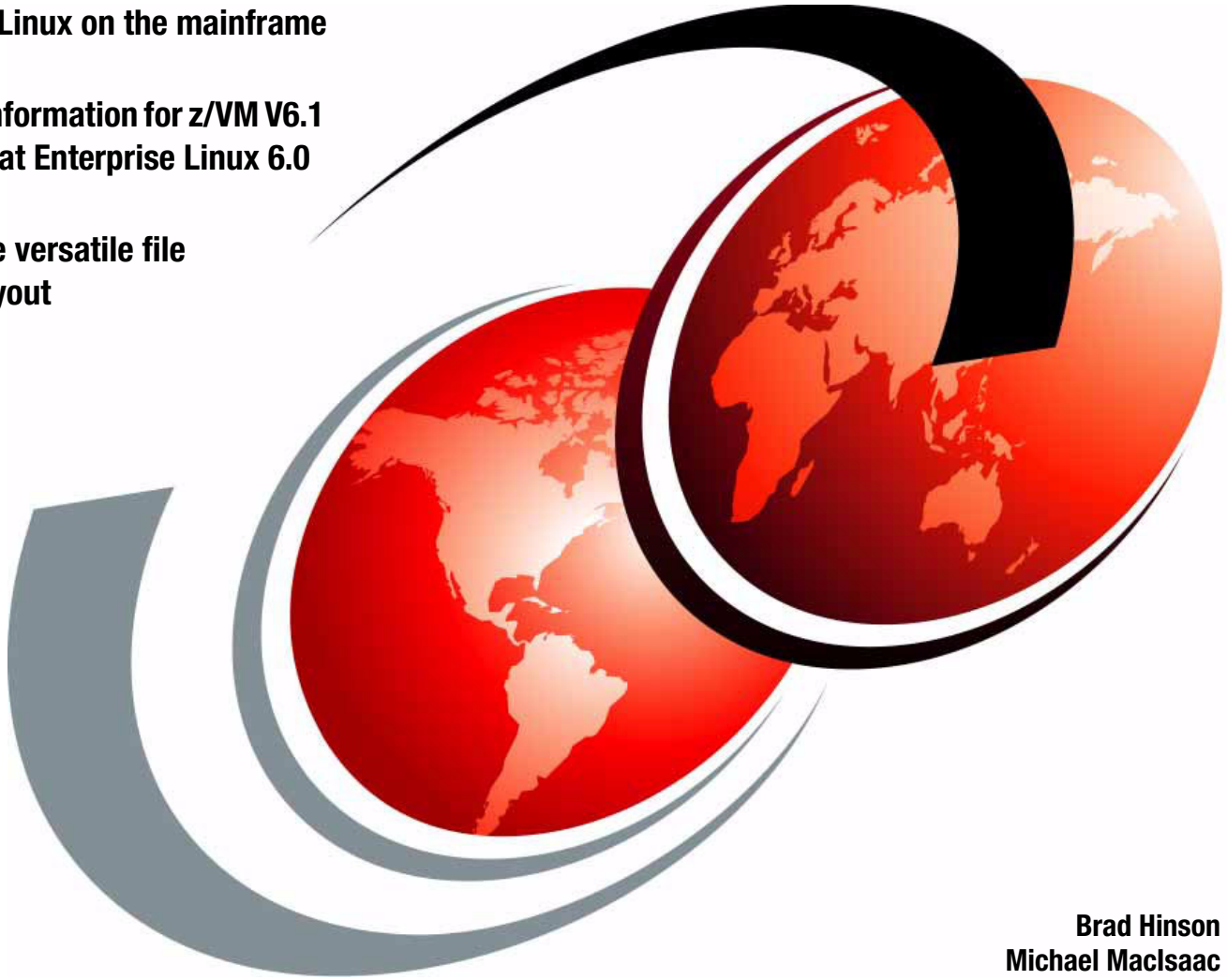
IBM

z/VM and Linux on IBM System z

The Virtualization Cookbook for Red Hat Enterprise Linux 6.0

- Hands-on instructions for installing z/VM and Linux on the mainframe
- Updated information for z/VM V6.1 and Red Hat Enterprise Linux 6.0
- New, more versatile file system layout



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International Technical Support Organization

z/VM and Linux on IBM System z: The Virtualization Cookbook for Red Hat Enterprise Linux 6.0

February 2011

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

First Edition (February 2011)

This edition applies to z/VM Version 6.1 and Red Hat Enterprise Linux 6.0.

Contents

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Preface

This IBM® Redbooks® publication describes how to create Linux® virtual servers in IBM z/VM® on IBM System z® hardware. This book adopts a cookbook format that provides a concise, repeatable set of procedures for installing and configuring z/VM in a logical partition (LPAR) and then installing and customizing Linux. You need an IBM System z LPAR with the associated resources, z/VM V6.1 media, and a Linux distribution.

This book assumes that you have a general familiarity with System z technology and terminology. It does not assume an in-depth understanding of z/VM and Linux. It is written for those clients who want to get a quick start with z/VM and Linux on the mainframe.

Chapters and appendixes

The chapters and appendixes in this book are summarized in the following list:

- Chapter 1, “Introduction to z/VM and Linux” on page 1 gives a brief introduction of the book.
- Chapter 2, “Planning” on page 7 describes how to plan hardware, software, and networking resources. It discusses the DASD labeling conventions used in the book and password planning. Sample worksheets are provided for the examples used in the book, as are blank copies for your use.
- Chapter 3, “Configuring a desktop machine” on page 19 describes how to set up Microsoft® Windows® desktops. Specifically, the following tools are discussed:
  - How to get and set up PuTTY, which is a commonly used SSH client.
  - How to get and set up a VNC client, which is a tool for running graphical applications.
  - 3270 emulator applications.
- Chapter 4, “Installing and configuring z/VM” on page 27 shows how to install and configure z/VM.
- Chapter 5, “Servicing z/VM” on page 73 describes how to apply services to z/VM both in the form of Programming Temporary Fixes (PTFs) and Recommended Service Upgrades (RSUs).
- Chapter 6, “Configuring an NFS/FTP server” on page 97 explains how to set up a temporary NFS server under Linux to install the first two Linux images. After the cloner is installed, you can copy the Linux installation tree to it and retire the Linux server.
- Chapter 7, “Installing RHEL 6 on the cloner” on page 105 describes how to install and configure a Linux image under the first Linux user IF, that is, the cloner, which does the cloning and other tasks.
- Chapter 8, “Installing and configuring the golden image” on page 137 describes how to install and configure a Linux image under the first Linux user ID, that is, the golden image, which is the image from which the clones are made.
- Chapter 9, “Configuring RHEL 6 for cloning” on page 155 explains how to prepare z/VM user IDs and clone your first virtual server.

- Chapter 10, “Installing Linux with kickstart” on page 175 describes how to use the Red Hat kickstart tool to create Linux systems. This process is fundamentally different from cloning, as this tool is a script that is used for an automated installation. You may try kickstart and you may also try cloning. Understand that they try to accomplish the same goal of being able to quickly get Linux systems up and running, and that you do not need to use both.
- Chapter 11, “Cloning open source virtual servers” on page 181 shows how to configure cloned Linux images on the following *appliances*:
  - Web server virtual server
  - LDAP virtual server
  - File and print virtual server
  - Application development system
- Chapter 12, “Servicing Linux with Red Hat Network” on page 199 describes how the *Red Hat Network* works. The Red Hat Network provides centralized management and provisioning for multiple RHEL 6 systems.
- Chapter 13, “Miscellaneous tasks” on page 203 describes how to add and extend logical volumes to Linux, and many other miscellaneous tasks.
- Chapter 14, “Monitoring and tuning z/VM and Linux” on page 239 describes the basic steps that you perform to begin monitoring z/VM and your new Linux virtual servers.
- Appendix A, “References” on page 257 provides references to websites, books, and other pertinent information..

History

There have been many versions of the Virtualization Cookbook:

2011

In February 2011, this book was published, targeting Red Hat’s RHEL 6 distribution, with the changes listed just above.

2008

In August 2008, *z/VM and Linux on IBM System z*, SG24-7492 was published targeting Red Hat’s RHEL 5.2 distribution.

2007

In March 2007, two books were published on `http://linuxvm.org/present`, each book targeting a different distribution:

- *z/VM and Linux on IBM System z: The Virtualization Cookbook for SLES 10*
- *z/VM and Linux on IBM System z: The Virtualization Cookbook for RHEL 5*

2006

In September 2006, *IBM z/VM and Linux on IBM System z: Virtualization Cookbook for Red Hat Enterprise Linux 4*, SG24-7272 was published, and addressed both 31-bit and 64-bit RHEL 4.

Conventions

Except where noted in the individual chapters, the following font conventions are used in this book:

Monospace and bold	Commands entered by the user on the command line when inline. This only applies to lower-case commands.
<value>	Values inside angle brackets are examples and are replaced with the values that are correct for your enterprise.
monospace	File, directories, statements, and commands set off in their own paragraph.

The following command conventions are used in this book:

- z/VM commands are prefixed with **==>**.
- z/VM XEDIT subcommands are prefixed with **====>**.
- Linux commands running as root are prefixed with #.
- Linux commands running as non-root are usually prefixed with $.

The team who wrote this book

This book was updated for z/VM V6.1 and RHEL 6 by Brad Hinson of Red Hat and Michael MacIsaac of IBM in late 2010.

Brad Hinson is the global lead for System z at Red Hat in Raleigh, NC.

Michael MacIsaac has been with IBM for 24 years and now works in Poughkeepsie. He enjoys working on Linux and z/VM and writing IBM Redbooks publications. He currently manages a systems management development team in the z/VM organization.

Special thanks

Sincere thanks goes out to the following people who contributed to this project in many different ways:

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Sine Nomine

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Red Hat, Raleigh, NC

Thanks to many others in IBM Poughkeepsie and to the many others who answered questions on the linux-390 and IBMVM list servers.

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Summary of changes

This section describes the technical changes made in this edition of the book and in previous editions. This edition might also include minor corrections and editorial changes that are not identified.

Summary of Changes
for SG24-7932-00
for z/VM and Linux on IBM System z: The Virtualization Cookbook for Red Hat Enterprise Linux 6.0
as created or updated on February 18, 2011.

Summary of changes in the February 2011 version

This revision reflects the addition, deletion, or modification of new and changed information described below.

There are significant changes in this book:

- The z/VM sections are updated for V6.1.
- The Linux sections are updated for RHEL 6.
- There are new sections about how to order z/VM electronically, and how to make the z/VM product files available for installation from an FTP server. See 4.1.1, “Obtaining z/VM through electronic download” on page 28 and 6.5, “Configuring an FTP server for z/VM installation” on page 102 for more details.
- Chapter 5, “Servicing z/VM” on page 73 has been updated to include information about service for the new IBM zEnterprise 196. See 5.2, “PTFs for the zEnterprise 196” on page 82 for more details.
- Section 13.4, “Adding SCSI/FCP disks” on page 213 is new.
- Section 13.6, “Setting up Linux Memory Hotplugging” on page 222 is new.
- Section 13.7, “Using the cpuplugd service” on page 224 is new.
- Section 13.8, “Hardware cryptographic support for OpenSSH” on page 227 is new.
- New document number, SG24-7932-00.

See “Preface” on page xi for information about past editions.

1

Introduction to z/VM and Linux

Virtualization is an important topic in the IT industry. The IBM z/VM mainframe and its predecessors have been performing virtualization for four decades. Today, it is the most functionally rich virtualization platform available. When Linux was ported to IBM mainframes in 2000, it was a natural fit to run under z/VM. You can run many tens of Linux images on the same IBM System z logical partition (LPAR). Some customers are running hundreds in production mode.

With a z/VM and Linux infrastructure, you can reduce the time between deciding on the acquisition of new servers and then implementing them because new servers can be deployed in a matter of minutes. This powerful build and clone capability can enable you to launch new products and services without the exhaustive planning, purchasing, installing, and configuring of new hardware and software that can be associated with conventional and discrete hardware servers. Development groups who need test environments built and rebuilt rapidly to enable them to efficiently deliver their projects and handle change management in the process can also benefit from this unique advantage.

Some of the mainframe's and z/VM's best strengths are:

- Their virtualization capabilities are more mature and robust than any other hardware and hypervisor combination.
- z/VM provides a rich, functional, and sophisticated level of systems management that can greatly help run large numbers of Linux servers.
- The z/VM virtual switch (VSWITCH) makes the networking of Linux much simpler.
- Full volume backup of systems allows for complete disaster recovery when another data center is available.
- z/VM is one of the easiest operating systems to customize at the base installation level. There is only a relatively small number of configuration files. Properly set up, z/VM can run for months with little maintenance or administration required.

Many functions have been added to z/VM since Version 5.2. The following sections give a brief summary of the functions added in the last three releases.

z/VM V6.1

z/VM V6.1, available since October 2009, is intended to be the base for all future z/VM enhancements. This release implements a new Architecture Level Set (ALS) available only on the IBM System z10® Enterprise Class server and System z10 Business Class server and future generations of System z servers. Requiring z10 technology or later allows z/VM to take advantage of newer hardware technology for future exploitation.

Enhancements in z/VM V6.1 provide:

- Enhanced performance of virtual networking environments running heavy guest-to-guest streaming workloads
- Faster access to data when utilizing FICON® Express8
- Closer integration with IBM Systems Director to eliminate the need to download agents and help simplify the installation of those agents
- Significantly better and more highly secure guest transactions when using Crypto Express3 as compared to Crypto Express2
- Guest support for IBM System Storage® DS8000® Extended Address Volumes (EAVs) to help simplify storage management and relieve address constraints

Read more about System z virtualization capabilities on the web at:

http://www.vm.ibm.com

z/VM V5.4

z/VM V5.4, available since August 2008, provides major improvements when operating on System z servers with large memory configurations. It improves scalability and can help support increased workloads on IBM System z servers. This release uses new capabilities of the System z10, including:

- Greater flexibility, with support for the new z/VM-mode logical partitions, allowing all System z processor-types (CPs, IFLs, zIIPs, zAAPs, and ICFs) to be defined in the same z/VM LPAR for use by various guest operating systems
- Capability to install Linux on System z from the HMC, which eliminates network setup or a connection between an LPAR and the HMC
- Enhanced physical connectivity by exploiting all OSA-Express3 ports, helping service the network and reducing the number of required resources

z/VM V5.4 dynamic memory upgrade support allows real memory to be added to a running z/VM system, avoiding the need to shut down z/VM and its guests, deactivate the LPAR, change its memory allocation, reactivate the LPAR, perform an IPL of z/VM, and restart its guests. Memory can be added nondisruptively to individual guests that support the dynamic memory reconfiguration architecture.

Read more about System z virtualization capabilities on the web at:

http://www.vm.ibm.com

z/VM V5.3

z/VM V5.3 became generally available in June 2007. Scalability was extended to allow 256 GB of real memory, a total of 8 TB of virtual storage, and 32 real processors. z/VM V5.3 also added support for the Collaborative Memory Management Assist (CMMA) on the z9® EC and

the z9 BC processors or later. Virtual Machine Resource Manager (VMRM) detects when memory is constrained and notifies the Linux guests, which can then adjust their memory consumption to help relieve the memory constraint. In the previous major release, z/VM V5.2, many memory contention issues were removed with the Control Program (CP) now using memory above 2 GB for a much broader set of operations. Previously, guest pages had to be moved below 2 GB for many reasons, for example, in both standard I/O and Queued Direct I/O (QDIO). Now I/O can be done using buffers anywhere in real memory, and QDIO structures can reside above 2 GB, as can most CP control blocks. These improvements offer constraint relief for large-real-memory virtual server environments that are memory intensive

1.1 What is virtualization

Virtualization is the ability for a computer system to share resources so that one physical server can act as many virtual servers. z/VM allows the sharing of the mainframe's physical resources, such as disk (DASD), memory (sometimes called *storage*), network adapters (OSA cards), and CPU (CPs or IFLs). These resources are managed by a *hypervisor*. The z/VM hypervisor is called Control Program (CP). When the user logs onto z/VM, the hypervisor creates a virtual machine that can run one of many different operating systems. The two operating systems that are discussed in this book are the z/VM native one, that is, the Conversational Monitoring System (CMS), which can be thought of as a z/VM *shell*. and Linux. Virtual machines running Linux as guests of a z/VM host become the *virtual servers*.

1.2 The philosophy adopted in this book

An important philosophy adopted in this book is to keep all the solutions simple. Albert Einstein once said, "Everything should be made as simple as possible, but not simpler", which sums up this philosophy. This book aims to use the same clear and insightful presentation.

Many books and papers discuss virtualization, but do not tell you how to accomplish virtualization. The remainder of this book discusses how to perform this virtualization.

1.3 Choices and decisions made in this book

When deciding about installing, maintaining, and provisioning (cloning) Linux virtual servers under z/VM, there are many basic choices to make. Here are some of the choices and assumptions made in this book:

- Use of a cloning product versus using your own cloning process: Cloning products, such as Aduva Onstage, Mainstar Provisioning Expert, IBM Tivoli® Provisioning Manager, and IBM Systems Director, are outside the scope of this book. While these are all viable solutions, the cloning described in this book allows you to create your own Linux images without using such products. However, these products are more sophisticated than the simple clone script and z/VM configuration described in this book.
- Directory Maintenance product versus the USER DIRECT file: The `USER DIRECT` file is chosen over a directory maintenance product such as IBM DirMaint™ or CA VM:Direct. If you feel that DirMaint as a directory maintenance product is better suited to your enterprise, refer to *Getting Started With Linux*, SC24-6096 to configure z/VM; you can still use this book to configure Linux.

- Provisioning versus predefined user IDs: z/VM user IDs must be predefined to clone them. There is no attempt to *provision* them (define and bring Linux user IDs online automatically) as part of the cloning process. The target Linux user ID must exist with the appropriate minidisks defined.
- Shared read-only Linux `/usr/` file system versus read-write: Some cloning solutions use an environment which shares the `/usr/` file system. This choice often makes the solution more complex, especially when adding software to the virtual servers. A read-write `/usr/` file system on the virtual servers is chosen to keep things as simple as possible.
- Conventional 3390 ECKD™ DASD versus FBA disks accessed with SCSI over FCP: The System z server has traditionally only supported 3390 DASD. Support has been extended to include SCSI/FBA disks in storage area networks (SANs). The support of FBA disks is slightly more complicated than conventional DASD. In keeping things as simple as possible, only conventional DASD is described in this book.
- Cloning script or EXEC versus manual installation: Two methods of cloning are described: a manual process and a process that uses a Linux bash script. The manual method is described so that we can better teach these concepts. The Linux script is provided so you can save time.

1.4 Infrastructure design

To install and configure z/VM, install, configure, and clone Linux, or *provision virtual servers*, there must be a certain infrastructure design in place. A System z server with its associated resources and the z/VM operating system define much of this infrastructure.

Figure 1-1 shows a block diagram of a System z10 with multiple LPARs. z/VM V5.4 is installed in one of these LPARs. z/VM comes with many user IDs predefined. The most important six IDs are shown in the z/VM LPAR above the dashed line. Below the dashed line, you see the user IDs described in this book.

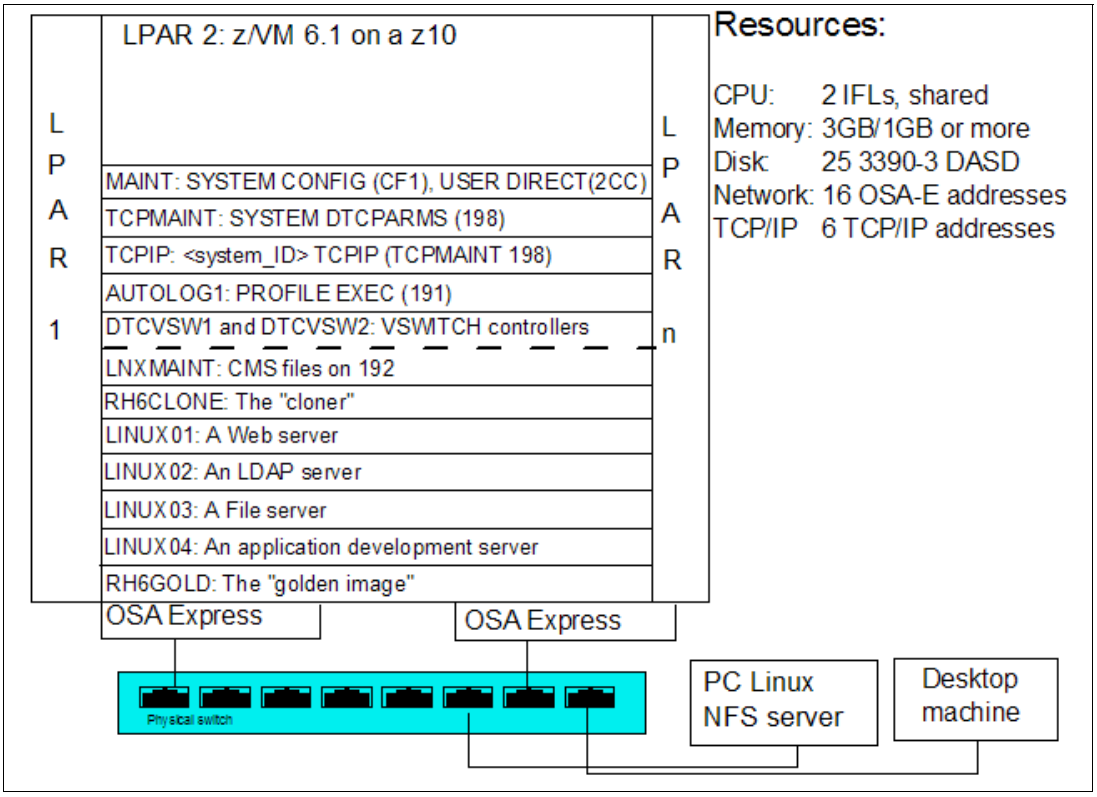


Figure 1-1 System infrastructure and z/VM user IDs

The user IDs that are described in this book have the following functions:

- LNXMAINT: A user ID on which to store files that will be used by both CMS and Linux.
- RH6CLONE: The cloner that does the cloning. It also serves as the Linux install server, and has other functions.
- LINUX01-04: The user IDs to which you clone. Each virtual server is configured with two 3390-3 minidisks to allow for slightly more than 4 GB of space.
- RH6GOLD: The RHEL 6 golden image. This is the Linux system that is cloned.

1.5 Usability tests performed for this book

During the writing of this book, many usability tests were conducted. The participants had a variety of skills, but none had both Linux and z/VM system administration skills. By the end of the first day of all of the formal tests, most participants had all completed up to and including Chapter 5, “Servicing z/VM” on page 73, so z/VM was installed, serviced, and customized for TCP/IP communications with a highly available VSWITCH. By the end of the second day, most participants had cloned their first Linux virtual server. You should be able to complete most steps in the book in four solid days of work, if all goes well.

2

Planning

This chapter covers the planning that should be done before installing z/VM. It begins by discussing a *bill of materials*, that is, all the resources that you need. Then it describes conventions adopted for labeling 3390 volumes. Finally, resource worksheets are presented for:

- z/VM resources other than direct access storage device (DASD)
- DASD resources
- Linux resources
- Linux user IDs

2.1 Bill of materials

The resources needed for a Linux on IBM System z project can be divided into the following areas:

- Hardware
- Software
- Networking

2.1.1 Hardware resources

The following hardware is needed:

- A System z logical partition (LPAR) and a System z10 or System z196
  - Processors or CPUs: One IFL (or CP) minimum, two or more are recommended.
  - Memory: 3 GB central memory and 1 GB of expanded minimum, 6 GB and 2 GB or more recommended. This 3:1 ratio of central to expanded storage is a good starting point for relatively small systems. See the following website for a discussion about how to apportion memory:

    `http://www.vm.ibm.com/perf/tips/storconf.html`
  - DASD: 27 3390-3s or nine 3390-9s at a minimum
  - Open Systems Adapter (OSA) network cards: One card minimum with eight device numbers (technically six, but OSA “triplets” usually start on an even address). Two OSA Express cards with eight device numbers on one and four on the other is recommended for high availability.
- A network-attached computer that will act as an NFS server and possibly an FTP server with at least 6 GB of disk space Setting up a Linux or UNIX® server is described.

  If you *only* have access to a Windows machine, AllegroNFS has been suggested as an NFS server. Refer to `http://nfsforwindows.com/home` for more information.
- A workstation or desktop that has network access to the mainframe.

2.1.2 Software resources

The following software resources are needed:

- z/VM V6.1 installation media with documentation. The physical media of DVDs is described. In addition, there are now sections describing how to use electronic delivery of z/VM using an FTP server so that physical media is not needed.
- RHEL 6 Linux install media. If you do not have it, you can request a no-cost 180-day evaluation copy at the following website:

  `http://www.redhat.com/z`

  See 6.3, “Setting up a RHEL 6 installation tree” on page 98 for details.
- An operating system for the NFS server.
- The code associated with this book, which can be found at the following website:

  `http://www.vm.ibm.com/devpages/mikemac/SG247932.tgz`
- Tools on the workstation and desktop:
  - A 3270 Emulator, such as Attachmate Extra, Hummingbird Host Explorer, or IBM Personal Communications for Windows desktops

- A Linux SSH client, such as PuTTY (recommended) or TeraTerm
- A VNC viewer

These resources are described in more detail in the chapters that follow.

2.1.3 Networking resources

The following network resources are needed:

- A TCP/IP address for z/VM
- One TCP/IP address for each Linux virtual server
- Associated TCP/IP information:
  - DNS host name
  - DNS domain
  - DNS server TCP/IP address
  - TCP/IP gateway
  - TCP/IP subnet mask
  - TCP/IP broadcast address (usually calculated from address and subnet mask)
  - TCP/IP MTU size

The TCP/IP addresses must be routed to the OSA card(s).

2.2 z/VM conventions

It is a best practice to use naming conventions so that you and others can recognize z/VM resources by their names. This section discusses conventions for DASD volume names and backup file names.

2.2.1 Volume labeling convention

You should have a convention for labeling DASDs. You might already have a labeling convention that will largely determine the labels to be given to the DASD used by your z/VM and Linux LPAR.

Each System z DASD is addressed with a device number consisting of four hexadecimal digits. Each System z DASD has a six character label. It is convenient to include the four-digit address in the label so that you can easily tell the address of each DASD from its label. When followed, this convention guarantees that no two DASDs will have the same label. This can be an important issue especially when z/OS® has access to the DASD.

Sometimes a DASD is shared among LPARs, in which case your z/VM LPAR can *see* a DASD *owned* by other LPARs. In this situation, it is convenient to identify the LPAR that *owns* the DASD. Therefore the volume labeling convention used in this book identifies the LPAR with the first character. That leaves the second character in the label to identify the basic function of the DASD.

The LPAR used in this book is identified by the character *M*. The following characters are used for the types of DASD in the second character of the label:

M	Minidisk space (PERM)
P	Paging space (PAGE)
S	Spool space (SPOL)
T	Temporary disk space (TDISK)
V	z/VM operating system volumes

For example, Figure 2-1 shows the labeling convention for the DASD in LPAR *M*, of type *minidisk* at real address *A700*.

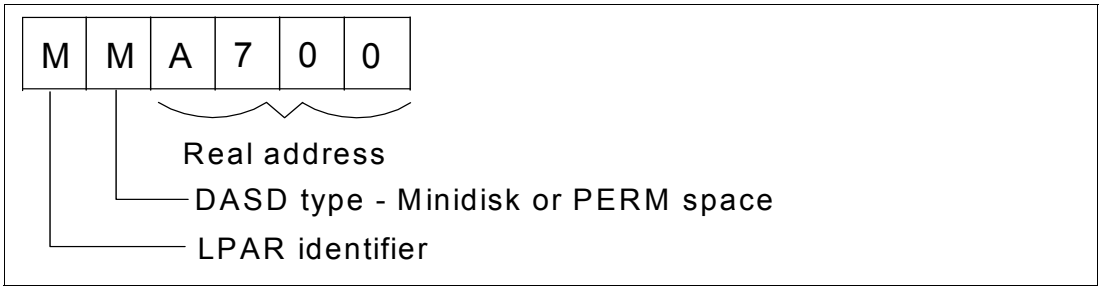


Figure 2-1 DASD labeling convention

The letter M is hardcoded into REXX EXECs that adopt this convention. If you want a different LPAR identifier character, they can easily be changed (search for the `firstChar` variable).

2.2.2 Backup file naming convention

Keep copies of important z/VM and Linux configuration files. You should always keep copies of original configuration files in case you need to restore from them. Because z/VM file names are limited to 16 characters (eight for the file name and eight for the file type), only the last four characters of the file type are used. This situation often requires some characters to be overwritten. For the original file, the suffix `ORIG` is used, and for the most recent working copy, the suffix `WRKS` (for “it WoRKS”!) is used. For example, the original `USER DIRECT` file is copied to the file `USER DIREORIG` before it is modified the first time.

2.2.3 The command retrieve convention

The ability to retrieve past commands is a common tool. The default Linux shell, bash, allows you to scroll through past commands by using the up arrow and down arrow keys.

There is a convention in z/VM to use the F12 function key (labeled PF12 on physical 3270 devices) to retrieve the last command, although it is not defined to all user IDs. There is no convention retrieve commands in the other direction, but it is possible to set another key to that function. Therefore, F11 is used to retrieve forward, because it is right next to F12. Also, the same function is useful in the editor, XEDIT. The ? subcommand retrieves past commands, so you should assign it to F12.

2.3 Disk planning

There are different aspects to consider when planning how to choose and allocate disk storage. Some aspects include the following items:

- Conventional ECKD DASD versus FBA disks over SCSI/FCP
- 3390-3s versus 3390-9s or large disk support
- Amount of disk storage per Linux image and how to allocate file systems

DASD versus SCSI/FCP

This book describes how to use conventional ECKD DASDs and does not discuss FBA disks accessed over SCSI/FCP, not because either technology is superior, but simply because DASDs seems to be much more common than SCSI/FCP disks. If you were to use SCSI/FCP disks, cloning with the clone.sh script would have to be modified to account for World Wide Port Names and Numbers. Sometimes a combination of these two types of disk storage is used; when that is the case, the ECKD emulated DASD is often used for the root file system and SCSI/FCP disks are used for large data storage areas.

3390-3s versus 3390-9s

Emulated 3390-3s format to about 2.3 GB, while 3390-9s are three times the size of emulated 3390-3s, or about 6.8 GB. Either size will work, although 3390-3s have been recommended over 3390-9s by some performance analysts. This book describes mainly using 3390-3s, however, and comments are added where using 3390-9s differs, especially with installing z/VM.

Disk storage per Linux image

Disk storage has the following characteristics:

- You should use two 3390-3 DASD to create minidisks at virtual addresses 100 and 101, instead of a single minidisk at virtual address 100.
- The root file system is on `/dev/dasda1` with a recommended size of 384 MB. It is not a logical volume, so if there are any problems with LVM, the system will still be able to boot.
- Other file systems are on logical volumes that are part of single volume group have the characteristics shown in Table 2-1.

