World and then creating an escape to the mountpoint. To create the escape, use the **linkx86** command. If the current working directory is not visible from the x86 World, the current working directory will be changed in the x86 shell to the *X86\_WORLDROOT* and a warning message will alert you to this change of directory.
- The PowerVM Lx86 translation daemon must be running in order to run x86 applications on the POWER machine. The PowerVM Lx86 installer will start the PowerVM Lx86 daemon on the system after the installation is completed. For further details about the PowerVM Lx86 translation daemon, see “Starting the PowerVM Lx86 daemon” on page 38

### Running x86 applications from an x86 shell

Using an x86 shell is the most flexible way of running x86 applications, but it has disadvantages in that the starting process is manual. For these reasons, running applications from an x86 shell is generally only suited to applications that are run by experienced users or system administrators. An example of this is a middleware application that is run on an application server.

### Example: Running applications from an x86 shell

This example shows how to run an application named TradeOffice. It normally runs on a Linux on x86 machine on a network. TradeOffice monitors a designated remote file system, processes files from the file system, and sends files to another remote file system.

In a POWER shell, enter the following command:

```
% runx86
```

The **runx86** command creates a VxE and starts an x86 shell from the native shell.

To confirm you are using a translated x86 shell, you can check the current architecture of the shell by entering the following command:

```
$ arch
```

A translated x86 shell will output i686 rather than ppc64.

In the translated x86 shell, start the application with the following command:

```
$ TradeOffice
```

This starts the TradeOffice application from the x86 shell.

## Running x86 applications from a native POWER shell

Applications can be started directly from a native POWER shell by passing them to the **runx86** command as a parameter. The path to the application must be a subpath relative to the x86 World root (for example, /bin/ls). Arguments are passed directly to the x86 application, so any paths that are passed as arguments should also be subpaths below the x86 World root (for example, /tmp rather than *X86\_WORLDROOT*/tmp).

This method has the advantage that it can be set up as a script that an end user runs. The end users do not need to know that they are running the application in a VxE on a POWER machine.

### Example: Running applications directly from a native POWER shell

This example translates the x86 World /bin/ls binary, and lists the contents of the directory.

You must enter the command from a directory that is visible from x86 World. See “Default escaped directories, files, and sockets” on page 67 in this guide for a list of directories that are automatically visible from x86 World. When invoking an x86 application directly from a native POWER shell, the **runx86** command will not change the current working directory for you automatically to one that is visible from the x86 World.

For example, you can run the following command from a POWER shell:

```
% runx86 /bin/ls /tmp
```

This command creates a VxE, translates the **ls** command, shows the results of the **ls** command, and then closes the VxE.

**Note:** x86 applications cannot be run directly from a POWER shell without invoking the **runx86** command.

---

## Starting the PowerVM Lx86 daemon

The PowerVM Lx86 translation daemon must be running in order to run x86 applications on the POWER machine.

The PowerVM Lx86 daemon enables x86 processes running within VxEs to communicate with each other. The PowerVM Lx86 installer starts the PowerVM Lx86 daemon on the system after the installation is completed. It also installs a startup script for the PowerVM Lx86 daemon named **/etc/init.d/powervm-lx86** to start the PowerVM Lx86 daemon and any x86 daemons when the system reboots or starts up.



**Note:** For details of how to run x86 daemons see Chapter 16, “Starting x86 daemons with PowerVM Lx86,” on page 71.

The PowerVM Lx86 daemon will normally be running on your system after installation. However, to start the PowerVM Lx86 daemon manually, run the **/etc/init.d/powervm-lx86** script as root. The output is as follows:

```
% /etc/init.d/powervm-lx86 start
Starting powervm-lx86-daemon [ OK ]
Starting x86 services
Entering non-interactive startup
Starting system logger: [ OK ]
Starting kernel logger: [ OK ]
Starting crond: [ OK ]
```

When the PowerVM Lx86 daemon starts, it creates a **/var/opt/powervm-lx86** directory. This directory must exist, and have full read and write permissions for all users, for PowerVM Lx86 to work.

You can now start a simple x86 binary using the **runx86** command. For example, the **ls /x86** command should give output similar to that shown in the following example, run in a POWER shell:

```
% runx86 /bin/ls /
bin dev home lib mnt proc sbin srv tmp var
boot etc initrd media opt root selinux sys usr
```

## PowerVM Lx86 start up script parameters

The PowerVM Lx86 daemon start up script **/etc/init.d/powervm-lx86** takes the following arguments:

- **start:** Checks if the PowerVM Lx86 daemon is started already, if not, it starts the daemon.
- **stop:** Halts the PowerVM Lx86 daemon.
- **restart:** Halts the PowerVM Lx86 daemon, then starts the PowerVM Lx86 daemon again.
- **status:** Reports the current status of the PowerVM Lx86 daemon.

## Example of using the PowerVM Lx86 startup script

To stop the PowerVM Lx86 daemon, run the following command in a POWER shell:

```
% /etc/init.d/powervm-lx86 stop
```

To restart the PowerVM Lx86 daemon, run the following command in a POWER shell:

```
% /etc/init.d/powervm-lx86 restart
```

### **Note:**

- You must have root access rights to run the PowerVM Lx86 startup script.
- Stopping the PowerVM Lx86 daemon while any x86 applications or x86 daemons are running will cause them to shut down.

---

## PowerVM Lx86 log files

PowerVM Lx86 creates log files during installation, for the PowerVM Lx86 daemon and any translated x86 processes that have errors. These log files are not automatically deleted, so you may want to clean them out periodically.

The PowerVM Lx86 daemon log file is created in the `/var/opt/powervm-lx86/daemon` directory, and is always given the name `powervm-lx86-daemon.log`. The `powervm-lx86-daemon.log` file lists communication failures between the translated x86 applications and the PowerVM Lx86 daemon, and internal errors, such as being out of memory.

Log files are created for x86 processes if they produce an error message, warning message, or fail as they are running within a VxE. The log files are created in the `/var/opt/powervm-lx86/log` directory. The filename takes the form:

`powervm-lx86.log.<process_name>.<process_id>.<unique_id>`.

The PowerVM Lx86 installer script generates a log file when it is run that contains a verbose record of each session including all screen output, user input and time stamps for each event. When the installer exits, it prints out the path to the log file for future reference. The log file is found in `/tmp/powervm-lx86_install_XXXXXX.log`, where `XXXXXX` is a unique identifier.

Report any application failures to IBM support. See “Reporting a PowerVM Lx86 failure” on page 41 for more details.

---

## Viewing the installation log file - logviewer

A script called **logviewer** is provided to allow the PowerVM Lx86 installation log files to be viewed in terminals with non-English locales.

The installation log file is stored in the UTF-8 encoding to support different locales. Although the log file contains the complete character information, it cannot be viewed in a terminal until it has been transcoded into the encoding specified by the current locale.

### Description

**logviewer** reads a PowerVM Lx86 installation log file (stored in the UTF-8 encoding) and transcodes it to the encoding specified in the current locale. **logviewer** behaves in a similar way to **cat**, taking files on stdin or as arguments and returning them to stdout. If you invoke **logviewer** without any arguments it will wait for input from stdin. You may specify the option **--more** or **--less** to have the output piped to the **more** or **less** command line programs respectively.

### Location

`<PowerVM Lx86 install location>/installer/resources/bin/RO/logviewer`

### Usage

**logviewer** [**--help**]

**logviewer** `/tmp/powervm-lx86_install_XXXXXX.log`

```
logviewer [ --more | --less] /tmp/powervm-lx86_install_XXXXXX.log
```

---

## Reporting a PowerVM Lx86 failure

If a Linux x86 application fails while being translated, an error is displayed. In addition, an error log is created in the `/var/opt/powervm-lx86/log` directory. You can change the location of the default log directory during installation. Log files are created for each running process that encounters an error.

Please report any errors to IBM support and include a description of the failure and what events preceded the failure.

**Note:** The reported error may be caused by an issue with the Linux x86 application being executed and may not be a problem with PowerVM Lx86.

See “PowerVM Lx86 log files” on page 40 for more details about log files generated by the PowerVM Lx86.

---

## Monitoring x86 applications

You can monitor running x86 applications using x86 commands.

x86 application monitoring commands displays information about any processes running in a VxE. POWER processes are not shown.

Processes running within a VxE can also be seen from the host POWER system using commands such as the **ps** command and the **top** command. The output is more verbose and shows the translator processes running the x86 applications. These details might not be required if you are only determining which x86 processes are running. However, you might prefer to use a POWER tool that you know is running natively, and use a script to filter out unwanted information.

Following is an example that shows the use of commands to monitor x86 applications. (On this system, the only x86 processes running are **bash** and **ps**).

From a translated x86 shell, enter the following:

```
$ ps -A
```

The output is similar to the following:

PID	TTY	TIME	CMD
3998	?	00:00:00	syslogd
4006	?	00:00:00	klogd
4033	?	00:00:00	crond
4144	pts/2	00:00:00	ps
4135	pts/2	00:00:00	bash
1	?	00:00:01	init

From a POWER shell, enter the following:

```
% ps w w ax
```

The output is similar to the following:

```

16097 pts/13  Ss    0:00 -bash
3932 ?        Ssl   0:00 /opt/powervm-lx86/bin/powervm-lx86-daemon
3998 ?        Ssl   0:00 /opt/powervm-lx86/bin/powervm-lx86 -D3 -F4 -f3ff -argv0
        syslogd /i386/sbin/syslogd -m 0
4006 ?        Ssl   0:00 /opt/powervm-lx86/bin/powervm-lx86 -D3 -F4 -f3ff -argv0
        klogd /i386/sbin/klogd -x
4033 ?        Ssl   0:00 /opt/powervm-lx86/bin/powervm-lx86 -D3 -F4 -f3ff -argv0
        crond /i386/usr/sbin/crond
16252 ?        R+    0:00 ps w w ax

```

## Maintaining x86 applications

Maintaining x86 applications includes debugging x86 applications and generating x86 core dump files.

### Debugging

When an in-house x86 application is migrated to POWER, developers might need to build or support the application on the POWER system. Developers cannot use native Linux on POWER debugging tools when the application is running in a VxE, because it results in the translator program itself being debugged. Instead, developers should use x86 debugging tools running within a VxE on the POWER machine.

The x86 command line debugging tools gdb, strace, and ltrace are supported within a VxE. It is possible to debug an x86 application from within a translated x86 gdb session. It is also possible to attach a translated x86 gdb to a running x86 process.

**Note:** Hardware watchpoints are not supported by PowerVM Lx86. When running gdb under translation you may see the following message:

```
"Couldn't write debug register: Input/output error."
```

This message is not fatal and is expected behaviour for PowerVM Lx86.

### x86 core dump files

Core dump files are supported for x86 processes running in a VxE. If an x86 process crashes unexpectedly while running within a VxE, it can produce a core dump file. If the crash was caused by a problem with the translator, then an error log will also be generated. The translator can also produce a core dump.

**Note:** Core dumps of simple applications (single threaded applications and those that do not register signal handlers) may produce inaccurate core files. To generate an accurate core file, set the EXTRA\_DEBUG\_SUPPORT\_FROM\_START configuration switch to y in the configuration file located in /etc/opt/powervm-lx86/config or as an environment variable and retry the application. This step is not required for the majority of applications. See the examples below.

### Example: Enabling accurate core dumps for simple applications

Using the PowerVM Lx86 configuration file, /etc/opt/powervm-lx86/config, the configuration variable can be set by adding the following line:

```
EXTRA_DEBUG_SUPPORT_FROM_START=y
```

Using the PowerVM Lx86 environment variable, set:

```
% export LX86_CFG_EXTRA_DEBUG_SUPPORT_FROM_START=y
```

For more details about configurations switches for PowerVM Lx86, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59.



---

## Chapter 10. Installing and configuring x86 applications on a PowerVM Lx86 system

This section explains how to install and configure x86 applications onto a POWER platform, and how to migrate existing applications from an x86 platform to a POWER platform.

The general approach to migration is to make the x86 application and data accessible from the POWER machine. This typically means installing the application or copying or mounting the application files. No alteration of application binaries is necessary and no conversion of the data is necessary.

The combination of an application and the data that it needs is defined here as a *workload*.

The migration has two parts:

1. Setting up the x86 system configuration.
2. Installing x86 applications.

---

### Setting up the x86 system configuration

Setting up local or remote user authentication, connecting to remote file systems, configuration x86 daemons, and setting up environment variables are part of the set up process that needs configuring on the system or migrating from an existing x86 system.

The installation script installs x86 libraries, commands, utilities, and infrastructure files in x86 World. For more information, see Chapter 12, “Installing and updating packages in x86 World,” on page 55. You can add additional packages later to x86 World (see Installing and updating packages in x86 World in Chapter 12, “Installing and updating packages in x86 World,” on page 55). This section summarizes the following areas of the x86 system that might need configuring or migrating:

- Local or remote user authentication
- Remote file systems
- x86 daemon configuration
- Environment variables

#### Local and remote user authentication

The local users within x86 World are separate from the local users on the POWER system.

The root password for x86 World can be the same as the root password for the POWER system, but the root password for x86 World is stored and maintained in the password files in x86 World.

If an x86 application creates a new user (for example, during installation), then this user is created in x86 World and is not available on the POWER system.

For more details about setting up local users in the x86 World, please see Chapter 22, “Managing local users, groups, and passwords with PowerVM Lx86,” on page 97.

Remote user authentication is also supported in the x86 World. For details, please see Chapter 21, “Managing remote users with PowerVM Lx86,” on page 95.

## Remote file systems

Non-local file systems can be made accessible from the x86 World. This is done by mounting the file system on the POWER system. You can mount the remote file system directly to a mountpoint within x86 World, or to a mountpoint external to x86 World, and then you use the **linkx86** command from the POWER side to create an escape to the mountpoint. Note that you can only use the **linkx86** command to create an escape on the POWER system and not from within a VxE. For details about creating mountpoints, please see “Installing x86 applications.”

## x86 configuration and daemons

x86 daemons are supported in the x86 World. Applications that use daemons will normally install and configure the daemons automatically when the application is installed.

It might be necessary to manually migrate x86 daemons onto the POWER system. Daemons can be automatically started in a VxE on the host system by inserting a suitable script in the *X86WORLD\_ROOT/etc/init.d* directory. See “x86 /etc/init.d support scripts” on page 71 for more information on how x86 daemons are handled by PowerVM Lx86.

---

## Installing x86 applications

This procedure describes how to install x86 applications onto a POWER system.

Installing an x86 application onto a POWER system is the next step after you install PowerVM Lx86 and configure the system. Installing x86 applications consists of the following tasks:

- Install, copy, or set access to the x86 application binaries.
- Transfer data, or set access to application data.
- Create access to required devices, such as remote file systems.

### Install, copy, or set access to the x86 application binaries

The x86 application binaries must be either installed in x86 World, or made accessible from x86 World.

To install binaries into x86 World, copy them directly into x86 World (or to a location accessible from x86 World through an escape or a mountpoint). If x86 application installation scripts or packages exist, then you can copy them into x86 World, or an accessible location, and run them using the **runx86** command.

You can make application binaries that are already installed on an x86 machine on the network accessible from x86 World either by creating a mountpoint on the POWER system and creating an escape from x86 World to the mountpoint, or by mounting a remote filesystem to a mountpoint within x86 World.



Java™ installation scripts will need the Java runtime libraries installed first (see Installing Java applications in x86 World below), although many ISV applications provide a Java runtime library as part of the installation.

### Transfer data, or set access to application data

If an x86 application requires access to specific data, the data must be made available. You can do this by copying the data to a location within x86 World, or making it available through a mountpoint or an escape.

Data stored in files on disk can be transferred between x86 machines and POWER machines without the need for any conversion. Provided the necessary mounts or escapes are created, an x86 application running with a VxE is able to access data stored in files that reside on both x86 and POWER file systems.

The example below shows how to make a CD drive accessible to the x86 World. The same technique can be used to make directories or files available to the x86 World.

## Creating mountpoints or access to devices

This procedure describes how to create a mountpoint for the x86 World or access to devices needed by x86 applications. A device, directory or file can be made accessible from x86 World either by creating a mountpoint on the POWER system and creating an escape from x86 World to the mountpoint, or by mounting a remote filesystem to a mountpoint within x86 World, or copying the contents of the directory or files to the x86 World itself.

### Create access to required devices

Some applications might require access to specific devices, such as tape drives. It is recommended that access to these devices are set in the Linux on POWER operating system.

Most applications will not require access to specific devices to be configured. Many common devices such as file storage and network interfaces appear to applications as files or directories in the VxE filesystem.

Standard devices that are not accessible by default, such as CD devices, should be mounted from the POWER system directly to a mountpoint within x86 World. Alternatively, you can mount to a mountpoint external to x86 World and then use the **linkx86** command to create an escape to the mountpoint. It is possible to mount the device in the VxE, but this is not the best method.

Following is an example of creating access to a device.

### Example: Creating access to a CD drive

In Linux, CD drives appear as devices in the `/dev` directory, such as the `/dev/cdrom` drive. The CD drives are accessed natively by mounting to a directory in the file system. To make a CD drive accessible from the VxE, you can:

1. Mount it at a mountpoint inside the x86 World using the POWER **mount** command.
2. Mount it to a directory accessible from x86 World by an escape using the POWER **mount** command.
3. Mount it using the x86 **mount** command from within a VxE.