Table 2-1 Recommended logical volume file systems and sizes

Mount point	Logical volume name	Size
`/usr/`	`usr-lv`	2 GB
`/var/`	`var-lv`	512 MB
`/opt/`	`opt-lv`	384 MB
`/tmp/`	`tmp-lv`	384 MB

This layout uses about 3.5 GB of 4.5 GB of disk space. You could choose to use other disk sizes than 3338 cylinders (3390-3 minus cylinder 0). For example, if you chose to use 3390-9s, you could give addresses 100 and 101 each half of the volume, giving each Linux about 6.8 GB of disk space.

Important: However you choose to layout the minidisks, it is important that the golden image and all target Linux user IDs have two minidisks of the same size at virtual addresses 100 and 101. These assumptions are coded into the clone.sh script.

2.4 Memory planning

Planning memory may be the most difficult issue for z/VM and Linux on System z, yet the most important to ensure adequate performance. The simplest solution may appear to involve having enough central memory (storage) in the LPAR so that z/VM never pages and Linux never swaps. However, such resources are often not realistically available. A best practice is to allocate memory on a just enough basis for each Linux server. A good starting point is to set a virtual machine size by changing the memory allocation value at just over the value at which the guest starts to swap at the Linux system level when under normal loading. If some level of sustained swapping is inevitable due to the nature of the workloads, then ensure virtual disks are used for the swap media.

To better understand of memory planning, refer to the following resources:

- *Linux on IBM System z: Performance Measurement and Tuning*, SG24-69266
- The IBM z/VM Performance Resource pages in general, which can be found on the web at:

  `http://www.vm.ibm.com/perf/`
- The IBM z/VM page specifically discussing memory allocation, which can be found on the web at:

  `http://www.vm.ibm.com/perf/tips/storconf.html`

One rule is to have as few virtual machines logged on (or disconnected) as possible to handle the workload being presented. Every virtual machine that is not required should be logged off where appropriate, as this will mean more memory for the other virtual servers that are still running.

2.5 Password planning

Good passwords are critical to good security. However, requiring many different passwords generally leads to people writing them down, which clearly detracts from good security. Sometimes it is difficult to balance these two extremes.

This book considers different system administration roles:

- The z/VM system administrator
- The Linux system administrator
- The Linux virtual server end users

The z/VM and Linux system administrator may be the same person.

The method of backing up z/VM data onto the Linux cloner means that the Linux administrator will have access to all z/VM passwords. Therefore, the examples in this book set all z/VM and Linux system administration passwords to the same value, lnx4vm. If the z/VM and Linux system administrator roles must be kept separate and the Linux administrator is not to have access to the z/VM passwords, then a different method of backing up z/VM data must be chosen.

You may want to define a finer granularity for passwords based on the following system administration roles:

- The main z/VM system administrator (MAINT)
- The z/VM network administrator (TCPMAINT)
- The z/VM Linux administrator (LNXMAINT, Linux cloner, and Linux virtual server user IDs)
- The Linux virtual server users (with or without access to 3270 sessions, with or without the root passwords)

The sets of passwords that you define will depend on the roles that your organization will adopt.

2.6 Planning worksheets

Four worksheets are included in this section. They are populated with the resources used in writing this book. There are also four corresponding blank worksheets in 2.7, “Blank worksheets” on page 16.

2.6.1 z/VM resources used in this book

Table 2-2 lists the z/VM resource values used in the examples in this book. You can use these values as a reference for completing the blank worksheets that follow.

Table 2-2 z/VM resources worksheet

Name	Value	Comment
LPAR name	LVM2	16 GB main storage/2 GB expanded, 10 shared IFLs
CPC name	H15C	Name of CPC on which the LPAR is located
z/VM system name	POKSND61	Name to be assigned to z/VM system
TCP/IP host name	gpok249	Assigned by a network administrator; helpful to set in DNS beforehand, but not necessary
TCP/IP domain name	endicott.ibm.com	Helpful to set in DNS beforehand
TCP/IP gateway	9.60.18.129	The router to and from the local subnet
DNS server 1	9.0.2.11	Assigned by the network administrator
DNS server 2/3 (optional)	9.0.3.1	Not used
OSA device name	eth0	Name of the interface to be assigned by IPWIZARD
OSA starting device number	B420	Start of OSA *triplet* for the z/VM TCP/IP stack
TCP/IP address	9.60.18.249	The TCP/IP address of the z/VM system
Subnet mask	255.255.255.128	Assigned by network administrator
OSA device type	QDIO	Often “QDIO” for OSA/Express cards
Network type	Ethernet	Usually “Ethernet”

Name	Value	Comment
Port name (optional)		Not required by z/VM
Router type	None	Usually “None”
MTU size	1500	Check with network administrator
Primary OSA device number for VSWITCH	B440	Specify the first device number (must be even number) and the next two device numbers will also be used
Secondary OSA device number for VSWITCH	B424	Should be on a different CHPID/OSA card

2.6.2 z/VM DASD used in this book

Table 2-3 lists the z/VM DASD resource values used in the examples in this book.

Table 2-3 z/VM DASD used in this book

Device number	Label	Type	Notes
6280	610RES	CP owned	z/VM system residence volume
6281	UV6281	CP owned	z/VM spool volume 1
6282	UV6282	CP owned	z/VM paging volume 1
6283	UV6283	CP owned	z/VM first work volume
6284	UV6284	CP owned	z/VM second work volume
6285	UP6285	CP owned	Paging volume 2
6286	UP6286	CP Owned	Paging volume 3
6287	UM6287	CP Owned	Paging volume 4
6289	UM6289	System (3390-3)	LNXMAINT 191, LNXMAINT 192,
6290	UM6290	System (3390-3)	RH6CLONE 100
6293	UM6293	System (3390-3)	RH6CLONE 101
6294	UM6294	System (3390-3)	RH6CLONE 102
63A2	UM63A2	System (3390-9)	RH6GOLD 100
63A9	UM63A9	System (3390-9)	RH6GOLD 101, LINUX01 100 and 101
63AA	UM63AA	System (3390-9)	LINUX02 100 and 101, LINUX03 100
63AB	UM3F09	System (3390-9)	LINUX03 101, LINUX04 100 and 101
6339	UM6339	System (3390-3)	For adding logical volumes
6360	UM6360	System (3390-3)	For extending logical volumes

2.6.3 Linux resources used in this book

Table 2-4 lists the Linux NFS server resources used for the first System z Linux installation.

Table 2-4 Linux NFS server resources used in this book

Name	Value	Comment
TCP/IP address	9.60.18.240	
User/password	root/lnx4vm	
NFS-exported install directory	`/nfs/rhel6/`	Directory with DVD 1

Table 2-5 lists the Linux resources used in the examples in this book.

Table 2-5 Linux resources used in this book

Name	Value	Comment
Linux root password	lnx4vm	
TCP/IP gateway	9.60.18.129	Obtain from network administrator
Subnet mask	255.255.255.128	Obtain from network administrator
DNS server	9.0.2.11, 9.0.3.1	Obtain from network administrator
VNC installation password	12345678	Must be 8 characters

2.6.4 Linux user IDs used in this book

Table 2-6 lists the z/VM user IDs for Linux used in the examples in this book.

Table 2-6 Linux user ID used in this book

User ID	IP address	DNS name	Notes
RH6GOLD	9.60.18.222	gpok222.endicott.ibm.com	RHEL 6 golden image
RH6CLONE	9.60.18.223	gpok223.endicott.ibm.com	The cloner
LINUX01	9.60.18.224	gpok224.endicott.ibm.com	A web virtual server
LINUX02	9.60.18.225	gpok246.endicott.ibm.com	An LDAP virtual server
LINUX03	9.60.18.226	gpok247.endicott.ibm.com	A file and print virtual server
LINUX04	9.60.18.227	gpok248.endicott.ibm.com	An application development server

2.7 Blank worksheets

Blank copies of the same four worksheets are provided for your use.

2.7.1 z/VM resources worksheet

Use the worksheet in Table 2-7 to document the z/VM resources that you will use.

Table 2-7 z/VM resources blank worksheet

Name	Value	Comment
LPAR name		
CPC name		
System name		
TCP/IP host name		
TCP/IP domain name		
TCP/IP gateway		
DNS server 1		
DNS server 2/3 (optional)		
OSA device name		Often “eth0”
OSA starting device number		
TCP/IP address		
Subnet mask		
OSA device type		Often “QDIO”
Network Type		Often “Ethernet
Port name (optional)		
Router Type		Often “None”
Primary OSA device number for VSWITCH		
Secondary OSA device number for VSWITCH		Should be on a different CHPID/OSA card than primary

2.7.2 z/VM DASD worksheet

Use the worksheet in Table 2-8 to document the z/VM DASD that you will use.

Table 2-8 z/VM DASD blank worksheet

Device number	Label	Type	Notes

2.7.3 Linux resources worksheet

Use the worksheet in Table 2-10 to document the resources associated with the NFS server that will be used as the installation source of the first System z Linux.

Table 2-9 Linux NFS server resources blank worksheet

Name	Value	Comment
TCP/IP address		
User/password		
NFS-exported install directory		

Use the worksheet in Table 2-11 to document your System z Linux resources.

Table 2-10 Linux resources blank worksheet

Name	Value	Comment
Linux install password		
Linux root password		
Apache user ID and password		
Linux TCP/IP gateway		
Linux TCP/IP broadcast		
Linux DNS server		
VNC Installation password		

2.7.4 Linux user ID worksheet

Use the worksheet in Table 2-11 to document the Linux user IDs that you will create.

Table 2-11 Linux user ID blank worksheet

Linux user ID	IP address	DNS name	Notes

3

Configuring a desktop machine

Many people use Microsoft Windows as a desktop operating system. This chapter addresses the following tools that are recommended for accessing z/VM and Linux from a Windows desktop:

- An SSH client: PuTTY is recommended
- A VNC client: RealVNC is recommended
- A 3270 emulator: Many choices are available

3.1 PuTTY: A no cost SSH client for Windows

Throughout this book, SSH is used to log into Linux systems. It is easy to use and cryptographically secure. If you are using a Linux desktop system, an SSH client is built in. But if you are using a Windows desktop, you will need a good SSH client.

PuTTY is probably the most commonly used. You can download PuTTY from the web at:

`http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html`

To download from this page, click the **putty.exe** link for your architecture. Save the file in a directory path such as `C:\WINNT`. PuTTY is a stand-alone executable (no installation needed other than copying the file). You may also want to create a shortcut on your desktop or task bar.

Open PuTTY and the configuration window shown in Figure 3-4 on page 22 should open. If you spend a few minutes to configure PuTTY it may pay off in time savings. The examples shown are using PuTTY Release 0.60.

1. In the PuTTY Configuration window, in the left Category window, click **Session**.
2. Under the Connection Type heading on the top right, click **SSH** as shown in Figure 3-1. This specifies to use the SSH protocol.

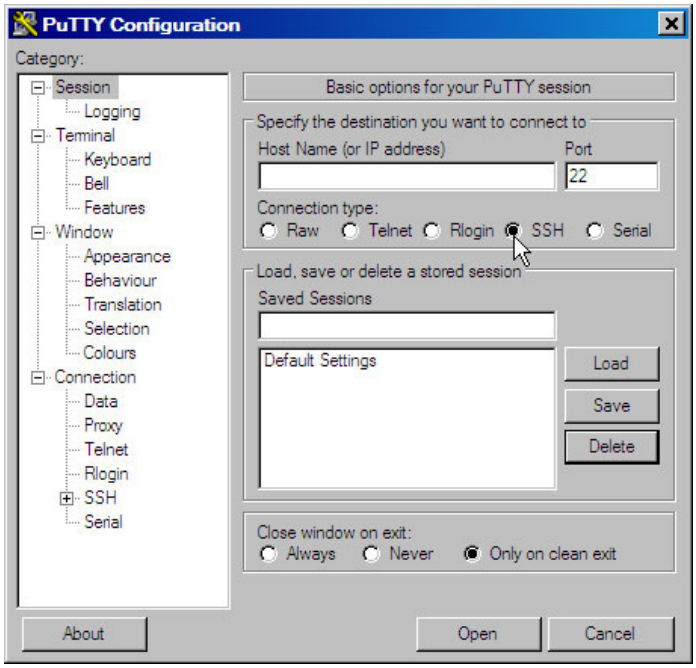


Figure 3-1 PuTTY Configuration window

3. Click **Logging** in the left pane as shown in Figure 3-2.
   - Select **Printable output** in the Session logging radio group. This allows you to go back and check the output of certain commands.
   - Set the Log file name to &H&M&D&T.log so that a time stamp will be in the file name.

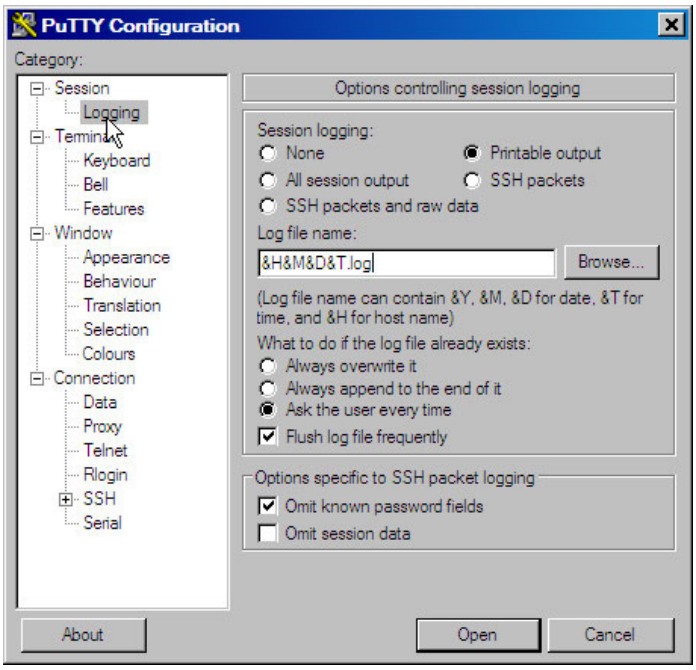


Figure 3-2 Setting logging

4. In the left pane, click **SSH** near the bottom as shown in Figure 3-3.
5. On the right side, under the Preferred SSH protocol version, select **2 only**.

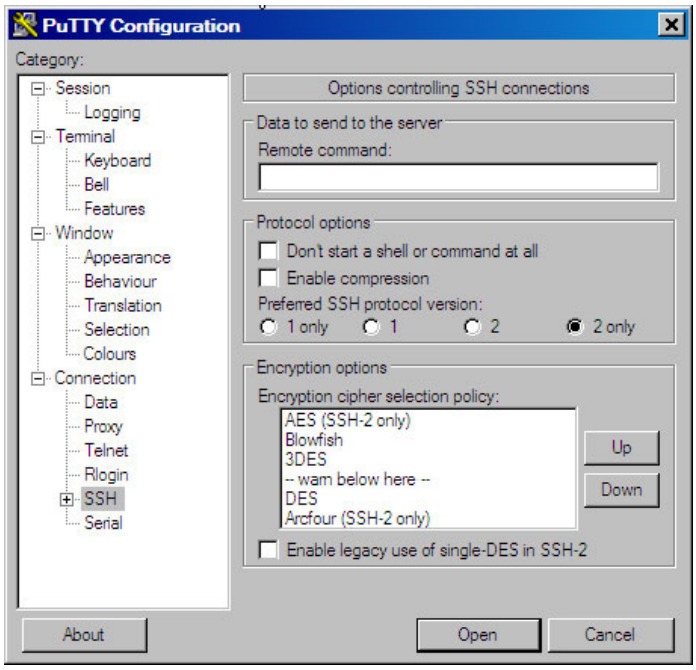


Figure 3-3 Setting SSH Protocol 2

6. In the left Category pane, click **Terminal** as shown in Figure 3-4.
7. Select the **Use background colour to erase screen** check box, which results in a better job of painting the window for applications that use curses (block graphics).

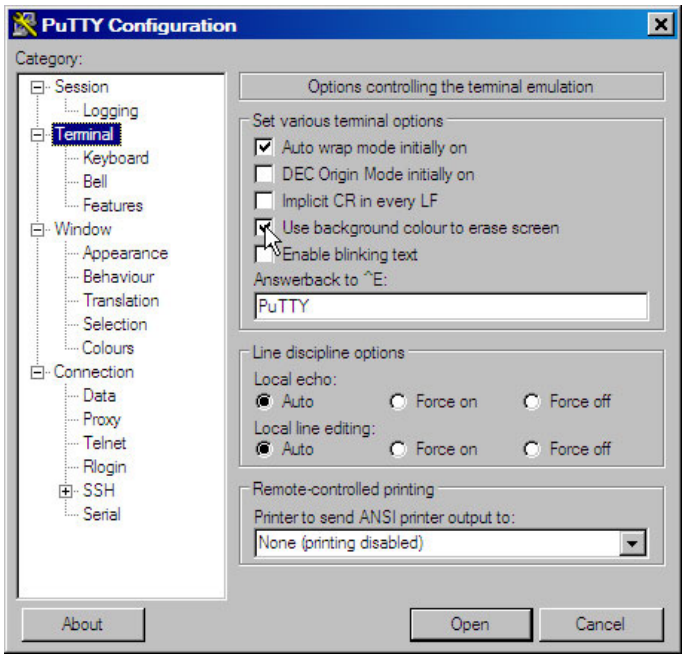


Figure 3-4 Customizing PuTTY SSH settings (Part 1 of 4)

8. Click **Window** in the left pane as shown in Figure 3-5.
9. You may choose a larger window size and more lines of scrollback. In this example, 50 rows, 100 columns and 1000 lines of scrollback are set.

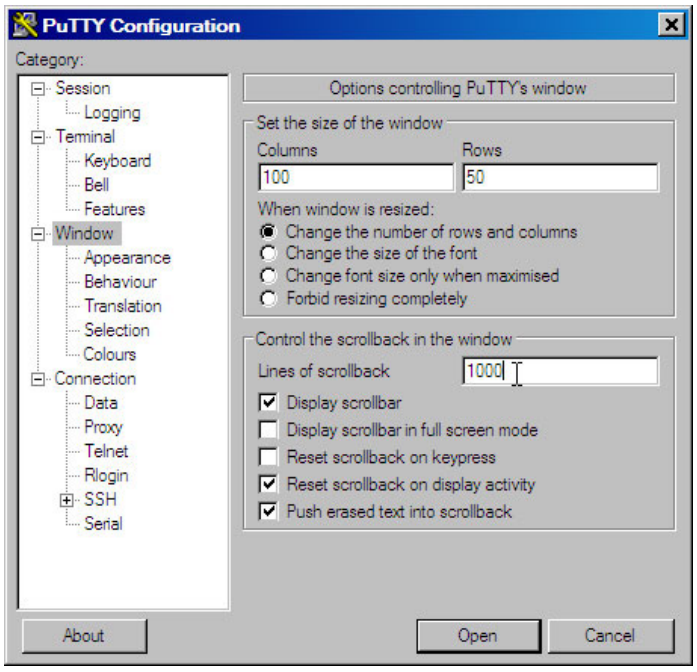


Figure 3-5 Setting window and scrollback size (Part 2 of 4)

10. Click **Session** in the left pane as shown in Figure 3-6.
11. Click **Default Settings** in the Saved Sessions pane, then click **Save**. This makes all future sessions that you define inherit the preferences you just set.

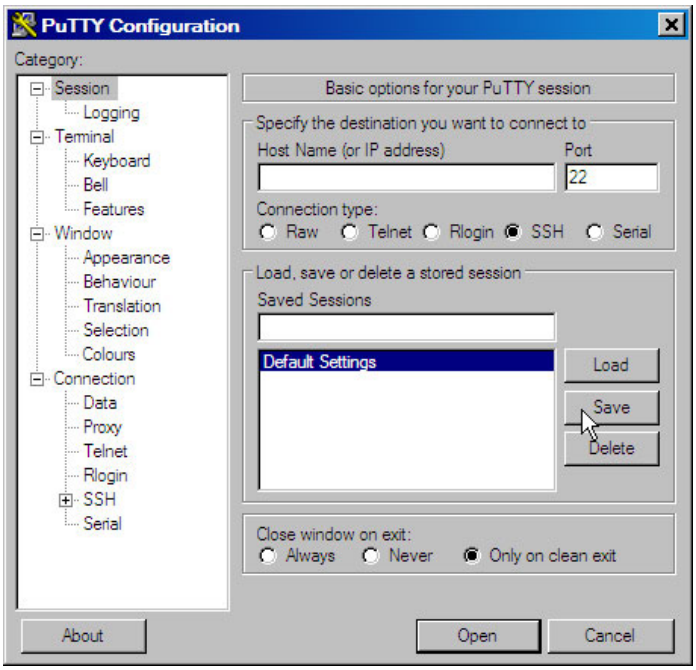


Figure 3-6 Saving new default settings (Part 3 of 4)

Saving sessions

To save sessions, perform the following steps. In this example, a session for LINUX00, or the cloner, is saved.

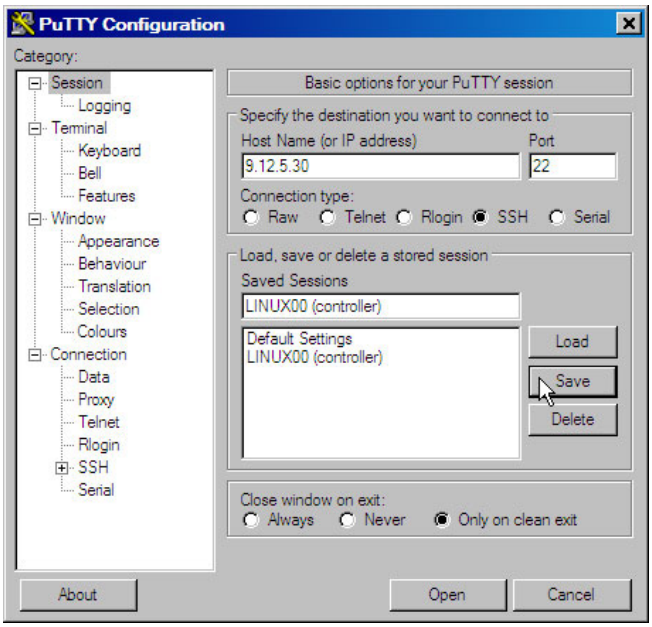


Figure 3-7 Customizing PuTTY window settings (Part 4 of 4)

Now to save a session for each virtual server, perform the following steps:

1. In the Host Name (or IP address) field, enter the TCP/IP address (or DNS name).
2. In the Saved Sessions text area, choose a name that you will remember. In this example, the name LINUX00 (cloner) is used.
3. Again click **Save** and you should see the name added to the Saved Session list.

   Now, whenever you start PuTTY, you can simply double-click any saved session name, and an SSH session to the desired Linux system will be invoked.

3.2 Setting up a VNC client

A VNC client allows access to a graphical windowing environment with System z Linux.

If you are using a Linux desktop you probably have, or at least have access to, a VNC client named vncviewer. It is part of the tightvnc package.

3.2.1 Downloading and running RealVNC

If you have a Windows desktop, the VNC client from RealVNC is a popular choice. You can purchase a full function RealVNC client, or there is a no cost version. The RealVNC home page is at:

`http://www.realvnc.com`

The download page is at:

`http://www.realvnc.com/download.html`

Click **Download and Use**. Fill out the web form and download the executable. When you have downloaded it, run it and an install program will start. At the time of writing of this book, RealVNC 4.1.2 was the current version.

Accept all defaults, however, you probably do not need a VNC server on your desktop. So you can deselect **VNC Server** from the Select Components window, as shown in Figure 3-8.

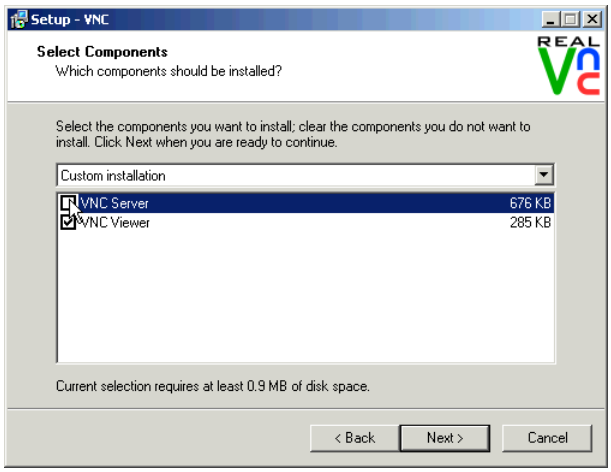


Figure 3-8 RealVNC Select Components window

Complete the windows and the installation process should go quickly.

3.3 3270 emulators

To access a logon session with z/VM, it is common to use a 3270 emulator that runs on Windows. Many commercial products are available. Some of the more common ones are:

- Attachmate Extra!
- Hummingbird Host Explorer
- IBM Personal Communications
- Quick3270

It is beyond the scope of this book to explain the details of configuring all the various emulators. However, it is recommended that you investigate the following settings for your emulator:

- Set the Enter and Clear function keys to be where you would expect them. On some emulators, the default Enter key action is set to the right Ctrl key of modern keyboards. Likewise the Clear key action is sometimes set to the Esc key in the upper left corner of modern keyboards or the Pause key in the upper right.
- Set a larger window. Often the default number of lines in an emulator session is 24. You will probably be more productive with a 32, 43 or more lines if they can easily fit in a window given your desktop display size and resolution.
- Have the session automatically reconnect after logoff. Having a new logon window come back immediately after you log off can also save you time in the long run. This is often not the default behavior.
- Save your connection sessions. Rather than continually typing in the IP address or DNS name of the z/VM system to which you want to connect, spend a few minutes to define and save a session for each system to which you may connect, as was described for PuTTY. Then you can usually double-click the saved connection to quickly access a new 3270 session.

4

Installing and configuring z/VM

z/VM can be installed first level from tape, from DVD, or from an FTP server. Installing from tape is not described in this book. However, installing from the physical media of DVDs, or without physical media, from an FTP server, are.

To complete this chapter, you must complete the majority of Chapter 6, “Configuring an NFS/FTP server” on page 97. If you are installing z/VM from an FTP server, you should complete 4.1, “Installing z/VM from DVD or FTP server” on page 28, then complete Chapter 6, “Configuring an NFS/FTP server” on page 97.

We recommend that you start here, because there is a step when installing z/VM (instdvd) that can take two or more hours to complete. While that process is running, you can complete Chapter 6, “Configuring an NFS/FTP server” on page 97. Alternatively, if you have other personnel who can work on the project, you can start both chapters at the same time on the different systems.

This chapter consists of the following sections that should be completed:

- “Installing z/VM from DVD or FTP server” on page 28
- “Configuring TCP/IP” on page 41
- “Configuring the XEDIT profile” on page 43
- “Customizing the SYSTEM CONFIG file” on page 44
- “Configuring TCP/IP to start at IPL time” on page 46
- “Adding paging volumes” on page 50
- “Creating a user ID for common files” on page 56

In addition, there are optional sections:

- “Addressing z/VM security issues” on page 64
- “Backing up your z/VM system to tape” on page 66
- “Relabeling system volumes” on page 66
- “Restoring your z/VM system from tape” on page 72

4.1 Installing z/VM from DVD or FTP server

This section assumes a first level installation of z/VM from DVD onto 3390 DASD. If you have not already done so, complete the worksheet in 2.7.1, “z/VM resources worksheet” on page 16.

For IBM System z9® hardware and older, you will need access to the Hardware Management Console (HMC) with a user ID that has authority to go into *single object operations mode*, though this is not pertinent for z/VM V6.1 because it installs onto System z10 or later. The requirement to be in single object operations mode for z10 or later has been removed.

z/VM V6.1 is shipped on tape, on DVD, and is available from the Internet through electronic download. z/VM should install faster from tape due to better I/O speeds; however, installing from tape is becoming less common.

If you are not familiar with the HMC and z/ VM, you may want to use the complete installation manual *z/VM Guide for Automated Installation and Service,* Version 6 Release 1.0, GC24-6097. If you are installing z/VM at the *second level* (z/VM under z/VM) or onto FCP/SCSI disk, you will want to use this z/VM manual because the sections that follow do not address these options.

4.1.1 Obtaining z/VM through electronic download

z/VM can be ordered and delivered electronically through IBM ShopzSeries. A detailed discussion is outside the scope of this book; however, short steps are documented. Note that the steps and links may change over time, but the basic process should remain the same.

You may download the z/VM product install files to a staging machine, such as a Windows desktop, as was done in this example, and later upload them to an FTP server. However, you may also download them directly to the machine that will be the FTP server, such as a Linux PC if it has access to the Internet and a browser.

To order z/VM, perform the following steps:

1. Go to the z/VM service page at:

   `http://www.vm.ibm.com/service/`

2. Click **IBM ShopzSeries** in the section IBM Support Portals.
3. Sign in by clicking **Sign in for registered users** in the upper right.
4. Click **create new software orders**.
5. On Step 1, select **z/VM Products** and choose **VM SDO version 6** in the drop-down menu to the right. Click **Continue**.
6. On Step 2, select a hardware system on which you plan to run z/VM from the list of Hardware systems for your customer number, and click **Continue**.
7. On Step 3, for the Filter, select **VM - VM Base Product,** select your language and for the *Filter*, select **Show all products**, then click **Show catalog**. A submenu appears.

   Select **z/VM V6 3390 System DDR** and click **Continue**.
8. On Step 4, verify the order and click **Continue**.
9. On Step 5, verify the entitlements and click **Continue**.
10. On Step 6, for the Preferred media, select **Internet** and click **Continue**.
11. On Step 7, review and click **Submit**.

12. It may take some time for the order to be prepared. In this example, the email stating that the order was ready for download was received after about four hours. When you receive the email, it will contain the URL for downloading your order. Use a browser to go to that URL.
13. From that address, there will be links to investigate as shown in Figure 4-1. It has the following five sections:
    - Order Packing List: The list of available products and manuals
    - Installation Instructions: Clicking **View now** will take you to a web page:

      `http://www.vm.ibm.com/install/vm61inst.pdf`

      This PDF describes in general terms how to go from the product install files to physical DVDs or to an FTP server. If you want to go from the product install files to physical DVDs, you should complete this section, but will not need to use the later section on how to set up an FTP server. If you want to use an FTP server to avoid physical media altogether, you can read the PDF for a general approach, and then complete this section and 6.4, “Enabling the NFS server” on page 100 for specific details.
    - Product Publications: Allows you to access z/VM publications related to installation.
    - Additional Publications: Allows you to download a z/VM SDO document (4 pages).
    - VM product material: This is the most important section because it is where you go to download z/VM product installation files. In the example used in this book, the link **Download to your workstation using IBM Download Director** was clicked as shown in Figure 4-1.

Figure 4-1 Web page for downloading z/VM electronically

14. Clicking this link brought up the window shown in Figure 4-2. The first and third check boxes were selected as z/VM is being installed onto 3390 DASD. The 1.3 GB of data was downloaded relatively quickly due to multiple connections being opened through the use of IBM Download Director.