These three examples are shown below:

### Mounting from within a POWER shell into the x86 World:

The following is an example of mounting a directory into the x86 World from a POWER shell, and then listing the mounted directory in the translated x86 shell:

```
% mkdir X86_WORLDROOT/cdrom
% mount /dev/cdrom X86_WORLDROOT/cdrom
mount: block device /dev/cdrom is write-protected, mounting read-only
% runx86
$ ls /cdrom
Copyright README installer ...
```

### Mounting from within a POWER shell to an escape accessible from x86 World:

The following is an example of mounting a directory for x86 World from a POWER shell, making that directory visible to the x86 World by creating an escape using the **linkx86** command, and then listing the mounted directory in the translated x86 shell:

```
% mkdir /cdrom
% mount /dev/cdrom /cdrom
mount: block device /dev/cdrom is write-protected, mounting read-only
% linkx86 /cdrom
% runx86
$ ls /cdrom
Copyright README installer ...
```

### Mounting from within an x86 shell:

The following is an example of starting an x86 shell from a POWER shell, and then mounting a directory in the translated x86 shell:

```
% runx86
$ mkdir /cdrom
$ mount /dev/cdrom /cdrom
mount: block device /dev/cdrom is write-protected, mounting read-only
$ ls /cdrom
Copyright README installer ...
```

For further details about creating mountpoints and some potential issues with creating mountpoints within an x86 shell, please see the following section “Issues using mount with PowerVM Lx86.”

## Issues using mount with PowerVM Lx86

Special care must be taken when using the **mount** command in the x86 World and also when using the **mount** command on the POWER system to make devices or directories accessible to x86 World. In particular, special care must be taken when unmounting these devices or directories with the **umount** command.

### Using mount from an x86 shell or application

If a directory or device is mounted from within a translated x86 shell, then the directory must only be unmounted from within a translated shell.

Unmounting the directory in a POWER shell will cause the unmount to occur, but the device may still appear to be mounted in the x86 World. This must then be explicitly cleared.

## Using mount from a Power shell

If a directory or device is mounted from a POWER shell, then the directory must be unmounted from a Power shell only.

## Using NFS mounts within a translated x86 shell or application

Mounting NFS folders from an x86 shell is not supported. Mount the NFS folders from a Power shell into the x86 World or to a mountpoint that is visible to the x86 World.

## Installing Java applications in x86 World

This procedure describes how to install x86 Java applications onto a POWER system.

PowerVM Lx86 can run Java applications on a POWER system. Java applications are run using an x86 Java Virtual Machine (JVM) that is running in the VxE.

**Note:** The correct x86 Java Runtime Environment (JRE) must be installed in x86 World before Java applications can be run.

It is possible to have an entirely different POWER JRE installed on the host system that is running PowerVM Lx86. These libraries do not affect the x86 Java applications.

## Configuring x86 World for Java

The only configuration required is for the JRE to be installed in x86 World, just as on a native x86 machine. Typically this means that it is installed in the `X86_WORLDROOT/usr/bin/` directory. Note that the x86 Java must be installed from an x86 shell.

### Example: installing IBM's J2SE 1.4 runtime binaries:

1. Download the `IBMJava2-142-ia32-JRE-1.4.2-8.0.i386.rpm` file from <http://www.ibm.com/developerworks/java/jdk/linux/download.html> to `X86_WORLDROOT`.
2. Start an x86 shell by entering the following command in a POWER shell:  

```
% runx86
```
3. Install the RPM by running the following command in the translated x86 shell:  

```
$ rpm -ivh IBMJava2-142-ia32-JRE-1.4.2-8.0.i386.rpm
```
4. Follow the installation prompts. Remember that the x86 shell is jailed, so the `X86_WORLDROOT/usr/bin/` directory appears as `/usr/bin/`.

## Running Java applications

Java applications are run using the **runx86** command, just like any other x86 applications. No special switches or system daemons are required.



---

## Part 4. Configuring and maintaining the x86 World and PowerVM Lx86

This reference section provides details about configuring and maintaining the x86 World and configuring PowerVM Lx86.

The reference includes:

- Information about upgrading PowerVM Lx86.
- Installing and updating packages in the x86 World.
- PowerVM Lx86 configuration settings.
- Details of default escapes and virtual files in the x86 World.
- Installing and running x86 daemons.
- SE Linux support for x86 applications.



---

## Chapter 11. Upgrading PowerVM Lx86

You can upgrade earlier versions of PowerVM Lx86.

For systems with a previous installation of PowerVM Lx86 either:

- Upgrade to the new version of PowerVM Lx86, or
- Uninstall PowerVM Lx86 and the x86 World and install the new version of the software and a new x86 World.

Check the PowerVM Lx86 release notes to see which method is recommended for your version of PowerVM Lx86 and x86 World.

---

### Upgrading previous versions of PowerVM Lx86

To upgrade PowerVM Lx86 to the new version, use the following instructions:

1. Check that all running x86 applications and processes have been closed or shut down.
2. Run the installer script: `% ./installer.pl`
3. Select option **2. Upgrade Software.** from the menu.
4. Select option **1. Upgrade a powervm-lx86 installation..**
5. Select option **1. powervm-lx86-<version name>.** to upgrade from the current version of the software.
6. If you are upgrading from PowerVM Lx86 version 1.1.x or 1.2.x , the installer will prompt you to update the install path to use the new product directory name. Would you like to update the install path from `/opt/p-ave` to `/opt/powervm-lx86`? [Y/n] Press Y and then Enter or just press Enter to update the path or N and Enter to use the original directory name.
7. If you are upgrading from PowerVM Lx86 version 1.1.x or 1.2.x , the installer will prompt you to update the log file path. Would you like to update the log file path from `/var/opt/p-ave/log` to `/var/opt/powervm-lx86/log`? [Y/n] Press Y and then Enter or just press Enter to update the log file path or N and Enter to use the log file path.
8. When the upgrade is complete, select option **6. Quit.** from the menu.

---

### Uninstalling previous versions of PowerVM Lx86 and x86 World

To uninstall the previous version of PowerVM Lx86 and the x86 World before reinstalling the latest PowerVM Lx86, use either the installer provided with the currently installed version of PowerVM Lx86 or the one provided with the latest release.

Check the PowerVM Lx86 Release Notes to see if upgrading or uninstalling and reinstalling is recommended for your version of PowerVM Lx86 and x86 World.

Uninstalling the x86 World deletes all the files within the x86 World. Escaped files such as the `/home` directory will not be deleted. You must back up any critical files before uninstalling.

To uninstall a previous version of PowerVM Lx86 and the x86 World together see the instructions in section Chapter 8, “Uninstalling PowerVM Lx86 and x86 World,” on page 31.

Now install the new version of PowerVM Lx86 and the x86 World using the installation script provided with the latest release by running the `installer.pl` script. See “Installing PowerVM Lx86 and x86 World” on page 23.



---

## Chapter 12. Installing and updating packages in x86 World

This section describes how to manage the software packages within the x86 World. As with any normal system, refer to your system administrator for advice and best practices before adding and upgrading software in the x86 World.

The x86 World using PowerVM Lx86 on a POWER system should be managed just as if it were an independent x86 system. The x86 World contains a set of x86 libraries, command line tools, applications and other system files, just like a native Linux on x86 file system. You can install new packages and update existing packages using the standard x86 package management tools, such as RPM. More advanced package management tools, such as system-config-packages (RHEL), up2date (RHEL), and YaST2 (SLES) are also supported.

The following sections provide detailed instructions for installing packages on RHEL4 and SLES10 systems. For other distributions please follow the equivalent procedure as described by your Linux distributor.

**Note:** When updating packages in the x86 World, ensure that you do not update them to a newer version of the Linux distribution than the underlying POWER system. For example, if you are running Red Hat Enterprise Linux 4.4 on the POWER system, ensure that you upgrade the POWER system to Red Hat 4.5 before upgrading the x86 World to that version. See Chapter 4, “System and installation requirements for PowerVM Lx86,” on page 13 for more details on which x86 World Linux distribution versions are supported under PowerVM Lx86 with which POWER operating system versions.

---

### Installing and updating packages for Red Hat (RHEL 4) in x86 World

For Red Hat, the up2date tool is recommended for managing packages. You can use up2date to install new packages and download updates from the internet via the Red Hat Network.

In addition to up2date, the rpm and system-config-packages tools can also be used to add packages to the x86 World. The system-config-packages tool is not installed by default in a minimum x86 World install.

#### Configuring up2date for the first time

1. Enter the `X86_WORLDROOT`, for example by entering the following command in a POWER shell:  

```
% cd /i386
```
2. Run PowerVM Lx86 by entering the following command in a POWER shell:  

```
% runx86
```
3. Become root in a translated x86 shell with the command:  

```
$ su
```
4. Run the up2date tool in the translated x86 shell with the command:  

```
$ up2date --config
```

If you need access to the Internet via a proxy, enter it under httpProxy (option 11) and then enable the proxy (option 3). Save the settings by pressing Enter.

5. If you see a prompt to install a GPG key, do that by entering the following command in the translated x86 shell:

```
$ rpm --import /usr/share/rhn/RPN-GPG-KEY
```

## Registering the system with the Red Hat Network (RHN)

This process only needs to be done once per PowerVM Lx86 installation.

1. Become root in a translated x86 shell by typing:  

```
$ su
```
2. Run the up2date in the translated x86 shell tool by typing:  

```
$ up2date
```

Follow the prompts on the screen. Enter your Red Hat Network registration details. Once complete, you will see the message: "You have successfully registered this System Profile on Red Hat Network."

## Adding packages to the x86 World

The up2date tool is used to add packages and their dependencies into the x86 World.

1. Become root in a translated x86 shell by typing:  

```
$ su
```
2. To install a package, use the `-i` command line option to up2date. For example, to install gcc (and its dependencies) by entering the following command in the translated x86 shell:  

```
$ up2date -i gcc
```

## Updating packages within x86 World

The up2date tool can also update packages within the x86 World.

1. Become root in a translated x86 shell by typing:  

```
$ su
```
2. Perform an online update of the x86 World by entering the following command in the translated x86 shell:  

```
$ up2date --update
```

---

## Chapter 13. Installing and updating packages for Novell SLES 10 in x86 World

For Novell SLES 10, the recommended method for managing (adding and updating) packages is to use the YaST tool.

A media source must be set up to allow YaST to manage packages in the x86 World. The media source contains the SLES 10 Linux distribution ISO images from which YaST can access all the x86 packages. The media source must be either on the local file system or on a shared server.

### Accessing the SLES 10 media source

The instructions assume that the media source has been created on a shared server (fileserver) which can be accessed by each system that needs additional packages installing.

Copy the SLES 10 Linux distribution ISO images into a suitable directory on the shared server. The instructions assume the ISO images are located in `/fileserver/isos/sles10x86`.

The shared server is assumed to already have been mounted on the POWER system to the `/fileserver` directory.

First, ensure the `/fileserver` directory is accessible from within the x86 World:

1. Become root in a POWER shell by typing:  

```
% su
```
2. Run the **linkx86** command in the POWER shell to create the escape to `/fileserver`:  

```
% /usr/local/bin/linkx86 /fileserver
```

Next, verify that the shared server is accessible from with the x86 World:

1. Enter the `X86WORLD_ROOT`, by entering the following command in a POWER shell:  

```
% cd /i386
```
2. Run PowerVM Lx86 by entering the following command in a POWER shell:  

```
% runx86
```
3. List the contents of the media source by typing entering the following command in the translated x86 shell:  

```
$ ls /fileserver/isos/sles10x86
```

The output from this command should list the ISO images on the shared server. If not, check that the shared server is accessible from a POWER shell and check the steps above.

### Configuring YaST to access the media source

Now that the media source is accessible in the x86 World, the next step is to configure YaST to access the media source so that it can find the x86 packages.

1. Become root in a translated x86 shell by typing:

```
$ su
```

2. Run YaST by entering the following command in a POWER shell:

```
$ yast
```

The YaST Control Centre will start and you will see a graphical text screen.

3. Select **Software** from the main menu on the left, and press Enter to confirm.
4. Select **Change Source of Installation** from the Software list on the right, and press Enter to confirm.
5. Press Tab to select the **Add** menu and press Enter to confirm.
6. Press Tab to select **Local Directory** from the list, and press Enter to confirm.
7. Press Tab to select **ISO image**, and press Enter to confirm.
8. Press Tab to select **Browse**, and press Enter to confirm.
9. Navigate to the SUSE SLES10 ISO images (/fileserver/isos/sles10x86) from the browse list using the Tab and Arrow keys and use the Enter key to highlight your selection.
10. Press Tab to select **Ok**, and press Enter to confirm.
11. Press Tab to select **Next**, and press Enter to confirm.
12. A License agreement will be displayed. Press Tab to select **Yes** if you agree to the license, and press Enter to confirm.
13. Press Tab to select **Next**, and press Enter to confirm.
14. Add additional media sources if required by repeating steps 5-13 or press Tab to select **Finish**, and press Enter to confirm.

## Managing packages

Now that YaST is aware of the media sources, it is possible to add or update packages in the x86 World.

1. From the YaST Software menu, select **Software Management**, and press Enter to confirm.
2. Press Tab to select **Filter**, then **Search**.
3. In the **Search Phrase** field, enter the name of the package you want to install, for example, gcc.
4. In the list of available packages, use the arrow keys to navigate and use the enter key to select packages you want to install. Package dependencies will be automatically resolved.
5. Repeat the previous two steps for all packages you want to install.
6. After you have selected all the packages you want to install, use the Tab key to select the **Accept** button, and press Enter to confirm. A prompt to display the resolved dependencies may appear; press the enter key to confirm. YaST will now install the selected packages.
7. At the **Install or remove more packages** prompt, press Tab to select **No**, and press Enter to confirm.
8. After the installation is complete, you can exit YaST by using Tab to select **Quit** and pressing Enter to confirm.

---

## Chapter 14. PowerVM Lx86 configuration settings

PowerVM Lx86 can be configured using various switches. The configuration switches supply parameters to the translator and change aspects of the translator's run time behavior. The configuration switches can be set using a configuration file or by setting environment variables.

### PowerVM Lx86 configuration file

The configuration file is located on the POWER system at: `/etc/opt/powervm-lx86/config`. Configuration switches can be added to the configuration file. The configuration switches are checked whenever a new process or application is started from an x86 shell. Changes made to the configuration switches will not effect processes that are already running.

The configuration switches take the following form:

`<CONFIGURATION_SWITCH>=<VALUE>`

#### Notes:

- Each configuration switch must be entered on a separate line in the configuration file.

By default, no configuration file is present when you install PowerVM Lx86. A configuration file will only be created by the PowerVM Lx86 installation process if non-default options are chosen for any one of the following installation options:

- PowerVM Lx86 directory
- PowerVM Lx86 log file directory
- x86 World directory

### Creating a configuration file

If a configuration file is not present on the system, one can be created using a standard text editor. Save the file as: `/etc/opt/powervm-lx86/config`

### Example configuration file

This is an example of the contents of a configuration file for a PowerVM Lx86 installation with the non-default PowerVM Lx86 directory: `/mylx86/install-location` and the non-default log file location: `/var/mylx86logs/log`

```
POWERMV_LX86_LOCATION=/mylx86/install-location
LOGFILE_PATH=/var/mylx86logs/log
LOCALISATION_FILES_DIR=/mylx86/install-location/locale
```

**Note:** The `LOCALISATION_FILES_DIR` configuration switch is set when a non-default PowerVM Lx86 directory is chosen.

### Configuration file switches

Switches effecting installation directories and log files:

Configuration switch name	Parameters and use
POWERVM_LX86_LOCATION	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> This switch specifies the PowerVM Lx86 installation directory. This should only be updated by the PowerVM Lx86 installer.pl script or set in the configuration file for non-interactive installation, see Chapter 20, “Running the automated installer,” on page 89.</p>
LOGFILE_PATH	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> This switch specifies the PowerVM Lx86 log file directory. If this is changed manually, then a log file directory must exist with the correct permissions (owner and group ‘root’ and set to 01777) before PowerVM Lx86 will run correctly. This defaults to /var/opt/powervm-lx86/log when no configuration switch is set. For non-interactive installations, this value can be set before installation.</p>
SUBJECT_WORLD_ROOT	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> This switch specifies the x86 World directory. This should only be updated by the PowerVM Lx86 installer.pl script or set in the configuration file for non-interactive installation, see Chapter 20, “Running the automated installer,” on page 89. The defaults to /i386 when no configuration switch is set.</p>
LOCALISATION_FILES_DIR	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> This switch specifies the PowerVM Lx86 localization files directory. This should only be updated by the PowerVM Lx86 installer.pl script and will be a subdirectory of the directory set by POWERVM_LX86 called locale.</p>

#### Switches effecting networking support:

**Note:** See Chapter 15, “Default PowerVM Lx86 escapes and virtual files in the x86 World,” on page 65 for more details about the use of these configuration switches.

Configuration switch name	Parameters and use
HAVE_SEPARATE_RESOLV_CONF_FILES	<p><b>Type</b> Boolean</p> <p><b>Parameters</b> y or n</p> <p><b>Use</b> The default is n. Setting this to y will cause PowerVM Lx86 to manage the x86 World resolv.conf file separately from the POWER system version of the file. This is an option for advanced users only.</p>

### Switches effecting the local user management support:

**Note:** See Chapter 22, “Managing local users, groups, and passwords with PowerVM Lx86,” on page 97 for more details about using these configuration switches, in particular the parameters for WORLD\_CHECK\_OR\_SYNC.