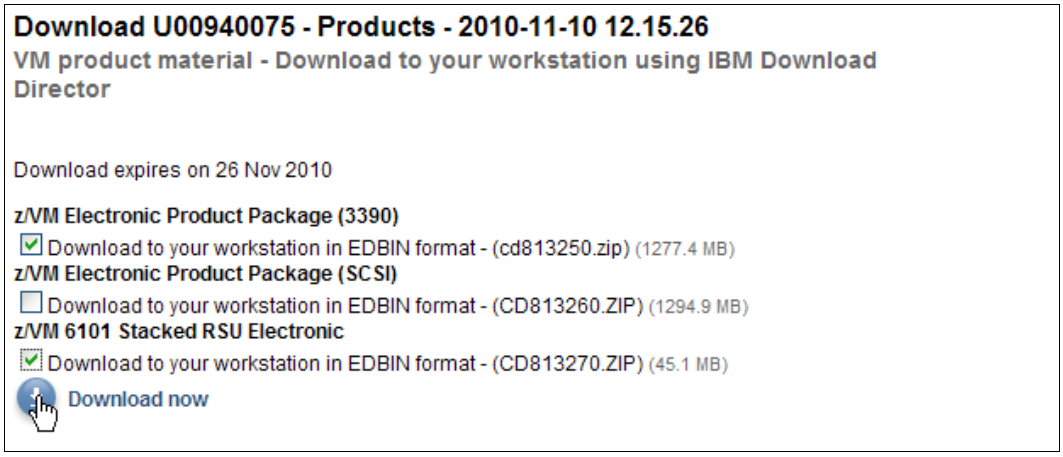


Figure 4-2 Choosing two files to be downloaded

15. The z/VM install code should now be staged or ready for the FTP server to be set up. In this example where the files are staged on a Windows workstation, the two files are shown from a DOS prompt:

```
C:\zvm61> dir
...
11/11/2010  08:54 AM     1,277,435,798 cd813250.zip
11/11/2010  08:54 AM        45,088,210 CD813270.ZIP
```

16. To configure an FTP server, complete all of Chapter 6, “Configuring an NFS/FTP server” on page 97 and especially 6.4, “Enabling the NFS server” on page 100.

When these steps are completed, you should be able to point the z/VM installation to the FTP server that was just set up.

4.1.2 Starting the z/VM installation

This section explains how to install z/VM V6.1 from an HMC onto 3390-3 equivalent DASD. Some words are included for installing onto the larger 3390-9 DASD. For alternative configurations, such as installing from tape or onto SCSI disks, refer to the z/VM documentation.

Perform the following steps:

1. Log on to the Hardware Management Console. You should see the HMC Workplace window.
2. Select the LPAR on which you want to install z/VM, often by clicking the CPC images icon. *Be sure* you have the correct LPAR selected. If you are not completely sure, check with someone who is.
3. If necessary, click the buttons with circular arrows on the bottom right corner of the CPC Recovery menu (this is sometimes referred to as “going around the racetrack”).

4. On the Recovery or CPC Recovery menu, double-click the **Integrated 3270 Console** as shown at the bottom of Figure 4-3. A window entitled “Integrated 3270 Console for <your CPC>” will open (on older HMC levels, the window may be entitled Personal Communications).

> **Hint**: It is convenient to use the Alt-Tab key sequence to move between the HMC window and 3270 console.

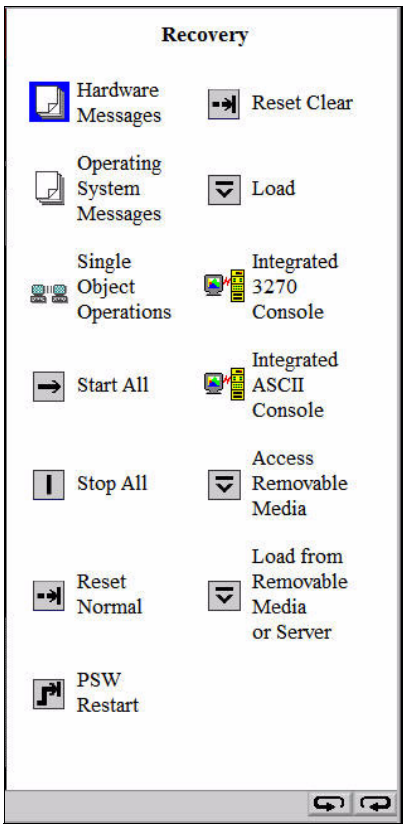


Figure 4-3 Recovery menu

5. Place the z/VM Product Package Version 6 Release 1.0 DVD in the HMC DVD drive.

Important: On z10 HMCs and later, it is no longer required to be in Single Object Operations mode to install z/VM.

On a z9 HMC and older, get into Single Object Operations mode by performing the following steps:

a. Double-click the **Groups** icon in the Views Area.

b. Double-click **Defined CPCs** in the Groups Work Area.

c. Select your CPC.

d. If necessary, go around the racetrack (the buttons with circular arrows on the bottom right corner) to the CPC Recovery menu.

e. Double-click the Single Object Operations icon. Click **Yes** to confirm. Now a new window, Primary Support Element Workplace, should appear (on older HMC levels it will be a “window within a window”). A window about a certificate not being valid may appear. If so, click **OK**.

f. Double-click **Groups** near the top of this window.

g. Double-click **Images** in the Groups Work Area.

If you are unable to get into Single Object Operations mode, it may be because you do not have sufficient permission. Check with the system administrator.

6. The LPAR that z/VM will be installed into should still be selected. On the right you should still see the (CPC) Recovery menu. Double-click the Load from Removable Media or Server icon.

   If you received the z/VM product electronically, you will need to create your own DVDs. This step is not covered in this book. See the z/VM manual *Installation Instructions for Electronically Delivered IBM z/VM Operating System Deliverable*, GI11-2900, on the web at:

   http://www.vm.ibm.com/install/prodinst.html

   If the DVD is not burned correctly, you may see the error message:

   ```
   ACT3620I "An error has occurred while trying to obtain a list of the software
   that can be loaded. ...".
   ```

   Further, this error may have the side effect of locking the DVD drive. The HMC may need to be rebooted. To prevent this from happening, be sure you create the DVDs correctly. Use newer copies of DVD-burning software that has an option for the ISO9660 format, which is recommended.

7. On the Load from Removable Media or Server window shown in Figure 4-4, the **Hardware Management Console CD-ROM/DVD** radio button should be selected.

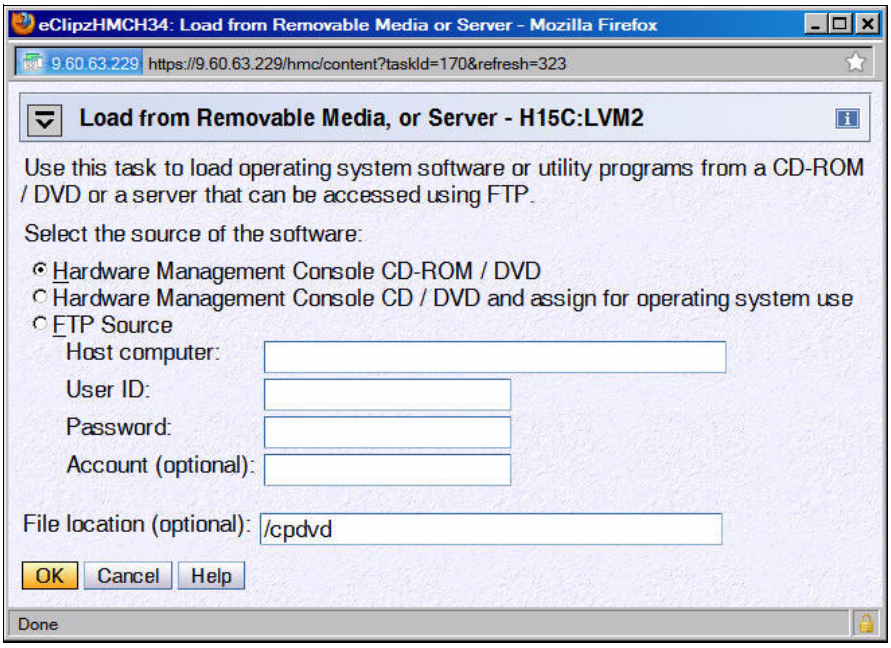


Figure 4-4 Load from Removable Media or Server window

8. In the same Load from Removable Media or Server window, fill in File Location with /cpdvd.This is the directory on the DVD with the z/VM V6.1 installation code. Click **OK**.

   If you do not have physical DVDs, but there is an FTP server set up with the z/VM installation code, then you can use FTP as an install method. If such an FTP server is set up, you can click **FTP Source** and fill in the fields Host Computer, User ID, Password and File location, as shown in Figure 4-5.

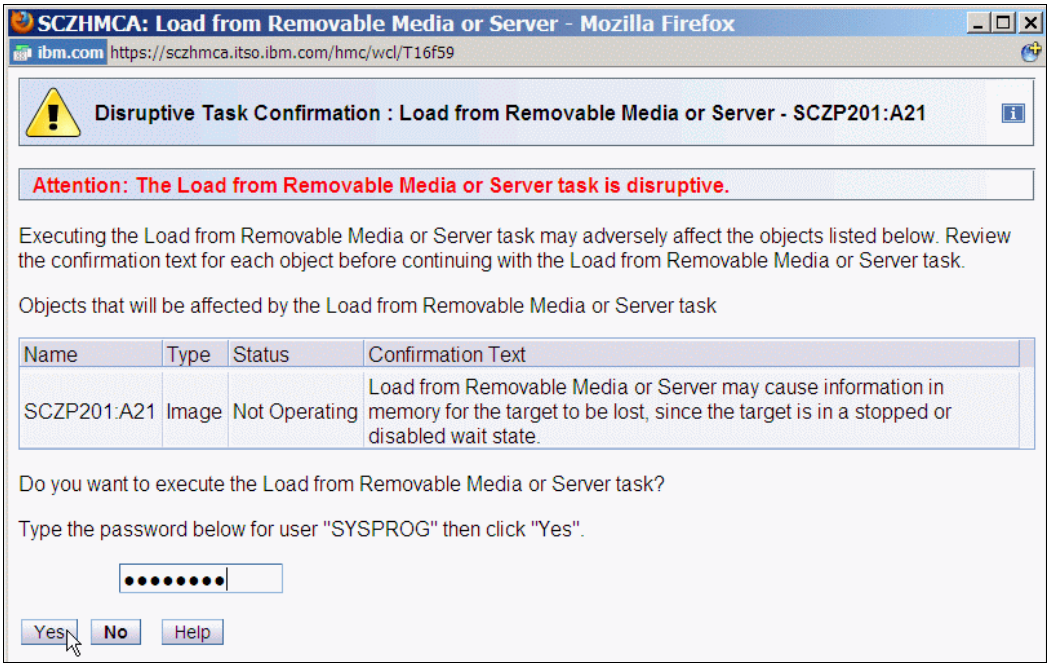


Figure 4-5 Load from Removable Media or Server window with FTP source

Setting up an FTP server so as to provide the z/VM product files for installation is described in 6.4, “Enabling the NFS server” on page 100.

9. Load the RAMDISK

   a. From the Load from Removable Media or Server window, the `610vm.ins` file should be selected as shown in Figure 4-6. Click **OK**. If you are at the HMC installing from DVD, you should see the green light on the DVD drive light up.

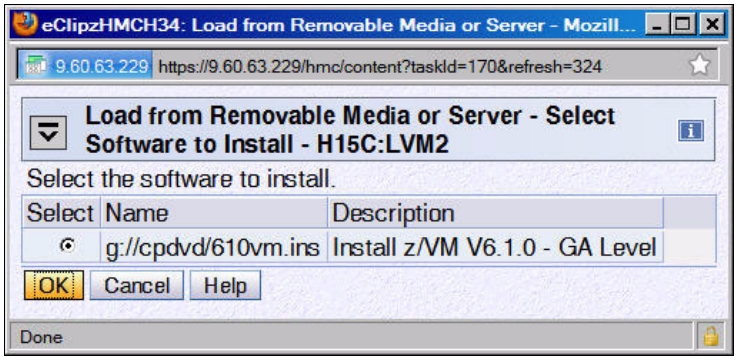


Figure 4-6 Selecting z/VM V6.1 RAMdisk system

   b. On the “Confirm the action” window, click **Yes**.

   c. You should see the Disruptive Task Confirmation: Load from CD-ROM, DVD or Server Progress window. You will be prompted for the password, as shown in Figure 4-7.

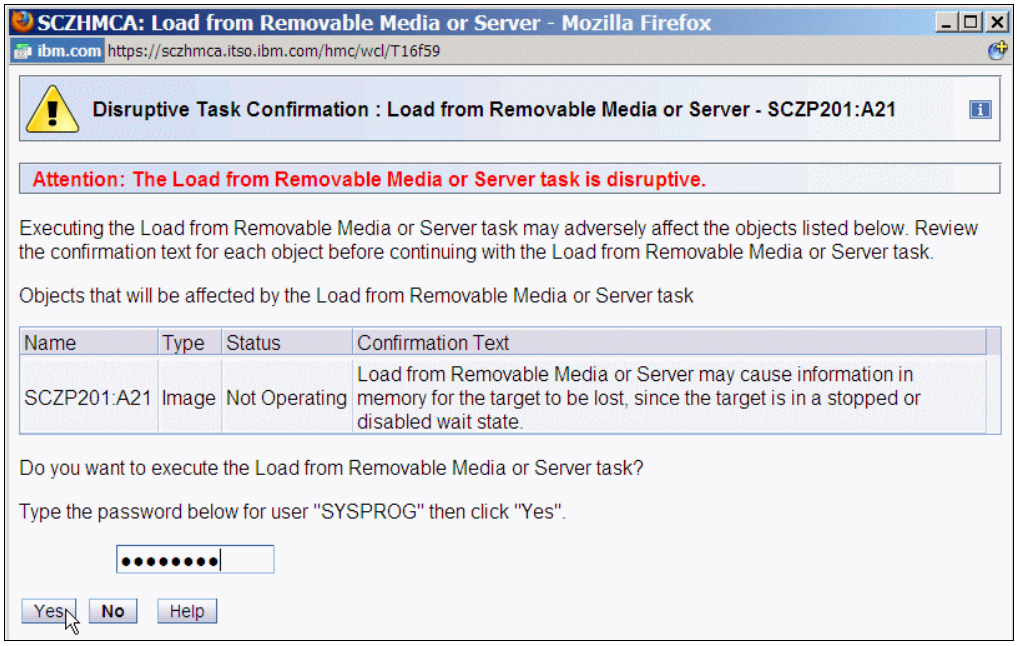


Figure 4-7 Supplying password for disruptive task

   d. When you see the message Completed successfully, click **OK** to close. This should normally take about two minutes or less.

You should now have an in-memory z/VM V6.1 system running.

4.1.3 Copying a vanilla z/VM system to DASD

This section describes the steps to copy z/VM to DASD.

Perform the following steps:

1. You can now get out of Single Object Operations mode (if you are in it). To do so, log off the primary SE window by closing that window.
2. Move to the Integrated 3270 Console window (you can use the Alt-Tab sequence). The RAMdisk should IPL and you should see z/VM boot as shown in Figure 4-8. If the Integrated 3270 Console window is still blank, be patient, it may take a minute or two to initialize.

Note: The Esc key in the upper left clears the Integrated 3270 console on the HMC.

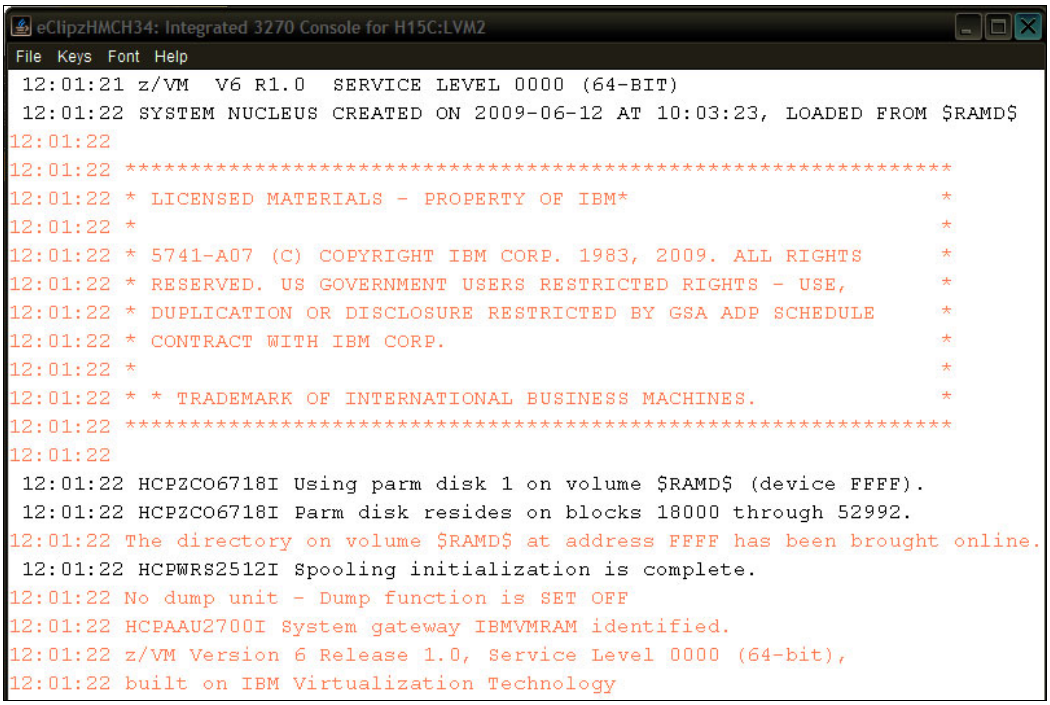


Figure 4-8 z/VM first boot on the Integrated console

3. Invoke the **instplan** command. This will allow you to choose associated z/VM products to install, the language to use, and the type of DASD on which to install (Figure 4-9):

```
==> instplan
```

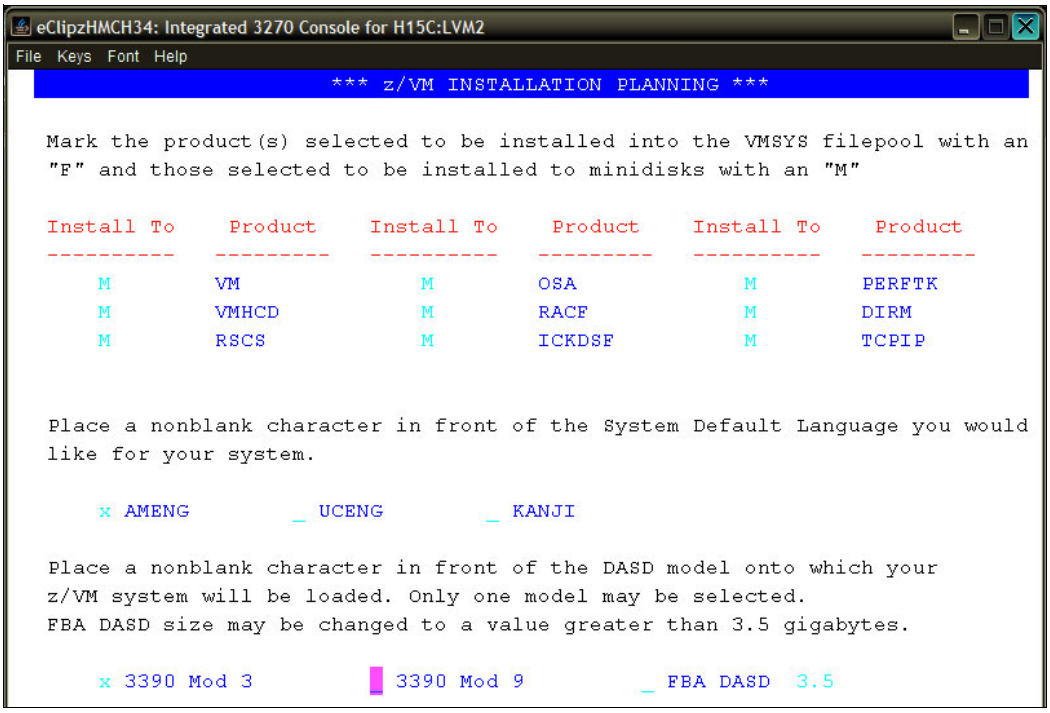


Figure 4-9 Installation planning panel

4. You may need to clear the window with the Esc key. You should then see the display as shown in Figure 4-9. It is recommended that you leave the Ms in the top section alone.
5. Type the letter x next to AMENG (or select your language) and 3390 Mod 3 (or the type of DASD you will use), as shown in Figure 4-9. You can use the Tab key to move to the next input field.
6. Press F5. You should see the message HCPINP8392I INSTPLAN EXEC ENDED SUCCESSFULLY after a list of what will be installed.
7. Attach the DASD devices onto which z/VM will be installed defined in your planning worksheet in 2.7.2, “z/VM DASD worksheet” on page 17. In this example, the devices are 6280-6284.

```
==> att 6280-6284 *
6280-6284 ATTACHED TO MAINT
```

Important: The devices 6280-6284 are in bold italics to signify that you should replace the example value with the correct value for your site. For example, if you are installing z/VM onto DASD 1200-1204, you would type the following:

```
==> att 1200-1204 *
```

This convention is used throughout the book.

Running INSTDVD

The INSTDVD EXEC copies the z/VM system from DVD to disk.

Perform the following steps:

1. Execute INSTDVD:

   ```
   ==> instdvd
   ```

2. If you are using 3390-3s, you see a panel asking for the five volumes, as shown in Figure 4-10 (if you are using 3390-9s, you will only see three lines).

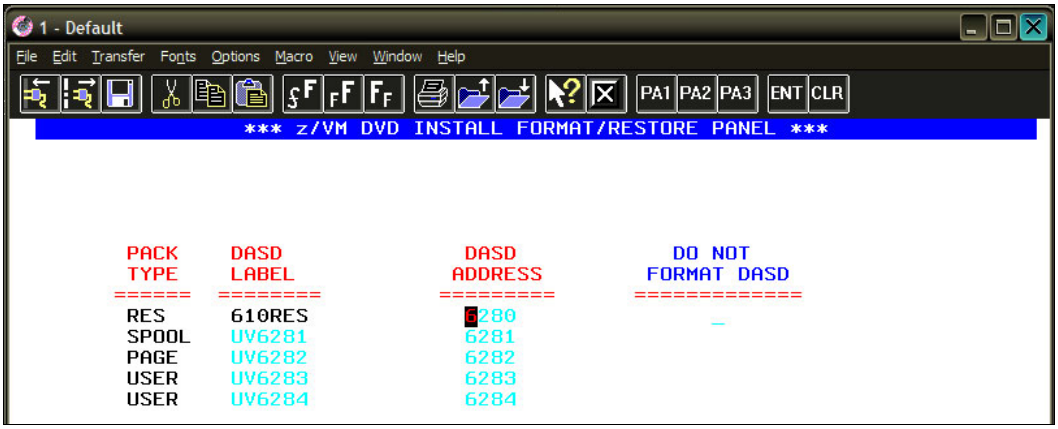


Figure 4-10 INSTDVD DASD address panel

   a. Enter the addresses of the five volumes (or three for 3390-9s) that z/VM will be installed on. The labels for the last four volumes are changed because the LPAR in this example had access to other z/VM systems. Changing the labels prevents the problem described in 4.11, “Relabeling system volumes” on page 66 from occurring.

   b. Press F5 to start the installation.

3. Verify that the five DASD addresses to be installed onto are correct. When you see the question `DO YOU WANT TO CONTINUE?`, type `y`. You should see the message `NOW FORMATTING DASD` ***`6280`***.

   Important: INSTDVD can take from 45 minutes to two hours. Now may be a good time to go to Chapter 6, “Configuring an NFS/FTP server” on page 97 to set up an NFS server.

   Also, read errors have been observed resulting in INSTDVD failing. If this is the case, you can try the command **`instdvd (restart`** and the install process should pick up where the read error occurred. This can be caused by dirt or fingerprints on the DVD.

4. You are asked to place the system RSU in the drive. Insert the z/VM Stacked Recommended Service Upgrade 6101 DVD into the HMC DVD-ROM drive

5. At the Integrated 3270 Console, type `go`. You should see a message of the form `DVDLOAD: LOADING FILE CKD5000x IMAGE *.` This step should take two to four minutes.

6. Finally, you should see the message `HCPIDV8329I INSTDVD EXEC ENDED SUCCESSFULLY.`

4.1.4 Performing an IPL of the vanilla z/VM from DASD

Perform an IPL of your initial z/VM system now on DASD. Your 3270 Integrated Console session should still be running by performing the following steps:

1. In the HMC Workplace window, your LPAR should still be selected. If not, select your LPAR by clicking it. You may have to first double-click **Groups**.
2. You should see the Recovery menu. Double-click the Load icon in the menu at the right side.
3. The Load window opens, as shown in Figure 4-11. Follow these steps:
   a. Set the load address to the new system residence (610RES) volume, which is ***6280*** in this example.
   b. Set the load parameter to SYSG. This specifies to use the Integrated 3270 console.
   c. Click **OK** to perform the IPL.

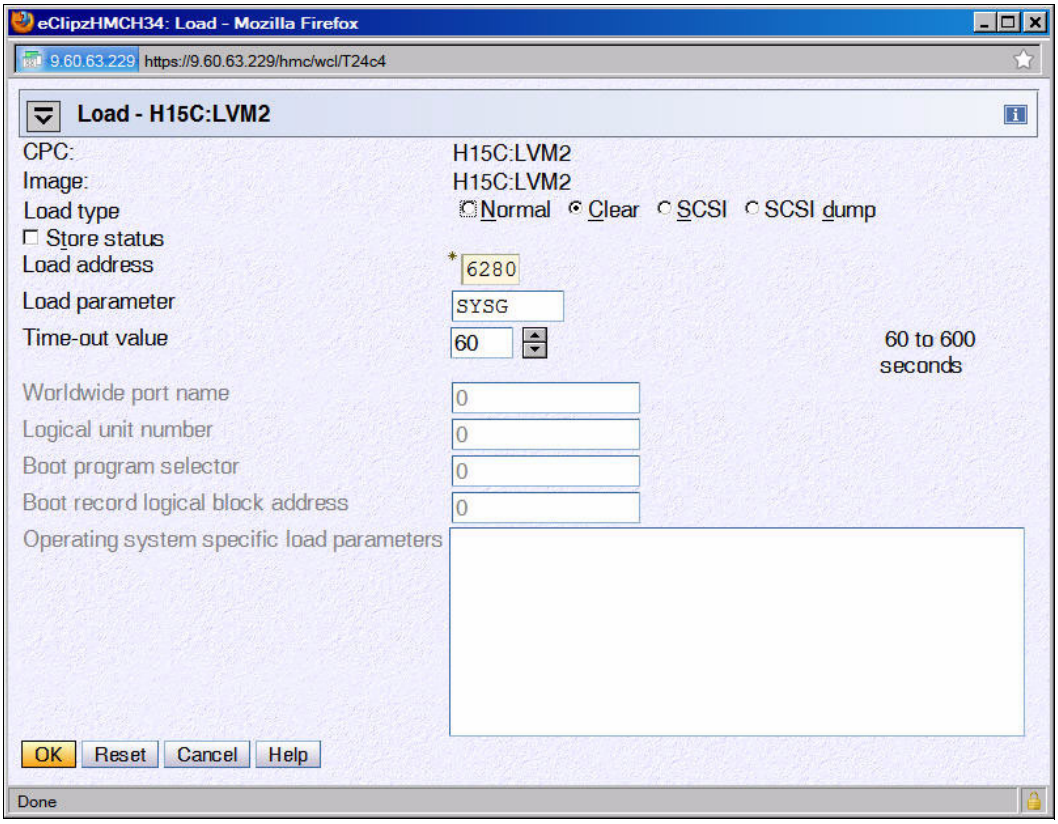


Figure 4-11 Load window

4. When you see the Load Task Confirmation window, click **Yes**.
5. After 1-3 minutes you should see a status of Success in the Load Progress window. Click **OK**.

6. Move back to the Integrated 3270 Console window. You should see the Standalone Program Loader panel as shown in Figure 4-12.

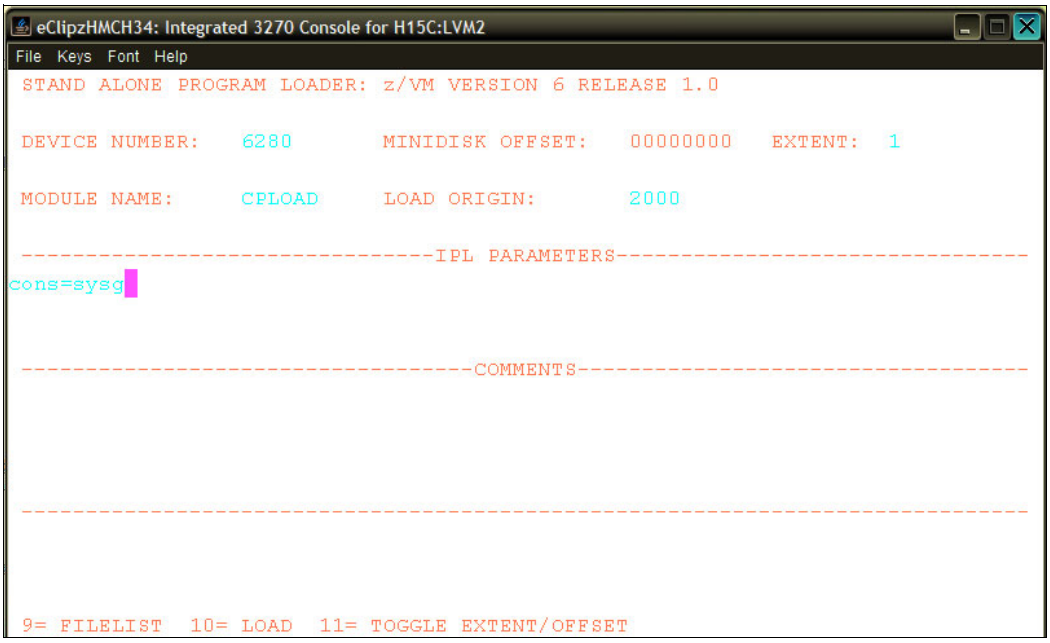


Figure 4-12 Stand Alone Program Loader

   a. Press the Tab key to get to the IPL Parameters section and enter the value `cons=sysg`. This specifies to use the Integrated 3270 console.

   b. Press the F10 key to continue the IPL of your z/VM system. This should take around 1 - 3 minutes.

7. At the `Start (Warm|Force|COLD|CLEAN)` prompt, enter:

   ```
   ==> cold drain noautolog
   ```

8. At the Change TOD clock prompt, enter:

   ```
   ==> no
   ```

9. The last message should be `HCPCRC8082I EREP records are accumulating for userID EREP`. Disconnect from the OPERATOR user ID using the **`disconnect`** command:

   ```
   ==> disc
   ```

   Press Enter to get a new logon window.

4.1.5 Completing the z/VM installation

Perform the following steps to complete the z/VM installation:

1. On the HMC z/VM login window, log on as MAINT. The password is MAINT. You may receive messages `HCPLNM102E` or `HCPLNM101E` about disks not linked or attached. This is not a problem. Press Enter when you see the `VM Read` prompt in the lower right corner.

   Important: When logging onto a z/VM user ID that runs CMS, you should usually press Enter at the `VM READ prompt`. Doing so will run the PROFILE EXEC and result in a prompt of the form:

   ```
   Ready; T=0.01/0.01 11:14:20
   ```

2. Run **IPL CMS**, then press Enter at the VM READ prompt in the lower right corner. You should see the Ready; prompt.

```
==> ipl cms
==> Press Enter at the VM READ prompt
```

3. Run the **instvm dvd** command:

```
==> instvm dvd
...
HCPPLD8329I POSTLOAD EXEC ENDED SUCCESSFULLY
...
HCPIVM8392I INSTVM ENDED SUCCESSFULLY
```

   This exec continues the installation process. This step should take about 4 - 8 minutes. The last message should be HCPIVM8392I INSTVM ENDED SUCCESSFULLY.

4. Load the recommended service. First run **ipl cms**, then press Enter at the VM READ prompt:

```
==> ipl cms
==> Press Enter at the VM READ prompt
Ready;
```

5. For z/VM V6.1, the service name is 6101RSU1. Verify that this file exists on the MAINT 500 disk:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
==> listfile * * c
6101RSU1 SERVLINK C1
```

6. Run the **service all** command to apply the service:

```
==> service all 6101rsu1
...
```

   This step should take about 3 - 6 minutes. The last message should be:

```
VMFSRV2760I SERVICE processing completed successfully.
```

7. Run **ipl cms** and run the **put2prod** command. This puts the service into production:

```
==> ipl cms
==> Press Enter
Ready;
==> put2prod
```

   This step should take about 2 - 4 minutes. The last message should be:

```
VMFP2P2760I PUT2PROD processing completed successfully.
```

   A return code of 0 is ideal. You may get a return code of 4 and the message:

```
VMFP2P2760I PUT2PROD process completed with warnings.
```

   In general on z/VM, a return code of 4 is acceptable. That means that only warnings were issued. A return code of 8 or greater generally means that errors were encountered.

8. Enter the following command to shut down and perform an IPL your system:

```
==> shutdown reipl
SYSTEM SHUTDOWN STARTED
```

9. You will lose the current session on the Integrated 3270 Console, but the system should come back in about 2 - 4 minutes.

10. After it comes back, the last message should be Press enter or clear key to continue. Press Enter and you should see a z/VM logon window.

Congratulations! You should now have a vanilla z/VM system installed.

4.2 Configuring TCP/IP

It is recommended that you initially configure TCP/IP using the IPWIZARD command, which is generally used just once. After IPWIZARD creates the initial configuration files, they are typically maintained manually.

From the HMC z/VM logon panel, logon to MAINT. The default password for all z/VM user IDs is the same as the user ID. So enter a password of maint, which will not be echoed on the window.

```
USERID   ==> maint
PASSWORD ==>
```

After entering the user ID and password, press Enter when the status area in the lower right reads `VM READ`.

4.2.1 Using the IPWIZARD tool

The IPWIZARD command is on the MAINT 193 disk. You need to access it with file mode G using the ACCESS command so you will pick up IPWIZARD from that minidisk.

Perform the following steps:

1. Access the MAINT 193 disk:

   ```
   ==> acc 193 g
   ```

2. Invoke IPWIZARD:

   ```
   ==> ipwizard
   ```

3. The z/VM TCP/IP Configuration Wizard opens, as shown in Figure 4-13. The first field, User ID, should always be `TCPIP`. Obtain the remaining values from 2.7.1, “z/VM resources worksheet” on page 16 and press F8.

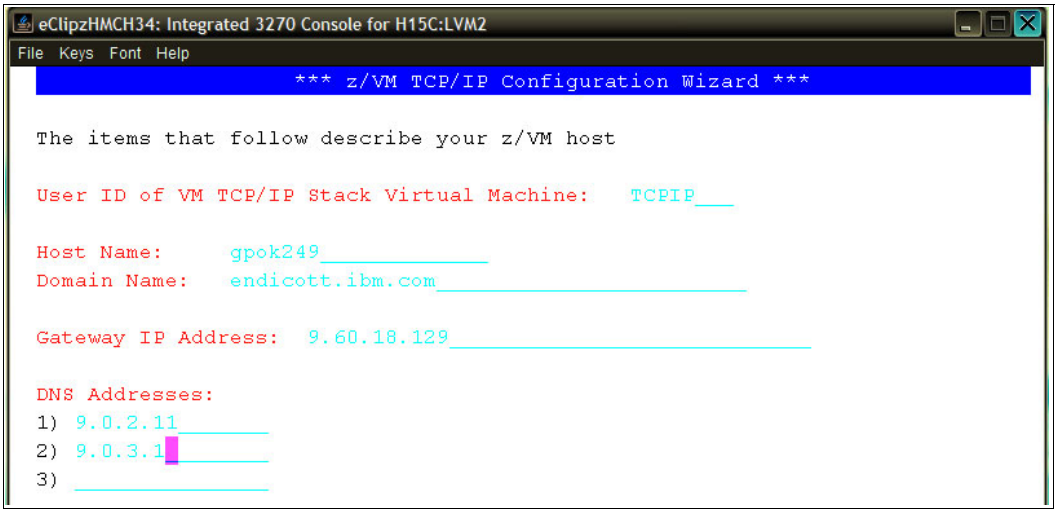


Figure 4-13 IPWIZARD panel 1

4. An Interface Name of `eth0` (Figure 4-14) is arbitrary but recommended. The `Device Number` will be the starting address of the OSA triplet that the z/VM stack will use. The `IP Address` which must be routed to the OSA card will become the TCP/IP address of the z/VM system. The Interface Type will typically be `QDIO (layer 3)` with modern OSA devices. When completed, press F8.

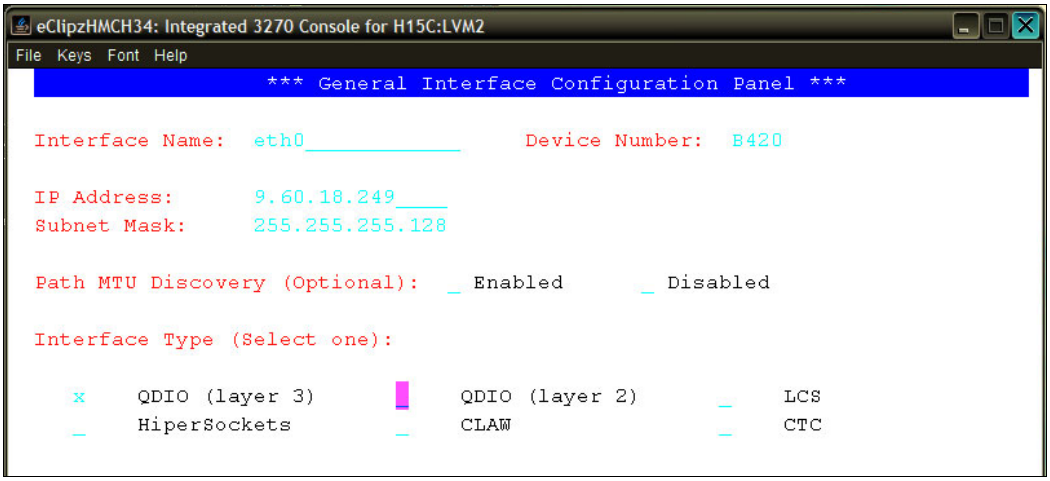


Figure 4-14 IPWIZARD panel 2

Note: To utilize QDIO (layer 2), certain prerequisites must be met. Consult with the system administrator.

5. In general, a value for the `Port Name` (Figure 4-15) is no longer necessary. Press F5 to complete the wizard:

```
DTCIPW2508I DTCIPWIZ EXEC is attempting to create the necessary
DTCIPW2508I configuration files
```

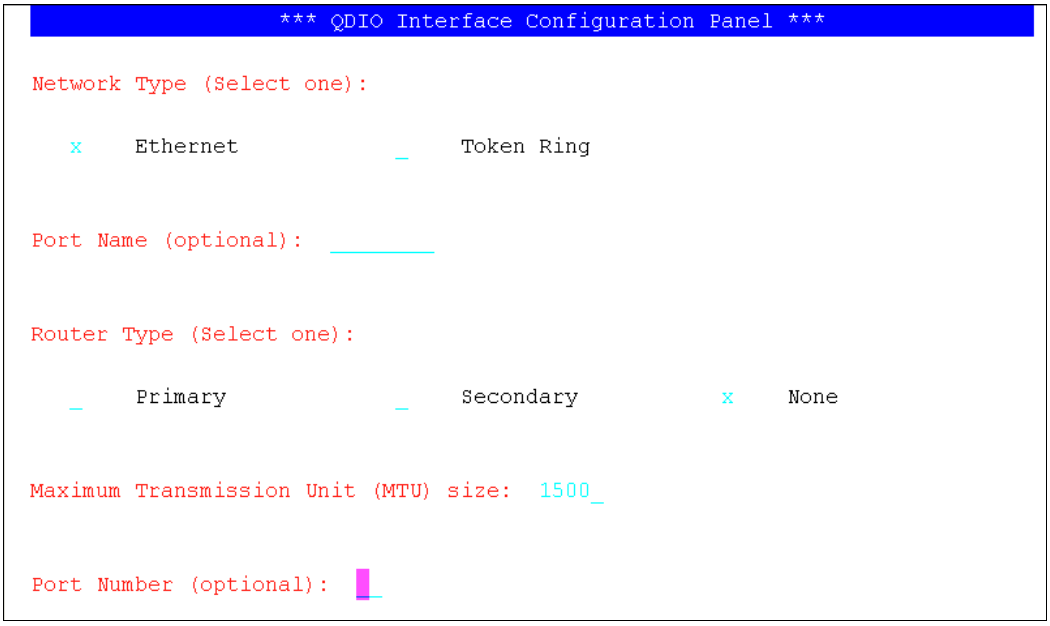


Figure 4-15 IPWIZARD panel 3

6. Enter 1 to restart the TCP/IP stack (you may see other warnings):

```
The TCP/IP stack (TCPIP) must be restarted as part of this procedure
Would you like to restart and continue?
Enter 0 (No), 1 (Yes) 1
USER DSC   LOGOFF AS  TCPIP    USERS = 2     FORCED BY MAINT
...
Successfully PINGed Interface (9.12.5.22)
Successfully PINGed Gateway (9.12.4.1)
Successfully PINGed DNS (9.12.6.7)
DTCIPW2519I Configuration complete; connectivity has been verified
DTCIPW2520I File PROFILE TCPIP created on TCPIP 198
DTCIPW2520I File TCPIP DATA created on TCPIP 592
DTCIPW2520I File SYSTEM DTCPARMS created on TCPIP 198
HCPINP8392I IPWIZARD EXEC ENDED SUCCESSFULLY
DMSVML2061I TCPIP 592 released
```

7. At this point your z/VM TCP/IP stack should be up. You should now be able to ping it from another system.

   If the IPWIZARD exec fails you must continue debugging it until it succeeds. Double-check all values. Verify that the TCP/IP network and OSA information you were given are properly associated.

HMC Integrated 3270 Console or 3270 emulator? At this point z/VM should be accessible over the network. You can continue working at the HMC, or you can access your new system using a 3270 emulator. See 3.3, “3270 emulators” on page 25 for some brief words on that subject.

If you want to switch to the 3270 emulator, first LOGOFF of MAINT or DISConnect on the Integrated 3270 Console.

If you log off, the session is ended—it is analogous to shutting and powering down a PC. If you disconnect, your session remains where it is and is resumed when you log back on. It is analogous to turning a PC’s monitor off. In general, you should LOGOFF of system administration user IDs such as MAINT. However, you should always DISConnect from z/VM service machines such as TCPIP and user IDs running Linux. Logging off of these will terminate the service or crash Linux.

4.3 Configuring the XEDIT profile

Log on to MAINT if you are not already logged on.

The XEDIT command looks for the `XEDIT PROFILE` configuration file when it is invoked. Many z/VM user IDs do not have such a personal or shared system file, so all XEDIT default values are in effect. The MAINT 191 (A) disk has a PROFILE XEDIT so when you are editing files on MAINT, the values in this profile are usually in effect.

If you have never used XEDIT before, there is a cheat sheet in “Cheat sheets” on page 258. The z/VM V6.1 PDF library is on the web at:

http://www-03.ibm.com/systems/z/os/zos/bkserv/zvmpdf/#zvm61

Search for the *XEDIT User's Guide and Command Reference*. Also, there is an old manual available at:

http://ukcc.uky.edu/ukccinfo/391/xeditref.html

One default setting that can be dangerous, especially if you use F12 to retrieve commands, is that PF12 is set to the FILE subcommand. Sometimes you may not want to save your changes with the stroke of one key. It is recommended that you set PF12 to the ? subcommand, which has the effect of a retrieve key:

```
==> copy profile xedit a profile xediorig a (oldd
==> x profile xedit a
```

Before:

```
SET PF12 FILE
```

After:

```
SET PF12 ?
```

Save your changes with the FILE subcommand.

4.4 Customizing the SYSTEM CONFIG file

The first configuration file read when z/VM performs an IPL is the `SYSTEM CONFIG` file. The following changes are recommended:

- Change the system name.
- Increase retrieve key capacity.
- Allow virtual disks (VDISKs) to be created.
- Turn off the Disconnect_Timeout (this will prevent idle disconnected users from being forced off the system).
- Define a virtual switch (VSWITCH) that will be used for Linux networking.

To make these changes, perform the following steps:

1. To edit the `SYSTEM CONFIG` file, the MAINT CF1 minidisk must be released as a CP disk using the CPRELASE command. The CP disks are queried using the QUERY CPDISK command. Note that the MAINT CF1 disk is accessed as CP disk A before it is released, but not after.

```
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF1 MAINT    0CF1  A   R/O  610RES 6280 CKD          39        158
MNTCF2 MAINT    0CF2  B   R/O  610RES 6280 CKD         159        278
MNTCF3 MAINT    0CF3  C   R/O  610RES 6280 CKD         279        398
==> cprel a
CPRELEASE request for disk A scheduled.
HCPZAC6730I CPRELEASE request for disk A completed.
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF2 MAINT    0CF2  B   R/O  610RES 6280 CKD         159        278
MNTCF3 MAINT    0CF3  C   R/O  610RES 6280 CKD         279        398
```

2. After it is released, you can access the MAINT CF1 disk read-write. Use the LINK command with the multi-read (MR) parameter and ACCESS command to get read-write access as your F disk.

```
==> link * cf1 cf1 mr
==> acc cf1 f
```

3. Make a backup copy of the vanilla `SYSTEM CONFIG` file using the COPYFILE command with the OLDDATE parameter so that the time stamp of the file is not modified. Note that because the target file name (`system`) and mode (`f`) are the same, the equal sign (`=`) can be used as a wildcard.

```
==> copy system config f = conforig = (oldd
```

4. Edit the original file:

```
==> x system config f
```

5. The system name is set to `ZVMV6R10` by default in the `System_Identifier_Default` statement. You can search for it using the / subcommand:

```
====> /System_Identifier_D
```

Modify this to the new name of your system. In this example, ***POKSND61*** is used.

```
System_Identifier_Default POKSND61
```

6. Next look for the `Features` statement. You can search for it again or you can use F8 to page down. The following changes and additions are recommended:
   - Increase the number of commands that can be retrieved from 20 to 99.
   - Set the Disconnect_Timeout to `off` so disconnected users do not get forced off.
   - Allow unlimited VDISKs to be created by users by changing `Userlim` to `infinite` and by adding the `Syslim infinite` clause:

```
Features ,
  Disable ,                       /* Disable the following features */
    Set_Privclass ,               /* Disallow SET PRIVCLASS command */
    Auto_Warm_IPL ,               /* Prompt at IPL always           */
    Clear_TDisk   ,               /* Don't clear TDisks at IPL time */
  Retrieve ,                      /* Retrieve options               */
    Default  99 ,                 /* Default.... default is 20      */
    Maximum  255 ,                /* Maximum.... default is 255     */
  MaxUsers noLimit ,              /* No limit on number of users    */
  Passwords_on_Cmds ,             /* What commands allow passwords? */
    Autolog  yes ,                /* ... AUTOLOG does               */
    Link     yes ,                /* ... LINK does                  */
    Logon    yes ,                /* ... and LOGON does, too        */
  Disconnect_Timeout off ,        /* Don't force disconnected users */
  Vdisk ,                         /* Allow VDISKS for Linux swaps   */
    Syslim  infinite  ,
    Userlim  infinite
```

7. Define a VSWITCH.

Use the BOTTOM subcommand to go to the bottom of the file. Add some lines (you can use the XEDIT add subcommand a3). Define a VSWITCH and set the MAC address prefix. This sets the first three bytes of the MAC address created for each virtual NIC. If you have multiple z/VM systems, increment this value to avoid having identical MAC addresses created. The last three bytes of the MAC address are automatically incremented by z/VM as they are assigned, so they will be unique on each z/VM system.

Modify the two starting addresses of the OSA triplets (***B440*** and ***B424*** in this example) to those you specified in 2.7.1, “z/VM resources worksheet” on page 16.

```
====> bot
====> a3
/* define vswitch named vsw1 and set MAC address prefixes to 02-00-01 */
define vswitch vsw1 rdev B440 B424
vmlan macprefix 020001
```

8. Save your changes with the XEDIT FILE subcommand:

```
====> file
```

9. Test your changes with the CPSYNTAX command, which is on the MAINT 193 disk:

```
==> acc 193 g
==> cpsyntax system config f
CONFIGURATION FILE PROCESSING COMPLETE -- NO ERRORS ENCOUNTERED.
```

Pay attention to the output. If you get any syntax errors, fix them before proceeding.

10. Release and detach the MAINT CF1 disk with the RELEASE command. Then put it back online with the CPACCESS command:

```
==> rel f (det
DASD OCF1 DETACHED
==> cpacc * cf1 a
CPACCESS request for mode A scheduled.
HCPZAC6732I CPACCESS request for MAINT's OCF1 in mode A completed.
```

11. Verify that the CP disk A has been accessed using the QUERY CPDISK command:

```
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF1 MAINT    OCF1  A   R/O  610RES 6280 CKD          39        158
MNTCF2 MAINT    OCF2  B   R/O  610RES 6280 CKD         159        278
MNTCF3 MAINT    OCF3  C   R/O  610RES 6280 CKD         279        398
```

Note that all three CP disks are now accessed.

4.5 Configuring TCP/IP to start at IPL time

Configure the TCPIP service machine to be started when you perform an IPL of z/VM. This is commonly accomplished from AUTOLOG1’s PROFILE EXEC. If the noautolog parameter is *not* specified when you perform an IPL of z/VM, the AUTOLOG1 virtual machine is started. Because this virtual machine performs an IPL of CMS, the PROFILE EXEC that is found on its A disk is run. This is analogous to the `/etc/profile` file on Linux and the `autoexec.bat` on DOS systems.

Perform the following steps:

1. Log off of MAINT:

```
==> log
```

2. You should see a new logon panel. Log on to AUTOLOG1. Again the password is the same as the user ID.
3. At the `VM READ` prompt, enter the command ACCESS (NOPROF so that the `PROFILE EXEC` is not run.

```
z/VM Version 6 Release 1.0, Service Level 0901 (64-bit),
built on IBM Virtualization Technology
```

```
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 09:29:16 EST FRIDAY 11/20/09
DMSIND2015W Unable to access the Y-disk. Filemode Y (19E) not accessed
z/VM V6.1.0    2009-11-19 13:47

==> acc (noprof
```

4. Copy the PROFILE XEDIT from the MAINT 191 disk so that XEDIT sessions will have a common interface among user IDs.
   a. Use the VMLINK command to both link to the disk read-only and to access it as the highest available file mode. The default read password is read:

      ```
      ==> vmlink maint 191
      ENTER READ PASSWORD:
      ==> read
      DMSVML2060I MAINT 191 linked as 0120 file mode Z
      ```

   b. Copy the PROFILE XEDIT to your A disk:

      ```
      ==> copy profile xedit z = = a
      ```

5. Make a backup copy of the PROFILE EXEC and edit it:

   ```
   ==> copy profile exec a = execorig =
   ==> x profile exec
   ```

6. You should see the text in the top half of the following example. Modify it as follows:
   a. You can safely delete the `Address Command` line.
   b. Add a line to start the TCPIP user ID using the XAUTOLOG command and keep two statements that start the VSWITCH cloners.
   c. Add a line to log off of AUTOLOG1 when the EXEC is complete. There is no need to keep that virtual machine running because its sole purpose is to run the PROFILE EXEC.

   Before:

   ```
   /*************************/
   /*  Autolog1 Profile Exec  */
   /*************************/

   Address Command
   'CP XAUTOLOG VMSERVS'
   'CP XAUTOLOG VMSERVU'
   'CP XAUTOLOG VMSERVR'
   'CP XAUTOLOG DTCVSW1'
   'CP XAUTOLOG DTCVSW2'
   ```

   After:

   ```
   /*************************/
   /*  Autolog1 Profile Exec  */
   /*************************/
   'cp xautolog tcpip'                /* start up TCPIP */
   'CP XAUTOLOG VMSERVS'
   'CP XAUTOLOG VMSERVU'
   'CP XAUTOLOG VMSERVR'
   'CP XAUTOLOG DTCVSW1'
   'CP XAUTOLOG DTCVSW2'
   'cp logoff'                        /* logoff when done */
   ```

7. Save your changes with the FILE subcommand:

```
====> file
```

8. Log off of AUTOLOG1:

```
==> log
```

When you perform an IPL of your z/VM system, the TCP/IP stack should now come up automatically (as long as you do *not* specify the notautolog parameter at IPL time).

4.5.1 Renaming the TCPIP configuration file

We recommend that you change the name of the main TCPIP configuration file from `PROFILE TCPIP` to `<system_ID> TCPIP`, where `<system_ID>` is the name of your new z/VM system. This is to avoid the possibility that the `PROFILE TCPIP file` will be overwritten when applying maintenance.

Perform the following steps:

1. Log on to TCPMAINT. The `PROFILE TCPIP` file is on the TCPMAINT 198 disk, which is accessed as the D disk.
2. Make a backup copy of the original `PROFILE TCPIP` file, then rename it to `<SYSTEM_ID> TCPIP` (where `<SYSTEM_ID>` is ***POKSND61*** in this example). When the TCPIP service machine starts, it will search for this file before the `PROFILE TCPIP` file.

```
==> copy profile tcpip d = tcpiorig = (oldd
==> rename profile tcpip d poksnd61 = =
```

3. You have now backed up and renamed your TCP/IP profile. You can verify this using the LISTFILE command:

```
==> listfile * * d
POKSND61 TCPIP    D1
PROFILE  $TCPBAK  D1
SYSTEM   $DTCBAK  D1
SYSTEM   DTCPARMS D1
TCPIORIG PROFILE  D1
```

4.5.2 Copying the PROFILE XEDIT file

Again, copy the `PROFILE XEDIT` file from the MAINT 191 disk so that XEDIT sessions will have a common interface among user IDs.

Perform the following steps:

1. Use the VMLINK command to both link to the disk read-only and to access it as the highest available file mode. The default read password is `read`:

```
==> vmlink maint 191
ENTER READ PASSWORD:
read
DMSVML2060I MAINT 191 linked as 0120 file mode Z
```

2. Copy the `PROFILE XEDIT file` to your A disk:

```
==> copy profile xedit z = = a
```

Now, XEDIT sessions on TCPMAINT will have the same configuration as on MAINT.

4.5.3 Configuring the FTP server

Turn on the FTP server by editing the renamed configuration file:

1. Edit the file

   ```
   ==> x poksnd61 tcpip d
   ```

2. Add an AUTOLOG statement near the top of the file with FTPSERVE as the only entry.

3. In the PORT statement, remove the semicolons to uncomment the lines with FTPSERVE on them (ports 20 and 21). These changes will cause the FTP server to start when TCPIP is started. The important lines before the file is edited and after are shown:

   ```
   ==> x poksnd61 tcpip d
   ```

   Before:

   ```
   ; ------------------------------------------------------------------
   OBEY
   OPERATOR TCPMAINT MAINT MPROUTE DHCPD REXECD SNMPD SNMPQE LDAPSRV
   ENDOBEY
   ; ------------------------------------------------------------------
   PORT
   ; 20 TCP FTPSERVE  NOAUTOLOG ; FTP Server
   ; 21 TCP FTPSERVE            ; FTP Server
     23 TCP INTCLIEN            ; TELNET Server
   ; 25 TCP SMTP                ; SMTP Server
   ...
   ```

   After:

   ```
   ; ------------------------------------------------------------------
   OBEY
   OPERATOR TCPMAINT MAINT MPROUTE ROUTED DHCPD REXECD SNMPD SNMPQE
   ENDOBEY
   ; ------------------------------------------------------------------
   AUTOLOG
     FTPSERVE  0
   ENDAUTOLOG
   PORT
     20   TCP FTPSERVE  NOAUTOLOG ; FTP Server
     21   TCP FTPSERVE            ; FTP Server
     23   TCP INTCLIEN            ; TELNET Server
   ; 25   TCP SMTP                ; SMTP Server
   ...
   ```

4. Save your changes with the FILE subcommand:

   ```
   ====> file
   ```

You could continue to configure the system, but at this time it is recommended that you test your changes by shutting down and performing an IPL of the system.

4.5.4 Shutting down and performing an IPL of the system

You may want to be able to shut down and perform an IPL of z/VM without having to access the HMC. Often, the HMC will be logged off and thus the Integrated 3270 console (SYSG) will not be available. Because of these factors it is useful to use the System Console (SYSC - which has a title of Operating System Messages on the HMC) to shut down z/VM and perform an IPL of it without needing to use the console.

This console is always accessible whether you are logged on to the HMC or not. z/VM messages during both the shutdown and IPL process will be written to the system console, but often you will be able to ignore them—you just want your system back in a few minutes over the network.

To shut down and perform an IPL of the system, perform the following steps:

1. Pass the parameter `IPLPARMS CONS=SYSC` to the SHUTDOWN REPIL command:

   ```
   ==> shutdown reipl iplparms cons=sysc
   ```

   You will lose your session, but it should come back in a few minutes as described above.

2. When your system is back, start a 3270 session and log on as MAINT. This shows that there is TCP/IP access to z/VM.

   Important: If you cannot start another 3270 session, do not despair, and consider this a good learning experience. You must go back to an Integrated 3270 session from the HMC. Verify that TCPIP is logged on. If it is logged on and you still cannot get to your system, log TCPIP off (or just re-IPL CMS), log back on, press Enter and watch the messages for errors.

3. Query the new VSWITCH:

   ```
   ==> q vswitch
   VSWITCH SYSTEM VSW1     Type: VSWITCH Connected: 0    Maxconn: INFINITE
     PERSISTENT  RESTRICTED    NONROUTER                 Accounting: OFF
     VLAN Unaware
     MAC address: 02-00-01-00-00-01
     State: Ready
     IPTimeout: 5         QueueStorage: 8
     Isolation Status: OFF
     RDEV: B440.P00 VDEV: B440 Controller: DTCVSW2
     RDEV: B424.P00 VDEV: B424 Controller: DTCVSW1  BACKUP
   ```

   You should see that the VSWITCH `VSW1` exists, that the OSA devices you specified are being used and that there are two built-in VSWITCH controllers, `DTCVSW1` and `DTCVSW2`.

4. Use the QUERY RETRIEVE and QUERY VDISK commands to see the changes made to the `Features` statement in the `SYSTEM CONFIG` file:

   ```
   ==> q retrieve
   99 buffers available.  Maximum of 255 buffers may be selected.
   ==> q vdisk userlim
   VDISK USER   LIMIT IS INFINITE
   ==> q vdisk syslim
   VDISK SYSTEM LIMIT IS INFINITE,               0 BLK IN USE
   ```

This shows that the changes to the `SYSTEM CONFIG` file have taken effect.

4.6 Adding paging volumes

The z/VM operating system resides on the first three CP volumes (or one volume if installing onto 3390-9s). z/VM V6.1 is installed with one full paging volume and one full spool volume. A single spool volume is probably adequate for Linux needs; however, a single paging volume is probably not.

It is recommended that you add at least three paging volumes, giving you a total of four (or one more 3390-9). Having adequate paging space will give you plenty of *headroom* to add more Linux virtual machines. A rule of thumb for the amount of paging space is to have twice as much as the total of all memory for all running Linux user IDs combined.

4.6.1 Formatting the paging volumes

Before adding paging volumes to the system, the DASD volumes to be used for minidisk space (PERM) and paging space (PAGE) must be formatted. Normally this is done one volume at a time using the CPFMTXA command. If you have just a few volumes, that is fine, but when you have many volumes to format, the process of running CPFMTXA can become time consuming and tedious, which can lead to errors.

Therefore, a REXX EXEC named CPFORMAT has been provided to allow you to format many volumes with a single command. The source code for “The CPFORMAT EXEC can be downloaded at:

`http://www.vm.ibm.com/devpages/mikemac/SG247932.tgz`

It is a wrapper around CPFMTXA. To use this EXEC, each DASD to be formatted must first be attached with the virtual device address—the same real device address (using ATTACH *realDev* *).

This EXEC will label the volumes according to the convention described in 2.2.1, “Volume labeling convention” on page 9. If you want different volume labels, you can use the CPFMTXA command and manually specify each volume label, or you can modify the REXX EXEC.

Getting the CPFORMAT EXEC to z/VM

Perform the following steps:

1. Log off of MAINT so you will be able to get the MAINT 191 disk in read-write mode using FTP.

   Important: At this point, you need access to the NFS server described in Chapter 6, “Configuring an NFS/FTP server” on page 97 to get the files `CPFORMAT EXEC`. If you did not complete that chapter, it is necessary to do so to proceed.

2. Start an SSH (putty) session to the NFS server and change to the `vm/` directory, which was created when you extracted the files associated with this book. Verify that the file `CPFORMAT.EXEC` exists:

   ```
   # cd /nfs/virt-cookbook-RH6/vm
   # ls cpformat*
   cpformat.exec
   ```

3. Start an FTP session to z/VM. If you get a reply from the FTP server, it shows that you correctly configured it on the z/VM TCPMAINT user ID. Issue the PUT subcommand to copy the file.

   ```
   # ftp 9.60.18.249
   Name (9.12.5.22:root): maint
   331-Password: maint
   230-MAINT logged in; working directory = MAINT 191
   ...
   ftp> put cpformat.exec
   ```

```
...
ftp> quit
```

You should now have the CPFORMAT EXEC on the MAINT 191 disk.

Using the CPFORMAT EXEC

To use the CPFORMAT EXEC, perform the following steps:

1. Log back into MAINT. You should now have access to the CPFORMAT EXEC. You can get brief help for CPFORMAT by using the parameter ?:

```
==> cpformat ?