Configuration switch name	Parameters and use
HAVE_SEPARATE_PASSWORDS	<p><b>Type</b> Boolean</p> <p><b>Parameters</b> y or n</p> <p><b>Use</b> The default is n. Setting this to y will cause PowerVM Lx86 to favor the x86 World entries for passwords, rather than the entries in the POWER system files.</p>
MERGE_PASSWD_FILES	<p><b>Type</b> Boolean</p> <p><b>Parameters</b> y or n</p> <p><b>Use</b> The default is y. Setting this to n will cause PowerVM Lx86 to manage the /etc/passwd, /etc/group and /etc/shadow (and on Red Hat systems there is also /etc/gshadow) files completely separately from the native POWER system. This is not recommended unless it is explicitly known that there are no security risks involved in doing so.</p>
WORLD_CHECK_OR_SYNC	<p><b>Type</b> String</p> <p><b>Parameters</b> sync_all, check_all, check_passwd, check_group, force_sync_mtab, none</p> <p><b>Use</b> The default is check_all. This switch defines whether the <i>user-ID cron</i> job, which checks for differences between the user files in the x86 World and the POWER system, runs on the system. Setting this to none will disable the <i>user-ID cron</i> job and the system administrator will not be notified of any conflicts between the user files in each environment.</p>

### Switches effecting SE Linux support on RHEL systems:

**Note:** See section Chapter 17, “SE Linux support with PowerVM Lx86,” on page 73 for more details on how to enable and use SE Linux with PowerVM Lx86.

Configuration switch name	Parameters and use
ENABLE_SELINUX_TRANSITIONS	<p><b>Type</b> Boolean</p> <p><b>Parameters</b> y or n</p> <p><b>Use</b> The default is n. If SE Linux is enabled on your Power system, you can enable SE Linux for x86 applications by setting this switch to y. If SE Linux is not enabled or installed on your Power system, enabling this switch will have no affect.</p>

#### Switches effecting floating-point accuracy of PowerVM Lx86:

Configuration switch name	Parameters and use
X87_PRECISION_TYPE	<p><b>Type</b> String</p> <p><b>Parameters</b> 64BIT, 80BIT, 64BIT_PLUS</p> <p><b>Use</b> The default is 64BIT_PLUS. PowerVM Lx86 provides different modes of accuracy for x87 floating-point maths. These modes are 64-bit, 80-bit, or 64-bit plus. The 64-bit mode matches the precision of the underlying POWER processor and has high performance. The 80-bit mode matches the higher precision of the x87 processor and has lower performance. The default 64-bit plus mode aims to provide a hybrid mode, which has the performance of the 64-bit mode, but improves the accuracy to be closer to the 80-bit mode. In the 64-bit plus mode, most calculations are carried out using 64-bit maths, but explicit 80-bit maths will switch to 80-bit mode, before switching back to the 64-bit mode.</p>

#### Switches controlling the virtual memory usage of PowerVM Lx86:

The amount of virtual memory used by PowerVM Lx86 can be restricted, specified as a ratio to the amount of memory used by the x86 application being translated. When PowerVM Lx86’s memory use exceeds this ratio, it will discard Power code translations until it is within the allowed threshold.

The limit is set to 250% of the x86 application’s memory usage by default; that is PowerVM Lx86 will not use more than two and a half times the amount of memory that the x86 application would have used. Setting the value to 100% will cap the memory usage when it reaches 1:1 with the x86 application usage. Setting the ratio to zero will disable the limit. Setting the limit to a low ratio, less than the default, may impact the performance of PowerVM Lx86 and hence the x86 application being translated.



Configuration switch name	Parameters and use
MEMORY_MONITOR_TRIGGER_RATIO	<p><b>Type</b> Integer</p> <p><b>Parameters</b> Integer</p> <p><b>Use</b> The default is 250, limiting the virtual memory usage of PowerVM Lx86 to 250% (or 2.5 times) the memory usage of the x86 application binaries. To disable the Lx86 virtual memory limit, set the value to 0.</p>

### Switches effecting gdb when it is being translated by PowerVM Lx86:

**Note:** See section “Maintaining x86 applications” on page 42 for more details about debugging x86 applications.

Configuration switch name	Parameters and use
EXTRA_DEBUG_SUPPORT_FROM_START	<p><b>Type</b> Boolean</p> <p><b>Parameters</b> y or n</p> <p><b>Use</b> The default is n. Setting this to y will cause PowerVM Lx86 to generate accurate core files for simple x86 applications (single threaded applications and those that do not register signal handlers). This step is not required for the majority of applications.</p>

## Setting configuration switches using environment variables

In addition to setting configuration switches in the configuration file, configuration switches can also be set using environment variables. The configuration switches must be set in a POWER shell before invoking PowerVM Lx86 with the **runx86** command. Some configuration switches affect the global characteristics of PowerVM Lx86 and cannot be set for each shell using environment variables. The configuration switches that can be set using environment variables are listed in the following table:

*Table 3. Configuration switches that can be set using environment variables*

Configuration switches that can be set using environment variables
EXTRA_DEBUG_SUPPORT_FROM_START
X87_PRECISION_TYPE

To set a configuration switch using environment variables, the name of the switch must be preceded with **LX86\_CFG\_** to ensure that PowerVM Lx86 detects that the configuration switch has been set in the environment. Set the configuration switch in the environment of a POWER shell and invoke **runx86** with the following commands in the POWER shell:

```
% export LX86_CFG_<CONFIGURATION_SWITCH>=VALUE
% runx86
```

Any applications that are run from this shell will have this configuration switch set.

To run another x86 application with the default configuration settings, either start a new POWER shell and invoke a new instance of PowerVM Lx86 with the **runx86** command or unset the switch in the current shell. To do this, exit from the translated x86 shell and return to the POWER shell where the environment variable was originally set, unset the value and then reinvoke **runx86** with the following commands in the POWER shell:

```
% unset LX86_CFG_<CONFIGURATION_SWITCH>
% runx86
```

Different x86 applications can be run concurrently with different configuration switches set by invoking them from different POWER shells with the environment variables set to the appropriate values.

---

## Chapter 15. Default PowerVM Lx86 escapes and virtual files in the x86 World

This section describes how virtual files are handled and how they are useful for system administrators managing a system with PowerVM Lx86 installed. In addition, the PowerVM Lx86 installer sets up some escapes by default that allow PowerVM Lx86 access to certain directories, files, and sockets on the POWER system.

---

### Virtual files and directories

PowerVM Lx86 maintains some system files in x86 World as virtual files.

#### Passwd, group, and shadow files

See Chapter 22, “Managing local users, groups, and passwords with PowerVM Lx86,” on page 97 for information on how PowerVM Lx86 manages user administration files within the x86 World. PowerVM Lx86 manages the files in the following table:

Name	Type of virtual file	Directory (D), File (F), or Socket (S)
/etc/passwd	Merged	F
/etc/group (optional during installation)	Merged	F
/etc/gshadow (RHEL only)	Merged	F
/etc/shadow	Merged	F

These files are virtual, and the contents are managed by PowerVM Lx86. In addition, physical files exist for these in the x86 World. The virtual file is a merged file, meaning that the contents are generated by merging the contents of the x86 World physical file and the POWER system version of the file.

If the files are written by a translated x86 application or shell, the underlying physical file in the x86 World will be updated. The change will be visible in the combined virtual view generated by PowerVM Lx86. In addition, any changes in this file will be detected by the user ID cron job, and the system administrator may be notified of any inconsistencies between the x86 World file and the POWER system file. See Chapter 22, “Managing local users, groups, and passwords with PowerVM Lx86,” on page 97 for more information.

#### utmp and wtmp

Name	Type of virtual file	Directory (D), File (F), or Socket (S)
/var/run/utmp	Contents as POWER system	F
/var/log/wtmp	Contents as POWER system	F

Both of these files are created during installation of the x86 World. In addition, physical files exist for these in the x86 World. In this case, the physical files are just stubs and will not be updated by any translated x86 application or shell. The virtual files have exactly the same contents as the equivalent files on the POWER system.

Writing to these from a translated x86 application, or while in a translated x86 shell causes an update to the file on the POWER system. There is effectively only one version of the file on the entire system – the one on the POWER system.

Updates to the POWER system version of the file are reflected in the virtual view of the file from within the x86 World.

If the physical x86 World files are opened from a non-translated shell (for example, by running `vi /i386/var/run/utmp`), then any changes are written back to the physical stub, but PowerVM Lx86 ignores the changes, and they are not visible to translated applications. They will only see the contents of the virtual file.

Do not delete the stub files. If you delete the `utmp` or `wtmp` x86 stub files this will normally have no effect, but it could cause a failure in applications that attempt to find the files, since the files will not appear in a directory listing.

**Note:**

- Although deleting the stub files is not recommended, if you want to delete them, it is only possible to delete either of the stub files using a native POWER shell (for example, `rm /i386/var/run/utmp`). If you attempt to delete the files from a translated x86 shell, it will fail.
- Editing the stub files from an x86 shell is not recommended. They are binary files and contain specific data structures. Editing the files manually may corrupt the data structures of the underlying POWER versions of the files.

**/etc/resolv.conf**

Name	Type of virtual file	Directory (D), File (F), or Socket (S)
/etc/resolv.conf	Contents as POWER system	F

This file is virtual, PowerVM Lx86 manages the contents, and it is the same as the POWER system version of the file. In addition, a physical file exists in the x86 World. The contents of the physical file are an exact copy of the POWER system version of the file at the point when PowerVM Lx86 is installed.

The virtual file can be read from a translated x86 application, or while in a translated x86 shell, but it cannot be written to. If you need to update the contents of the file, you must update the POWER system version of the file. Once the file has been updated, the change is seen by applications in the x86 World.

It is possible for PowerVM Lx86 to manage the x86 World `/etc/resolv.conf` file independently of the POWER system version in advanced mode. In this case, the physical file is visible to translated x86 applications and from a translated shell.

**HAVE\_SEPARATE\_RESOLV\_CONF\_FILES=y**

The configuration switch to enable advanced mode. This causes the

contents of the x86 file to be used. Any changes to the x86 file will be seen by translated x86 applications. In this mode, if you change the POWER file, this will not be seen by translated applications.

#### **HAVE\_SEPARATE\_RESOLV\_CONF\_FILES=n**

To disable advanced mode, either set the switch to this or remove the line from the configuration file. The contents of the POWER file will be visible to translated x86 applications. The x86 file will not be affected.

If you try to delete the /etc/resolv.conf file from an x86 shell you will get an error. The x86 version of the file must exist so that it can be opened, but its contents are virtual and appear the same as the POWER file. The x86 version of the file can be deleted from a POWER shell (for example, `rm /i386/etc/resolv.conf`). Once deleted, the file will not be visible to x86 applications. After deleting the x86 file, the user can recreate the file from a POWER shell. The contents of the x86 file are ignored and will always have the contents of the POWER file.

### **/proc**

Name	Type of virtual file	Directory (D), File (F), or Socket (S)
/proc	Entirely virtual	D

The /proc directory is created by the PowerVM Lx86 installer. There are no physical files in the /proc directory. If inspected from a non-translated shell, the directory appears to be empty (for example, `ls /i386/proc`). The entire contents of the /proc directory are virtual and managed by PowerVM Lx86 to represent the detailed processor and system information of an x86 platform. The specific contents of the /proc tree vary depending on the specific OS distribution that is installed for the x86 World and on the underlying POWER system.

Some of the directories and files in /proc are very specific to the x86 hardware and are not supported by PowerVM Lx86. PowerVM Lx86 will deny access if any attempts made to access these directories and files.

---

## **Default escaped directories, files, and sockets**

Directories and files are created as escapes when PowerVM Lx86 is installed. These are required for PowerVM Lx86 to function.

x86 World path or filename	Directory (D), File (F), or Socket (S)
/dev	D
/home (optional during installation)	D
/media	D
/mnt	D
/selinux (RHEL only)	D
/sys	D
/var/yp/binding	F

As an example, /home in the x86 World (the directory itself is visible as /i386/home from a POWER shell) is escaped to /home on the POWER system.

This means that x86 and POWER applications share home directories on the system. See “Jailing and escapes for PowerVM Lx86” on page 9 for more details.

---

## Syslog support

Support for logging system messages is handled in a special manner for PowerVM Lx86 so that system messages in the x86 World and the POWER system are kept separate.

Kernel messages are only logged by the POWER system and are found in `/var/log/messages` by default. System messages generated by POWER applications are also logged there by default. System messages generated by translated x86 applications are logged in `/var/log/messages` in the x86 World (for example, `/i386/var/log/messages` from a POWER shell).

### System logging background

It is possible to run the system logging daemons within x86 World, but the sockets and files they use are handled specially by PowerVM Lx86. The `/etc/init.d/syslog` script starts two daemons: **klogd** and **syslogd**. The **klogd** daemon is responsible for collecting any messages that have come directly from the kernel. It can do this by either reading `/proc/kmsg` (default) or by making the **syslog** system call. If there is no data to read in `/proc/kmsg` **klogd** blocks and waits for data to appear. When **klogd** gets messages from the kernel, it passes them to the **syslogd** daemon via the `/dev/log` socket. The **syslogd** daemon waits on the `/dev/log` socket for data which can come from either **klogd** or directly from a user program such as **initlog** or **logger**. The messages are then written to the `/var/log/messages` file.

### System logging with PowerVM Lx86

In the x86 World, the **syslog** system call, `/proc/kmsg` file, and `/dev/log` files are handled in a special manner. If a translated x86 **klogd** process tries to read data from `/proc/kmsg`, PowerVM Lx86 will never read `/proc/kmsg`, but instead blocks the process by never returning any data. Therefore, kernel messages are not logged into the x86 World `/var/log/messages` file.

Kernel messages are only logged by the POWER system and will be found in `/var/log/messages` by default.

Any translated x86 processes such as **syslogd** that perform operations on the `/dev/log` socket will work as normal, however, PowerVM Lx86 will not open `/dev/log`, but instead will open the file `/var/opt/powervm-lx86/devLog` instead. All operations on `/dev/log` will map directly to the socket file `/var/opt/powervm-lx86/devLog`. If an x86 process tries to delete `/dev/log` it will actually correspond to deleting `/var/opt/powervm-lx86/devLog`. The system logs will be written to `/var/log/messages` in the x86 World (for example, `/i386/var/log/messages` from a POWER shell). Only messages from translated x86 applications are logged in the `/var/log/messages` file in the x86 World. All other messages are logged in `/var/log/messages` on the POWER system. This ensures that translated x86 processes cannot collect messages either from the kernel or other POWER processes.

**Note:** The `/dev` directory is escaped by default in the x86 World to the `/dev` directory on the POWER system. The `/dev/log` file is a special case and is not escaped.

<b>x86 World log socket</b>	<b>Maps to</b>	<b>Directory (D), File (F) or Socket (S)</b>
/dev/log	/var/opt/powervm-lx86/ devLog	S





---

## Chapter 16. Starting x86 daemons with PowerVM Lx86

You can run x86 daemons in the VxE.

The PowerVM Lx86 `/etc/init.d/powervm-lx86` script starts any x86 daemons in x86 World after starting the PowerVM Lx86 daemon.

The script runs whenever the POWER system is booted or the runlevel changes to 2, 3, or 5. The script triggers the rc script for the x86 distribution (rc is responsible for starting and stopping services on runlevel changes) and starts the appropriate x86 services according to the current runlevel of the POWER distribution. For example, if the current runlevel on the POWER distro is 3, the x86 distro will start the x86 services configured for runlevel 3.

---

### x86 /etc/init.d support scripts

On a Linux system, the `/etc/init.d` directory contains initialization and termination scripts for setting up subsystems or start-stop services.

#### Introduction

Every kernel runlevel has a corresponding directory in `/etc/rc{0-6}.d` (for example, `rc0.d`, `rc1.d` etc.) where symbolic links are created to the scripts located under `/etc/init.d/`. When the system boots, reboots, or there is any other runlevel change, the symbolic links are called to start and stop services.

The scripts are called by the rc script according to a priority number and script name. In a system with PowerVM Lx86 installed, there are two sets of `init.d` scripts. One set corresponds to the host POWER system, and the other set corresponds to the x86 World.

PowerVM Lx86 contains a number of utilities that enable the execution of `init.d` scripts in the x86 World with every runlevel change on the host system. This infrastructure allows PowerVM Lx86 to start x86 services with `init.d` scripts in the same way as if they were running on the original x86 platform in a completely transparent way for the system administrator.

If a newly installed x86 application adds entries to the x86 World `init.d` scripts, they are handled correctly, with the new services being started or stopped when the system boots, reboots, or when the runlevel changes, or when the PowerVM Lx86 daemon is started or stopped manually.

#### Implementation

A new installation of PowerVM Lx86, and corresponding x86 World, only have a limited number of services enabled. These are only `dbus` and `syslog`. During installation of the x86 World, once all the x86 RPMs are installed, the installer clears the `/etc/rc{0-6}.d` directories, leaving only the necessary services for initial operation of PowerVM Lx86.

After installation, the administrator has the opportunity to start any installed service using the normal utilities provided with the distribution. These typically include `chkconfig` and other distribution specific tools, such as SUSE's `YaST2`.

During normal operation, every time the POWER system boots, reboots, or changes runlevel, a PowerVM Lx86 script is run to trigger the execution of the corresponding init.d scripts in the x86 World. This PowerVM Lx86 script acts as a wrapper for the rc script in the x86 World. These PowerVM Lx86 scripts are named `powervm-lx86-rc{2-5}`, and are installed in the `/etc/init.d` directory in the host system.

Some of the services that normally run on an x86 environment are not necessary in a PowerVM Lx86 x86 World. This implementation checks that these unnecessary services, or any services that conflict with already running POWER services, are disabled. In addition, SUSE allows dependencies to be defined between the scripts. Therefore, as part of the installation process and later as part of the maintenance tasks, a dependency checker will be run to edit the init.d scripts and delete any known unnecessary dependencies (for example, `boot.*`, `acpid`, `haldemon`, and so on).

The perl script that edits the init.d scripts is named `dependency_checker.pl`, and the installer calls it as the final step in the installation process, and during normal operation when a change in the x86 World `/etc/init.d` directory is detected. Notification of changes in the x86 World `/etc/init.d` directory are sent to a directory monitor called `rc_monitor`. This program receives events when new files are added or when the permissions are changed on existing files. These events trigger the execution of the `dependency_checker.pl` script.