Synopsis:

  Format one or a range of DASD as page, perm, spool or temp disk space
  The label written to each DASD is U<t><xxxx> where:
    <t> is type - P (page), M (perm), S (spool) or T (Temp disk)
    <xxxx> is the 4 digit address

Syntax is:
                                              .-PAGE-.
   >>--CPFORMAT--.-rdev--------------.--AS---+-PERM-+--------><
                 | <---------------< |       '-SPOL-'
                 '-rdev1-rdev2-------'
```

   The following example shows how to attach three 3390-3 volumes and use CPFORMAT to format them as paging space. Refer to the planning work sheets that you filled out in 2.7.2, “z/VM DASD worksheet” on page 17.

   For 3390-9 volumes: If you are installing onto 3390-9s, only one more paging volume may be adequate to start. This will give you two full volumes, or the equivalent of six 3390-3s.

2. The DASD that will be used for paging volumes in this example are at real addresses ***6285***, ***6286***, and ***6287***. Query the DASD devices to see their status:

```
==> q 6285 6286 6287
DASD 6285 UM6285  , DASD 6286 UM6286  , DASD 6287 UM6287
```

3. Attach the devices to MAINT (the last parameter of * means the current user ID) using the ATTACH command:

```
==> att 6285-6287 *
6285-6287 ATTACHED TO MAINT
```

4. Use the CPFORMAT command with the AS PAGE parameter:

```
==> cpformat 6285-6287 as page

Format the following DASD:
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    6285 MAINT    6285 3390  FR6285 6285          0       3339
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    6286 MAINT    6286 3390  FR6286 6286          0       3339
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    6287 MAINT    6287 3390  FR6287 6287          0       3339

WARNING - this will destroy data!
```

```
ARE YOU SURE you want to format the DASD as PAGE space (y/n)?
y
...
DASD status after:
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    6285 MAINT    6285 3390  UP6285 6285          0       3339
MAINT    6286 MAINT    6286 3390  UP6286 6286          0       3339
MAINT    6287 MAINT    6287 3390  UP6287 6287          0       3339
```

This formatting job should run for about 10-30 minutes, depending on many factors.

4.6.2 Formatting DASD for minidisks

In addition to CP disks such as page space, system disks are needed to create minidisks for the virtual machines. In this section the DASD that will be used for the minidisks of LNXMAINT, RH6CLONE, and RH6GOLD will be formatted.

Perform the followings steps:

1. Query the DASD that will be used for minidisks. In this example, they are ***6289***, ***6290***, ***6293***, ***6294*** (3390-3s), ***63A2***, and ***63A9*** (3390-9s):

   ```
   ==> q 6289 6290 6293 6294 63a2 63a9
   DASD 6289 FR6289  , DASD 6290 FR6290  , DASD 6293 FR6293  , DASD 6294 FR6294
   DASD 63A2 FR63A2  , DASD 63A9 FR63A9
   ```

2. Attach the six volumes that will be used for the cloner, the common CMS disk and the golden image. Note that in this example the DASD are four 3390-3s and two 3390-9s. If you are using all 3390-3s, you will need eight devices:

   ```
   ==> att 6289 6290 6293 6294 63a2 63a9 *
   6289 6290 6293 6294 63A2 63A9 ATTACHED TO MAINT
   ```

3. Invoke the CPFORMAT command against these volumes using the parameter as perm:

   ```
   ==> cpformat 6289 6290 6293 6294 63a2 63a9 as perm

   Format the following DASD:
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    6289 MAINT    6289 3390  FR6289 6289          0       3339
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    6290 MAINT    6290 3390  FR6290 6290          0       3339
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    6293 MAINT    6293 3390  FR6293 6293          0       3339
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    6294 MAINT    6294 3390  FR6294 6294          0       3339
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    63A2 MAINT    63A2 3390  FR63A2 63A2          0      10017
   TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
   MAINT    63A9 MAINT    63A9 3390  FR63A2 63A9          0      10017

   WARNING - this will destroy data!
   ARE YOU SURE you want to format the DASD as PERM space (y/n)? y

   ...
   DASD successfully formatted:  UM6289 UM6290 UM6293 UM6294 UM63A2 UM63A9
   6289 6290 6293 6294 63A2 63A9 DETACHED
   6289 6290 6293 6294 63A2 63A9 ATTACHED TO MAINT
   ```

```
DASD status after:
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    6289 MAINT    6289 3390  UM6289 6289          0       3339
MAINT    6290 MAINT    6290 3390  UM6290 6290          0       3339
MAINT    6293 MAINT    6293 3390  UM6293 6293          0       3339
MAINT    6294 MAINT    6294 3390  UM6294 6294          0       3339
MAINT    63A2 MAINT    63A2 3390  UM63A2 63A2          0      10017
MAINT    63A9 MAINT    63A9 3390  UM63A9 63A9          0      10017
```

You should now have newly formatted volumes that can be used for minidisks.

4.6.3 Updating the SYSTEM CONFIG file

Now that the PAGE and PERM volumes are ready for use, they must be added to the SYSTEM CONFIG file so that z/VM can use them. Follow these steps to update the SYSTEM CONFIG file:

1. Log on to MAINT.
2. The following example uses the same steps to access the MAINT CF1 disk read-write that you used earlier:

```
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF1 MAINT    OCF1  A   R/O  610RES 61A2 CKD          39        158
MNTCF2 MAINT    OCF2  B   R/O  610RES 61A2 CKD         159        278
MNTCF3 MAINT    OCF3  C   R/O  610RES 61A2 CKD         279        398
==> cprel a
CPRELEASE request for disk A scheduled.
HCPZAC6730I CPRELEASE request for disk A completed.
==> link * cf1 cf1 mr
==> acc cf1 f
```

   It is good to remember this sequence of steps.

3. Make a copy of the working SYSTEM CONFIG file using the “WRKS” (it works!) suffix convention:

```
==> copy system config f = confwrks =
```

4. Edit the SYSTEM CONFIG file and specify each of the new page volumes (PAGE) by name as CP_Owned. When your system performs an IPL, it will pick these up as paging volumes.

```
==> x system config f
====> /cp_owned
...
/*****************************************************************/
/*                    CP_Owned Volume Statements                 */
/*****************************************************************/

    CP_Owned   Slot   1  610RES
    CP_Owned   Slot   2  UV6281
    CP_Owned   Slot   3  UV6282
    CP_Owned   Slot   4  UV6283
    CP_Owned   Slot   5  UV6284
    CP_Owned   Slot   6  UP6285
    CP_Owned   Slot   7  UP6286
    CP_Owned   Slot   8  UP6287
    CP_Owned   Slot   9  RESERVED
```

```
    CP_Owned   Slot   10  RESERVED
    CP_Owned   Slot   11  RESERVED
...
```

5. Move down to the `User_Volume_List` section. User volumes (PERM) can be specified individually with the `User_Volume_List statement`, or with wild cards using the `User_Volume_Include` statement. If you are using the labelling convention enforced by the CPFORMAT EXEC and no other LPAR will be using the same volumes with the same prefix, then add the following single line to include all PERM space as volume labels all beginning with UM6:

```
====> /user_v
/*****************************************************************/
/*                          User_Volume_List                     */
/* These statements are not active at the present time.  They are  */
/* examples, and can be activated by removing the comment delimeters  */
/*****************************************************************/
User_Volume_Include UM6*
/*  User_Volume_List USRPO1    */
/*  User_Volume_List USRPO2    */
...
====> file
```

Important: If other z/VM LPARs might be attaching volumes with the UM prefix, you should specifically list each volume to be attached to SYSTEM using the `User_Volume_List statement`. This will prevent the possibility of multiple z/VM systems writing to the same volume. In this example, the list would be:

```
User_Volume_List UM6289
User_Volume_List UM629O
User_Volume_List UM6293
User_Volume_List UM6294
User_Volume_List UM63A2
```

6. Save your changes with the FILE subcommand. Verify the integrity of the changes with the CPSYNTAX command:

```
==> acc 193 g
==> cpsyntax system config f
CONFIGURATION FILE PROCESSING COMPLETE -- NO ERRORS ENCOUNTERED.
```

7. When you have confirmed that there are no syntax errors, put the MAINT CF1 disk back online. The following example shows how you did this previously:

```
==> rel f (det
DASD OCF1 DETACHED
==> cpacc * cf1 a
CPACCESS request for mode A scheduled.
HCPZAC6732I CPACCESS request for MAINT's OCF1 in mode A completed.
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF1 MAINT    OCF1  A   R/O  610RES 0200 CKD          39         83
MNTCF2 MAINT    OCF2  B   R/O  610RES 0200 CKD          84        128
MNTCF3 MAINT    OCF3  C   R/O  610RES 0200 CKD         129        188
```

4.6.4 Testing the changes

It is recommended that you again shut down and perform an IPL to test the changes. Before you shut down, note that you have only one page volume (UV6282 in this example) using the QUERY ALLOC PAGE command. Your output should look similar to the following:

```
==> q alloc page
EXTENT     EXTENT  TOTAL  PAGES   HIGH    %
VOLID  RDEV      START        END  PAGES IN USE   PAGE USED
------ ---- ---------- ---------- ------ ------ ------ ----
UV6282 6282          1       3338 600840      1      4   1%
                                  ------ ------        ----
SUMMARY                           600840      1          1%
USABLE                            600840      1          1%
```

Now shut the system down again with the command SHUTDOWN REIPL IPLPARMS CONS=SYSC. This is analogous to the Linux **reboot** command in that the system attempts to come back up after it shuts down. If you are connected using a 3270 emulator, you will lose your session, but if all goes well, your system will be available again in a couple of minutes.

```
==> shutdown reipl iplparms cons=sysc
```

After the system comes back, log on as `MAINT` and look at the page space again. You should now see that you have six paging volumes:

```
==> q alloc page
               EXTENT     EXTENT  TOTAL  PAGES   HIGH    %
VOLID  RDEV      START        END  PAGES IN USE   PAGE USED
------ ---- ---------- ---------- ------ ------ ------ ----
UV6282 6282          1       3338 600840      1      5   1%
UP6285 6285          0       3338 601020      0      0   0%
UP6286 6286          0       3338 601020      0      0   0%
UP6287 6287          0       3338 601020      0      0   0%
                                  ------ ------        ----
SUMMARY                            2348K      1          1%
USABLE                             2348K      1          1%
```

The output shows that there are four paging volumes constituting 2348 K pages, or about 9 GB of page space (a page is 4 KB).

4.7 Creating a user ID for common files

Now it is time to define your first z/VM user ID, LNXMAINT. It will be used to store files that will be shared by Linux user IDs. Before starting, make a copy of the original `USER DIRECT file`:

```
==> copy user direct c = direorig = (oldd
```

4.7.1 Defining the user in the USER DIRECT file

A small 20-cylinder minidisk is allocated at virtual address 191 and a larger 300-cylinder minidisk (approximately 225 MB), to be shared by many guests, is defined at virtual address 192. Use the next free DASD designated as PERM space on your worksheet (2.7.2, “z/VM DASD worksheet” on page 17). Cylinder 0 should always be reserved for the label. Therefore, you should start minidisks at cylinder 1.

Perform the following steps:

1. Edit the `USER DIRECT` file and add the following user ID definition to the bottom of the file. A comment is added signifying the split between z/VM system user IDs and locally added user IDs (this can be helpful when moving to a new version of z/VM):

```
==> x user direct c
====> bottom
====> a 9
...
*-------------------------------------------------------------
* z/VM system user IDs are above, local user IDs are below
*-------------------------------------------------------------
USER LNXMAINT LNXMAINT 64M 128M BEG          1
 INCLUDE TCPCMSU                             2
 LINK TCPMAINT 592 592 RR                    3
 MDISK 0191 3390 0001 0020 UM6289 MR READ     WRITE    MULTIPLE   4
 MDISK 0192 3390 0021 0300 UM6289 MR ALL      WRITE    MULTIPLE   5
*                                                                 6
...
====> file
```

   Note the following points for the numbers in black:

   1 User ID LNXMAINT, same password, default size of 64 MB, with class B, E, and G privileges.

   2 Include the profile named TCPCMSU (defined earlier in the `USER DIRECT` file).

   3 Link to the TCPMAINT 592 disk read-only for access to FTP and other TCP/IP commands.

   4 Define a 191 minidisk of size 20 cylinders from volume UM6289.

   5 Define a 192 minidisk of size 300 cylinders (approximately 225 MB) from volume UM6289 with the special read password of `ALL`, which allows read access from any user ID without a disk password.

   6 An empty comment line for better readability.

2. Whenever an `MDISK` statement is added or modified in the `USER DIRECT` file, always check for overlapping cylinders and gaps (gaps will only leave empty disk space; however, overlaps can occur because z/VM will allow you to *shoot yourself in the foot* by defining multiple minidisks over the same disk space). This is done with the DISKMAP command:

```
==> diskmap user
The minidisks with the END option specified in this directory will not be
includ
ed in the following DISKMAP file.

File USER DISKMAP A has been created.
```

3. The file created, `USER DISKMAP`, contains a mapping of all minidisk volumes defined in the `USER DIRECT` file. It will list any overlaps or gaps found on the volumes. Edit the file and turn off the prefix area with the XEDIT PREFIX OFF subcommand to view 80 columns:

```
==> x user diskmap
====> prefix off
```

4. Search for the text overlap with the / subcommand:

```
====> /overlap
```

   You should see the error message `DMSXDC546E Target not found`. This means that no minidisks are overlapping each other.

Now search for all the gaps using the ALL subcommand. You should see some gaps:

```
====> all /gap
                                        0         500         501    GAP
-------------------  6  line(s) not displayed --------------------
                                        0           0           1    GAP
-------------------  216  line(s) not displayed --------------------
                                        0           0           1    GAP
-------------------  86  line(s) not displayed --------------------
```

Type `all` with no argument again to get out of this mode:

```
====> all
```

Three gaps should be listed on the right side:

- 501 cylinders on the $$$$$$ volume
- 1 cylinder on the $$$LNX volume
- 1 cylinder on volume used for LNXMAINT 191 and 192 disks (UM6289 in this example)

You do not have to worry about the first two gaps because they are expected, given the layout of the default `USER DIRECT` file. To avoid a 1-cylinder gap being reported on each user volume, we recommend to use the user ID $ALLOC$. This user is set to NOLOG, which means it can never be logged onto. Thus it is not a conventional user ID. Rather, it is a convenient place to put dummy minidisk definitions for cylinder 0 of all PERM volumes.

5. Get out of the file `USER DISKMAP` with the QUIT command or by pressing F3.
6. Edit the `USER DIRECT` file again and add a new minidisk definition at virtual address A04 for the first cylinder of the DASD you added (the label is UM6289 in this example):

```
==> x user direct
====> /user $alloc
USER $ALLOC$  NOLOG
 MDISK A01 3390 000 001 610RES R
 MDISK A02 3390 000 001 UV6283 R
 MDISK A03 3390 000 001 UV6284 R
 MDISK A04 3390 000 001 UM6289 R
```

7. Save your changes with the FILE subcommand and run DISKMAP again. Edit the `USER DISKMAP` file. This time you should see just two gaps for volumes with labels $$$$$$ and $$$LNX. If you search for the $ALLOC$ user ID, you should see the disk map of the volume you added for LNXMAINT:

```
==> diskmap user
The minidisks with the END option specified in this directory will not be
includ
ed in the following DISKMAP file.

File USER DISKMAP A has been created.
==> x user diskmap
====> prefix off
====> all /gap
                                          0         500         501    GAP
-------------------  6  line(s) not displayed --------------------
                                          0           0           1    GAP
-------------------  303  line(s) not displayed --------------------
```

8. When you are done you can quit by pressing F3.

```
====> F3
```

9. Now that you are sure the minidisk layout is correct, the changes to the `USER DIRECT` file can be brought online using the DIRECTXA command:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 43 disk pages
```

If the DIRECTXA command fails, correct the problem before proceeding.

You have now defined your first z/VM user ID named LNXMAINT.

4.7.2 Logging and customizing the new user ID

Now you should be able to log on to the new user ID and format its two minidisks.

Perform the following steps:

1. Log off of MAINT and log on to LNXMAINT:

```
LOGON LNXMAINT
z/VM Version 6 Release 1.0, Service Level 0901 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 13:14:38 EST FRIDAY 11/20/09
z/VM V6.1.0    2009-11-19 13:47

DMSACP112S A(191) device error
```

   You should see an error message ending in "`device error`. When CMS is started, it tries to access the user's 191 minidisk as file mode A. The 191 minidisk has been defined to this user ID. However, it has never been formatted as a CMS file system.

2. To format this disk for CMS use the FORMAT command. It requires a parameter specifying the file mode to access the disk as mode A in the following example:

```
==> format 191 a
DMSFOR603R FORMAT will erase all files on disk A(191). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
1
DMSFOR605R Enter disk label:
lxm191
DMSFOR733I Formatting disk A
DMSFOR732I 20 cylinders formatted on A(191)
```

3. Format the larger 192 disk as the D minidisk, which should take a minute or two:

```
==> format 192 d
DMSFOR603R FORMAT will erase all files on disk D(192). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
1
DMSFOR605R Enter disk label:
lxm192
DMSFOR733I Formatting disk D
DMSFOR732I 300 cylinders formatted on D(192)
```

4. You have now formatted the two minidisks and accessed them as file modes A and D. You can confirm this with the QUERY DISK command:

```
==> q disk
LABEL  VDEV M  STAT   CYL TYPE BLKSZ   FILES  BLKS USED-(%) BLKS LEFT  BLK TOTAL
LNX191 191  A   R/W    20 3390 4096        0          7-00       3593       3600
LXM192 192  D   R/W   300 3390 4096        0         11-00      53989      54000
MNT190 190  S   R/O   100 3390 4096      694      15028-83       2972      18000
MNT19E 19E  Y/S R/O   250 3390 4096     1021      28254-63      16746      45000
```

4.7.3 Copying a PROFILE XEDIT

Copy the `PROFILE XEDIT` file from the MAINT 191 disk so that XEDIT sessions will have a common interface among user IDs.

Perform the following steps:

1. Use the VMLINK command to both link to the disk read-only and to access it as the highest available file mode. The default read password is `read`:

```
==> vmlink maint 191
ENTER READ PASSWORD:
==> read
DMSVML2060I MAINT 191 linked as 0120 file mode Z
```

2. Copy the `PROFILE XEDIT` file to the A disk:

```
==> copy profile xedit z = = a
```

3. Also copy the same file to the D disk (which will become the Linux user ID's read-only A disk). Then release and detach the MAINT 191 disk:

```
==> copy profile xedit z = = d
==> rel z (det
DASD 0120 DETACHED
```

4.7.4 Creating a PROFILE EXEC

Create a simple PROFILE EXEC that will be run each time this user ID is logged on.

Perform the following steps:

1. Create the new file using XEDIT and add the following lines (be sure to type the A file mode so you do not pick up a PROFILE EXEC on another disk). REXX EXECs must always begin with a C language-style comment.

```
==> x profile exec a
====> a 5
/* PROFILE EXEC */
'acc 592 e'
'cp set run on'
'cp set pf11 retrieve forward'
'cp set pf12 retrieve'
====> file
```

   This PROFILE EXEC accesses the TCPMAINT 592 disk as file mode E, sets CP run on, and sets the retrieve keys per convention.

2. You could test your changes by logging off and logging back on. However, typing the command PROFILE will do the same:

```
==> profile
DMSACP723I E (592) R/O
```

3. By default CMS tries to access the 191 disk as A and the 192 disk as D. Also, you should have the TCPMAINT 592 disk accessed as E. Verify that these three disks are accessed with the QUERY DISK command:

```
==> q disk
LABEL  VDEV M  STAT   CYL TYPE BLKSZ   FILES  BLKS USED-(%) BLKS LEFT  BLK
TOTAL
LXM191 191  A   R/W    20 3390 4096        2          9-01       3591
3600
LXM192 192  D   R/W   300 3390 4096        0         11-00      53989
54000
TCM592 592  E   R/O    70 3390 4096      903      10183-81       2417
12600
MNT190 190  S   R/O   100 3390 4096      694      15028-83       2972
18000
MNT19E 19E  Y/S R/O   250 3390 4096     1021      28254-63      16746
45000
```

4. Verify that your F11 and F12 keys are set to the RETRIEVE command using the QUERY PFKEYS command:

```
==> q pf
...
PF10 UNDEFINED
PF11 RETRIEVE FORWARD
PF12 RETRIEVE BACKWARD
...
```

4.7.5 Copying the files associated with this book to LNXMAINT

The z/VM files associated with this book are in the vm/ subdirectory of the NFS server you set up earlier. These files should be stored on the larger 192 disk, which is accessed as your D disk. Perform the following steps:

1. Log off of LNXMAINT so that the 192 disk is available as a read-write disk.
2. Start an SSH session on the NFS server and change the directory to the VM files associated with this book. The directory name will be:

```
# cd /nfs/virt-cookbook-RH6/vm
```

3. FTP to z/VM. By default, FTP copies files to your 191 disk, so first change the directory to the LNXMAINT 192 disk. The files are all in ASCII and the default behavior is to convert to ASCII to EBCDIC. Use the **mput *** subcommand to copy the files from the vm/ directory to LNXMAINT:

```
# ftp 9.60.18.249
Connected to 9.12.5.22.
Name (9.12.5.22:root): lnxmaint
331-Password:
Password: lnxmaint
230-LNXMAINT logged in; working directory = LNXMAINT 191
Remote system type is z/VM.
ftp> cd lnxmaint.192
```

```
250 Working directory is LNXMAINT 192
ftp> prompt
Interactive mode off
ftp> mput *
...
ftp> quit
```

4. Log on to LNXMAINT. You should see the following files on your D disk:

```
==> filel * * d
LNXMAINT FILELIST A0  V 169  Trunc=169 Size=5 Line=1 Col=1 Alt=0
Cmd   Filename Filetype Fm Format Lrecl    Records     Blocks   Date     Time
      CHPW610  XEDIT    D1 V         72        190          3 11/04/10 13:57:39
      CPFORMAT EXEC     D1 V         79        252          3 11/04/10 13:57:39
      PROFILE  EXEC     D1 V         63         17          1 11/04/10 13:57:39
      RHEL6    EXEC     D1 V         69         10          1 11/04/10 13:57:39
      SAMPLE   CONF-RH6 D1 V         38         11          1 11/04/10 13:57:39
      SAMPLE   PARM-RH6 D1 V         80          3          1 11/04/10 13:57:39
      SWAPGEN  EXEC     D1 V         72        467          6 11/04/10 13:57:39
      PROFILE  XEDIT    D1 V         45         17          1 11/04/10 13:48:08
```

4.8 Customizing system startup and shutdown

When your z/VM system performs an IPL, it is often desirable to have important Linux systems also start. Conversely, when you shut down z/VM, it is desirable to have all Linux systems shut down first.

4.8.1 Configuring the AUTOLOG1 PROFILE EXEC

We recommend that the following tasks be accomplished by using AUTOLOG1's PROFILE EXEC.

- Configure Linux to shut down gracefully using the SET SIGNAL command.
- Overcommit memory using the SET SRM STORBUF command.
- Grant access to the VSWITCH for each Linux user.
- Start user IDs that should be started using the XAUTOLOG command.
- Limit minidisk cache in main storage and turn it off in expanded storage.

To accomplish this task, perform the following steps:

1. Log off of LNXMAINT and log on to AUTOLOG1. At the `VM READ` prompt you have usually been pressing Enter, which causes the PROFILE EXEC to be run. If you do not want this EXEC to run, enter the command ACCESS (NOPROF:

```
LOGON AUTOLOG1
z/VM Version 6 Release 1.0, Service Level 0901 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 09:29:16 EST FRIDAY 11/20/09
DMSIND2015W Unable to access the Y-disk. Filemode Y (19E) not accessed
z/VM V6.1.0    2009-11-19 13:47

==> acc (noprof
```

2. Make a copy of the working PROFILE EXEC:

```
==> copy profile exec a = execwrks =
```

3. Edit the file and add the emboldened text. A LOGOFF command is added at the end of the EXEC so that the virtual machine will be logged off when it is complete. This will save a small amount of memory on the system, but does add the requirement that you type **acc (noprof** at the VM READ prompt when you log on interactively.

```
==> x profile exec
/**************************/
/*  Autolog1 Profile Exec  */
/**************************/
'cp xautolog tcpip'                 /* start up TCPIP */
'CP XAUTOLOG VMSERVS'
'CP XAUTOLOG VMSERVU'
'CP XAUTOLOG VMSERVR'
'CP XAUTOLOG DTCVSW1'
'CP XAUTOLOG DTCVSW2'
'cp set pf12 ret'                   /* set the retrieve key */
'cp set mdc stor 0m 128m'           /* Limit minidisk cache in CSTOR */
'cp set mdc xstore 0m 0m'           /* Disable minidisk cache in XSTOR */
'cp set srm storbuf 300% 250% 200%' /* Overcommit memory */
'cp set signal shutdown 300'        /* Allow guests 5 min to shut down */
'cp logoff'                         /* logoff when done */
```

4. Save your changes with the FILE subcommand.

Important: The `set mdc` and `set srm` lines are z/VM tuning values. It is believed that these are good starts for Linux systems, but will not be optimal for all z/VM systems. For more reading on these values, see the following websites:

- http://www.vm.ibm.com/perf/tips/linuxper.html
- http://www.vm.ibm.com/perf/tips/prgmdcar.html

You may choose to modify or omit some of these settings. Your system should now be configured to start up and send a signal to shut down Linux user IDs.

4.8.2 Testing the changes

To test your changes, you must perform an IPL of z/VM again. Be sure you are in a position to do so!

Perform the following steps:

1. Shut down and perform an IPL of your system:

```
==> shutdown reipl iplparms cons=sysc
SYSTEM SHUTDOWN STARTED
```

2. When your system comes back, log on as MAINT.
3. Query the SRM values to see that the new STORBUF settings are in effect and the `SIGNAL SHUTDOWN` value is set to 300 seconds:

```
==> q srm
IABIAS : INTENSITY=90%; DURATION=2
LDUBUF : Q1=100% Q2=75% Q3=60%
STORBUF: Q1=300% Q2=250% Q3=200%
DSPBUF : Q1=32767 Q2=32767 Q3=32767
```

```
...
==> q signal shutdown
System default shutdown signal timeout: 300 seconds
```

This output shows that your changes have taken effect.

4.9 Addressing z/VM security issues

This section briefly discusses the following security issues.

- z/VM security products
- High-level z/VM security
- Linux user ID privilege classes
- z/VM user ID and minidisk passwords

4.9.1 VM security products

You might want to use a z/VM security product such as IBM RACF® or CA VM:Secure. They allow you to address more security issues such as password aging and the auditing of users' access attempts.

4.9.2 High-level z/VM security

The paper *z/VM Security and Integrity* discusses the isolation and integrity of virtual servers under z/VM. It is on the web at:

`http://www.vm.ibm.com/library/zvmsecint.pdf`

4.9.3 Linux user ID privilege classes

Another security issue is the privilege class that Linux user IDs are assigned. *Running Linux Guests with less than CP Class G Privilege*, REDP-3870 addresses this issue.

4.9.4 z/VM user ID and minidisk passwords

All passwords in a vanilla z/VM system are the same as the user ID. This is a large security hole. The *minimum* you should do is to address this issue.

There are two types of passwords in the `USER DIRECT` file:

User IDs The password required to log on with

Minidisks Separate passwords for read access, write access, and multi-write access

Both types of passwords should be modified. This can be done using the CHPW610 XEDIT macro described in the next section.

4.9.5 Changing passwords in USER DIRECT

Changing the passwords can be done manually in XEDIT. However, this is both tedious and error-prone. An XEDIT macro named CHPW610 XEDIT can be used. The source code for this can be found at:

http://www.vm.ibm.com/devpages/mikemac/SG247932.tgz

This macro changes all z/VM passwords to the same value, which may still not be adequate security given the different function of the various user IDs. If you want different passwords, you have to modify the USER DIRECT file manually, either with or without using the CHPW52 XEDIT macro.

To modify all user ID and minidisk passwords to the same value, perform the following steps:

1. Log on to MAINT.
2. Link and access the LNXMAINT 192 disk to pick up the CHPW610 XEDIT macro:

```
==> vmlink lnxmaint 192
DMSVML2060I LNXMAINT 192 linked as 0120 file mode Z
```

3. Make a backup copy of the USER DIRECT file and first be sure the password that you want to use is not a string in the file. For example, if you want to change all passwords to lnx4vm, then perform the following steps:

```
==> copy user direct c = direwrks = (oldd
==> x user direct c
====> /lnx4vm
DMSXDC546E Target not found
====> quit
```

   The Target not found message shows that the string lnx4vm is not used in the USER DIRECT file, so it is a good candidate for a password.

4. Edit the USER DIRECT file with the parameter (profile chpw610) followed by the new password. Rather than invoking the default profile of PROFILE XEDIT, this command invokes the XEDIT macro named CHPW610 XEDIT and passes it the new password. For example, to change all passwords to lnx4vm, enter the following command:

```
==> x user direct c (profile chpw610) lnx4vm

Changing all passwords to: LNX4VM

DMSXCG517I 1 occurrence(s) changed on 1 line(s)
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
...
```

5. When the profile finishes you are left in the XEDIT session with all passwords modified. You may want to first examine the changes. Then save the changes with the FILE subcommand:

```
====> file
```

6. Bring the changes online with the DIRECTXA command:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 43 disk pages
```

Your new directory is online. Do not forget the new password!

Note that this XEDIT macro will only work on a vanilla `USER DIRECT` file because it searches for the original user IDs next to passwords. If you want to change your password again, it should be much easier because you can use the XEDIT CHANGE subcommand. For example, to change all passwords from lnx4vm to vm4lnx, invoke the following commands:

```
==> x user direct c
====> c/LNX4VM/VM4LNX/* *
DMSXCG517I 798 occurrence(s) changed on 345 line(s)
```

Congratulations, your z/VM system is now customized and ready for Linux.

4.10 Backing up your z/VM system to tape

Your system is now customized with a running TCP/IP stack, a highly available VSWITCH, a startup and shutdown process, and with a user ID for shared files. You have changed the passwords. This would be a good time to back up the system to tape.

There are five system volumes that should be backed up, 610RES, 610SPL, 610PAG, 610W01, and 610W02 (or just the first three if you are using 3390-9s). If you changed the labels of the last four at install time, then use those labels. You have also configured a sixth volume that is important to Linux: that is, the first 320 cylinders of the volume with LNXMAINT on it.

To back up these volumes to tape, refer to Chapter 8, “Load the System Image, Step 11. Store a Backup Copy of the z/VM System on Tape” in *The z/VM Guide for Automated Installation and Service*, GC204-6099.

4.11 Relabeling system volumes

In previous books, the z/VM installation was described using “standard labels” on the CP-owned volumes (for example, 610RES, 610SPL, 610PAG, 610W01, and 610W02). In this book, changing the last four labels to include the real device address in the last four characters of each label is recommended (the label of the “res pack”, for example 610RES, cannot be modified at install time). This alleviates the possibility that another vanilla z/VM system with the same labels is installed onto volumes accessible by your z/VM system. If that happens, it is likely that one of the systems will not IPL correctly.

To understand this possibility, refer to Figure 4-16. The z/VM system with the lower device addresses starting at E340 should perform an IPL fine (though you may see a warning at system startup time about duplicate volume labels). However, if the z/VM system starting at device address F000 performs an IPL, the 540RES volume will be used, but the remaining volumes in the system are searched for by volume label, not by device address. Because z/VM system 1's addresses are lower than z/VM system 2's, system 2 will be using system 1's volumes. This is not good for either system!

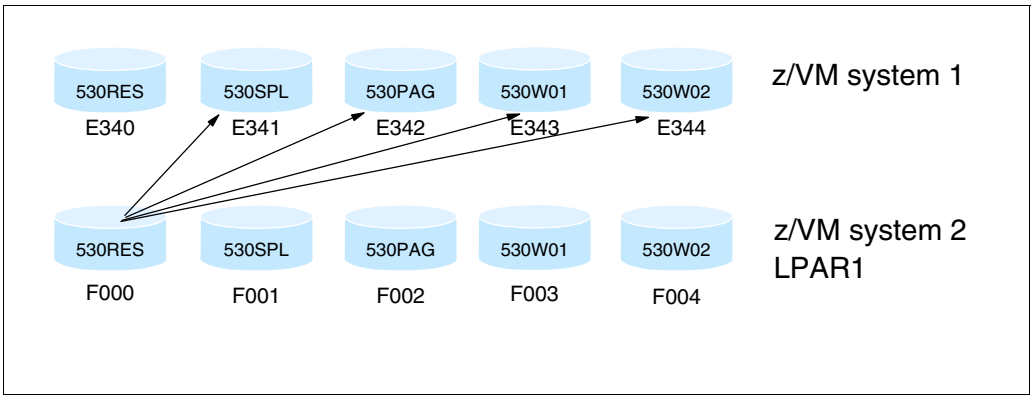


Figure 4-16 The problem with two z/VM systems with identical volume labels

In previous books a REXX EXEC and an XEDIT macro were provided to help in the process of relabeling system volumes. However, if you followed the previous steps, you will have only one standard label, `610RES`. The EXEC and macro are no longer provided because they relied on standard labels. However, high-level steps are still included. If you modified all labels except for the first one at install time, it is usually not necessary to perform the steps in this section.

If you do need to relabel the system volumes, perform the following steps:

- "Modifying labels in the SYSTEM CONFIG file" on page 67
- "Modifying labels in the USER DIRECT file" on page 69
- "Changing the labels on the five volumes" on page 69
- "Shutting down your system and restarting it" on page 70

Important: This process must be done as documented. Making a mistake in one of the steps can easily result in an unusable system. Check your steps carefully and your system will come back with no problems. Try to do all steps in succession in a short amount of time.

4.11.1 Modifying labels in the SYSTEM CONFIG file

An HMC Integrated 3270 Console session will be needed in this section because z/VM will have to be restarted with a FORCE option.

Perform the following steps:

1. Start a 3270 session. It can be a 3270 emulator session for now, or all of the steps can be done from the HMC.
2. Note the first five CP-owned volumes using the QUERY CPOWNED command. In this example they are `D850-D854`:

```
==> q cpowned
   1  610RES  D850  Own    Online and attached
```

```
  2  610SPL  D851  Own    Online and attached
  3  610PAG  D852  Own    Online and attached
  4  610W01  D853  Own    Online and attached
  5  610W02  D854  Own    Online and attached
  6  MPD855  D855  Own    Online and attached
 ...
```

3. To modify the labels in the SYSTEM CONFIG file, begin by releasing the A CP-disk and access it read-write. Back up the SYSTEM CONFIG file:

```
==> cprel a
CPRELEASE request for disk A scheduled.
HCPZAC6730I CPRELEASE request for disk A completed.
==> link * cf1 cf1 mr
==> acc cf1 f
==> copy system config f = confwrks = (oldd rep
```

4. Edit the SYSTEM CONFIG file and modify the five labels (if you installed onto 3390-9s, there are only three labels, no W01 and W02 volumes are required):

```
==> x system config f
====> c/610RES/MVD850/*
DMSXCG517I 3 occurrence(s) changed on 3 line(s)
====> top
====> c/610SPL/MVD851/*
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
====> top
====> c/610PAG/MVD852/*
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
====> top
====> c/610W01/MVD853/*
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
====> top
====> c/610W02/MVD854/*
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
```

5. Search for the string cp_owned and you should see the new labels. Be sure they are correct before saving the file with the FILE subcommand:

```
====> top
====> /cp_owned
/*                     CP_Owned Volume Statements                     */
/********************************************************************/

 CP_Owned   Slot   1  MVD850
 CP_Owned   Slot   2  MVD851
 CP_Owned   Slot   3  MVD852
 CP_Owned   Slot   4  MVD853
 CP_Owned   Slot   5  MVD854
 CP_Owned   Slot   6  MPD855
 ...
====> file
```

6. Verify that there are no syntax errors:

```
==> acc 193 g
==> cpsyntax system config f
CONFIGURATION FILE PROCESSING COMPLETE -- NO ERRORS ENCOUNTERED.
```

7. Release and detach the F disk, CPACCESS the A disk, and verify with the QUERY CPDISK command:

```
==> rel f (det
DASD OCF1 DETACHED
==> cpacc * cf1 a
CPACCESS request for mode A scheduled.
Ready; T=0.01/0.01 09:19:57
HCPZAC6732I CPACCESS request for MAINT's OCF1 in mode A completed.
==> q cpdisk
Label  Userid   Vdev Mode Stat Vol-ID Rdev Type   StartLoc     EndLoc
MNTCF1 MAINT    OCF1  A   R/O  610RES D850 CKD          39        158
MNTCF2 MAINT    OCF2  B   R/O  610RES D850 CKD         159        278
MNTCF3 MAINT    OCF3  C   R/O  610RES D850 CKD         279        398
```

You have now changed the labels of the system volumes in the SYSTEM CONFIG file. It is critical that you proceed as your system is now in a state where it will not IPL cleanly.

4.11.2 Modifying labels in the USER DIRECT file

In this section, you will modify the system volume labels in the USER DIRECT file.

Modify the labels in the USER DIRECT file. If you installed z/VM onto 3390-9s, you will need only the first three CHANGE subcommands:

```
==> copy user direct c = direwrks = (oldd rep
==> x user direct c
====> c/610RES/MVD850/*
DMSXCG517I 94 occurrence(s) changed on 94 line(s)
====> top
====> c/610SPL/MVD851/*
DMSXCG517I 78 occurrence(s) changed on 78 line(s)
====> top
====> c/610PAG/MVD852/*
DMSXCG517I 117 occurrence(s) changed on 117 line(s)
====> top
====> c/610W01/MVD853/*
DMSXCG517I 2 occurrence(s) changed on 2 line(s)
====> top
====> c/610W02/MVD854/*
DMSXCG517I 1 occurrence(s) changed on 1 line(s)
```

Traverse the file to view the changes before saving the changes with the FILE subcommand:

```
====> file
```

You have now changed the labels of the system volumes in the USER DIRECT and SYSTEM CONFIG files. Again, it is critical that you proceed with the remaining steps.

4.11.3 Changing the labels on the five volumes

In this section, you will change the labels on the five volumes using the CPFMTXA command. Four of the five system disks are defined as full-pack minidisks to MAINT as virtual devices 122-124 (610RES, 610SPL, 610W01, and 610W02). If you installed z/VM onto 3390-9s, you will not need to use 124 and 125. The fifth volume, 610PAG, is defined as the virtual device $PAGE$ A03. To modify the system volumes' labels, you will use these virtual addresses.

For reference, here are the entries in the USER DIRECT file:

```
...
USER $PAGE$   NOLOG
 MDISK A03 3390 000 END 610PAG R
..
MDISK 122 3390 000 END 610SPL MR
MDISK 123 3390 000 END 610RES MR
MDISK 124 3390 000 END 610W01 MR
MDISK 125 3390 000 END 610W02 MR
...
```

Perform the following steps:

1. Use the CPFMTXA command to relabel the five system volumes (you will only need the first three if you installed onto 3390-9s). Be sure to watch for a return code of 0 on each command:

   ```
   ==> cpfmtxa 123 mvd850 label
   ...
   ==> cpfmtxa 122 mvd851 label
   ...
   ==> link $page$ a03 a03 mr
   ==> cpfmtxa a03 mvd852 label
   ...
   ==> cpfmtxa 124 mvd853 label
   ...
   ==> cpfmtxa 125 mvd854 label
   ...
   ```

2. Now that the five volumes have been relabeled (sometimes called *clipping the volumes,* derived from a contraction of the z/OS term ***c****hange* ***l****abel* ***p****rogram*), you can run the DIRECTXA command to update the directory:

   ```
   ==> directxa user
   z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
   EOJ DIRECTORY UPDATED AND ON LINE
   HCPDIR494I User directory occupies 43 disk pages
   Ready(00005); T=0.01/0.01 15:45:51
   ```

   A return code of 5 is expected because the labels in the USER DIRECT file are different from the spool data in the currently running system.

Finally, you are ready to issue a SHUTDOWN command.

4.11.4 Shutting down your system and restarting it

You need an HMC console session for this step, if you are not already running from there. To test the changes you must shut your system down and then restart it. You cannot do a SHUTDOWN REIPL in this situation because you will have to do a FORCE start:

```
==> shutdown
SYSTEM SHUTDOWN STARTED
HCPSHU960I System shutdown may be delayed for up to 210 seconds
```

Perform the following steps to bring the system back up:

1. Open an HMC session.
2. Select your LPAR.

3. Use the circular arrow racetrack buttons to get to the CPC Recovery (or just Recovery) menu.
4. Double-click the **Integrated 3270 Console** menu item. A new window should appear.
5. Double-click the **LOAD** menu item. The Load Address (D850 in this example) and Load Parameter (SYSG) fields should be correct from the previous IPL.
6. Select **Clear**. The Load Address and Load Parameter fields should be correct from the previous IPL. Click **OK**.
7. Click **Yes** on the Load Task Confirmation window.
8. Go back to the Integrated 3270 console. After a few minutes, the Standalone Program Loader panel should appear. Use the Tab key to traverse to the section IPL Parameters and enter the value `cons=sysg`.
9. Press the F10 key to continue the IPL of your z/VM system. This should take 1 - 3 minutes.
10. At the Start prompt you have to specify a FORCE start, again because the spool volume label has changed:

    ```
    ==> force drain
    ```

11. Do not change the time of day clock:

    ```
    ==> no
    ```

12. When the IPL completes, DISCONNECT from the OPERATOR user ID:

    ```
    ==> disc
    ```

13. Close the HMC windows.
14. Start a 3270 emulator session, as the TCPIP service machine should be up. Log on as MAINT.
15. Open a 3270 session as MAINT and verify that the volume labels have changed with the QUERY CPOWNED command:

    ```
    ==> q cpowned
    Slot  Vol-ID  Rdev  Type   Status
       1  MVD850  D850  Own    Online and attached
       2  MVD851  D851  Own    Online and attached
       3  MVD852  D852  Own    Online and attached
       4  MVD853  D853  Own    Online and attached
       5  MVD854  D854  Own    Online and attached
       6  MPD855  D855  Own    Online and attached
      ...
    ```

Important: In the event that you perform an IPL of a system with duplicate system volumes, it is possible that you may have destroyed your saved segments. You will know this is the case when you cannot run **`ipl cms`**. Rather, you will have to run **`ipl 190`**. To rebuild saved segments, try the following commands (*only do this* if your saved segments are trashed!):

```
==> vmfsetup zvm cms
==> sampnss cms
==> ipl 190 clear parm nosprof instseg no
==> acc (noprof
==> acc 5e6 b
==> acc 51d d
==> vmfbld ppf segbld esasegs segblist ( all
```

4.12 Restoring your z/VM system from tape

It is good to practice to restore a system. You do not want to be doing your first restore when the pressure is on.

Restoring a z/VM system from tape that has the same set of volume labels as the system that is running is problematic. If there are two z/VM systems on the same LPAR with the same volume labels, both systems cannot be IPLed cleanly. If you have backed up your system in 4.10, “Backing up your z/VM system to tape” on page 66, you can restore this system to five other 3390-3s. Refer to the Appendix E, “Restore the z/VM System Backup Copy from Tape”, in *The z/VM Guide for Automated Installation and Service*, GC204-6099.

5

Servicing z/VM

This chapter describes how to apply the two main types of service:

- A Recommended Service Upgrade (RSU), which is analogous to a Service Pack.
- A Programming Temporary Fix (PTF), which is analogous to a bug fix.

The processes to install these types of service are basically the same.

Important: When applying service, there is always a chance that you may want to back it out. It is recommended that you have an up-to-date backup of your system before starting this section.

The application of corrective service to z/VM is covered in two manuals:

- *z/VM V6.1 Guide for Automated Installation and Service* (see Part 4), on the web at:

  `http://publibz.boulder.ibm.com/epubs/pdf/hcsk2c00.pdf`

- *z/VM Service Guide, Version 6, Release 1*, on the web at:

  `http://publib.boulder.ibm.com/epubs/pdf/hcsf1c00.pdf`

These manuals are much more complete than this chapter. You might consider using these first, rather than this chapter, or you should certainly use them as references.

VMSES/E is a component of z/VM that provides the SERVICE and PUT2PROD EXECs. The SERVICE EXEC:

- Installs an RSU or applies CORrective service for z/VM components, features, or products.
- Displays either the RSU level of the component specified or whether a particular PTF or APAR has been applied (when used with STATUS).
- Creates PTF bitmap files (when used with BITMAP).

When SERVICE is successfully completed, the PUT2PROD EXEC places the z/VM components, features, or products that are installed on the z/VM System deliverable, and were serviced, into production. A good website to start at is:

`http://www.vm.ibm.com/service/`

The body of the page should look similar to Figure 5-1.

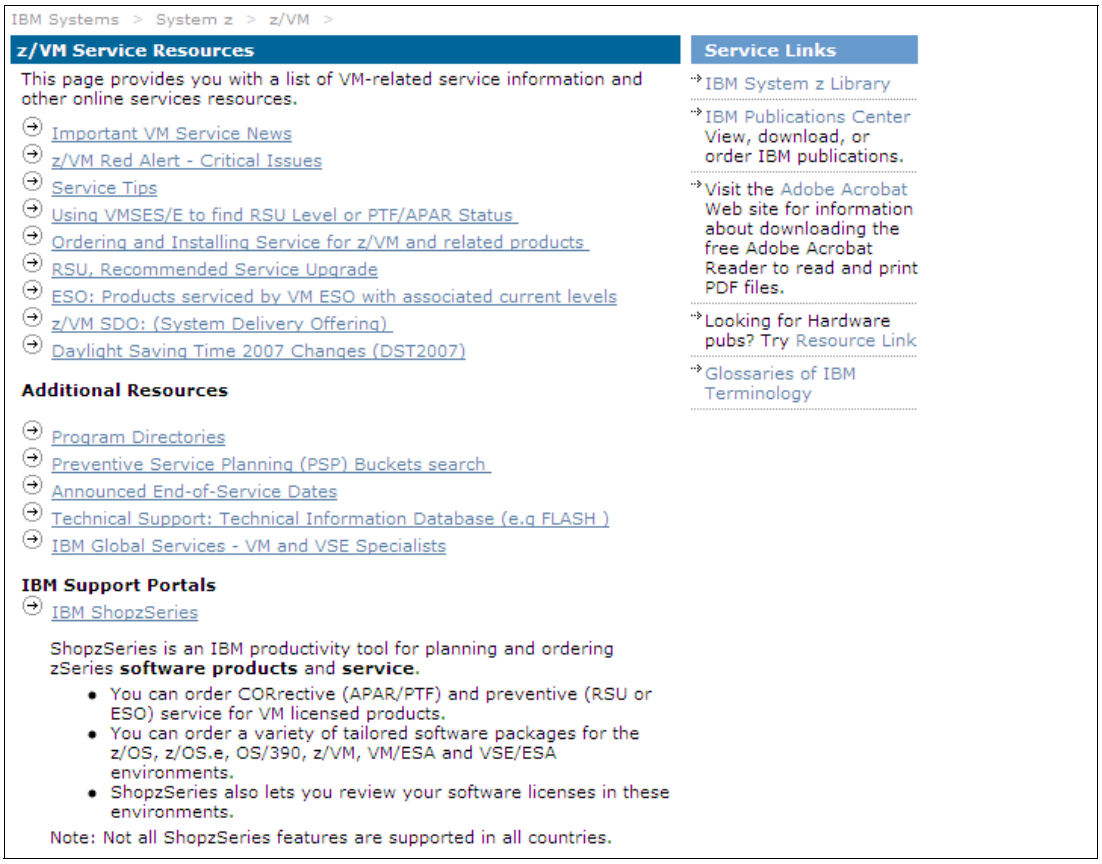


Figure 5-1 z/VM Service main web page

You may want to consider viewing some of the links from this page.

The following sections comprise this chapter:

5.1 Applying a Recommended Service Upgrade

Applying a Recommended Service Upgrade (RSU) is similar to applying a PTF described in the previous section. z/VM service can be preventive (RSU) or corrective (COR). Part 4, "Service Procedure", in *Guide for Automated Installation and Service* gives a complete description of applying service to z/VM. You may prefer to use the official z/VM documentation.

Following is an example of upgrading to a z/VM V6.1 RSU with the medium being files downloaded from the Internet.

The section that follows is a summary of applying service and also describes how to obtain service over the Internet using IBM ShopzSeries.

First determine whether your system needs service. Use the QUERY CPLEVEL command:

```
==> q cplevel
z/VM Version 6 Release 1.0, service level 0901 (64-bit)
Generated at 09/11/09 16:51:48 EDT
IPL at 08/31/10 08:44:19 EDT
```

The *service level* (or RSU) is a 4-digit field composed of two segments, each consisting of two digits. The first two digits represent the last two digits of the year and the second two digits represent the sequential RSU level within that year. Some examples are 0903RSU and 1002RSU. With 0903, the first two digits in the level, 09, represent the last two digits of the year 2009 and the 03 represents the third RSU service level of that year. Therefore, the 0903 is the third RSU issued in 2009. RSU 1002 would be the second RSU issued in 2010.

The overall steps in applying an RSU are as follow:

- "Getting service from the Internet" on page 75
- "Downloading the service files" on page 76
- "Creating a new MAINT minidisk" on page 77 (not usually required)
- "Receiving, applying, and building the service" on page 78
- "Putting the service into production" on page 81

5.1.1 Getting service from the Internet

An RSU is obtained by its PTF number. The PTF for the most current RSU is of the form UM97*xyz*, where xyz is the z/VM version-release-modification level. So for z/VM V6.1, the RSU would be UM97610.

With ShopzSeries, knowing the PTF number is not necessary. If you know you want the latest RSU, you can get it directly, based on the version of z/VM you are running.

Perform the following steps (note that these same steps are documented with some window shots in 5.4, "Applying a PTF" on page 88):

1. Point a web browser to the z/VM Service page:

   `http://www.vm.ibm.com/service/`

2. Click **IBM ShopzSeries** under the IBM Support Portals section.
3. Click the link **Sign In for registered users**. If you have a user ID and password, use that. If you do not, click the link **New user registration** and fill out the form to create an ID and password. You must have your IBM customer number.
4. Click the link **Create new software orders** at the top.
5. The My Orders page should show. Under the Package Category section, click **z/VM - Service** and also choose **RSU recommended service** in the drop-down menu. Click **Continue**.
6. There will be five windows of forms that are hopefully self-explanatory. On window 3 of 5, choose the radio button that is applicable to your version of z/VM. In this example it was **z/VM Version 6.1.0 Stacked 6103RSU (PTF UM97610)**.
7. On window 4 of 5 choose **Internet** as the delivery mechanism.
8. On window 5 of 5, complete the form and click **Submit**.
9. In a few minutes, you should get two e-mails, one for the core RSU and one for the PSP bucket (additional fixes that may have come out after the RSU).

5.1.2 Downloading the service files

In this example, the service files are staged on a desktop machine, then copied to z/VM with FTP.

Perform the following steps:

1. Download the files to your desktop or another staging system. This example has two files: the `SHIPTFSS` file is for the PSP bucket and the `SHIPRSU1` file is for the RSU.
2. FTP the file to the MAINT 500 disk. Here is an example of using FTP from a DOS session:

```
C:\Downloads>ftp 9.60.18.249
User (9.60.18.249:(none)): maint
Password:
ftp> cd maint.500
...
ftp> bin
...
ftp> quote site fix 1024
...
ftp> put S9338801.shiptfss
...
ftp> put S9338766.shiprsu1
...
ftp> quit
```

3. Log on to MAINT. Access the MAINT 500 disk as file mode C. Query the disks:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
==> q disk
LABEL  VDEV M  STAT   CYL TYPE BLKSZ   FILES  BLKS USED-(%) BLKS LEFT  BLK
TOTAL
MNT191 191  A   R/W   175 3390 4096       41        214-01      31286
31500
MNT5E5 5E5  B   R/W     9 3390 4096      131       1290-80        330
1620
MNT500 500  C   R/W   600 3390 4096        3      38497-36      69503
108000
MNT51D 51D  D   R/W    26 3390 4096      305       1574-34       3106
4680
MNT190 190  S   R/O   100 3390 4096      691      14921-83       3079
18000
MNT19E 19E  Y/S R/O   250 3390 4096     1021      28225-63      16775
45000
```

4. Extract the files:

```
==> deterse s9338801 shiptfss c = servlink =
==> deterse s9338766 shiprsu1 c = servlink =
```

Usually this step should succeed. However, very large RSUs can fill up the MAINT 500 disk either on the FTP or the DETERSE steps. For example, you may get the error on the DETERSE step:

```
DMSERD107S Disk C(500) is full
 No traceback - not enough CTL storage
```

If this occurs, an extra step of creating a new disk is necessary.

5.1.3 Creating a new MAINT minidisk

Important: Normally, this step is not necessary. Some RSUs can be so large that they will not fit on the MAINT 500 minidisk. This is the case with the stacked RSU 5405 for z/VM V5.4.

If you have adequate space to extract the files on the MAINT 500 disk, you can skip this section. If you received the error `DMSERD107S Disk C(500) is full` on the previous step, creating a new minidisk for MAINT will be necessary. If so, perform the following steps:

1. Create a new MAINT 501 disk for temporary storage of the uncompressed RSU by using 400 cylinders of space taken from the end of the W02 disk (volser is UV6284 in this example). Verify that the disk layout is good, then bring the changes online with the DIRECTXA command:

```
==> acc 2cc c
DMSACC724I 2CC replaces C (500)
==> x user direct c
...
USER MAINT LNX4VM 128M 1000M ABCDEFG
 AUTOLOG AUTOLOG1 OP1 MAINT
 ACCOUNT 1 SYSPROG
...
* add a new MAINT 501 disk for additional space for service files
 MDISK 501 3390 2371 400 UV6284  MR LNX4VM LNX4VM LNX4VM
...
==> diskmap user
...
==> x user diskmap
... // check the report file for gaps or overlaps
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 45 disk pages
```

2. Log off `MAINT` and log back on to load the new directory entry. An attempt is made to access the MAINT 500 and 501 disks as file mode C and F, respectively. However, the new 501 disk has never been formatted. Format it and access it as file mode F:

```
==> log
... // log back on
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
==> acc 501 f
DMSACP112S F(501) device error
==> format 501 f
DMSFOR603R FORMAT will erase all files on disk F(501). Do you wish to continue?
Enter 1 (YES) or 0 (NO).
1
DMSFOR605R Enter disk label:
mnt501
DMSFOR733I Formatting disk F
```

   Now that a new MAINT 501 disk is available, it can be used to stage the RSU file.

3. Move the large RSU file from the MAINT 500 (C) to the 501 (F) disk and query the disks:

```
==> copy s8873950 shiprsu1 c = = f
==> erase S8873950 shiprsu1 c
==> q disk
LABEL  VDEV M  STAT   CYL TYPE BLKSZ   FILES  BLKS USED-(%) BLKS LEFT  BLK
TOTAL
MNT191 191  A   R/W   175 3390 4096       41        214-01      31286
31500
MNT5E5 5E5  B   R/W     9 3390 4096      131       1290-80        330
1620
MNT500 500  C   R/W   600 3390 4096        2      13054-12      94946
108000
MNT51D 51D  D   R/W    26 3390 4096      305       1574-34       3106
4680
MNT501 501  F   R/W   400 3390 4096        1      45207-63      26793
72000
...
```

4. Extract the RSU from the 501 disk (F) back to the 500 disk (C) and again query the disks:

```
==> deterse s8873950 shiprsu1 f = servlink c
==> q disk
LABEL  VDEV M  STAT   CYL TYPE BLKSZ   FILES  BLKS USED-(%) BLKS LEFT  BLK
TOTAL
MNT191 191  A   R/W   175 3390 4096       41        214-01      31286
31500
MNT5E5 5E5  B   R/W     9 3390 4096      131       1290-80        330
1620
MNT500 500  C   R/W   600 3390 4096        4      98341-91       9659
108000
MNT51D 51D  D   R/W    26 3390 4096      305       1574-34       3106
4680
MNT501 501  F   R/W   400 3390 4096        1      45207-63      26793
72000
...
```

This shows that the MAINT 500 disk is now 91% full. The tersed file on the 501 disk is no longer necessary, but it is left there for reference.

5.1.4 Receiving, applying, and building the service

You must receive, apply, and build the service. Then it can be put into production.

In the past, this was a more lengthy and detailed procedure. For example, to receive, apply and build the CP component, the following steps were needed:

```
vmfmrdsk zvm cp apply (setup
vmfsetup zvm cp
vmfpsu zvm cp
vmfins install ppf zvm cp (nomemo env {filename} nolink override no
vmfapply ppf zvm cp (setup
vmfbld ppf zvm cp (status
vmfbld ppf zvm cp (serviced
```

Then the same steps were needed for many other components. The process is much easier now with the SERVICE ALL command. On the other hand, the previous method is more granular and better enables the system administrator to know which pieces of service have been applied.

Perform the following steps:

1. Apply the service with the SERVICE ALL command. The RSU must be applied first (S8873950 SERVLINK in this example). Then any PTFs that came after the RSU can be applied:

```
==> service all S9338766
...
VMFSRV2760I SERVICE processing completed successfully for GCS BUILD
VMFSUT2760I VMFSUFTB processing started
VMFSUT2760I VMFSUFTB processing completed successfully
VMFSRV2760I SERVICE processing completed successfully
Ready; T=129.22/138.98 10:14:11
```

   A return code of 0 is ideal. If the last `Ready` line has a number in parenthesis, that is the return code. In general a return code of 4 is acceptable. That means that only warnings were issued. A return code of 8 or greater generally means that errors were encountered. View details with the VMFVIEW command:

```
==> vmfview service
===> VMFVIEW - Message Log Browse of $VMFSRV  $MSGLOG  A1 <===
You are viewing ¬ST: messages from the LAST run.
No messages meet the search criteria.
********************************************************************************
****             SERVICE               USERID: MAINT                 ****
********************************************************************************
****            Date: 09/16/10            Time: 15:45:29             ****
********************************************************************************
* * * End of File * * *
```

   You may also see warning messages. For example:

```
You are viewing ¬ST: messages from the LAST run.
Number of messages shown = 12 <===> Number of messages not shown = 985
********************************************************************************
****             SERVICE               USERID: MAINT                 ****
********************************************************************************
****            Date: 12/17/09            Time: 10:06:17             ****
********************************************************************************
CK:VMFSUI2104I PTF UM32616 contains user information. Review the :UMEMO
CK:            section in file UM32616 $PTFPART
CK:VMFSUI2104I PTF UM32616 contains user information. Review the :UMEMO
CK:            section in file UM32616 $PTFPART
CK:VMFSUI2104I PTF UA46229 contains user information. Review the :UMEMO
CK:            section in file UA46229 $PTFPART
CK:VMFSUI2104I PTF UA46229 contains user information. Review the :UMEMO
CK:            section in file UA46229 $PTFPART
CK:VMFSUI2104I PTF UA46229 contains user information. Review the :UMEMO
CK:            section in file UA46229 $PTFPART
CK:VMFSUI2104I PTF UA46229 contains user information. Review the :UMEMO
CK:            section in file UA46229 $PTFPART
WN:VMFBDC2250W The following OSA objects have been built on BUILD0 100
WN:            (L) and should be copied to your workstation:
WN:VMFBDC2250W IOAJAVA  BIN
```

```
CK:VMFSUI2104I PTF UM32501 contains user information. Review the :UMEMO
CK:            section in file UM32501 $PTFPART
CK:VMFSUI2104I PTF UM32654 contains user information. Review the :UMEMO
CK:            section in file UM32654 $PTFPART
WN:VMFBDC2250W The following VMHCD objects have been built on BUILD0 300
WN:            (J) and should be copied to your workstation:
WN:VMFBDC2250W EEQINSTX EXEBIN
```

For these example warnings, if you are running OSA or HCD then as the `VMFBDC2250W` message states you will need to copy the stated objects to your workstation at some point.