The directory monitor, `rc_monitor`, is installed in `/etc/init.d/powervm-lx86-rcmonitor`. Although this is invoked automatically by the `/etc/init.d/powervm-lx86` script (which also invokes the `powervm-lx86-daemon`), the `rc_monitor` can be controlled independently of the `/etc/init.d/powervm-lx86` script by running `/etc/init.d/powervm-lx86-rcmonitor` manually.

The `powervm-lx86-rcmonitor` has the following usage options:

```
/etc/init.d/powervm-lx86-rcmonitor [start|stop|force-reload|restart|status]
```

---

## Chapter 17. SE Linux support with PowerVM Lx86

SE Linux is supported by PowerVM Lx86 when running on RHEL. This section describes how to enable SE Linux and how to configure security polices to work with PowerVM Lx86.

### Overview of SE Linux support in PowerVM Lx86

As of version 1.3, PowerVM Lx86 provides support for running translated x86 applications in restricted SE Linux domains on Red Hat Enterprise Linux (RHEL) systems. This chapter provides an overview of this support, including instructions for enabling it and information on creating custom policies for x86 applications. Some familiarity with SE Linux concepts is assumed in this chapter; for a more complete description of SE Linux itself, please refer to your Red Hat documentation.

Prior versions of PowerVM Lx86 ran all processes in the `unconfined_t` domain, including those processes for which more restricted domains were defined in the SE Linux policy. For version 1.3 and above, this remains the default behaviour; after installing PowerVM Lx86 for the first time all x86 processes will continue to run without domain-specific SE Linux restrictions. By installing PowerVM Lx86 extensions to the standard SE Linux policies, x86 processes can be restricted to domains, and the SE Linux features of the underlying Linux kernel will enforce these restrictions. For guidance on installing and enabling these policy extensions and configuring PowerVM Lx86 to use them, please refer to the next section.

Due to certain additional requirements of the PowerVM Lx86 translator, including the need to communicate with the PowerVM Lx86 daemon, translated x86 processes are not able to run in the restricted domains provided by the standard SE Linux policies. In order to support SE Linux, for each domain in the base policy, an equivalent PowerVM Lx86 domain has been created, which permits each domain access to a small number of additional operations as required by the PowerVM Lx86 translator. These extra domains, and the supporting policy rules, are distributed in the PowerVM Lx86 rpm in both binary and source form. When these policy extensions are installed, the PowerVM Lx86 translator will adhere to the SE Linux policy when the `ENABLE_SE_LINUX_TRANSITIONS` switch is turned on in the PowerVM Lx86 config file.

For example, the syslog daemon, `syslogd`, will run in the `syslogd_t` domain on an SE Linux enabled Red Hat system. When SE Linux is enabled for PowerVM Lx86 and the x86 syslog daemon is started it will run in the `lx86_syslogd_t` domain, which is defined in the policy extensions provided with PowerVM Lx86. This domain is very similar to the normal `syslogd_t` domain, but it also allows for the additional requirements of the translator.

As well as extra PowerVM Lx86 domains to support translated x86 processes, the PowerVM Lx86 daemon is also run in its own restricted domain, `lx86_t`. Note that only the domains in Red Hat's targeted policies are supported by PowerVM Lx86. Although it is possible to run PowerVM Lx86 in more comprehensive policies, such as the strict policy, no additional policy extensions are provided or supported with PowerVM Lx86. Note also that during installation of an x86 World, such as when Lx86 is first installed, the PowerVM Lx86 SE Linux support must be disabled. The installer will not allow x86 World installation to proceed with SE

Linux support enabled in PowerVM Lx86. To disable PowerVM Lx86's SE Linux support, simply set `ENABLE_SE_LINUX_TRANSITIONS=n` in the config file.

---

## Enabling SE Linux in PowerVM Lx86

To enable support for SE Linux in PowerVM Lx86, some additional steps are required. PowerVM Lx86 supplies a prebuilt binary SE Linux policy for each supported version of RHEL 4, and a set of binary policy modules for RHEL 5. Additionally, policy source files are provided for users wishing to use custom policies. The steps needed to enable SE Linux in PowerVM Lx86 for each RHEL version are provided below. Details of how custom policies are supported are provided in the next section.

Note that any changes to the SE Linux configuration, for example enabling or disabling SE Linux on the Power machine or making any changes to the SE Linux policy or the SE Linux setting in the PowerVM Lx86 config, should be made while no x86 processes are running. To ensure that no x86 processes are running, close all running x86 applications, then execute:

```
% /etc/init.d/powervm-lx86 stop
```

After stopping all translated processes and the `powervm-lx86-daemon`, the following steps are required to enable PowerVM Lx86's SE Linux support. All of these steps should be run as the root user, from a native Power shell.

### Enabling SE Linux in PowerVM Lx86 for RHEL 4

1. Enable SE Linux on the Power machine. If SE Linux is not enabled in the Power kernel, PowerVM Lx86 cannot make use of its features. If SE Linux is not already enabled, please refer to your Red Hat Linux documentation for details on how to do this.
2. Install the appropriate binary policy. The supported binary policies are provided in the SE Linux subdirectory of the PowerVM Lx86 install (by default, this will be `/opt/powervm-lx86/selinux`). For each supported RHEL 4 revision there is a directory containing the files specific to this version; for example the RHEL 4 update 4 files are provided in `/opt/powervm-lx86/selinux/rhel4u4`. Select the appropriate directory for the RHEL 4 version of your Power machine, and copy the `policy.18` file into the `/etc/selinux/targeted/policy` directory, for example:

```
% cp /opt/powervm-lx86/selinux/rhel4u4/policy.18
    /etc/selinux/targeted/policy/policy.18
```

3. Install the appropriate file contexts. Accompanying each binary policy is a set of file contexts listing how the filesystem should be labelled. For each RHEL 4 revision, there is a `file_contexts` file in the same directory as the policy. This must be placed in the `/etc/selinux/targeted/contexts/files/` directory, for example:

```
% cp /opt/powervm-lx86/selinux/rhel4u4/file_contexts
    /etc/selinux/targeted/contexts/files/file_contexts
```

4. Load the new policy. Having installed the policy files, the new policy can be enabled by executing:

```
% /usr/sbin/load_policy /etc/selinux/targeted/policy/policy.18
```

Alternatively, rebooting the Power system will cause this policy to be loaded.

5. Ensure that PowerVM Lx86 files are correctly labelled. To reset the labels for PowerVM Lx86's files and directories based on the new policy, either invoke a full filesystem relabel (as described in your Red Hat Linux documentation), or execute `restorecon` on the PowerVM Lx86 package's files:

```
% rpm -ql powervm-lx86 | restorecon -vR -f -
```

Note the dash (-) at the end of the command line options for restorecon.

6. Enable PowerVM Lx86 domain transitions in the PowerVM Lx86 config file. To do this, add an entry to `/etc/opt/powervm-lx86/config` as follows:

```
ENABLE_SELINUX_TRANSITIONS=y
```

7. Finally, start the PowerVM Lx86 daemon using the init script:

```
% /etc/init.d/powervm-lx86 start
```

All PowerVM Lx86 processes, as well as the PowerVM Lx86 daemon, will now run in confined domains. Note that these domains are not the same as those available to Power processes. For example, a process that would normally run in the `unconfined_t` domain will now run in `lx86_unconfined_t`. This difference is not visible to translated x86 processes, but may be observed from the host Power system. No further action should be required to make use of the SE Linux features. Executing **runx86** to start a translated shell will now automatically move into an equivalent lx86 domain.

## Enabling SE Linux in PowerVM Lx86 for RHEL 5

1. Enable SE Linux on the Power machine. If SE Linux is not enabled in the Power kernel, PowerVM Lx86 cannot make use of its features. If SE Linux is not already enabled, please refer to your Red Hat Linux documentation for details on how to do this.

2. Load the policy module for the core PowerVM Lx86 types. This module is provided in the SE Llinux subdirectory of the PowerVM Lx86 install (by default, this will be `/opt/powervm-lx86/selinux`). This module is compatible with all supported releases of RHEL 5. To load the module, enter:

```
% semodule -i /opt/powervm-lx86/selinux/lx86.pp
```

3. Ensure that PowerVM Lx86 files are correctly labelled. To reset the labels for PowerVM Lx86's files and directories based on the new policy, either invoke a full filesystem relabel (as described in your Red Hat Linux documentation), or execute restorecon on the PowerVM Lx86 package's files:

```
% rpm -ql powervm-lx86 | restorecon -vR -f -
```

Note the dash (-) at the end of the command line options for restorecon.

4. Load the policy module for the translated SE Linux domains. A policy is provided for each supported release of RHEL 5, and is located in the corresponding subdirectory of the PowerVM Lx86 installation. For example, for RHEL 5 update 3, the policy module will be located in `/opt/powervm-lx86/selinux/rhel5u3` by default. To load this module, enter the following:

```
% semodule -i /opt/powervm-lx86/selinux/rhel5u3/lx86_x86.pp
```

5. Enable PowerVM Lx86 domain transitions in the PowerVM Lx86 config file. To do this, add an entry to `/etc/opt/powervm-lx86/config` as follows:

```
ENABLE_SELINUX_TRANSITIONS=y
```

6. Finally, start the PowerVM Lx86 daemon using the init script:

```
% /etc/init.d/powervm-lx86 start
```

All PowerVM Lx86 processes, as well as the PowerVM Lx86 daemon, will now run in confined domains. Note that these domains are not the same as those available to Power processes. For example, a process that would normally run in the `unconfined_t` domain will now run in `lx86_unconfined_t`. This difference is not visible to translated x86 processes, but may be observed from the host Power system. No further action should be required to make use of the SE Linux features.

Executing **runx86** to start a translated shell will now automatically move into an equivalent lx86 domain.

---

## Building custom policies for PowerVM Lx86

If PowerVM Lx86 SE Linux support is required on a Red Hat system using a custom SE Linux policy, or if modifications to the PowerVM Lx86 policies are needed, some additional steps may be required. Note that this section assumes familiarity with the process of compiling and loading SE Linux policies for your particular Red Hat version.

### Customizing or adding PowerVM Lx86 domains

This section describes how to install PowerVM Lx86 policy extensions into an environment where the policy in use is different to the default targeted policy provided by Red Hat. For details on configuring or adding PowerVM Lx86 domains, please see the next section.

For RHEL 5, this configuration is already catered for by the modular policy. The PowerVM Lx86 policies are provided in two modules, `lx86.pp` and `lx86_x86.pp`, which can be loaded into custom policies, or loaded along side other modules as required.

For RHEL 4, only a single monolithic policy is supported. To allow PowerVM Lx86 policy extensions to operate correctly in a custom policy, it will be necessary to compile a new policy including both the local customizations and the PowerVM Lx86 extensions. In order to do this, four files from the PowerVM Lx86 rpm must be included in the policy sources: `lx86.te`, `lx86.fc`, `lx86_x86.te` and `lx86_x86.fc`. Note that the different `lx86_x86` files are provided for each minor release of RHEL 4. Copy the appropriate `.te` and `.fc` files into the appropriate subdirectories of the SE Linux policy source tree, along with any local customizations required, and recompile the policy.

For example, on a RHEL 4 update 6 system, it will be necessary to copy `/opt/powervm-lx86/selinux/lx86.te` and `/opt/powervm-lx86/selinux/rhel4u6/lx86_x86.te` into the `domains/program` subdirectory of the SE Linux policy source. `/opt/powervm-lx86/selinux/lx86.fc` and `/opt/powervm-lx86/selinux/rhel4u6/lx86_x86.fc` should be copied to the `file_contexts/program` subdirectory. For further details on this process, please refer to the Red Hat documentation.

If customization of an PowerVM Lx86 domain is needed, or if a new PowerVM Lx86 domain is to be added, the PowerVM Lx86 policy extensions will need to be recompiled. For RHEL 4, this can be done simply by modifying the `lx86_x86.te` file and recompiling the monolithic policy as described in the preceding section.

For RHEL 5, the `lx86_x86` policy module must be recompiled, then reinstalled into the policy. To do this, in the directory containing the policy module for the appropriate RHEL 5 version, for example, `/opt/powervm-lx86/selinux/rhel5u1`, execute the following commands:

```
% make -f /usr/share/selinux/devel/Makefile lx86_x86.pp
% semodule -i lx86_x86.pp
```

Note that the `selinux-policy-devel` package must be installed to recompile the policy.



The remainder of this section briefly discusses the details of PowerVM Lx86 policy modification.

As described above, each domain which is used by a translated PowerVM Lx86 process must provide a number of additional operations to permit PowerVM Lx86 to function correctly. These extra rules are defined in the PowerVM Lx86 policy extensions with respect to the `lx86_domain` attribute. Each PowerVM Lx86 domain has this attribute, and thus is permitted the additional access required to run under translation. Any new domains which are added to the policy for use in the x86 environment must also declare this attribute, or they may fail to operate correctly.

Having defined the new domain, created the required policy rules for it and added the `lx86_domain` attribute, the entry points to the domain must be considered. If the domain is to be entered by a transition caused by executing files with particular labels, such as is the case of the standard targeted daemons (for example, `syslogd_t` entered by executing `syslogd_exec_t` files), then two such `exec_types` must be created. Firstly, the type of the executables must be created (`syslogd_exec_t` in the above example). Secondly, an additional `exec` type is needed by PowerVM Lx86 to make the transition; this must be named the same as the first `exec_type`, but with an `lx86_` prefix (for example, `lx86_syslogd_exec_t`). This type is required by the PowerVM Lx86 translator to make the transition between domains when the binary is executed.

Finally, to complete the addition of the new domain, an entry must be added to `/etc/opt/powervm-lx86/exec_types`. This is a simple list of the supported domain entry points in the current policy. The entry added here should be the type without the `lx86_` prefix.

The new policies may now be loaded onto the system. As described above, it is important to ensure that all PowerVM Lx86 processes and the PowerVM Lx86 daemon are shut down before making modifications to the underlying policy.





---

## Part 5. Advanced PowerVM Lx86 installation features

This section provides a reference to the advanced features of the PowerVM Lx86 installer. This reference includes how to use the automated installation features of the PowerVM Lx86 installer and how to archive an installed x86 World for backup, migration to another system, or distribution to a set of systems.

### Overview of advanced installation features

Enhanced installer supports:

- Archiving previously installed x86 Worlds for backup or migration to other systems.
- Automated installation for non-interactive installation of both PowerVM Lx86 and the x86 World. The automated installation facility also supports installing the x86 World from an archive.
- IBM Installation Toolkit for Linux on Power.

The following sections describe how to use the advanced features of the installer.

### IBM Installation Toolkit for Linux on Power support

The IBM Installation Toolkit for Linux on Power is supported by PowerVM Lx86 and will make use of the advanced PowerVM Lx86 installation features.

See the IBM Installation Toolkit for Linux on Power website for further details, <http://www.ibm.com/developerworks/power/library/l-power-installation-toolkit/index.html>.



---

## Chapter 18. Creating an archive of the x86 World

For an existing PowerVM Lx86 and x86 World installation, the x86 World can be archived for backup, migration to another system, or distribution to a set of systems.

Once you have installed PowerVM Lx86 and the x86 World onto a system, you can create an archive of the x86 World at any point. The PowerVM Lx86 installer is used to create the archive and also used to unpack the archive onto the same or another system. A common deployment option is to create an x86 World installation on one system. You can install any additional custom packages, x86 applications and data files within that x86 World. Once the x86 World meets all your requirements, an archive can be made which can then be easily installed on multiple systems.

### Note:

- The **star** package must be installed on the system before an archive can be created or installed. The PowerVM Lx86 installer script will inform you if the **star** package is not installed.
- The installer will suggest a default name for the archive file. Any name and extension is allowed.
- Any escapes in the x86 World will be preserved in the archive and will be recreated by the installer when the archive is installed on another machine, even if the location of the x86 World is different from the original x86 World.
- An x86 World archive can only be created in the interactive mode. Although you can install an archive onto a system using the non-interactive mode, you cannot create an archive using non-interactive mode. See Chapter 20, “Running the automated installer,” on page 89 for more details about the installer non-interactive mode.

1. Become root on the POWER system.

2. Run the PowerVM Lx86 installation script:

```
% ./installer.pl
```

The installer will start and the following prompt is displayed:

```
Host OS detected as Red Hat Enterprise Linux release 4 (RHEL4U6)
```

```
Welcome to the PowerVM Lx86 Installer
```

```
To run Linux/x86 applications the installation will require Linux/x86
application binaries, libraries and infrastructure files as well as the
PowerVM Lx86 software.
```

```
Please refer to the PowerVM Lx86 Administration Guide and Release Notes
for further details of the installation requirements.
```

```
License file found
```

```
Registration with IBM
```

```
Existing registration with IBM has been found
in /etc/opt/powervm-lx86/activation-detail.
Would you like to re-register? [y/N]
```

3. If you want to re-register the PowerVM Lx86 product then press **y** and Enter. Usually you will just press Enter to proceed without re-registering. You will see the following prompt:

Registration with Red Hat Inc.  
Would you like to register? [y/N]

4. If you want to register again with Red Hat Inc. then press y and the press Enter. Usually you will just press Enter to proceed without re-registering. You will see the standard installer menu prompt:

```
1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.
```

Please select the type of operation you would like to perform:

5. Select option 5 and press Enter to go to the archive menu. You will see the following prompt:

```
1. Create archive of x86 World.
2. Go back to the Main Menu.
```

Please select the type of operation you would like to perform:

6. Select option 1 and press Enter to configure the settings for the archive location and file name. You will see the following prompt:

If any x86 applications are still running, the system prompts you with the following message:

```
The following translated processes (pids) are running:
xxxxx xxxxx xxxxx
```

You cannot create an archive while there are translated processes running.

Kill these processes to continue.