2. Press F3 to get out of XEDIT.
3. Run **`ipl cms`** and press Enter at the `VM READ` prompt.

```
==> ipl cms
z/VM V5.4.0    2008-10-22 15:36

Ready; T=0.01/0.01 10:46:46
```

4. Re-access the MAINT 500 disk as C:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
```

5. Apply the PSP bucket (***`S9338801`*** in this example):

```
==> service all S9338801
...
VMFSUT2760I VMFSUFTB processing started
VMFSUT2760I VMFSUFTB processing completed successfully
VMFSRV2760I SERVICE processing completed with warnings
Ready(00004); T=29.96/33.46 15:55:40
```

In this example, the service was installed, but there were warnings.

6. Run the VMFVIEW SERVICE command:

```
==> vmfview service
    ===> VMFVIEW - Message Log Browse of $VMFSRV  $MSGLOG  A1 <===
You are viewing ¬ST: messages from the LAST run.
Number of messages shown = 1 <===> Number of messages not shown = 510
********************************************************************************
****             SERVICE               USERID: MAINT                ****
********************************************************************************
****            Date: 09/16/10            Time: 15:53:09            ****
********************************************************************************
RO:VMFAPP2112W PTF UK59536 has a IFREQ requisite for PTF UM33113 in
RO:            product 6VMCMS10 (CMS component for z/VM 6.1.0)
* * * End of File * * *
```

This message is letting you know that there is a relationship between the two PTFs (UM33113 and UK59536). It is advisable to make sure you have both, or know about the requisite and decide it is not important in your environment.

7. Press F3 to get out of XEDIT.

5.1.5 Putting the service into production

This section describes how to use the PUT2PROD command to put the service into production.

Important: The PUT2PROD command will affect your production environment. We recommend that all users be logged off before running it. Placing service into production should be performed as part of a planned system outage because a SHUTDOWN REIPL is recommended after running it.

Perform the following steps:

1. Use the PUT2PROD command to put the service into production. Many windows will scroll by. This command can take quite a number of minutes to complete:

```
==> put2prod
...
VMFP2P2760I PUT2PROD processing completed successfully for SAVECMS
VMFP2P2760I PUT2PROD processing completed with warnings
Ready(00004); T=13.93/15.21 16:03:13
```

2. The return code was 4 in this example. Review the warning messages with the VMFVIEW PUT2PROD command:

```
==> vmfview put2prod
    ===> VMFVIEW - Message Log Browse of $VMFP2P  $MSGLOG  A1 <===
You are viewing ¬ST: messages from the LAST run.
No messages meet the search criteria.
********************************************************************************
****              PUT2PROD              USERID: MAINT                 ****
********************************************************************************
****             Date: 09/16/10            Time: 16:00:26             ****
********************************************************************************
WN:DTCPRD3043W   File PROFILE STCPIP I has been updated; Its content
WN:             should be reviewed for changes that may affect your use of
WN:             this file
WN:DTCPRD3043W   File SCEXIT SAMPASM I has been updated; Its content
WN:             should be reviewed for changes that may affect your use of
WN:             this file
WN:DTCPRD3021W TCP2PROD processing completed with RC = 4
```

   With these warnings you should do as message `DTCPRD3043W` suggests and compare the files to see whether you need to pick up any of the new changes in your running copy of the sample file.

3. Press F3 to get out of XEDIT.

4. Even though the service has been “put into production”, the QUERY CPLEVEL command should still return the current service level, in this example 0901. This is because the new CP load module (nucleus) has not been loaded:

```
==> q cplevel
z/VM Version 6 Release 1.0, service level 0901 (64-bit)
Generated at 09/11/09 16:51:48 EDT
IPL at 09/15/10 15:52:34 EDT
```

5. To load the new CP load module, use the SHUTDOWN REIPL command. When your system comes back up, it should be at the new CP service level, in this example 0903:

```
==> shutdown reipl iplparms cons=sysc
HCPSHU960I System shutdown may be delayed for up to 330 seconds
Ready; T=0.01/0.01 11:12:32
```

6. After the system comes back up in a few minutes, start a new 3270 session and log on as MAINT.
7. Run the QUERY CPLEVEL command again:

```
==> q cplevel
z/VM Version 6 Release 1.0, service level 1002 (64-bit)
Generated at 09/16/10 15:54:07 EDT
IPL at 09/16/10 16:07:01 EDT
```

This shows that the new CP load module is now being used, and that the service level is the second RSU in the year 2010.

5.2 PTFs for the zEnterprise 196

In September of 2010, a new mainframe became available: the zEnterprise 196. See the following website for a list of the PMRs that apply to it:

http://www.vm.ibm.com/service/vmreqze.html

This web page also includes a link to the Preventative Service Planning (PSP) bucket for z/VM on the zEnterprise 196. The PSP bucket should always contain all the latest service information for z/VM on the z196.

Table 5-1 shows a summary of the APARS for z/VM V6.1.

Important: This list was correct at the time of the writing of this book in late 2010. It could change, so refer to the previous web page to confirm. Also, it is likely that all of the PTFs associated with these APARs will be rolled into the first RSU of 2011. So if you are up to service level 1101 or later, you can verify that the PTFs are applied with the steps shown in 5.2.3, “Verifying that the zEnterprise 196 service is applied” on page 86.

Table 5-1 z/VM V6.1 APARs for the zEnterprise 196

APAR	Component	Description
VM64774	CP	Set/Query reorder command
VM64798	CP	zEnterprise 196 Processor Support
VM64879	CP	zEnterprise 196 Processor Support
VM64881	CP	VM Coupling Facility hang at IPL
VM64793	CP	Secure-Key Bulk Encryption Support
VM64820	PERFTK	New function in the Performance Toolkit
VM64814	CP	XRC Time-stamping Support
VM64807	EREP	EREP support for zEnterprise 196
VM64672	HCD	HCD support for zEnterprise 196

APAR	Component	Description
VM64774	CP	Set/Query reorder command
VM64747	HCM	HCM support for zEnterprise 196
VM64799	CMS	IOCP support for zEnterprise 196
VM64891	CP	HIPER data corruption issue in VM64709, EAV support

Because support for HCD and HCM was not necessary for the system used in the examples in this book, only the PTFs for the following APARs were ordered from ShopzSeries: VM64774, VM64798, VM64879, VM64881, VM64793, VM64820, VM64814, VM64807, VM64799, VM64818, and VM64891.

5.2.1 Ordering service for the zEnterprise 196 PTFs

This section briefly describes how to order PTFs for the zEnterprize 196.

Perform the following steps:

1. Follow the steps in 5.1.1, “Getting service from the Internet” on page 75, up to the point where you click **z/VM - Service** on the My orders page.
2. Rather than clicking RSU Recommended Service Upgrade in the drop-down menu to the right, accept the default of **Individual PTFs**. Click **Continue**.
3. In Step 1 of 5, select **Individual PTFs by APAR number** as shown in Figure 5-2. Click **Continue**.

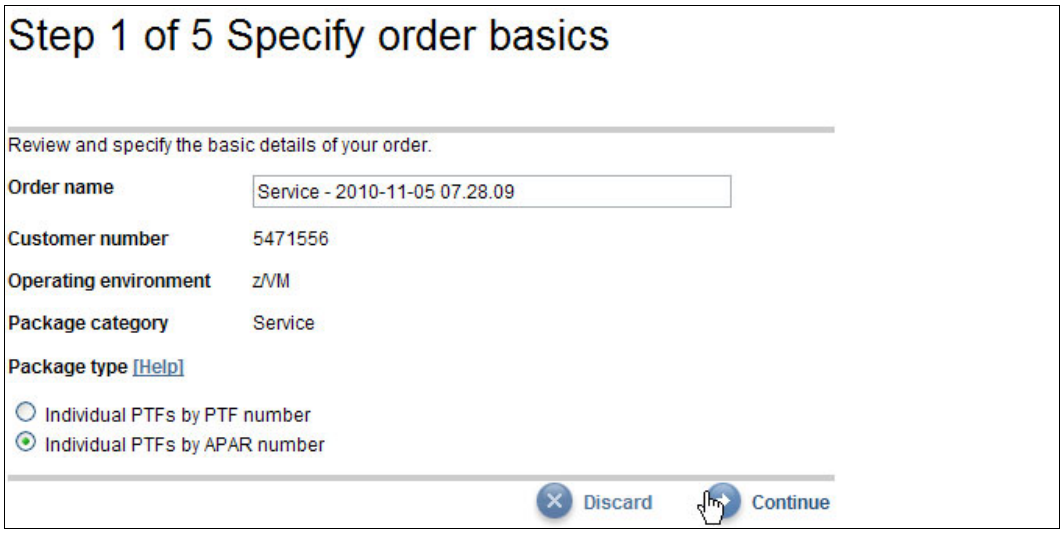


Figure 5-2 Ordering PTFs by APAR number

4. In Step 2 of 5, accept the default of **Do not use a report for this order** and click **Continue**.

5. In Step 3 of 5, enter the APAR numbers as shown in Figure 5-3.

Figure 5-3 Specifying service order contents

6. In Step 4 of 5, specify your delivery options. In this example, **Internet** was chosen as the preferred media, and no alternate method was chosen. Click **Continue**.
7. In Step 5 of 5, review your order and click **Submit** when it is correct.
8. You can leave that web page up and click **Refresh order status** from time to time. It should move from Submitted to Received to Final Packaging to becoming a link named `Download`.
9. Click **Download** when it becomes available. You should see a window similar to what is shown in Figure 5-4.

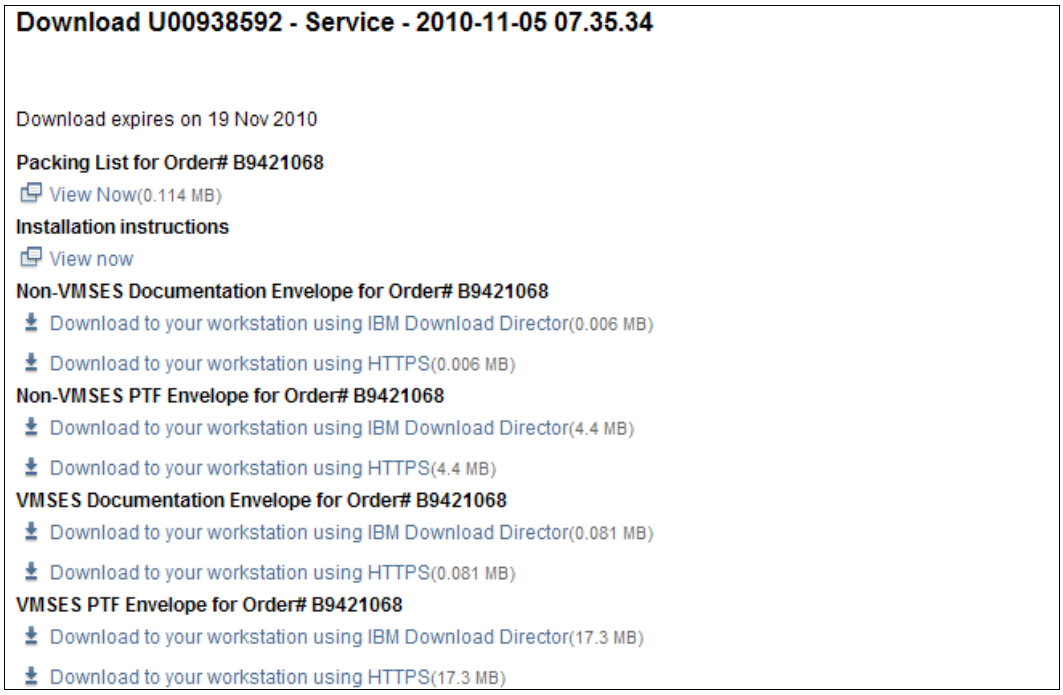


Figure 5-4 Downloading service for zEnterprise 196 PTFs

10. Download the two documentation envelopes and the two PTF envelopes to your workstation or other staging system.
11. Complete the steps in a similar fashion to those starting at 5.1.2, “Downloading the service files” on page 76. This completes the process of applying the SES PTFs (with file types ending in `S`).
12. Refer to the following section to apply the non-SES PTF (with file types ending in `N`).

You may consider performing a SHUTDOWN REIPL command at this point, or wait until after you finish the next section.

5.2.2 Applying the non-SES PTF UV61111

At the time of the writing of this book, PTF UV61111 corresponded to APAR VM64807. This PTF is non-SES, which means it cannot be applied using the typical SERVICE ALL and PUT2PROD commands.

Perform the following steps:

1. After you get the PTF from ShopzSeries, copy it to the MAINT 500 disk in binary fixed 1024 byte record format. In the previous example, four files with a file name of `S9421068` were uploaded to the MAINT 500 disk. The one with a file type of SHIPTFSS was extracted to a new file type of SERVLINK and applied with SERVICE ALL and PUT2PROD.
2. Access the MAINT 500 disk as C:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
```

3. List the files that you uploaded. In this example, the file name is ***S9421068***:

```
==> filel S9421068 * c
MAINT    FILELIST A0  V 169  Trunc=169 Size=5 Line=1 Col=1 Alt=0
Cmd   Filename Filetype Fm Format Lrecl    Records     Blocks   Date     Time
      S9421068 SERVLINK C1 V       4005      18865      14243 11/05/10 13:52:19
      S9421068 SHIPTFSS C1 F       1024      17686       4422 11/05/10 13:04:43
      S9421068 SHIPTFSN C1 F       1024       4466       1117 11/05/10 13:04:37
      S9421068 SHIPDOCS C1 F       1024         83         21 11/05/10 13:04:28
      S9421068 SHIPDOCN C1 F       1024          6          2 11/05/10 13:04:25
```

   The two files in bold are non-SES, identified by a trailing `N`.

4. Extract the object code file to a file with a type of NOSESLNK and the documentation file to a file with a type of NOSESDOC. This can be done directly from FILELIST with the following DETERSE commands:

```
      S9421068 SERVLINK C1 V       4005      18865      14243 11/05/10 13:52:19
      S9421068 SHIPTFSS C1 F       1024      17686       4422 11/05/10 13:04:43
deterse / = noseslnk =  C1 F       1024       4466       1117 11/05/10 13:04:37
      S9421068 SHIPDOCS C1 F       1024         83         21 11/05/10 13:04:28
deterse / = nosesdoc =  C1 F       1024          6          2 11/05/10 13:04:25
```

5. Press F3 to get out of FILELIST.
6. Perform the following VMFPLCD command:

```
==> vmfplcd scan env= s9421068 noseslnk c (disk date eod
```

7. This should create the file `DISK MAP` on your `A` disk. Edit the file and view the lines by running the following commands:

```
==> x disk map
====> pre off
====> ALL /ERPTFLIB
 ERPTFLIB TLB61111 U1               F         80      22266  08/24/10 16:46:32
 ERPTFLIB TLB60820 U1               F         80      21911  09/29/03 20:02:53
 ERPTFLIB TLB60786 U1               F         80      21882  03/26/03 16:57:52
 ERPTFLIB TLB60432 U1               F         80      21791  06/01/99 09:18:46
 ERPTFLIB TLB60345 U1               F         80      19312  12/10/98 11:28:23
```

   Note that the most recent file has a date of 2010 and the last five digits of the file type correspond to the last five digits of the PTF.

8. The EREP program directory states that just one file needs be copied. Perform the following VMPLCD commands to do this:

```
==> vmfplcd rst
==> vmfplcd load erptflib tlb61111 a (eod
Loading ...
 End-Of-Group OR End-Of-Disk
 ERPTFLIB TLB61111 A1
```

9. Access the MAINT 201 disk as file mode Z, back up the old EREP TXTLIB and replace it with the new one on the A disk:

```
==> acc 201 z
==> rename erptflib txtlib z erptflib tlbold z
==> copy erptflib tlb61111 a erptflib txtlib z (replace
```

10. A SHUTDOWN REIPL is not necessary. However, if you did not do one in the previous section, one is recommended now. Otherwise, the EREP virtual machine can just be recycled with the FORCE and XAUTOLOG commands:

```
==> force erep
USER DSC   LOGOFF AS  EREP     USERS = 11    FORCED BY MAINT
==> xautolog erep
Command accepted
AUTO LOGON  ***       EREP     USERS = 12
HCPCLS6056I XAUTOLOG information for EREP: The IPL command is verified by the
IP
L command processor.
```

You should now have all the service needed for the zEnterprise 196.

5.2.3 Verifying that the zEnterprise 196 service is applied

A short REXX EXEC is written and run to verify that service for the zEnterprise 196 has been applied:

```
==> type check910 exec

/* EXEC to check for z196 PTFs */
'service cp status VM64774'
'service cp status VM64798'
'service cp status VM64879'
'service cp status VM64881'
'service cp status VM64793'
'service perftk status VM64820'
```

```
'service cp status VM64814'
'service cms status VM64799'
'service cp status VM64818'

==> check910
VMFSRV2760I SERVICE processing started
VMFSRV1226I CP (6VMCPR10%CP) APAR VM64774 (PTF UM33169) status:
VMFSRV1226I    RECEIVED  11/05/10 13:52:51
VMFSRV1226I    APPLIED   11/05/10 13:52:52
VMFSRV1226I    BUILT     11/05/10 13:53:57
VMFSRV1226I    PUT2PROD  11/05/10 13:55:55
VMFSRV2760I SERVICE processing completed successfully
...
```

Verify that all of the APARs are reported as received, applied, built, and put into production.

5.3 Determining the z/VM service level

Often, you will want to be able to query more than just the service level. The following steps were taken from the links CP Maintenance Levels and Virtual Switch TCP/IP Maintenance Levels starting at the website:

http://www.vm.ibm.com/virtualnetwork/

Perform the following steps:

1. Log on to TCPMAINT. Use the QUERY VMLAN command to determine the latest APAR applied:

   ```
   ==> cp query vmlan
   VMLAN maintenance level:
     Latest Service: VM64604
   VMLAN MAC address assignment:
     MACADDR Prefix: 020003
     MACIDRANGE SYSTEM: 000001-FFFFFF
                USER:   000000-000000
   VMLAN default accounting status:
     SYSTEM Accounting: OFF       USER Accounting: OFF
   VMLAN general activity:
     PERSISTENT Limit: INFINITE   Current: 1
     TRANSIENT  Limit: INFINITE   Current: 0
   ```

   This shows that the latest APAR applied is VM64604.

2. The maintenance level of the TCP/IP stack is important to virtual networking. To determine this, first get the active VSWITCH controller:

   ```
   ==> q vswitch
   VSWITCH SYSTEM VSW1     Type: VSWITCH Connected: 0    Maxconn: INFINITE
     PERSISTENT  RESTRICTED    NONROUTER                 Accounting: OFF
     VLAN Unaware
     MAC address: 02-00-03-00-00-01
     State: Ready
     IPTimeout: 5         QueueStorage: 8
     Isolation Status: OFF
     RDEV: 1004.P00 VDEV: 1004 Controller: DTCVSW1
     RDEV: 1100.P00 VDEV: 1100 Controller: DTCVSW2  BACKUP
   ```

This shows the controller is named DTCVSW1.

3. Use the NETSTAT command with the controller name to determine the maintenance of the TCPIP MODULE:

```
==> netstat tcp dtcvsw1 level
VM TCP/IP Netstat Level 540       TCP/IP Server Name: DTCVSW1

IBM 2084; z/VM Version 5 Release 4.0, service level 0903 (64-bit), VM TCP/IP
Lev
el 540; RSU 0903 running TCPIP MODULE E2 dated 12/17/09 at 10:53
TCP/IP Module Load Address:  00C21000
```

4. This shows information about the TCPIP MODULE. Use the TCPSLVL command and the complete file specification (TCPIP MODULE E in this example) to get more information. Of particular interest is the latest APAR applied to TCTOOSD:

```
==> tcpslvl tcpip module e
DTCLVL3306I SLVL data obtained; file TCPIP SLVLDATA A created
==> x TCPIP SLVLDATA
SLVL  TCPIP PK67610
...
SLVL  TCTOOSD PK98608
...
```

5.4 Applying a PTF

You may determine that you need to apply a specific fix or PTF to your system. For example, an Authorized Program Analysis Report (APAR), VM64670, was opened when Linux guests were hanging intermittently. The summary of the APAR is as follows:

```
PROBLEM SUMMARY:     LINUX USER HUNG BECAUSE SVPBK LOCK HELD
USERS AFFECTED:      All users of z/VM running Linux guests.
PROBLEM DESCRIPTION: Linux guests may become hung due to a problem in managing a
lock word.  This problem is timing-related and may occur intermittently.
PROBLEM CONCLUSION:  Lock word processing in HCPWED is updated to properly handle
all possible states of the lock.
```

The APAR was assigned the following Programming Temporary Fix (PTF) numbers for each of the following z/VM releases:

z/VM V5.3	UM32809
z/VM V5.4	UM32810
z/VM V6.1	UM32811

So for z/VM V6.1, you want to apply PTF UM32811. The next section shows how to perform that task.

5.4.1 Getting service using ShopzSeries

Service for z/VM is still available on the media of tape. However, getting service over the Internet is more convenient and becoming more common. Typically this is done with IBM ShopzSeries. Perform the following steps:

1. Click the link **IBM ShopzSeries** under the IBM Support Portals heading on the main Service page, as shown in Figure 5-1 on page 74. This should take you to the following address:

   `https://www14.software.ibm.com/webapp/ShopzSeries/ShopzSeries.jsp`

2. From there you can search for an APAR if you have the APAR number. In Figure 5-5, the first three steps to do this are shown:

   a. On the menu bar at the top, click **Support and Downloads**, then choose **Search** in the drop-down menu. This is shown at the top of the figure.

   b. In the Support type menu, choose **System z** and in the Search text area, type the APAR number, VM64670 in this example. This is shown in the middle of the figure.

   c. If the APAR is found, you should see a link as a result. Click that link, **VM64670: LINUX USER HUNG**..., in this example. This is shown at the bottom of the figure.

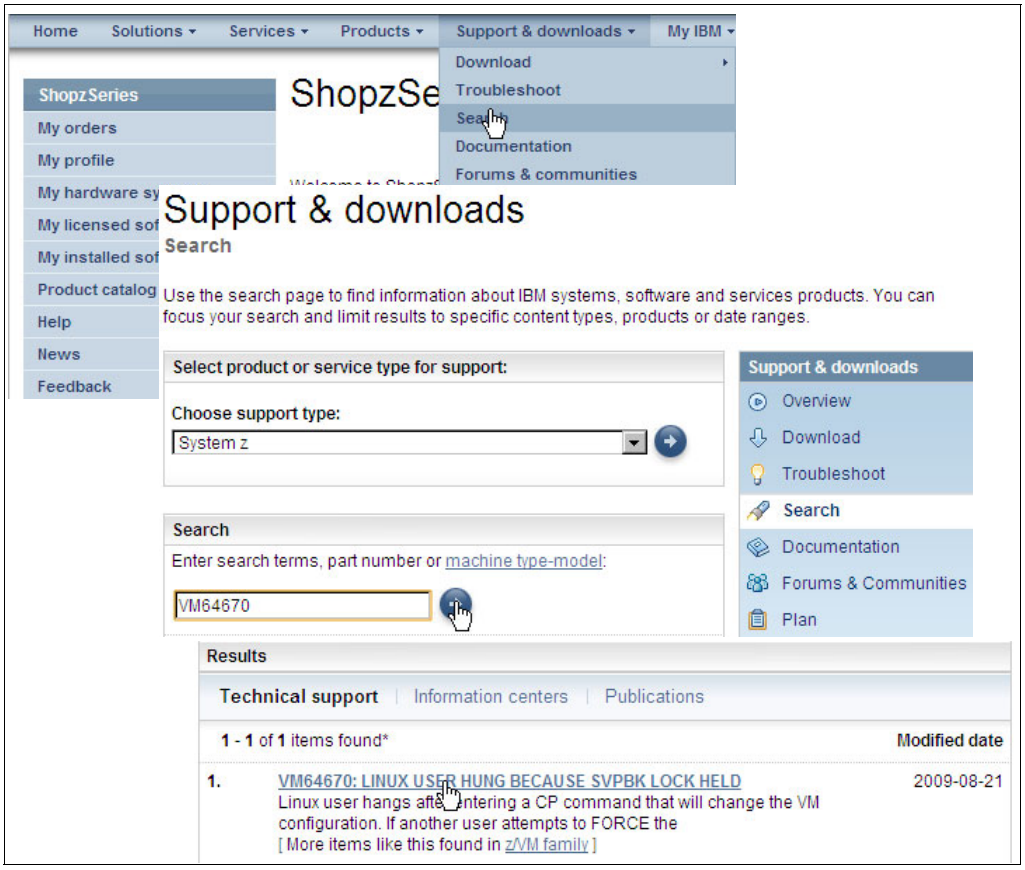
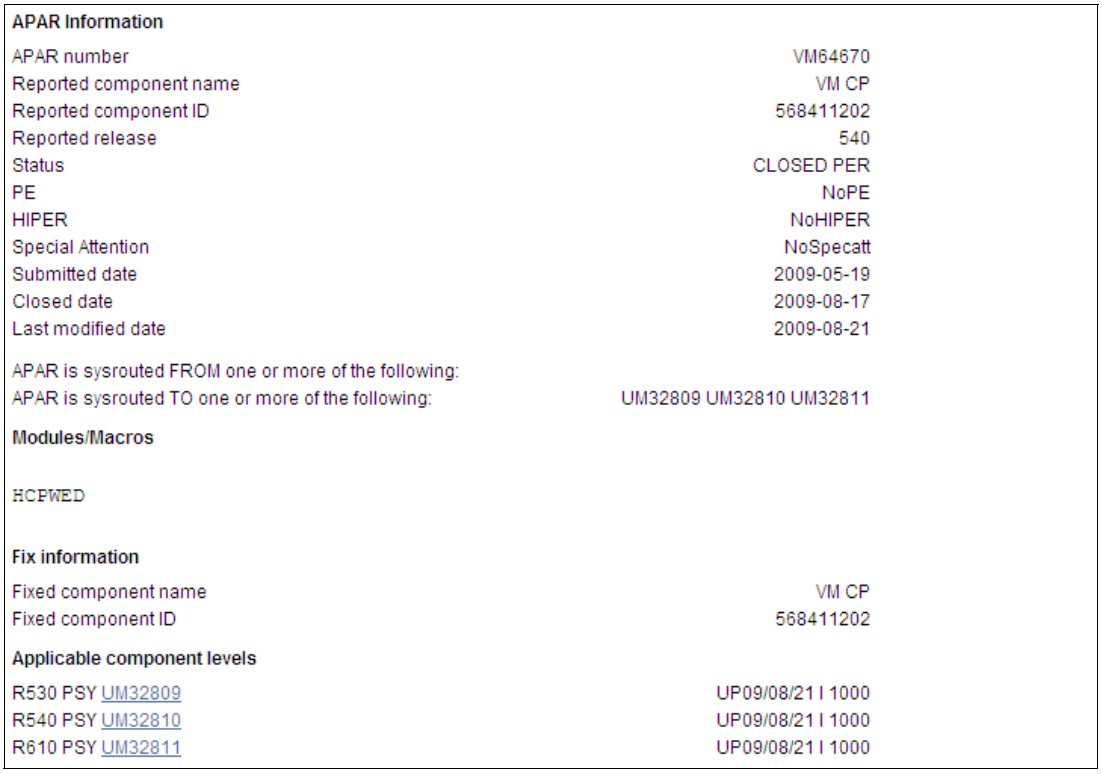


Figure 5-5 Searching for a PTF on ShopzSeries

Clicking the link should bring you to the APAR. In this example, you should find the information about APAR VM64670 that was summarized previously. At the top of the page, look for the section “A fix is available.” In this example, there is a fix available.

Farther down the page, note the Fixed component name, which is important. In this example it is `VM CP` shown near the bottom of Figure 5-6.



APAR Information

APAR number	VM64670
Reported component name	VM CP
Reported component ID	568411202
Reported release	540
Status	CLOSED PER
PE	NoPE
HIPER	NoHIPER
Special Attention	NoSpecatt
Submitted date	2009-05-19
Closed date	2009-08-17
Last modified date	2009-08-21
APAR is sysrouted FROM one or more of the following:	
APAR is sysrouted TO one or more of the following:	UM32809 UM32810 UM32811

Modules/Macros

HCPWED

Fix information

Fixed component name	VM CP
Fixed component ID	568411202

Applicable component levels

R530 PSY UM32809	UP09/08/21 I 1000
R540 PSY UM32810	UP09/08/21 I 1000
R610 PSY UM32811	UP09/08/21 I 1000

Figure 5-6 Web page for APAR VM64670

At the bottom of the page the “Applicable component levels” section shows that PTF UM32811 is available for z/VM V6.1. Before getting that PTF, you may want to be sure that it has not already been applied.

5.4.2 Determining whether a PTF has been applied

Check to make sure that the PTF has not previously been applied. In this example it is known that the PTF is UM32811 and the component is VM CP.

Because the description of the PTF cites a component name of VM CP, the component CP is used in the following command. Use the SERVICE command to query whether the PTF has been applied:

```
==> service cp status um32811
VMFSRV2760I SERVICE processing started
VMFSRV1227I UM32811 is not received or applied to CP (6VMCPR10%CP)
VMFSRV2760I SERVICE processing completed successfully
```

This shows that PTF UM32811 has *not* been applied. The sections that follow describe how to obtain and apply it.

5.4.3 Downloading the service to z/VM

Perform the following steps:

1. From the previous APAR web page search, the link for UM32811 is clicked, which results in a web page that should be similar to the one shown in Figure 5-7.