Do you want to kill these processes now? [y/N]

7. Enter y followed by the Enter key to kill the running x86 applications.

The system prompts you with the following message:

In what directory should the archive be placed? [/]

8. Enter the name of a directory where the x86 World archive will be saved, for example /tmp. You will see the following prompt:

```
What should the file be called?
[powervm-lx86-archive-RHEL4U6AS_FULL.bin]
```

9. The installer will suggest a default name for archive that includes, for reference, the name of the Linux distribution used to create the x86 World. To accept the suggested name, press Enter or type a filename and press Enter. You will see the following output as the archive is being created and you will then be returned to the installer menu:

```
Creating archive /tmp/powervm-lx86-archive-RHEL4U6AS_FULL.bin.
This may take several minutes to complete. Please wait...
Done.
```

```
1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.
```

Please select the type of operation you would like to perform:

10. The archive has now been created. Exit the installer by typing 6 and pressing Enter. The installer will provide a summary of the archive you have created. All actions have been recorded in the installer log file.

Thank you for using the PowerVM Lx86 Installer

Today you performed the following transactions:

Created archive of x86 World in  
/tmp/powervm-lx86-archive-RHEL4U6AS\_FULLL.bin

End of Transaction log.

To start a translated x86 World shell, run /usr/local/bin/runx86

The full log of your session is in /tmp/powervm-lx86\_install\_XXXXXX.log



---

## Chapter 19. Installing an x86 World archive

This section describes how to install a previously created x86 World archive onto a system.

The PowerVM Lx86 installer is used to install the archive onto a system. First you must install PowerVM Lx86 and then install the archived x86 World.

### Note:

- The **star** package must be installed on the system before an archive can be installed. The PowerVM Lx86 installer script will inform you if the **star** package is not installed.
- The archive can only be installed onto a POWER system with a compatible Linux operating system. See section Chapter 4, “System and installation requirements for PowerVM Lx86,” on page 13 for the list of officially supported OS combinations.
- Any escapes in the original x86 World will be preserved in the archive and will be recreated by the installer when the archive is installed, even if the location of the x86 World is different from the original x86 World.

Run the installer as described in section “Installing PowerVM Lx86 and x86 World” on page 23. Once you have read and accepted the license agreement, continue to register the product with IBM and then (on Red Hat systems only) register with Red Hat Inc. The following section describes how to install the previously created x86 World archive onto the system.

1. You will see the standard installer menu prompt:

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

2. Enter 1 to begin the installation. The following menu is displayed:

1. Install powervm-lx86 + x86 World.
2. Install powervm-lx86.
3. Install x86 World.
4. Install x86 World from a pregenerated archive.
5. Go back to the Main Menu.
6. Quit.

Please select the type of operation you would like to perform:

3. Enter 2 to install PowerVM Lx86. The following prompt is displayed:

Install powervm-lx86 to: [/opt/powervm-lx86]

4. Press Enter to accept the default installation location, or enter an alternative location. The following prompt is displayed:

Log files created by powervm-lx86 will be stored in:  
[/var/opt/powervm-lx86/log]

5. Press Enter to accept the default log file location, or enter an alternative location. The following prompt is displayed:

1. `powervm-lx86-<version>`
2. Go back to the Main Menu.

Please select the version of `powervm-lx86` you would like to install:

6. Select the version of PowerVM Lx86 to install by pressing 1 and then Enter. The following prompt is displayed:

About to proceed with the following:

- Install `powervm-lx86` to `/opt/powervm-lx86`
- Log files will be stored in `/var/opt/powervm-lx86/log`

1. Continue.
2. Change settings.
3. Go back to the Main Menu.

Please select the type of operation you would like to perform:

7. Continue the installation of PowerVM Lx86 by pressing 1 and then Enter. The following output and prompt is displayed:

`powervm-lx86` installed successfully.

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

8. Enter 1 to go to the install menu. The following menu is displayed:

1. Install `powervm-lx86` + x86 World.
2. Install `powervm-lx86`.
3. Install x86 World.
4. Install x86 World from a pregenerated archive.
5. Go back to the Main Menu.
6. Quit.

Please select the type of operation you would like to perform:

9. Enter 4 to install the previously created x86 World archive. The following prompt is displayed:

Install x86 World to: `[/i386]`

10. Press Enter to install the archive x86 World in the recommended default location, or enter an alternative location. The following prompt is displayed:

Please specify the location of the archive file (type 'skip' to return to the main menu):

11. Enter the full path and filename of the x86 World archive and press Enter or type skip to return to the main menu. You will see the following output and menu:

About to proceed with the following:

- Install x86 World to `/i386`
- Selected distribution is Red Hat Enterprise Linux AS release 4, Update 6 (full)

1. Continue.
2. Change settings.
3. Go back to the Main Menu.

Please select the type of operation you would like to perform:

12. Select option 1 and press Enter to continue to install the x86 World archive.



Installing x86 World...

Extracting x86 World file  
from /tmp/powervm-lx86-archive-RHEL4U6AS\_FULL.bin.  
This may take several minutes to complete. Please wait...  
Done.  
Finalizing x86 World installation. Please wait...  
Removing /tmp/x86rpms...

x86 World installed successfully.

powervm-lx86 and x86 World are now installed.

Binding them together and creating runx86 script.

To start a translated x86 World shell, run /usr/local/bin/runx86

Note: SELinux is not enabled by default for PowerVM Lx86 after installation.  
If SELinux is enabled on your Power system, you can enable SELinux for x86 applications by enabling the SELinux configuration switches in the PowerVM Lx86 configuration file. Please see the Administration Guide for details.

1. Install Software.
2. Upgrade Software.
3. Uninstall Software.
4. Show Installed Products.
5. Configure Software.
6. Quit.

Please select the type of operation you would like to perform:

13. The x86 World and PowerVM Lx86 have now been installed. Exit the installer by typing 6 and pressing Enter. The installer will provide a summary of the installation you have carried out. All actions have been recorded in the installer log file.

The Activation email data is stored on the system in activation-detail.

If this system is not set up to send email, please email this data file to IBM at <pave@us.ibm.com>.

Installation Summary

Installed x86 World

- Distribution: Red Hat Enterprise Linux AS release 4, Update 6 (full)
- Installed at: /i386
- Home directories will not be shared

Thank you for using the PowerVM Lx86 Installer

Today you performed the following transactions:

Accepted license agreement  
Registered with IBM  
Installed PowerVM Lx86  
Installed installer into /opt/powervm-lx86/installer  
Installed x86 World (Red Hat Enterprise Linux AS release 4, Update 6 (full))

End of Transaction log.

To start a translated x86 World shell, run /usr/local/bin/runx86

The full log of your session is in /tmp/powervm-lx86\_install\_XXXXXX.log



---

## Chapter 20. Running the automated installer

The PowerVM Lx86 installer provides a non-interactive installation option, allowing PowerVM Lx86, the x86 World or an x86 World archive, to be installed automatically on a system using the command line.

Non-interactive mode supports installation and uninstallation of PowerVM Lx86, the x86 World or an x86 World archive, using the default locations (as per the interactive install), or using a predefined set of locations in a configuration file that uses the same format as the PowerVM Lx86 configuration file. For details, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59. The installation of the x86 World from media (CD and DVD ISO images, a directory of RPMs, or a mounted DVD), and from an archive are both supported. The installer’s upgrade and configuration options are not supported in non-interactive mode.

### Note:

- The **star** package must be installed on the system before an archive can be unpacked and installed by the non-interactive mode. The PowerVM Lx86 installer script will inform you if the **star** package is not installed.
- An x86 World archive can only be created in the interactive mode. Although you can install an archive onto a system using the non-interactive mode, you cannot create an archive using non-interactive mode.
- Any escapes in the x86 World will be preserved in the archive and will be recreated by the installer when the archive is installed on another machine, even if the location of the x86 World is different from the original x86 World.

The default installation locations are:

- PowerVM Lx86 directory: `/opt/powervm-lx86`
- PowerVM Lx86 log file directory: `/var/opt/powervm-lx86/log`
- PowerVM Lx86 configuration file: `/etc/opt/powervm-lx86/config`
- x86 World directory: `/i386`

### License agreement

You must accept the terms of the PowerVM Lx86 license agreement to install the product. If you have not read the license agreement, run the installer script in interactive mode first, by typing `% ./installer.pl` and read the license agreement and then quit the installer. In non-interactive mode, you accept the license agreement by passing `--license-accepted` to the installer as a command-line argument.

### Examples of usage

Install PowerVM Lx86 to the default location (`/opt/powervm-lx86`):

```
% ./installer.pl --install Lx86 --license-accepted
```

Install PowerVM Lx86 and the x86 World of type `SLES10_MIN` (the SLES 10 minimal OS install) to the default locations (`/opt/powervm-lx86` and `/i386` respectively):

```
% ./installer.pl --install Lx86 --license-accepted --install x86world
--distro SLES10_MIN --media /path/to/sles10.cd1.iso --media
/path/to/sles10.cd2.iso
```

Install PowerVM Lx86 and an x86 World archive:

```
% ./installer.pl --install Lx86 --license-accepted --install x86world
--archive /powervm-lx86-archive-SLES10_MIN.bin
```

Use a configuration file to specify a non-default location for PowerVM Lx86:

```
% ./installer.pl --install Lx86 --license-accepted --config my-config.conf
```

## Non-interactive configuration file options

The following options are supported in the installation configuration file to change the behaviour of the installer in non-interactive mode.

The configuration file may also be used as the PowerVM Lx86 configuration if it is stored in the standard file location: `/etc/opt/powervm-lx86/config`. If the file is placed in this location, the `--config` option is unnecessary as the configuration file will be read automatically by the non-interactive installer and any installer settings in the file will override the default settings. To further override any of the settings in the configuration file, specify the values on the command line.

Non-interactive mode configuration switch name	Parameters and use
INSTALLER_SW_TARBALL_LOCATION	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> Optional. Same as <code>--archive</code> on the command line. This switch specifies where the x86 World archive is located.</p>
INSTALLER_SW_DISTRO	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> Optional. Same as <code>--distro</code> on the command line. This switch specifies which Linux distribution will be installed for the x86 World, also designating a minimal or full installation.</p>
INSTALLER_SW_INSTALL_MEDIA	<p><b>Type</b> String</p> <p><b>Parameters</b> An absolute path</p> <p><b>Use</b> Optional. Same as <code>--media</code> on the command line. This switch specifies the location of the Linux distribution media. May be specified multiple times in the configuration file.</p>
POWERMV_LX86_LOCATION	This switch specifies the PowerVM Lx86 installation directory, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59 for further details.

Non-interactive mode configuration switch name	Parameters and use
LOGFILE_PATH	This switch specifies the PowerVM Lx86 log file directory, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59 for further details.
SUBJECT_WORLD_ROOT	This switch specifies the x86 World directory, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59 for further details.



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## **Part 6. Managing remote and local users with PowerVM Lx86**

This section provides a reference to managing and configuring the x86 World to support local and remote users with PowerVM Lx86.





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## Chapter 21. Managing remote users with PowerVM Lx86

To enable remote users to authenticate in the x86 environment, for example using NIS, LDAP, or Kerberos, you must set up the x86 World to match the remote user settings of the host POWER system.

With the creation of the x86 World there are now two sets of system configuration files, one for the new x86 World and one for the host POWER system. In particular, there are now two sets of remote user configuration files on the system. To enable remote users to authenticate in the x86 environment, for example using NIS, LDAP or Kerberos, you must enable remote user support in the x86 World. Set up the remote user configuration files in *X86WORLD\_ROOT* to match the settings on the host POWER system. The exact changes to the x86 World files will depend on the specific configurations used in your network environment.

As with any normal system, refer to your system administrator for advice and best practices before changing the Linux configuration files in the x86 World.



---

## Chapter 22. Managing local users, groups, and passwords with PowerVM Lx86

With the creation of the x86 World there are now two definitions of users, groups, and passwords on the system.

### Conflicting definitions of users, groups, and passwords

The x86 World that is installed with PowerVM Lx86 comes with its own set of passwords, groups, and shadow files that are normally found on a native POWER system in the locations `/etc/passwd`, `/etc/group` and `/etc/shadow`, respectively. Therefore, with the introduction of the x86 World there are now two definitions of users, groups and passwords on the system.

This can be confusing to the system administrator and to end users, and there is also a potential security risk. Supposing the x86 World is installed in the location `/i386`, consider the two possible scenarios outlined below:

**Scenario 1:** Consider two users named fred and bob, both of whom share the same user ID. User fred exists in the native POWER `/etc/passwd` file, and user bob exists in the x86 World `/i386/etc/passwd` file. Suppose you change to user fred in a native POWER shell and then run PowerVM Lx86. In the x86 World you are now user bob, since both fred and bob share the same user ID. Not only is this confusing (try running the `id` command, and you can see that your username has changed from fred to bob), but it can pose security issues, because users fred and bob might have different primary groups.

**Scenario 2:** Now consider that a user named fred exists in both `/etc/passwd` and `/i386/etc/passwd`, but they have different user IDs. In a native POWER shell you log in as user fred and create a file in `/home/fred` that is only readable by fred. Now suppose you run PowerVM Lx86 as a normal user, and then change to user fred and try to read that file. You won't be able to read it because you have different user IDs.

These two scenarios also apply in a similar way to groups. In its default installation, PowerVM Lx86 attempts to manage these problems transparently by presenting the user with a consistent *one system*, or unified, view of users and groups.

---

### The solution: A unified view

PowerVM Lx86 attempts to unify the definitions of users, groups, and passwords by collecting information from both the native POWER system and the x86 World and producing a merged view of the `/etc/passwd`, `/etc/group` and `/etc/shadow` files (and on Red Hat there is also `/etc/gshadow`).

Again, assuming the x86 World is installed in the `/i386` directory, the solution for `/etc/passwd` follows:

- Whenever a translated x86 program tries to open `/i386/etc/passwd` (the `passwd` file in the x86 World), PowerVM Lx86 instead opens both the native POWER file `/etc/passwd` and the x86 World file `/i386/etc/passwd` at the same time and

attempts to merge all the entries together to provide a single view in such a way that all conflicts and inconsistencies are resolved.

For example, if PowerVM Lx86 finds that user bob exists in both `/i386/etc/passwd` and `/etc/passwd` files, then PowerVM Lx86 favors the bob entry in `/i386/etc/passwd`, and ignores the bob entry in `/etc/passwd`. This solves the problem described in Scenario 2 above.

- Or if PowerVM Lx86 finds users in both `/i386/etc/passwd` and `/etc/passwd` sharing the same user ID PowerVM Lx86 will always favor the native POWER entry and ignore the x86 version. This solves the problem described in Scenario 1 above.

Operations on `/i386/etc/group` are treated in a similar manner, which solves both of the issues mentioned previously.

However, when conflicting users are found in the shadow files on both the native POWER system and the x86 World, PowerVM Lx86 favors the POWER system entry by default. It is possible to configure PowerVM Lx86 to always favor the x86 World shadow entries by setting the `HAVE_SEPARATE_PASSWORDS=y` configuration variable in the standard `/etc/opt/powervm-lx86/config` configuration file.

By default, PowerVM Lx86 operates in this one system mode; however, it is possible to revert PowerVM Lx86 back to a two-system mode by setting the `MERGE_PASSWD_FILES=n` configuration variable in the standard PowerVM Lx86 configuration file. This means that the `/etc/passwd`, `/etc/group`, and `/etc/shadow` (and on Red Hat there is also `/etc/gshadow`) files are handled completely separately by PowerVM Lx86 and the native POWER system. This is not recommended unless it is explicitly known that there are no security risks involved in doing so.

For further details about setting configuration variables for PowerVM Lx86, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59.

For further details about the escapes and virtual files for local user management, see “Default escaped directories, files, and sockets” on page 67.

---

## Periodic checks of the subject x86 World

As part of the PowerVM Lx86 installation, a cron job is installed in `/etc/cron.d/powervm-lx86` that invokes the `powervm-lx86-world-sync` script (by default located in `/usr/sbin`). This periodically checks the x86 World to see if the password, group, or shadow files have become inconsistent (that is, there is a difference between the corresponding x86 World and native POWER file).

From a security perspective, PowerVM Lx86 checks for aliased user IDs (different user names with the same user ID) and new users present in the x86 World but not in the native POWER system. It is the responsibility of the system administrator to adjust the periodicity and timing of the cron job.

By default, the cron job is installed to check the environments every twenty minutes. If a problem is found, then a message is logged to `/var/log/messages`, and an e-mail is sent to the root user. This e-mail contains clear guidance about how best to resolve the inconsistency by using standard Linux utilities available on the native POWER system.

If the system administrator does not care that certain users or groups are present in the x86 World but not in the native POWER system, then it is possible to configure the cron job to not report about such users or groups. This can be achieved by creating a *white list* of users and groups in the `/etc/opt/powervm-lx86/user_ignore` and `/etc/opt/powervm-lx86/group_ignore` files, respectively. For example, if the system administrator knew about users fred, jane, and bob, but did not want to be warned about them, the administrator could generate the `/etc/opt/powervm-lx86/user_ignore` file with the following contents:

```
fred
bob
jane
```

Each user needs to be on a new line. The same applies for groups.

It is possible to disable this cron job by editing the PowerVM Lx86 configuration file to set the `WORLD_CHECK_OR_SYNC=none` variable. However, this causes the system administrator to have no visibility of issues as they arise. For further details of the options for the `WORLD_CHECK_OR_SYNC` configuration switch, see “`WORLD_CHECK_OR_SYNC` options” on page 100.

Although the cron job does not modify any of the native POWER or x86 World password, group, or shadow files, there are cases when PowerVM Lx86 will update the actual x86 World files on disk. In these circumstances, the x86 World files will be synchronized physically on disk by PowerVM Lx86 with the equivalent merged view. Three cases where this could occur are:

- A user manually adds, deletes or modifies a user or group.
- A user manually changes a user or group password.
- Users or groups are added automatically as part of an application installation such as WebSphere® or DB2®.

PowerVM Lx86 will always present a consistent merged view of the password, shadow, or group files even though this virtual file is not synchronized physically on disk all the time. Any updates to the physical files will be reflected in the merged view. In any of these cases, the cron job will detect the presence of new users or groups and warn the system administrator accordingly.

---

## Known issues with the unified view approach

Find some known issues with this unified view approach that the system administrator should understand.

- It is possible to enable NIS for the x86 World. If NIS is enabled in the x86 World, NIS users will be visible when running PowerVM Lx86. If NIS support is not enabled in the x86 World, PowerVM Lx86 will ignore any NIS entries from the native POWER system.
- PowerVM Lx86 always favors the native password entries. In the case of a user ID clash there is a danger that the user’s home directory will not be visible within the subject world. That is, consider these entries: `/etc/passwd: ‘fred:x:30003:12113::/fred:/bin/bash’` `/i386/etc/passwd: ‘bob:x:30003:12113::/bob:/bin/bash’` Since PowerVM Lx86 favors user fred from the native POWER system, it is possible that the `/i386/fred` directory does not actually exist within the x86 World. However, the cron job should detect any such issues, and provide the system administrator with a means to resolve them.
- It is possible for entries to appear and disappear in a translated x86 shell. For example, consider the following sequence of events:

1. A system administrator adds user fred in the x86 World and then logs in as user fred. The administrator then runs the id utility, which shows output such as: 'uid=30001(fred) gid=500(some company) groups=17(audio),500(some company)'
2. The administrator then adds user bob in a native POWER shell, which happens to be allocated the same user ID (30001). The system administrator then runs a translated x86 shell and again runs the id utility, now producing the following output: 'uid=30001(bob) gid=500(some company) groups=18(uucp),500(some company)'
3. If the system administrator now returns to a native POWER shell, deletes user bob, then runs the 'id' utility again in a translated x86 shell, the output will be as before: 'uid=30001(fred) gid=500(some company) groups=17(audio),500(some company)'. As above, the cron job will periodically check the x86 World for any such inconsistencies and warn the system administrator

---

## WORLD\_CHECK\_OR\_SYNC options

The WORLD\_CHECK\_OR\_SYNC configuration switch has multiple options which effects which of the system files are checked by PowerVM Lx86.

The options are shown in the following chart:

Configuration switch value	Effect
check_all	The default value. The cron will check the passwd and group files for any issues.
check_passwd	The cron will only check the passwd files for any issues. The group files will be not be checked for issues with group ids.
check_group	The cron will only check the group files for any issues. The passwd files will not be checked for issues with user ids.
none	This will disable the cron job without removing the cron files. No checking of the passwd or group files or updates to the /etc/mtab files will occur.
sync_all	Performs the same checks as the check_all option, but in addition the cron will keep the /etc/mtab file in the x86 World up to date with entries found in POWER /proc/mounts whenever the cron runs.
force_sync_mtab	The cron will only keep the /etc/mtab file in the x86 World up to date with entries found in POWER /proc/mounts whenever the cron runs. No checking of the passwd or group files will occur.

It is possible to invoke the powervm-lx86-world-sync script directly with the force\_sync\_mtab option. This forces the x86 World mtab to be updated in sync with the POWER version of the file. This is only expected to be used in a situation where the x86 World mtab file has become corrupt or out of date.

Invoke the script as root with the command:

```
% /usr/sbin/powervm-lx86-world-sync force_sync_mtab
```

**Note:** The PowerVM Lx86 daemon must be running for this operation to succeed.

---

## Root user and root passwords

The root user on the system is also a local user and is handled by the user ID mechanism in a special way.

The privileges of a translated root user are the same as a root user on the host POWER system. In a translated x86 shell, if the user is running as root, then the user has the same privileges as root in the POWER environment. This is an expected behavior of the x86 environment.

If an escape is created from the x86 World to the POWER filesystem (which can only be carried out by the POWER root user), then a root user in the x86 environment can access the POWER file system as the root user.

The user ID support within PowerVM Lx86 defaults to using the POWER password for the root user in the x86 World. When prompted for the root password while running in the x86 environment, use the POWER password. However, if PowerVM Lx86 is explicitly setup to use separate passwords (by setting the `HAVE_SEPARATE_PASSWORDS=y` configuration variable in the standard `/etc/opt/powervm-lx86/config` configuration file) for the x86 World and POWER system, when you are prompted for the root password, use the x86 World password.

For further details about setting configuration variables for PowerVM Lx86, see Chapter 14, “PowerVM Lx86 configuration settings,” on page 59.





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## Part 7. PowerVM Lx86 error messages and resolutions

This section describes the error messages that can be reported on the terminal by the components of PowerVM Lx86 and details of how to resolve each problem.

If the resolution section for each error does not help you to resolve the problem, report the failure by contacting IBM Support.

There are several components of PowerVM Lx86 that can produce error messages:

- The PowerVM Lx86 translator itself (powervm-lx86)
- The PowerVM Lx86 translator daemon (powervm-lx86-daemon)
- The x86 /etc/init.d scripts
- The local user ID support (powervm-lx86-world-sync)
- The PowerVM Lx86 installer

### Error message template

The PowerVM Lx86 errors messages use the following template:

```
[Module] [Error: xxxx]<error text>
```

Where [Module] is powervm-lx86, powervm-lx86-daemon, or similar, xxxx in [Error: xxxx] is a unique error number for that module starting from 0001, and <error text> is plain text describing the error and its possible resolution.



---

## Chapter 23. PowerVM Lx86 (powervm-lx86) errors

This section lists error messages for PowerVM Lx86 (powervm-lx86), including cause and resolution.

Error message	[powervm-lx86][Error: 0001] Process received signal <signalname> (<signalnumber>).
Cause	One of the running x86 applications received a signal unexpectedly.
Resolution	Normally an x86 application will produce an error, report or log file when this problem occurs. Contact IBM support for further help.

Error message	[powervm-lx86][Error: 0002] Access denied for x86 binary '<binaryname>'. Please check the permissions on the file.
Cause	You do not have permissions to access the binary file.
Resolution	Check the permissions on the binary you attempted to execute and try again.

Error message	[powervm-lx86][Error: 0003] File '<filename>' is not a valid x86 binary. The file may be a POWER binary. Please check the type of the file.
Cause	The binary may not be a valid x86 binary.
Resolution	Check that the binary is a valid x86 binary, for example by running the command line tool 'file'. PowerVM Lx86 can only execute Linux/x86 elf binary files.

Error message	[powervm-lx86][Error: 0004] Cannot read x86 binary '<filename>'. Please check the permissions on the file.
Cause	You do not have permissions to read the binary file. This case should be handled correctly when running within a translated x86 shell.
Resolution	Ensure that you are running within a translated x86 shell and attempt to execute the binary again.

Error message	[powervm-lx86][Error: 0005] Current working directory is not visible from the x86 World root. Please "cd "<path>" and try again.
Cause	The current working directory must be one of the following: <ul style="list-style-type: none"><li>• The X86WORLD_ROOT directory or any of its subdirectories, for example, /i386 or /i386/etc.</li><li>• An escape directory or any of its subdirectories, for example, /home/mike or /home/mike/myDirectory.</li></ul>

<b>Error message</b>	<b>[powervm-lx86][Error: 0005] Current working directory is not visible from the x86 World root. Please "cd "&lt;path&gt;" and try again.</b>
<b>Resolution</b>	<p>Ensure that the current working directory is visible to the Linux/x86 environment, by ensuring it meets the criteria in the Cause section above.</p> <p>Ensure that you are invoking the <b>runx86</b> script correctly and check the default list of escapes for the x86 World and any escapes you have added to the x86 World since installation.</p>

<b>Error message</b>	<b>[powervm-lx86][Error: 0006] x86 binary '&lt;binaryname&gt;' is not a valid binary. It may be a data file. Please check that the file is an executable binary.</b>
<b>Cause</b>	The binary may not be a valid Linux/x86 elf binary.
<b>Resolution</b>	Check that the binary is a valid Linux/x86 elf binary, for example by running the command line tool 'file'. PowerVM Lx86 can only execute valid Linux/x86 elf binary files.

<b>Error message</b>	<b>[powervm-lx86][Error: 0007] x86 binary '&lt;binaryname&gt;' is not a valid file. It may be a directory. Please check that the file is an executable binary.</b>
<b>Cause</b>	You may have attempted to execute a directory instead of a binary file within that directory, for example, /home/user instead of /home/user/myDirectory/myBinary.
<b>Resolution</b>	Ensure that you have correctly typed the name of the binary file you want to execute.

<b>Error message</b>	<b>[powervm-lx86][Error: 0008] Cannot access x86 binary '&lt;binaryname&gt;'. Please check that the file exists, the path to the file is valid and that the permissions on the path are correct.</b>
<b>Cause</b>	You may not have permissions to access the binary file or the file may not exist or the path to the file may not be valid.
<b>Resolution</b>	Check that the file exists, the path to the file is valid and that the permissions on the path are correct and try again.

<b>Error message</b>	<b>[powervm-lx86][Error: 0009] Too many symbolic link loops encountered for x86 binary '&lt;binaryname&gt;'. Please check for loops in any symbolic links in the path to the binary and try again.</b>
<b>Cause</b>	When attempting to resolve the path to the file, too many (more than 20) symbolic links were encountered. This may be caused by a symbolic link loop, for example, a symbolic link pointing back to itself.
<b>Resolution</b>	Ensure that a symbolic link loop has not been created for the file you are trying to access.

<b>Error message</b>	<b>[powervm-lx86][Error: 0010] Unknown problem with file '&lt;filename&gt;'. Please save the log file '&lt;logfile&gt;' and contact IBM support.</b>
Cause	Unknown.
Resolution	Contact IBM support with details of how the error occurred and send any log files that were generated.

<b>Error message</b>	<b>[powervm-lx86][Error: 0011] Could not contact the powervm-lx86-daemon (error ('&lt;errorname&gt;', '&lt;errornumber&gt;')). Please check that the powervm-lx86-daemon is running and try again.</b>
Cause	PowerVM Lx86 has failed to connect to the PowerVM Lx86 daemon (powervm-lx86-daemon).
Resolution	Check that the powervm-lx86-daemon is running by using the command: /etc/init.d/powervm-lx86 status. If the powervm-lx86-daemon is not running, then start the powervm-lx86-daemon by using the command: /etc/init.d/powervm-lx86 start. If the powervm-lx86-daemon is running, then try launching the x86 application again. If PowerVM Lx86 still cannot contact the powervm-lx86-daemon, then contact IBM support.

<b>Error message</b>	<b>[powervm-lx86][Error: 0012] powervm-lx86 cannot write to the specified log file '&lt;logfile&gt;' (error (&lt;errorname&gt;, &lt;errornumber&gt;))</b>
Cause	An error has occurred and PowerVM Lx86 has attempted but failed to write to the log file.
Resolution	<ul style="list-style-type: none"> <li>• Check that the directory where the log file is being written to exists, if not, create a directory with the same name and try again.</li> <li>• Check that permissions have been granted to allow access to the directory.</li> </ul>

<b>Error message</b>	<b>[powervm-lx86][Error: 0013] powervm-lx86 has terminated unexpectedly. Please save the log file '&lt;filename&gt;' and contact IBM support.</b>
Cause	An error has occurred in PowerVM Lx86 or the x86 application, causing the translated process to be terminated.
Resolution	Save the log files and contact IBM support.

<b>Error message</b>	<b>[powervm-lx86][Error: 0014] Please invoke PowerVM Lx86 using the runx86 script.</b>
Cause	The powervm-lx86 binary has been invoked directly (for example, /opt/powervm-lx86/bin/powervm-lx86).
Resolution	To invoke PowerVM Lx86, use the <b>runx86</b> script, for example, /usr/local/bin/runx86.



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## Chapter 24. PowerVM Lx86 log file errors

This section lists the log file error messages, including cause and resolution.

Error message	[powervm-lx86][Error: 0015] Cannot write to specified log directory '<logdirectory>'. Please check the permissions on the directory.
Cause	PowerVM Lx86 is attempting to write to the log file directory but failed.
Resolution	Check that the directory has write permissions.

Error message	[powervm-lx86][Error: 0016] Cannot open logfile. Unexpected error occurred while initializing '<logfile>'. Please contact IBM support.
Cause	Unknown.
Resolution	Contact IBM support.

Error message	[powervm-lx86][Error: 0017] Failed to create unique logfile name.
Cause	PowerVM Lx86 attempts to create a uniquely numbered log file name each time it generates a new log file, powervm-lx86.log.<binaryname>.<processID>.<uniquenumber> (for example, powervm-lx86.log.perl.23724.4)  PowerVM Lx86 has been unable to create a file with a new unique number.
Resolution	Check the log directory to see if a particular process has generated an unexpected number of log files. Do not delete the log files unless you are certain they are not required to help resolve the issue further. If the problem persists, contact IBM support.

Error message	[powervm-lx86][Error: 0018] Cannot open logfile - filesystem is full.
Cause	The file system where PowerVM Lx86 stores the log files appears to be full.
Resolution	Check for free space on the file system and make more space available if none is free.

Error message	[powervm-lx86][Error: 0019] Cannot open logfile - filesystem is not writable. Please check the permission on the file.
Cause	The log file is not writable because the whole file system is read-only.
Resolution	Either change the log file directory location in the config file or remount the file system where the log file is located with read-write permissions.





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## Chapter 25. PowerVM Lx86 daemon (powervm-lx86-daemon) errors

This section describes PowerVM Lx86 daemon (powervm-lx86-daemon) error messages, including cause and resolution.

Error message	<b>[powervm-lx86-daemon] powervm-lx86-daemon not starting due to errors. Please correct the problem and try again.</b>
Cause	An error has occurred while invoking the PowerVM Lx86 daemon.
Resolution	A more detailed error message will be printed with this message. Follow the instructions in that message.

Error message	<b>[powervm-lx86-daemon][Error: 0001] Usage: /etc/init.d/powervm-lx86 [start   stop   force-reload   restart   status]</b>
Cause	<ul style="list-style-type: none"><li>• The /etc/init.d/powervm-lx86 script has been invoked with an invalid argument not listed above.</li><li>• The powervm-lx86-daemon binary has been invoked directly on the command line with an argument (it can only be invoked directly if no arguments are provided and this will invoke the daemon with the start option).</li></ul>
Resolution	Invoke the powervm-lx86-daemon using the /etc/init.d/powervm-lx86 script with one of the arguments listed above. If you want to invoke powervm-lx86-daemon directly, then do not provide any arguments to the binary on the command line.

Error message	<b>[powervm-lx86-daemon][Error: 0002] This machine model is not supported. Please check the system requirements in the PowerVM Lx86 Administration Guide.</b>
Cause	The PowerVM Lx86 daemon failed to start as it appears that the system is not an IBM System p server.
Resolution	Ensure that you are running PowerVM Lx86 on a supported platform by checking the system requirements in the PowerVM Lx86 Administration Guide.

Error message	<b>[powervm-lx86-daemon][Error: 0003] Failed to open lock file '&lt;lockfile&gt;' (error ('&lt;errorname&gt;', &lt;errornumber&gt;)). Please check the permissions on the directory and lock file, then try again.</b>
Cause	The PowerVM Lx86 daemon failed to start because it cannot open the lock file.
Resolution	Check the permissions on the directory and lock file. The lock file is located in /var/opt/powervm-lx86/daemon/powervm-lx86-daemon.lock.

<b>Error message</b>	<b>[powervm-lx86-daemon][Error: 0004] powervm-lx86-daemon is already running (lock file detected). You do not need to invoke powervm-lx86-daemon again.</b>
Cause	The PowerVM Lx86 daemon is already running and you have attempted to start another instance.
Resolution	Check that the powervm-lx86-daemon is running with the following command: /etc/init.d/powervm-lx86 status. If the powervm-lx86-daemon is running, then continue to launch x86 applications as normal. If not, then start the powervm-lx86-daemon with the following command: /etc/init.d/powervm-lx86 start.

<b>Error message</b>	<b>[powervm-lx86-daemon][Error: 0005] Failed to open log file '&lt;logfile&gt;' (error ('errorname', &lt;errornumber&gt;)). Please check the permissions on the directory and log file, then try again.</b>
Cause	The PowerVM Lx86 daemon could not open the log file.
Resolution	Check that the directory where the log file is being written to exists, if not, create a directory with that name and try again. Check the permissions on the directory (which should be writable by daemon) and the log file (which should be owned by daemon and readable and writable by daemon) and try again.

<b>Error message</b>	<b>[powervm-lx86-daemon][Error: 0006] Failed to make directory '&lt;directoryname&gt;' (error ('&lt;errorname&gt;', &lt;errornumber&gt;)). Please check the permissions on the directory and try again.</b>
Cause	The PowerVM Lx86 daemon could not create a directory on the system.
Resolution	Check the permissions on the parent directory (which should be writable daemon) where the directory is being created and try again.

<b>Error message</b>	<b>[powervm-lx86-daemon][Error: 0007] Socket directory '&lt;socketdirectory&gt;' must be owned by user '&lt;user1&gt;' (id &lt;userid1&gt;) but is owned by user '&lt;user2&gt;' (id &lt;userid2&gt;). Please correct the ownership on the directory and try again.</b>
Cause	The ownership of the PowerVM Lx86 daemon socket is not correct.
Resolution	Change the ownership of the socket directory from <user2> to <user1> and try again.

<b>Error message</b>	<b>[powervm-lx86-daemon][Error: 0008] powervm-lx86-daemon cannot change user or group. Please invoke the powervm-lx86-daemon as root.</b>
Cause	The PowerVM Lx86 daemon was not invoked by root.
Resolution	Invoke PowerVM Lx86 daemon as root. First become root, then invoke the daemon with the following command: /etc/init.d/powervm-lx86 start.

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## Chapter 26. Errors and warnings from the runx86 script

The runx86 script may produce the errors when being used to run x86 applications.

### Warnings from the runx86 script

Warning message	[runx86][Warning: 0001] The current working directory is not visible from the x86 World. The x86 shell will be invoked with the x86 World root ' <code>&lt;X86WORLD_ROOT&gt;</code> ' as the current working directory.
Cause	As the current working directory is not visible from the x86 World, the runx86 command warns that it changed the current working directory to the x86 World root.

Warning message	[runx86][Warning: 0002] Cannot re-open psuedo terminal <code>&lt;file&gt; -&gt; &lt;pseudo terminal path&gt;: open: &lt;error&gt;</code> .
Cause	runx86 was unable to re-open a psuedo terminal with the new SELinux security context, so if the security context is restrictive then terminal interaction may not work.

Warning message	[runx86][Warning: 0003] Cannot re-open psuedo terminal <code>&lt;file&gt; -&gt; &lt;pseudo terminal path&gt;: dup2: &lt;error&gt;</code> .
Cause	runx86 was unable to re-open a psuedo terminal with the new SELinux security context, so if the security context is restrictive then terminal interaction may not work.

### Errors from the runx86 script

Error message	[runx86][Error: 0001] Cannot execute ' <code>&lt;x86 binary&gt;</code> '. The current working directory is not accessible from your x86 World ' <code>&lt;x86 World&gt;</code> '. To execute ' <code>&lt;x86 binary&gt;</code> ' either change directories so that you are in a directory visible from the x86 World (e.g. ' <code>cd /i386</code> ') or use the <code>link86(8)</code> command to make the current directory visible to the x86 World (consult the Administration Guide).
Cause	runx86 has been invoked with an x86 program as an argument, but the current working directory is not accessible from the x86 World. runx86 will not change the current working directory for you.
Resolution	You must change the directory manually to the x86 World or make the directory visible from the x86 World as directed.

Error message	[runx86][Error: 0002] Cannot chdir into ' <code>&lt;X86WORLD_ROOT&gt;</code> '.
Cause	runx86 cannot change the directory to the x86 World root.
Resolution	Check the directory exists and the permissions on the directory are correct then try again.

<b>Error message</b>	<b>[runx86][Error: 0003] The required PowerVM Lx86 security context '&lt;security context&gt;' was not valid. Please ensure the PowerVM Lx86 security policy is loaded (consult the Administration Guide).</b>
Cause	The PowerVM Lx86 security context is not valid.
Resolution	If you did not intend to use SELinux, remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again. If you did intend to use SELinux, ensure that the security policy is loaded. Consult the security section of the Administration Guide (Chapter 17, "SE Linux support with PowerVM Lx86," on page 73) for further details.

<b>Error message</b>	<b>[runx86][Error: 0004] Cannot execute powervm-lx86: '&lt;error&gt;'.</b>
Cause	PowerVM Lx86 failed to execute.
Resolution	Ensure that the binary exists, the permissions on the file and directory are correct, and runx86 is executing in the appropriate SELinux security context if appropriate.

<b>Error message</b>	<b>[runx86][Error: 0005] SELinux transitions are enabled but SELinux does not appear to be installed. Please disable SELinux transitions in the PowerVM Lx86 config file (consult the Administration Guide).</b>
Cause	PowerVM Lx86 failed to execute because SELinux transitions are enabled but SELinux does not appear to be installed on the POWER system.
Resolution	If you intend to use SELinux, ensure that it is installed, enabled, and that /usr/sbin/selinuxenabled exists and is executable. Otherwise you will need to remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again.

<b>Error message</b>	<b>[runx86][Error: 0006] SELinux transitions are enabled but SELinux is disabled. Please enable SELinux or disable SELinux transitions in the PowerVM Lx86 config file, and then restart the powervm-lx86 daemon (consult the Administration Guide).</b>
Cause	PowerVM Lx86 failed to execute because SELinux transitions are enabled but SELinux is disabled on the POWER system.
Resolution	If you intended to use SELinux, ensure that it is enabled. Otherwise you will need to remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 configuration file and try again.

<b>Error message</b>	<b>[runx86][Error: 0007] Cannot open '&lt;config file&gt;' for reading: &lt;error&gt;.</b>
Cause	The specified PowerVM Lx86 configuration file could not be read.
Resolution	Check that the permissions on the file are correct.

<b>Error message</b>	<b>[runx86][Error: 0008] Cannot open '/proc/self/attr/current' for reading: &lt;error&gt;.</b>
Cause	There was a problem finding the current SELinux security context.
Resolution	Ensure that SELinux is installed correctly or remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again.

<b>Error message</b>	<b>[runx86][Error: 0009] Cannot open '/proc/self/attr/exec' for writing: &lt;error&gt;.</b>
Cause	There was a problem switching to the required SELinux security context.
Resolution	Ensure that SELinux is installed correctly or remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again.

<b>Error message</b>	<b>[runx86][Error: 0010] Cannot switch to the required PowerVM Lx86 security context '&lt;context&gt;': &lt;error&gt;.</b>
Cause	There was a problem switching to the required SELinux security context.
Resolution	Ensure that SELinux is installed correctly or remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again.

<b>Error message</b>	<b>[runx86][Error: 0011] Cannot close '/proc/self/attr/exec': &lt;error&gt;.</b>
Cause	There was a problem switching to the required SELinux security context.
Resolution	Ensure that SELinux is installed correctly or remove 'ENABLE_SELINUX_TRANSITIONS=y' from the PowerVM Lx86 config file and try again.



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## Chapter 27. Errors from the linkx86 script

The linkx86 script may produce the errors when being used to create an escape from the x86 World to a directory on the POWER system.

Error message	[linkx86][Error: 0001] linkx86 must not be run under translation.
Cause	The linkx86 script has been invoked from within the x86 environment, probably from a translated x86 shell.
Resolution	linkx86 can only be invoked from a POWER shell. Check that you are using a POWER shell and invoke the linkx86 script again.

Error message	[linkx86][Error: 0002] Superuser privileges are required for this script.
Cause	The linkx86 script has been invoked by a non-root user.
Resolution	Ensure that you are root and try again.

Error message	[linkx86][Error: 0003] Path must be absolute.
Cause	The path provided as an argument to linkx86 is not an absolute path. It is likely that you provided a relative path as an argument.
Resolution	Invoke linkx86 with an absolute path as an argument.

Error message	[linkx86][Error: 0004] Path must not be the root '/' directory.
Cause	The path provided as an argument to linkx86 was the root ('/') directory.
Resolution	Invoke linkx86 with an absolute path as an argument that is not the root ('/') directory.

Error message	[linkx86][Error: 0005] <path> does not exist.
Cause	The path that you are trying to create an escape directory to does not exist on the POWER system.
Resolution	Check that the path exists on the POWER system. If not, create the directory on the POWER system. Check that you have correctly typed the name of the path and invoke linkx86 again.

Error message	[linkx86][Error: 0006] Unable to create <path/filename> because it already exists.
Cause	The escape link cannot be created because something with that name already exists in the x86 World.
Resolution	Ensure that the link you are trying to create does not already exist. Check that you have correctly typed the name of the link and invoke linkx86 again.

Error message	[linkx86][Error: 0007] Unable to create <path/filename>. Please check you have the necessary permission.
Cause	The escape link cannot be created because you do not have the correct permissions.
Resolution	Check the permissions on the directory where the file is being created and ensure that users have write permissions.



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## Chapter 28. Errors from the x86 /etc/init.d support scripts

This section describes error messages from the x86 /etc/init.d support scripts, including cause and resolution.

### Errors from the /etc/init.d/powervm-lx86 script

Error message	<b>[/etc/init.d/powervm-lx86][Error: 0001] You must be root to run this script.</b>
Cause	The powervm-lx86 script has been launched by a non-root user.
Resolution	The powervm-lx86 script must be run by root. Ensure that you are running as root and run the script again.

Error message	<b>[/etc/init.d/powervm-lx86][Error: 0002] /etc/opt/powervm-lx86/config must be owned by root.</b>
Cause	The PowerVM Lx86 configuration file needs to be owned by root to ensure that it cannot be tampered with by any non-root user. The configuration file is not currently owned by root.
Resolution	Check that the configuration file is owned by root. Contact IBM support if you have any further problems.

Error message	<b>[/etc/init.d/powervm-lx86][Error: 0003] /etc/opt/powervm-lx86/config must be writable only by root.</b>
Cause	The PowerVM Lx86 configuration file must be writable only by root to ensure that it cannot be tampered with by any non-root user. The configuration file is currently writable by non-root users.
Resolution	Check that the configuration file is writable only by root. Contact IBM support if you have any further problems.

Error message	<b>[/etc/init.d/powervm-lx86][Error: 0004] Kernel doesn't contain binfmt_misc, and loading it as a module failed. Please check your kernel configuration and ensure binfmt_misc is available.</b>
Cause	The powervm-lx86 script requires that the binfmt_misc kernel feature is enabled on the POWER system.
Resolution	Contact IBM support for further help.

Error message	<b>[/etc/init.d/powervm-lx86][Error: 0005] Could not mount /proc/sys/fs/binfmt_misc (from binfmt_misc).</b>
Cause	The powervm-lx86 script requires that the binfmt_misc kernel feature is enabled on the POWER system. The script failed to mount the binfmt_misc file in /proc.
Resolution	Contact IBM support for further help.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86][Error: 0006] Failed to register i386 handler with binfmt_misc.</b>
Cause	The powervm-lx86 script failed to register the i386 handler with binfmt_misc on the POWER system.
Resolution	Contact IBM support for further help.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86][Error: 0007] Failed to register i386so handler with binfmt_misc.</b>
Cause	The powervm-lx86 script failed to register the i386so handler with binfmt_misc on the POWER system.
Resolution	Contact IBM support for further help.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86][Error: 0008] Unable to source init-script functions.</b>
Cause	The powervm-lx86 script failed to launch.
Resolution	Contact IBM support.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86][Error: 0009] /var/opt/powervm-lx86/daemon/&lt;file&gt; must be owned by daemon.</b>
Cause	The PowerVM Lx86 daemon file is currently not owned by daemon.
Resolution	Check that the daemon file is owned by daemon and update if necessary. Contact IBM support if you have any further problems.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86][Error: 0010] /var/opt/powervm-lx86/daemon/&lt;file&gt; must be writable by daemon.</b>
Cause	The PowerVM Lx86 daemon file is currently not writable by daemon.
Resolution	Check that the daemon file is writable by daemon and update if necessary. Contact IBM support if you have any further problems.

## Errors from the powervm-lx86-rc runlevel scripts

The powervm-lx86-rc runlevel scripts (/etc/init.d/powervm-lx86-rc{1 - 6}) are invoked when the host POWER system runlevel changes.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rc&lt;number&gt;][Error: 0001] You must be root to run this script.</b>
Cause	The powervm-lx86-rc script was launched by a non-root user.
Resolution	The powervm-lx86-rc scripts must be run by root. The scripts are not expected to be run manually. Contact IBM support.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rc&lt;number&gt;][Error: 0002] /etc/opt/powervm-lx86/config must be owned by root.</b>
<b>Cause</b>	The PowerVM Lx86 configuration file needs to be owned by root to ensure that it cannot be tampered with by any non-root user. The configuration file is not currently owned by root.
<b>Resolution</b>	Check that the configuration file is owned by root. Contact IBM support if you have any further problems.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rc&lt;number&gt;][Error: 0003] /etc/opt/powervm-lx86/config must be writable only by root.</b>
<b>Cause</b>	The PowerVM Lx86 configuration file must be writable only by root to ensure that it cannot be tampered with by any non-root user. The configuration file is currently writable by non-root users.
<b>Resolution</b>	Check that the configuration file is writable only by root. Contact IBM support if you have any further problems.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rc&lt;number&gt;][Error: 0004] Error changing x86 runlevel.</b>
<b>Cause</b>	The powervm-lx86-rc script failed to change the x86 runlevel.
<b>Resolution</b>	Contact IBM support.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rc&lt;number&gt;][Error: 0005] Unable to source init-script functions.</b>
<b>Cause</b>	The powervm-lx86-rc script failed to launch when invoked.
<b>Resolution</b>	Contact IBM support.

## Errors from the /etc/init.d/powervm-lx86-rcmonitor script

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rcmonitor][Error: 0001] You must be root to run this script.</b>
<b>Cause</b>	The powervm-lx86-rcmonitor script has been launched by a non-root user.
<b>Resolution</b>	The powervm-lx86-rcmonitor script must be run by root. Ensure that you are running as root and run the script again.

<b>Error message</b>	<b>[/etc/init.d/powervm-lx86-rcmonitor][Error: 0002] Unable to source init-script functions.</b>
<b>Cause</b>	The powervm-lx86-rcmonitor script failed to launch.
<b>Resolution</b>	Contact IBM support.

## Errors from the dependency\_checker.pl script

<b>Error message</b>	<b>[dependency_checker.pl][Error: 0001] You must be root to run this script</b>
<b>Cause</b>	The dependency_checker.pl script has been invoked by a non-root user.

<b>Error message</b>	<b>[dependency_checker.pl][Error: 0001] You must be root to run this script</b>
Resolution	The powervm-lx86-rmonitor script normally invokes this script. The script should not normally be invoked manually. Contact IBM support for further help.

<b>Error message</b>	<b>[dependency_checker.pl][Error: 0002] Directory &lt;directoryName&gt; does not exist.</b>
Cause	The dependency_checker.pl script failed to find the main init.d directory.
Resolution	Check if the directory exists. Contact IBM support for further help.

<b>Error message</b>	<b>[dependency_checker.pl][Error: 0003] Cannot open &lt;file&gt; for reading: &lt;errornumber&gt;.</b>
Cause	The dependency_checker.pl script failed to open a file in the main init.d directory.
Resolution	Check that the file exists and the permissions on the file. Contact IBM support for further help.

<b>Error message</b>	<b>[dependency_checker.pl][Error: 0004] Cannot open &lt;file&gt; for writing: &lt;errornumber&gt;.</b>
Cause	The dependency_checker.pl script has failed to open a file in the main init.d directory.
Resolution	Check that the file exists and the permissions on the file. Contact IBM support for further help.

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## Chapter 29. Errors from the execve router

The execve router is responsible for launching certain processes for PowerVM Lx86. If in the unlikely circumstances that it failed to invoke PowerVM Lx86, one of the following errors may be seen:

Error message	[powervm-lx86 exec router][Error: 0001] powervm-lx86 exec router could not invoke powervm-lx86, (error <errornumber>).
Cause	The powervm-lx86-world-sync script failed to invoke the PowerVM Lx86 binary (powervm-lx86). The powervm-lx86 binary may not exist or the configuration file (if one exists) may have POWERVM_LX86_LOCATION set to an incorrect location.
Resolution	Check that the powervm-lx86 binary exists in the default installation location or where you chose to install the binary if to a non-default location. If installed to a non-default location, check that POWERVM_LX86_LOCATION configuration switch in /etc/opt/powervm-lx86/config correctly points to the powervm-lx86 binary. If you cannot resolve the problem, contact IBM Support.

Error message	[powervm-lx86 exec router][Error: 0002] Path to powervm-lx86 binary is too long (<number>).
Cause	The path to the powervm-lx86 binary is too long, for example /opt/<many_character_directory_name>/powervm-lx86.
Resolution	Ensure that the PowerVM Lx86 binary is installed into a directory with a reasonably short length directory path.



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## Chapter 30. Syslog messages

Support for logging system messages is handled in a special manner by PowerVM Lx86 so that system messages in the x86 World and the POWER system are kept separate.

See Chapter 15, “Default PowerVM Lx86 escapes and virtual files in the x86 World,” on page 65 for detail of how system logs and error messages are handled by PowerVM Lx86.





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## Chapter 31. Alerts and errors when managing local users, groups, and passwords with PowerVM Lx86

This section describes alert and error messages, including cause and resolution.

### E-mail alerts

The following alerts are sent via e-mail by the `powervm-lx86-world-sync` script to root and logged in `/var/log/messages` on the POWER system when conflicts are found with the users, groups and passwords with PowerVM Lx86 and the underlying POWER system.

Alert message	New user account (<useraccount>) found in <file>
Cause	A new user account has been added to the file (for example, <code>/etc/passwd</code> ) in the x86 World.
Resolution	The root user will be e-mailed specific details about how to resolve the issues with this event. See Chapter 32, “E-mail messages for managing local users, groups, and passwords in PowerVM Lx86,” on page 129.

Alert message	Aliased user id (<userid>) found in <file>
Cause	A username has been found in the file (for example, <code>/etc/passwd</code> ) which has the same user id as an entry in the POWER version of the file.
Resolution	The root user will be e-mailed specific details about how to resolve the issues with this event. See Chapter 32, “E-mail messages for managing local users, groups, and passwords in PowerVM Lx86,” on page 129.

Alert message	New group (<group>) found in <file>
Cause	A new group has been added to the file (for example, <code>/etc/group</code> ) in the x86 World.
Resolution	The root user will be e-mailed specific details about how to resolve the issues with this event. See Chapter 32, “E-mail messages for managing local users, groups, and passwords in PowerVM Lx86,” on page 129.

Alert message	Aliased group id (<groupid>) found in <file>
Cause	A group name has been found in the file (for example, <code>/etc/group</code> ) which has the same group id as an entry in the POWER version of the file.
Resolution	The root user will be e-mailed specific details about how to resolve the issues with this event. See Chapter 32, “E-mail messages for managing local users, groups, and passwords in PowerVM Lx86,” on page 129.

## Errors from the powervm-lx86-world-sync script

Error message	[powervm-lx86-world-sync][Error: 0001] You must be root to run this script.
Cause	The powervm-lx86-world-sync script has been invoked by a non-root user.
Resolution	The cron job /etc/cron.d/powervm-lx86 invokes powervm-lx86-world-sync as root. If this error message occurs, contact IBM support.

Error message	[powervm-lx86-world-sync][Error: 0002] Failed to get current set of mount entries
Cause	The powervm-lx86-world-sync script has been invoked with the sync_all argument, but was unable to access the POWER system /proc/mounts file.
Resolution	Contact IBM support.

Error message	[powervm-lx86-world-sync][Error: 0003] Cannot open <filename>: <errorcode>
Cause	The powervm-lx86-world-sync script failed to open a user management file, for example /etc/passwd.
Resolution	Check the file exists in the x86 World and check that it is owned by root, group root, and the permissions are set to 644 (RW owner, R group, and R others).

Error message	[powervm-lx86-world-sync][Error: 0004] The powervm-lx86-daemon is not running. Please start the powervm-lx86-daemon.
Cause	The powervm-lx86-daemon is not running and is required for managing users, groups and passwords with PowerVM Lx86
Resolution	Invoke PowerVM Lx86 daemon as root. First become root, then invoke the daemon with the following command: /etc/init.d/powervm-lx86 start

Error message	[powervm-lx86-world-sync][Error: 0005] Unrecognised option 'WORLD_CHECK_OR_SYNC=<option>'
Cause	The WORLD_CHECK_OR_SYNC configuration file option has been set to an unrecognized value.
Resolution	The valid options are:  sync_all, check_all, check_passwd, check_group, force_sync_mtab, nonecheck_all is the default. The WORLD_CHECK_OR_SYNC option can also be enabled by default to check_all by removing the WORLD_CHECK_OR_SYNC line from the configuration file.

---

## Chapter 32. E-mail messages for managing local users, groups, and passwords in PowerVM Lx86

These tables show the templates for the e-mails sent to the root user when a local user ID alert occurs. The text with square brackets ([\_number]) represent specific files and details to the alert.

Alert message	New user account ('<useraccount>') found in <file>.
Example e-mail	<p>A new user account has been found in the x86 World password file ([_1]) that is not present in the POWER password file. The relevant password entry found in [_2] is shown here:</p> <p>[_3]</p> <p>where the fields represent the user account, password, user id, primary group id, comment, home directory and default shell, respectively. Also, the output of the translated command <code>'/usr/bin/id [_4]'</code> is shown below</p> <p>[_5]</p> <p>where the second field shows the primary group and the third field shows the full list of groups to which user [_6] belongs, including the primary and supplementary groups.</p> <p>In order to stop receiving this email in future you have two options. The first option is to add the user [_7] to the user whitelist file found in <code>/etc/opt/powervm-lx86/user_ignore</code>. In this case you don't need to add the user to the POWER side and this user will be ignored in future. The second option is to add the user on the POWER side yourself. One way of doing this (but not necessarily the most complete) is to execute the following command in a native POWER shell:</p> <p><code>/usr/sbin/useradd -m -d &lt;home directory&gt; [_8]</code></p> <p>To replicate the x86 World setup completely you will have to ensure that all the groups to which user [_9] is a member exist on the POWER side and then set both the primary and supplementary groups for the user [_10] accordingly.</p> <p>(This mail was generated by the cron script [_1] and can be disabled by setting the configuration variable <code>WORLD_CHECK_OR_SYNC=none</code> in <code>/etc/opt/powervm-lx86/config</code>).</p>

Alert message	Aliased user id ('<userid>') found in <file>.
Example e-mail	<p>A user account has been found in the x86 World password file ([_1]) that shares the same user id ([_2]) with an account found in the POWER password file (/etc/passwd). The relevant password entry found in the x86 World file ([_3]) is shown here:</p> <p>[_4] and the relevant password entry found in the POWER file (/etc/passwd) is shown here:</p> <p>[_5]</p> <p>where the fields represent the user account, password, user id, primary group id, comment, home directory and default shell, respectively.</p> <p>Although highly unlikely, this could represent a serious security risk, since the identity corresponding to user id [_6] is ambiguous.</p> <p>In order to stop receiving this email in future you have two options. If you believe there to be no security risk involved then you can add the user id [_7] to the whitelist file found in /etc/opt/powervm-lx86/uid_ignore. Otherwise, it is recommended that you rectify the problem by changing the user id of [_8] in the x86 World. However, before doing so you MUST first shut down PowerVM Lx86 by running the command:</p> <pre>/etc/init.d/powervm-lx86 stop</pre> <p>You must do this as there may currently be Lx86 processes running as user [_9]. Next, you need to choose a new, unique user id for user [_10], ensuring that this user id does not already exist in either the x86 World or POWER password files. The simplest way to change the user id of user [_11] is to manually edit the x86 World password file, updating the user id accordingly. Finally, you must update the ownership of all files in the x86 World that are owned by user id [_12]. There are several ways to update the ownership on files in the x86 World, however here is one simple command you can run:</p> <pre>/bin/chown --from=[_13] -R &lt;new user&gt; [_14]</pre> <p><b>CAUTION:</b>  <b>Any mistakes made at this stage could damage both your x86 World and your POWER system. You should then be able to restart PowerVM Lx86 with the following command:</b></p> <pre>/etc/init.d/powervm-lx86 start</pre> <p>(This mail was generated by the cron script [_1] and can be disabled by setting the configuration variable  WORLD_CHECK_OR_SYNC=none in /etc/opt/powervm-lx86/config)</p>

Alert message	New group ('<group>') found in <file>.
Example e-mail	<p>A new group account has been found in the x86 World group file ([_1]) that is not present in the POWER group file. The relevant group entry found in [_2] is shown here:</p> <p>[_3]</p> <p>where the fields represent the group account, password, group id, and users that are members of this group, respectively. In order to stop receiving this email in future you have two options. The first option is to add the group [_4] to the group whitelist file found in /etc/opt/powervm-lx86/group_ignore. In this case you don't need to add the group to the POWER side and this group will be ignored in future. The second option is to add the group on the POWER side yourself. One way of doing this (but not necessarily the most complete) is to execute the following command in a native POWER shell:</p> <pre>/usr/sbin/groupadd [_5]</pre> <p>(This mail was generated by the cron script [_1] and can be disabled by setting the configuration variable WORLD_CHECK_OR_SYNC=none in /etc/opt/powervm-lx86/config)</p>

Alert message	Aliased group id ('<groupid>') found in <file>.
Example e-mail	<p>A group account has been found in the x86 World group file ([_1]) that shares the same group id ([_2]) with an account found in the POWER group file (/etc/group). The relevant group entry found in the x86 World file ([_3]) is shown here:</p> <p>[_4] and the relevant group entry found in the POWER file (/etc/group) is shown here:</p> <p>[_5] where the fields represent the group account, password, group ID, and users that are members of this group, respectively.</p> <p>Although highly unlikely, this could represent a serious security risk, since the identity corresponding to group id [_6] is ambiguous.</p> <p>In order to stop receiving this email in future you have two options. If you believe there to be no security risk involved then you can add the group id [_7] to the whitelist file found in /etc/opt/powervm-lx86/gid_ignore Otherwise, it is recommended that you rectify the problem by changing the group id of [_8] in the x86 World. However, before doing so you MUST first shut down PowerVM Lx86 by running the command:</p> <pre>/etc/init.d/powervm-lx86 stop</pre> <p>since there may currently be PowerVM Lx86 processes running as group [_9]. Next, you need to choose a new, unique group id for group [_10], ensuring that this group id does not already exist in either the x86 World or POWER group files. The simplest way to change the group id of group [_11] is to manually edit the x86 World group file, updating the group id accordingly. Finally, you must update the ownership of all files in the x86 World that are owned by group id [_12]. There are several ways to update the ownership on files in the x86 World, however here is one simple command you can run:</p> <pre>/bin/chown --from=[_13] -R :&lt;new group id&gt; [_14]</pre> <p>CAUTION: Any mistakes made at this stage could damage both your x86 world and your POWER system.</p> <p>You should then be able to restart PowerVM Lx86 with the following command:</p> <pre>/etc/init.d/powervm-lx86 start</pre> <p>(This mail was generated by the cron script [_1] and can be disabled by setting the configuration variable WORLD_CHECK_OR_SYNC=none in /etc/opt/powervm-lx86/config)</p>

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## **Part 8. Appendixes**





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## Appendix. Known issues with PowerVM Lx86

There are some known issues with PowerVM Lx86. This section details those issues and any workarounds that are available. See the Release Notes for the most recent updates.

### **gdb support on RHEL 4 Update 3**

The version of gdb included in the RHEL 4 Update 3 x86 World may fail to run a multi-threaded application. This can be worked around by updating the gdb rpm to **gdb-6.3.0.0-1.132.EL4.i386** or later.

### **Access times on directories**

As part of the operation of PowerVM Lx86, access times of directories may be updated more regularly than normally expected by a running x86 application due to the *jailing* mechanism. This is not expected to have an impact on any applications. This will not be addressed in a future release.

### **Argument lengths**

The PowerVM Lx86 *jailing* mechanism adds the `X86_WORLD_ROOT` (e.g. `/i386`) string to some system call arguments. This reduces the maximum length of arguments that can be made by a translated x86 application. This will not be addressed in a future release.

### **UTF-8 console**

If the installer is run from a console that does not support UTF-8, some characters might be shown incorrectly. This will not be addressed in a future release.

### **Limitations with escapes**

It is not possible to move an existing escape directory or file from within the x86 World, for example by using the **mv** command. To move an escape, delete the escape (by deleting the symlink file in the x86 World from a POWER shell), move the underlying POWER file or directory, and then use **linkx86** to create a new escape to the file or directory.

### **Stopped and zombie processes**

If a translated x86 process is stopped, the process will not appear in the x86 `/proc` entries. The process is still running on the system and will be visible from a POWER shell, but will not be visible to x86 tools such as **ps** and **top**. If the process is *continued*, it will reappear in the x86 `/proc` entries and will be visible to the x86 **ps** and **top** commands again.

### **Local X11 display on RHEL 4 and SLES 9**

Graphical applications may not work when running on the local X11 display or using VNC due to an error in the X server and VNC Server. Running on the local X display may also require the command **xhost+** to be run from within a POWER shell before running the translated applications. Also, ensure that the display is set

to a defined network name, for example, `DISPLAY=localhost:0.0`, not `DISPLAY=:0.0`. If you want to use a local display and connect directly to the local X server (rather than via TCP), an escape can be created for the `.X11-unix` socket directory. Use **linkx86** to create the socket from a POWER shell by typing the following command:

```
% linkx86 /tmp/.X11-unix
```

## Colors in X11 applications

Some graphical applications, such as Adobe® Macromedia Flash, may display colors incorrectly when run under translation if displayed on a local POWER X server.

## System resource conflicts

Certain system resources are shared between PowerVM Lx86 and the host POWER system. By default, PowerVM Lx86 and the POWER system use the same IP address. Attempts to bind to a certain port by a translated x86 application will fail if that port is already used by a running POWER application.

For example, if a POWER version of apache (**httpd**) is using port 80, an x86 instance of apache (**httpd**) will be unable to use that port. This can be resolved by running one of the apache instances on a different port number.

## Disk performance

Disk performance may be slower on disks formatted using reiserfs than with ext2 or ext3. ext3 should be used as the default disk format for PowerVM Lx86.

## Out of memory

If an x86 application uses up all of the available system memory, PowerVM Lx86 may exit with an error.

## Accuracy of floating-point instructions

Due to the precision differences in floating point hardware implementations between the x86 and native Power systems, the precise results of floating point instructions may not be the same as running the application natively on x86 hardware.

## reboot command in an x86 shell

The **reboot** command has no affect when run from a translated x86 shell. This is the desired affect. If you want to reboot the system, please run the **reboot** command from a POWER shell. If you want to restart just the x86 services running on the system, in a similar way to rebooting the x86 components running on the POWER system, restart the PowerVM Lx86 daemon with the following command:

```
% /etc/init.d/powervm-lx86 restart
```

For more details about the PowerVM Lx86 daemon, see “Starting the PowerVM Lx86 daemon” on page 38.

## binfmt\_misc not supported in x86 environment

The binfmt\_misc Linux kernel feature is not supported in the x86 environment. If an x86 application running in the VxE attempts to register with binfmt\_misc it will fail and PowerVM Lx86 may error.

---

## PowerVM Lx86 translation process

The PowerVM Lx86 translation process is multi-stage and iterative.

Once an x86 application is loaded into memory, it undergoes a continuous process of translation and optimization. This is shown in the following diagram.

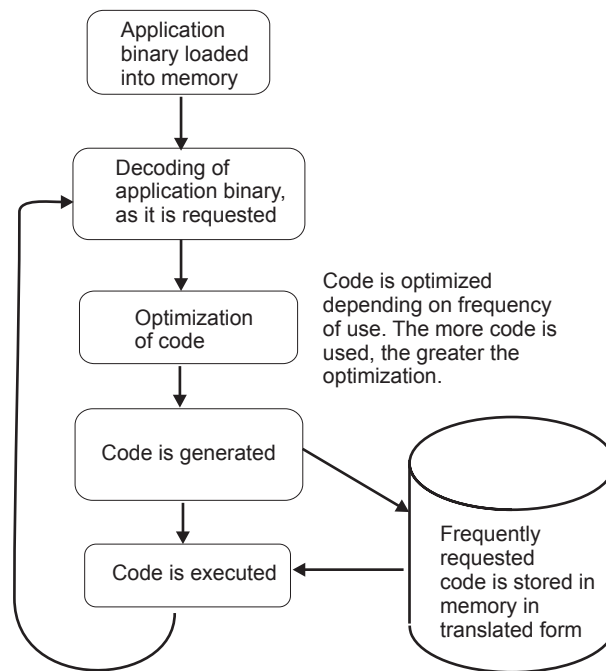


Figure 4. PowerVM Lx86 translation process

As the x86 application runs, PowerVM Lx86 dynamically translates the x86 code into POWER code. The translation is a three-stage process:

1. Decoding of application binary: x86 binary instructions are decoded as the translator requests them.
2. Optimization: The optimization is iterative, so more optimization is done on frequently-used code.
3. Generation of POWER code: The decoded x86 instructions are now translated into POWER code. Frequently-used code is stored in memory, so it does not need retranslating the next time it runs.

## Linux on x86 system calls

x86 applications use system calls to request services from the x86 kernel.

The translator maps x86 system calls to their POWER equivalents.

## System resources, binaries, and files

x86 applications need access to system resources, and to be able to access their own data and files as if they reside on an x86 system. They also need to be able to access files in the Linux on POWER system.

System resources such as x86 applications are translated as they are run. This means that the x86 applications can interact with POWER system resources as if they were a native POWER application. System resources include graphics, disk access, users, and network devices.

x86 binaries and libraries are all installed in one location on the same machine as the translator. The translator ensures that x86 applications can access the binaries and libraries that they require. See Chapter 3, “PowerVM Lx86 concepts,” on page 7 in this guide for more information about x86 World, jailing, and escapes.

Linux on POWER files and resources can be accessed by x86 applications. This may require some configuration.

---

## Glossary

This is a glossary for the PowerVM Lx86 for x86 Linux Applications Administration Guide.

**escape** A mechanism that allows access to files on the local Linux on POWER file system, which are external to x86 World from the VxE.

**host system** The POWER system on which PowerVM Lx86 has been installed. It is able to run x86 applications within a VxE.

**jailing** The restriction of the view of the Linux file system from the VxE. Similar in concept to UNIX chroot.

**Linux on POWER system** A system with a POWER CPU running the Linux operating system.

**Linux on x86 system** A system with an x86 CPU running the Linux operating system.

**Linux on POWER application** A Linux application compiled for a Linux on POWER system.

**Linux on x86 application** A Linux application compiled for a Linux on x86 system.

**native POWER application** A Linux on POWER application running natively on a Linux on POWER system.

**native x86 application** A Linux on x86 application running natively on a Linux on x86 system.

**native POWER shell** The Linux shell running natively on the Linux on POWER host system.

**native x86 shell** The Linux shell running natively on a Linux on x86 system.

**runx86** The command that runs an x86 binary within a Virtual x86 Environment.

**powervm-lx86** The program that translates x86 applications so they can run on POWER systems.

**powervm-lx86-daemon** The daemon program that PowerVM Lx86 uses to communicate between translated x86 processes on the POWER system.

**PowerVM Lx86** A product that enables POWER systems to run x86 applications alongside native POWER applications. No modifications, recompiling, or changes are needed to the x86 applications.

**translator** The powervm-lx86 program that handles the mapping of instructions and requests from the VxE onto the underlying Linux on POWER system.

**Virtual x86 Environment (VxE)** The method that PowerVM Lx86 uses to add Linux on x86 compatibility to Linux on POWER systems. Linux on x86 applications are encapsulated so the operating environment appears to be x86, even though the underlying system is POWER. This is achieved using the files and libraries in x86 World, the translator, and selective integration between the VxE and the POWER host system.

**x86 application** A Linux on x86 application running within a VxE on a Linux on POWER host system.

**x86 shell** The Linux shell running within a VxE on a Linux on POWER host system. Linux on x86 commands entered from the x86 shell prompt will also be run within a VxE.

**x86 World** A set of Linux on x86 libraries, commands, applications, and other system files that are installed in a directory on the POWER system.

---

## Accessibility features

Accessibility features help users who have a physical disability, such as restricted mobility or limited vision, to use information technology products successfully.

The following list includes the major accessibility features:

- Keyboard-only operation
- Interfaces that are commonly used by screen readers
- Keys that are tactilely discernible and do not activate just by touching them
- Industry-standard devices for ports and connectors
- The attachment of alternative input and output devices

### IBM and accessibility

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