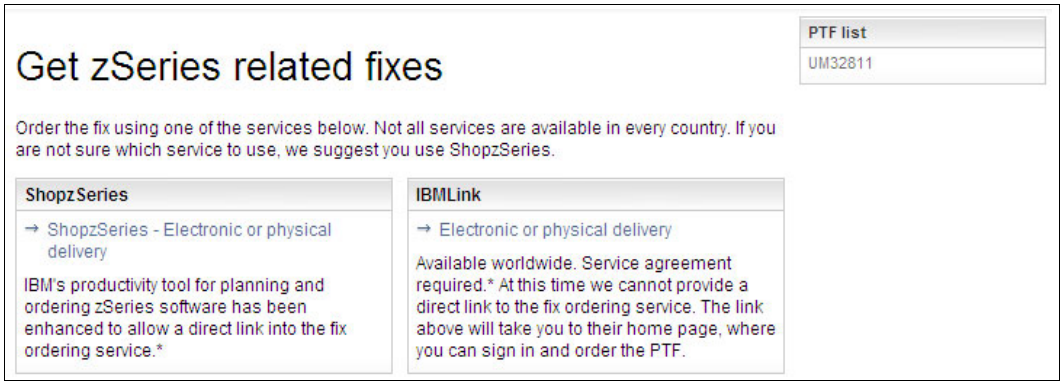


Figure 5-7 Getting fixes from ShopzSeries on IBMLink

2. In this example, the link **ShopzSeries - Electronic or physical delivery** is selected. Sign into ShopzSeries with your IBM ID and follow the five self-explanatory steps to order your PTF. When you are finished, click **Submit** to place your order.
3. You should receive an email within a few minutes. It will have your order number and a link to start the download of service files. Following is an example of the important information in the email:

```
From:    Oms Client01/Boulder/IBM
Subject: IBM Order <Bxxxxxxx> is ready for download.
...
To access your order directly, go to:
https://www14.software.ibm.com/webapp/ShopzSeries/ShopzSeries.jsp?action=downlo
ad&orderId=<Uxxxxxxxd>0
```

4. Point your browser to the link in the email. You should see a web page similar to the one shown in Figure 5-8.

Figure 5-8 Web page created for downloading a PTF

5. Choose a method of downloading the VMSES PTF Envelope for your order to your desktop machine. You may also choose to download the VMSES Documentation Envelope.
6. There should be a SES envelope (the PTF or PTFs themselves) and a documentation envelope. Copy both to z/VM in binary with fixed 1024-byte records to the MAINT 500 disk. Usually, FTP is used. The PTF envelope files can be large, so this may take some time. As you are downloading the files, note the file sizes. Following is an example of FTPing from a DOS session:

```
C:\downloads> ftp 9.60.18.249
User (9.60.18.249:(none)): maint
Password:
...
ftp> cd maint.500
...
ftp> bin
...
ftp> quote site fix 1024
...
ftp> mput s8873674.*
mput S8873674.SHIPDOCS? y
...
ftp: 6144 bytes sent in 0.05Seconds 130.72Kbytes/sec.
mput S8873674.SHIPTFSS? y
...
ftp: 4096 bytes sent in 0.01Seconds 273.07Kbytes/sec.
ftp> quit
```

7. Log on to z/VM as MAINT.

8. Access the MAINT 500 disk as C:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
```

9. The envelope files arrive in a compressed format to speed downloads. In order to use them they must first be renamed to have a file type of SERVLINK and uncompressed with the DETERSE command. Therefore, we recommend to leave the file name of the SES envelope unchanged, but to change the prefix letter of the documentation envelope to D. First rename them, then use the DETERSE command with the (REPLACE parameter to uncompress them in place and save disk space:

```
==> rename s8873674 shipftss c = servlink =
==> rename s8873674 shipdocs c d8873674 servlink =
==> deterse s8873674 servlink c = = = (replace
==> deterse d8873674 servlink c = = = (replace
```

Be sure all commands complete successfully.

5.4.4 Receiving, applying, and building service

You must receive, apply, and build the PTF. Then it can be put into production. This can be done in a process that is much easier now with the SERVICE command.

To prepare to use the SERVICE command, you must have a minidisk with a lot of free space (that is what the MAINT 500 minidisk is for).

Perform the following steps:

1. Access the MAINT 500 disk as file mode C:

```
==> acc 500 c
DMSACC724I 500 replaces C (2CC)
```

2. Use the SERVICE ALL command specifying the envelope files you downloaded. Many, many windows of output will scroll by and will automatically be cleared. Important messages will be saved to the 500 disk. This process may take many minutes. Following is an example:

```
==> service all d8873674
...
VMFSUT2760I VMFSUFTB processing completed successfully
VMFSRV2760I SERVICE processing completed successfully
==> service all s8873674
...
VMFSUT2760I VMFSUFTB processing completed successfully
VMFSRV2760I SERVICE processing completed successfully
```

If you see no number in parenthesis after the Ready; prompt, then the return code is 0. Any non-zero return code will be in parenthesis. A return code of 0 is ideal. In general a return code of 4 is acceptable. It means that only warnings were issued. A return code of 8 or greater generally means that errors were encountered.

3. The output files are of the form $VMF* $MSGLOG. You may want to inspect these files:

```
==> filel $vmf* $msglog
      $VMFSRV  $MSGLOG  A1 V         80        728          14 12/15/09 13:43:34
      $VMFBLD  $MSGLOG  A1 V         80        787          11 12/15/09 13:41:47
      $VMFAPP  $MSGLOG  A1 V         80        252           4 12/15/09 13:41:37
      $VMFREC  $MSGLOG  A1 V         80         56           1 12/15/09 13:41:36
      $VMFMRD  $MSGLOG  A1 V         80        231           4 12/15/09 13:41:35
```

```
$VMFP2P  $MSGLOG  A1 V         80        805         15 11/19/09 13:52:09
$VMFINS  $MSGLOG  A1 V         80        163          3 11/19/09 13:47:25
```

4. Invoke the VMFVIEW SERVICE command to review the results of the previous SERVICE command. Press the F3 key to quit. Here is an example:

```
==> vmfview service
===> VMFVIEW - Message Log Browse of $VMFSRV  $MSGLOG  A1 <===
You are viewing ¬ST: messages from the LAST run.
Number of messages shown = 1 <===> Number of messages not shown = 3
********************************************************************************
****             SERVICE               USERID: MAINT                 ****
********************************************************************************
****            Date: 12/15/09            Time: 13:43:34            ****
********************************************************************************
====> F3
```

Ideally there will be no output. If there are errors, they must be addressed. If there are warnings, they may be acceptable but should be investigated.

5.4.5 Putting the service into production

To put the service into production, perform the following steps:

1. Use the PUT2PROD command to put the service into production:

```
==> put2prod
...
VMFP2P2760I PUT2PROD processing completed successfully
```

   Again, watch for a return code of 0.

2. Your PTF should now be *put into production*. You may or may not have to perform an IPL of the system, depending on the nature of the PTF applied. If you are in a position to perform an IPL of your system, it may be safest to perform the IPL using the SHUTDOWN REIPL command to completely test the changes:

```
==> shutdown reipl iplparms cons=sysc
SYSTEM SHUTDOWN STARTED
...
```

3. Your z/VM system should come back in a few minutes. When the system comes back, start a 3270 session to MAINT and again query the status of the PTF:

```
==> service cp status um32811
VMFSRV2760I SERVICE processing started
VMFSRV1226I CP (6VMCPR10%CP) PTF UM32811 status:
VMFSRV1226I    RECEIVED  12/15/09 13:41:36
VMFSRV1226I    APPLIED   12/15/09 13:41:37
VMFSRV1226I    BUILT     12/15/09 13:42:14
VMFSRV1226I    PUT2PROD  12/15/09 13:47:59
VMFSRV2760I SERVICE processing completed successfully
```

This shows that the PTF has been successfully applied.

5.4.6 Checking for APARMEMO files

After you have applied the PTFs, you should check for files with a file type of APARMEMO on the MAINT 500 disk. These files may have additional instructions on work to do after the PTFs have been applied. Perform the following steps:

1. Access the MAINT 500 disk as C and list the files with file type APARMEMO:

```
==> acc 500 c
==> listfile * aparmemo c
6VMCMS10 APARMEMO C1
```

   In this example, there is one APARMEMO file.

2. Look at the contents of the file:

```
==> type 6vmcms10 aparmemo c

APAR MEMOS      01/26/10.12:50:20
================================

        THE FOLLOWING MEMOS WERE INCLUDED WITH THE PTFS SHIPPED:

        NONE.
```

In this example, the APARMEMO file was created, but no additional memorandums are present.

You will not see any new information in the APARMEMO file if you have not run SERVICE against the documentation SERVLINK file. This is because the <prodid> MEMO file is in the documentation SERVLINK file.

6

Configuring an NFS/FTP server

A common method of installing Linux on z/VM on a server is over the network from another server using the Network File System (NFS). To accomplish this task, you should use a PC system that has Linux installed on it. This server supplies both the RHEL 6 distribution and the files associated with this book. The server must have at least 4 GB of free disk space. It can be a Linux PC, but it can also be a UNIX box (Sun Solaris, Hewlett Packard HP-UX, IBM AIX®, or other). You can also choose to use a Windows workstation with FTP or HTTP, if you absolutely must. Often, more problems are encountered when using a Windows workstation than a Linux or UNIX workstation to serve the RHEL 6 install tree, so this choice is not recommended.

The steps in this chapter explain how to configure a PC Linux box as the NFS server. The *Red Hat Installation Guide for the IBM S/390 and IBM System z Architectures* manual provides additional information about the installation options, and can be found at the following address:

`http://www.redhat.com/docs/manuals/enterprise/`

In addition to being an NFS server for Linux installation, this system can also be used as an FTP server for z/VM installation. If this is the case, the steps in 6.5, “Configuring an FTP server for z/VM installation” on page 102 must be completed before completing the steps in Chapter 4, “Installing and configuring z/VM” on page 27.

The following tasks will set up a Linux server:

- “Installing Linux on the PC” on page 98
- “Downloading the files associated with this book” on page 98
- “Setting up a RHEL 6 installation tree” on page 98
- “Enabling the NFS server” on page 100
- “Configuring an FTP server for z/VM installation” on page 102

6.1 Installing Linux on the PC

If you do not have a Linux PC, then you must get access to a PC in the network and install Linux onto it. Describing that installation is outside the scope of this book. However, installing the same distribution onto a PC server on which you plan to install IBM System z is recommended. Doing so will give you practice with the installation process and will give you a reference system that may be helpful in understanding the differences between the Intel® (i386, i686) and System z (s390x) architectures. In this chapter, a PC running RHEL 6 is used.

6.2 Downloading the files associated with this book

This book has files associated with it that make the task of customizing and cloning your virtual servers easier. The TAR file can be found at the following address:

`http://www.vm.ibm.com/devpages/mikemac/SG247932.tgz`

Perform the following steps:

1. The `virt-cookbook-RH6.tgz` TAR file is only about 24 KB. Download the file and extract it. The following example shows the extracted files being place into the newly created `/nfs/` directory:

```
# mkdir /nfs
# cd /nfs
... download or copy the file SH247932.tgz to /nfs/ ...
# tar xzf SG247932.tgz
```

2. List the files in the new `virt-cookbook-RH6/` directory:

```
# cd virt-cookbook-RH6
# ls
README.txt  clone-1.0-10.s390x.rpm  disclaimer.txt  vm/
```

The `README.txt` file briefly describes each of the files and the one directory. You may want to briefly view that file.

You now have downloaded and uncompressed the files associated with this book.

6.3 Setting up a RHEL 6 installation tree

You must have a valid Red Hat entitlement for Linux on IBM System z to access the Red Hat Enterprise Linux 6 ISO images. If you do not have one, you can request a no cost 180-day evaluation copy at the following address:

`http://www.redhat.com/z`

Click the **Free Evaluation** link on the left and complete the online form. If you do not have a Red Hat login ID, you will need to create one by clicking the **Register and Continue** button. Otherwise, enter your Red Hat login and password, then click **Log In** to continue. After completing the form, you will automatically receive an email with instructions about how to access the Red Hat Network (RHN), where you can download the installation discs, at the following address:

`https://rhn.redhat.com`

You can also click the **Contact Sales** link at the left of the page or call 1-888-733-4281.

6.3.1 Copying from physical CDs or a DVD

RHEL 6 is distributed on physical CDs or files that are ISO images of CDs. RHEL 6 is also distributed on a single physical DVD disc as a single ISO image. It is easier to work with a single DVD ISO image than to work with multiple CD ISO images, so this approach is recommended.

In the event that you have a physical DVD, but not an ISO image, you should create an ISO image. You could skip creating the ISO image and copy the data directly from the DVD to the installation tree, but creating the ISO image is recommended so you have a reference file.

Be sure your PC has a DVD drive, not just a CD drive (if you have a PC that only has a CD drive, you can create ISO images of the CDs, but this task is not described in this book). Put the DVD in the tray and use the **dd command** to create the ISO image. The device file named `/dev/cdrom` is often associated with the CD/DVD drive, but your device file name may be different. If so, you must determine the correct name.

Run these commands only if you are starting with a physical DVD disc:

```
# cd /nfs
# dd if=/dev/cdrom of=rhel-6-server-s390x-dvd.iso
# umount /mnt/cdrom
```

You should now have an ISO image of the DVD.

6.3.2 Verifying the ISO image

An important early step is to verify the integrity of DVD ISO image. This is done by comparing the checksum value that was calculated when the DVD was created against a checksum value calculated against your ISO image. If the two checksum values differ, then there was an error somewhere in the copying process.

The **md5sum** command allows you to compare checksum files. The checksum value for RHEL 6 for the s390x architecture is as follows:

```
# cat MD5SUM
9d7aac4bb79db67b1add308be7019760
```

Run the **md5sum** command against the `MD5SUM` file:

```
# md5sum -c MD5SUM
rhel-server-6.0-s390x-dvd.iso: OK
```

Important: Your `MD5SUM` file may have checksum values for the DVD *and* the CD ISO images. If this is true and you only have one DVD ISO image, **md5sum** will generate errors similar to the following form:

```
md5sum: rhel-server-6.0-s390x-dvd.iso: No such file or directory
rhel-server-6.0-s390x-dvd.iso: FAILED open or read
```

This is not a problem as long as the DVD ISO image is reported as `OK`.

If the ISO image does not report `OK`, it must be downloaded or copied again until it does.

6.3.3 Copying the DVD contents

Copy the contents of the ISO image to the file system. Temporarily mount it on a new `tmp/` directory using a loopback device:

```
# cd /nfs
# mkdir tmp
# mount -o loop rhel-server-6.0-s390x-dvd.iso tmp
```

List the contents of the mounted ISO image:

```
# ls tmp
EULA            README-pa.html         RELEASE-NOTES-ml.html
eula.en_US      README-pt_BR.html      RELEASE-NOTES-mr.html
generic.ins     README-ru.html         RELEASE-NOTES-or.html
...
```

Make a new directory, `/nfs/rhel6/`, and recursively copy the contents of the DVD to it with the **`cp -a`** command. This will take a number of minutes to complete. Then unmount `tmp/`:

```
# cp -a tmp/* rhel6/
# umount tmp
```

Important: With RHEL 5, building a new repository for yum was necessary. With RHEL 6, this step should not be necessary, as the repository on the ISO image is correct. However, this short section from the previous book is left here for reference, should you need to build a repository.

For the **`yum`** command to work, a common metadata repository must be built with the **`createrepo`** command. There is a sample repository in the `Server/repodata/` directory. The group XML file named `comps-rhel5-server-core.xml` should be used to create group information:

```
# cd /nfs/rhel5/Server/
# mv repodata/ repodata.orig
# createrepo -g repodata.orig/comps-rhel5-server-core.xml .
2495/2495 - junit-javadoc-3.8.2-3jpp.1.s390x.rpm
Saving Primary metadata
Saving file lists metadata
Saving other metadata
```

The newly created repodata/ directory contains the correct common metadata.

6.4 Enabling the NFS server

The method of enabling an NFS server will differ depending upon the operating system. However, the steps are basically the same:

- Export the appropriate directories.
- Start the NFS server in the current run level.

The directories to export with NFS are in the `/etc/exports` configuration file. Export the `/nfs/rhel6/` directory to make the installation tree available and `/nfs/virt-cookbook-RH6/` to make the files associated with this book available. First, make a backup copy of the file. Then edit the original copy and add the two directories as follows:

```
# cd /etc
# cp exports exports.orig
# vi exports       // add two lines
/nfs/rhel6             *(ro,sync)
/nfs/virt-cookbook-RH6 *(ro,sync)
```

The *(ro,sync) parameter specifies that any client with access to this server can get the NFS mount in read-only mode. You may want to be more restrictive than allowing any client (with the “*”) for security reasons. Type **`man exports`** for more details.

Set the NFS server to start with the **`chkconfig`** command and start it on the current session with the **`service nfs start`** command:

```
# chkconfig nfs on
# chkconfig --list nfs
nfs             0:off   1:off   2:on    3:on    4:on    5:on    6:off
# service nfs start
Starting NFS services: [ OK ]
Starting NFS quotas: [ OK ]
Starting NFS daemon: [ OK ]
Starting NFS mountd: [ OK ]
```

Your NFS server should now be running with the directory exported. You should test this configuration by mounting the exported directory locally. The following example shows that the `/mnt/` directory is empty. Then the newly exported `/nfs/` directory is mounted and the files are listed.

```
# mkdir /mnt/tmp
# mount localhost:/nfs/rhel6/ /mnt/tmp
# ls -F /mnt/tmp
EULA            README-or.html          RELEASE-NOTES-ja.html
eula.en_US      README-pa.html          RELEASE-NOTES-ko.html
generic.ins     README-pt_BR.html       RELEASE-NOTES-ml.html
GPL             README-ru.html          RELEASE-NOTES-mr.html
images/         README-si.html          RELEASE-NOTES-or.html
...
```

The output shows that the RHEL 6 installation tree is accessible through NFS. Now unmount it and test the `virt-cookbook-RH6/` directory:

```
# umount /mnt/tmp
# mount localhost:/nfs/virt-cookbook-RH6 /mnt/tmp
# ls -F /mnt/tmp
clone-1.0-9.s390x.rpm  README.txt  vm/
# umount /mnt/tmp
```

You should now be able to use this server as the source of a RHEL 6 mainframe Linux installation. Later, you will be able to copy the installation tree to a System z Linux virtual server.

6.5 Configuring an FTP server for z/VM installation

This section assumes that you have access to the z/VM V6.1 installation code in electronic format. Ordering it through ShopzSeries is briefly described in 4.1.1, “Obtaining z/VM through electronic download” on page 28. If you have completed that section, you may have the two z/VM product install files staged on a intermediate workstation, or you may be ready to download them from the Internet.

6.5.1 Preparing the z/VM product installation files

The two compresed files correspond to the first (larger) z/VM product DVD and to the second (smaller) second DVD (the RSU). The contents of these files must be copied to the directory on the FTP server. To accomplish this task, perform the following steps:

1. Create a target directory. In this example, the `/ftp/zvm61/` directory is used:

   ```
   # mkdir -p /ftp/zvm61
   ```

2. Set the group ownership of this directory, recursively, to `ftp`. This will allow the FTP daemon, which runs as the user `ftp`, to change to that directory:

   ```
   # chgrp -R ftp /nfs/zvm61
   ```

3. Either upload the two z/VM installation compressed files from the intermediate workstation, or download them directly from the Internet. The following example shows copying them from an intermediate workstation using a Windows DOS session to the FTP server at IP address 9.60.18.233 into the `/ftp/zvm61/` directory. We use the **`pscp`** command (Putty scp):

   ```
   C:>pscp *.zip root@9.60.18.233:/ftp/zvm61
   ...
   cd813250.zip              | 1247495 kB | 303.2 kB/s | ETA: 00:00:00 | 100%
   CD813270.ZIP              | 44031 kB | 352.3 kB/s | ETA: 00:00:00 | 100%
   ```

4. List the newly copied files:

   ```
   # cd /ftp/zvm61
   # ls -l
   total 1291532
   -rw-r--r--. 1 root root 1277435798 Nov 11 14:08 cd813250.zip
   -rw-r--r--. 1 root root   45088210 Nov 11 14:06 CD813270.ZIP
   ```

5. Extract the files from DVD1, the larger file, using the **`unzip`** command. This action creates the `cpdvd/` directory:

   ```
   # unzip cd813250.zip
   Archive:  cd813250.zip
      creating: cpdvd/
     inflating: cpdvd/610GANUC
     inflating: cpdvd/610GARAM
   ...
   ```

6. Extract the files from the RSU DVD2. When prompted to replace files, respond with `A` for all:

   ```
   # unzip CD813270.ZIP
   Archive:  CD813270.ZIP
     inflating: cpdvd/610rsu.dvdimage
     inflating: cpdvd/61ckdrsu.srl
     inflating: cpdvd/61fbarsu.srl
   replace cpdvd/CKD50000? [y]es, [n]o, [A]ll, [N]one, [r]ename: A
   ```

```
  inflating: cpdvd/CKD50000
  ...
```

You should now have all the z/VM product installation files in place under the `/ftp/zvm61/cpdvd/` directory.

6.5.2 Installing and configuring the FTP server

An FTP server must be installed and configured. The vsftpd FTP server is recommended. This section shows how to configure it as an anonymous FTP server. To accomplish these tasks, perform the following steps:

1. Use the **`rpm -qa`** command to see if the RPM is installed:

   ```
   # rpm -qa | grep ftpd
   ```

2. The output shows that it is not installed. Use the **`yum -y`** command to install the package:

   ```
   # yum -y install vsftpd
   Loaded plugins: rhnplugin
   This system is not registered with RHN.
   ...
   Installed:
     vsftpd.s390x 0:2.2.2-6.el6
   ```

3. Make a backup of the `/etc/vsftpd/vsftpd.conf` vsftpd configuration file:

   ```
   # cd /etc/vsftpd
   # cp vsftpd.conf vsftpd.conf.orig
   ```

4. Modify the configuration file to set the directory so that an anonymous user will be logged in to `/ftp/zvm61/` using the `anon_root` variable. Also, disable local (non-anonymous) logins by commenting out the `local_enable=YES` and `write_enable=YES` lines:

   ```
   # Example config file /etc/vsftpd/vsftpd.conf
   #
   # The default compiled in settings are fairly paranoid. This sample file
   # loosens things up a bit, to make the ftp daemon more usable.
   # Please see vsftpd.conf.5 for all compiled in defaults.
   #
   # READ THIS: This example file is NOT an exhaustive list of vsftpd options.
   # Please read the vsftpd.conf.5 manual page to get a full idea of vsftpd's
   # capabilities.
   #
   # Allow anonymous FTP? (Beware - allowed by default if you comment this out).
   anonymous_enable=YES
   # set the home directory of anonymous FTP to /ftp/zvm61
   anon_root=/ftp/zvm61
   #
   # Uncomment this to allow local users to log in.
   # local_enable=YES
   #
   # Uncomment this to enable any form of FTP write command.
   # write_enable=YES
   ...
   ```

5. Set the vsftpd service to start at boot time by using the **chkconfig** command and, for this session, with the **service** command:

```
# chkconfig vsftpd on
# service vsftpd start
Starting vsftpd for vsftpd: [  OK  ]
```

An anonymous FTP server should now be running with the z/VM V6.1 directory in `/cpdvd` (relative to the anonymous FTP root directory).

6.5.3 Testing the anonymous FTP server

Test your setup by using FTP to log in as an anonymous user from another system. You should see the `cpdvd/` directory and the following output:

```
# ftp gpok223
Connected to gpok223.endicott.ibm.com.
220 (vsFTPd 2.2.2)
Name (gpok223:root): anonymous
331 Please specify the password.
Password:
230 Login successful.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> dir
229 Entering Extended Passive Mode (|||6252|).
150 Here comes the directory listing.
-rw-r--r--    1 0        0        45088210 Nov 11 19:06 CD813270.ZIP
dr-xr-xr-x    2 0        0           24576 Nov 11 19:23 cpdvd
226 Directory send OK.
ftp> quit
```

This output shows that the anonymous FTP server is working. You should now be able to continue with a z/VM installation via FTP, starting in 4.1, “Installing z/VM from DVD or FTP server” on page 28.

7

Installing RHEL 6 on the cloner

By now, you must have created a new z/VM user ID named LNXMAINT. Now it is time to create the first Linux user ID, which is named RH6CLONE. This Linux ID is used for the cloner installation server, and serves as the administration point for future Linux IDs. This server is referred to as the cloner.

RH6CLONE serves in the following capacities:

- Red Hat Enterprise Linux 6 installation server: This server is a tree of Red Hat packages (RPMs) and other files required for installation.
- Network File System (NFS) server: This server exports the installation tree and possibly other useful files.
- Clone server: This server is used for cloning an existing installation to a new Linux ID. See Chapter 9, “Configuring RHEL 6 for cloning” on page 155 for more details.
- Kickstart server: This hosts files the product install files that are necessary for automated installations. See Chapter 10, “Installing Linux with kickstart” on page 175 for more information.

Chapter 4, “Installing and configuring z/VM” on page 27, Chapter 5, “Servicing z/VM” on page 73, and Chapter 6, “Configuring an NFS/FTP server” on page 97 must be completed before proceeding. In this chapter, you will perform following tasks:

- “Installing the cloner” on page 106
- “Configuring the cloner” on page 127

7.1 Installing the cloner

In this section, you install the RHEL 6 cloner under the RH6CLONE user. This cloner is the guest server that will serve as the installation and file server for future Linux guests.

7.1.1 Creating the RH6CLONE user ID

In this section, you define the RH6CLONE user ID in z/VM by performing the following steps:

1. Log on to MAINT and make a backup of and edit the `USER DIRECT` file:

   ```
   ==> copy user direct c = direwrks = (rep
   ==> x user direct c
   ```

   In the `USER DIRECT` file, you can group statements that will be common to many user definitions in a construct called a *profile*. This profile can then become part of the user definitions using the `INCLUDE` statement. You used the existing TCPCMSU profile when you defined the LNXMAINT user.

2. Create a new profile named LNXDFLT. This profile contains the user directory statements that will be common to all Linux user IDs. You can use the **""** prefix commands to duplicate the `IBMDFLT` profile that should be on lines 37-50:

   ```
   ""037 ************************************************************
   00038 *
   00039 PROFILE IBMDFLT
   00040   SPOOL 000C 2540 READER *
   00041   SPOOL 000D 2540 PUNCH A
   00042   SPOOL 000E 1403 A
   00043   CONSOLE 009 3215 T
   00044   LINK MAINT 0190 0190 RR
   00045   LINK MAINT 019D 019D RR
   00046   LINK MAINT 019E 019E RR
   00047   LINK MAINT 0402 0402 RR
   00048   LINK MAINT 0401 0401 RR
   ""049 ****************************
   ```

3. Issue the CP command QUERY PROCESSORS to see how many physical CPUs your LPAR has. In this example, it is 10:

   ```
   ==> q proc
   PROCESSOR 00 MASTER CP
   PROCESSOR 01 ALTERNATE CP
   PROCESSOR 02 ALTERNATE CP
   PROCESSOR 03 ALTERNATE CP
   PROCESSOR 04 ALTERNATE CP
   PROCESSOR 05 ALTERNATE CP
   PROCESSOR 06 ALTERNATE CP
   PROCESSOR 07 ALTERNATE CP
   PROCESSOR 08 ALTERNATE CP
   PROCESSOR 09 ALTERNATE CP
   ```

Important: In the past, only two virtual CPUs were recommended for the next step. With the new cpuplugd service (see 13.7, “Using the cpuplugd service” on page 224), this recommendation has changed to be the same number as the physical CPUs. This setting could have the side effect of allowing a single Linux virtual machine to consume a large amount of CPU resource. You may consider leaving this setting at two for now.

4. Edit the duplicated profile by deleting the three `LINK MAINT 040x` lines, and inserting the lines that are shown in bold text:

```
PROFILE LNXDFLT
  IPL CMS
  MACHINE ESA 10
  CPU 00 BASE
  CPU 01
  CPU 02
  CPU 03
  CPU 04
  CPU 05
  CPU 06
  CPU 07
  CPU 08
  CPU 09
  NICDEF 600 TYPE QDIO LAN SYSTEM VSW1
  SPOOL 000C 2540 READER *
  SPOOL 000D 2540 PUNCH A
  SPOOL 000E 1403 A
  CONSOLE 009 3215 T
  LINK MAINT 0190 0190 RR
  LINK MAINT 019D 019D RR
  LINK MAINT 019E 019E RR
  LINK LNXMAINT 192 191 RR
  LINK TCPMAINT 592 592 RR
```

   Note that:

   – The first line performs an IPL of CMS when the user ID is logged onto.

   – You should update the `MACHINE` statement line to set the machine type to ESA with a maximum number of CPUs that can be defined. In this example, the LPAR has 10 processors, so the value of the last parameter is set to 10.

   – The next ten lines define ten virtual CPUs. Be sure to set the number of virtual CPUs equal to (or less than) the number of physical CPUs.

   – The NICDEF line defines a virtual NIC connected to the VSWITCH starting at virtual address `600`.

   – The last two lines provide read access to the LNXMAINT 192 disk, as the user’s 191 disk, and the TCPMAINT 592 disk, so that the user has access to TCP/IP services, such as FTP.

5. Go to the bottom of the file and add the definition for a new user ID named RH6CLONE. This user ID is given class B, D, and E privilege classes, aside from the typical class G, to run the FLASHCOPY command (B), the QUERY ALLOC MAP (D) command, and the QUERY NSS (E) command. Be sure to replace the volume labels in bold and italics (for example, ***UM6290***) with the labels of your DASD:

```
USER RH6CLONE LNX4VM 512M 1G BDEG
 INCLUDE LNXDFLT
```

```
 OPTION LNKNOPAS APPLMON
 MDISK 100 3390 0001 3338 UM6290 MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 0001 3338 UM6293 MR LNX4VM LNX4VM LNX4VM
 MDISK 102 3390 0001 3338 UM6294 MR LNX4VM LNX4VM LNX4VM
*
```

This Linux user ID will have the minidisks and virtual disks (VDISKs) shown in Table 7-1.

Table 7-1 Minidisks to be defined

Minidisk or VDISK	Description
100	The root file system of the Linux cloner. This system serves as the administration point for all your Linux virtual servers.
101-102	These are the minidisks that are used to create a logical volume mounted over `/nfs/`. This file system is used to make the RHEL 6 installation tree and the files associated with this book available over NFS.
300-301	These are virtual disk (VDISK) swap spaces that are not defined in the `USER DIRECT` file, but defined by calls to the SWAPGEN EXEC in the user's PROFILE EXEC so that when the user ID logs on the VDISKs are created.

6. Go back to the top of the file and search for the `USER $ALLOC$` string. Add cylinder 0 of each of the new volumes to this dummy user ID so they do not show up as gaps in the `USER DISKMAP` report file:

```
====> top
====> /user $alloc$
USER $ALLOC$  NOLOG
 MDISK A01 3390 000 001 610RES R
 MDISK A02 3390 000 001 UV6283 R
 MDISK A03 3390 000 001 UV6284 R
 MDISK A04 3390 000 001 UM6289 R
 MDISK A05 3390 000 001 UM6290 R
 MDISK A06 3390 000 001 UM6293 R
 MDISK A07 3390 000 001 UM6294 R
...
====> file
```

7. Run DISKMAP to check for overlaps and gaps. You should only see only a 501 and a one cylinder gap:

```
==> diskmap user
==> x user diskmap
====> all /gap/|/overlap/
--------------------  4  line(s) not displayed --------------------
                                          0         500         501    GAP
--------------------  6  line(s) not displayed --------------------
                                          0           0           1    GAP
--------------------  355  line(s) not displayed --------------------
====> quit
```

- When the disk layout is correct, run DIRECTXA to bring the changes online:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 5 RELEASE 3.0
EOJ DIRECTORY UPDATED AND ON LINE
```

You have now defined the user ID that will be both the master Linux image and the cloner.

7.1.2 Adding RH6CLONE to AUTOLOG1 PROFILE EXEC

The new Linux ID you defined needs access to the VSWITCH. A SET VSWITCH command with the GRANT parameter can be added to `AUTOLOG1 PROFILE EXEC` to accomplish this task. Also, an `XAUTOLOG` statement can be added if the user ID is automatically logged on at z/VM IPL time.

Other examples show how to log off of MAINT and log on to AUTOLOG1. You can also modify the file by linking to the AUTOLOG1 191 disk read/write.

Perform the following steps:

1. Use the LINK and ACCESS commands to link to and access the AUTOLOG1 191 disk in read/write mode:

```
==> link autolog1 191 1191 mr
==> acc 1191 f
```

2. Edit the `PROFILE EXEC` file. Add the RH6CLONE user ID to the sections that grant access to the VSWITCH and that use `XAUTOLOG` on the Linux user IDs:

```
==> x profile exec f   // add two lines
/*************************/
/*  Autolog1 Profile Exec  */
/*************************/
'cp xautolog tcpip'                 /* start up TCPIP */
'CP XAUTOLOG DTCVSW1'               /* start VSWITCH controller 1 */
'CP XAUTOLOG DTCVSW2'               /* start VSWITCH controller 2 */
'cp set pf12 ret'                   /* set the retrieve key */
'cp set mdc stor 0m 128m'           /* Limit minidisk cache in CSTOR */
'cp set mdc xstore 0m 0m'           /* Disable minidisk cache in XSTOR */
'cp set srm storbuf 300% 250% 200%' /* Overcommit memory */
'cp set signal shutdown 300'        /* Allow guests 5 min to shut down */

/* Grant access to VSWITCH for each Linux user */
'cp set vswitch vsw1 grant rh6clone'

/* XAUTOLOG each Linux user that should be started */
'cp xautolog rh6clone'

'cp logoff'                          /* logoff when done */
====> file
```

These changes will not take effect until the next IPL, so you must grant this user ID access to the VSWITCH for this z/VM session. This is done by running the following command:

```
==> set vswitch vsw1 grant rh6clone
Command complete
```

7.1.3 Preparing RH6CLONE bootstrap files

To perform an IPL on a RHEL 6 installation system, four bootstrap files must be prepared. Three are punched to the z/VM reader and then an IPL is performed. These three files are a kernel, a parameter file, and an initial RAM disk. The fourth file is a configuration file stored on a CMS disk to which the parameter file points.

Think of these files as the files that are on as a PC Linux boot CD (or floppy disk). Also, a small REXX EXEC is commonly used to clean out the reader, punch the three files, and

perform an IPL of the reader. A sample RHEL 6 parameter file, configuration file, and installation EXEC are supplied and should be on the LNXMAINT 192 disk (this task is described in 4.7.5, “Copying the files associated with this book to LNXMAINT” on page 61). Therefore, only the kernel and RAM disk need to be copied.

Perform the following steps:

1. Start an SSH session as root on the NFS server.
2. Use the **ftp** command to copy the RHEL 6 kernel and initial RAM disk to the LNXMAINT D disk. These files must have a record format of fixed 80 byte records. This format can be set by running the **site fix 80** FTP subcommand (if this subcommand fails, try **quote site fix 80**). Here is an example:

```
# cd /nfs/rhel6/dvd1/images
# ftp 9.60.18.249
Name (9.60.18.249:root): lnxmaint
Password:
230 LNXMAINT logged in; working directory = LNXMAINT 191
Remote system type is z/VM.
ftp> cd lnxmaint.192
250 Working directory is LNXMAINT 192
ftp> site fix 80
200 Site command was accepted.
ftp> bin
200 Representation type is IMAGE.
ftp> put initrd.img rhel6.initrd
...
23651842 bytes sent in 00:01 (11.34 MB/s)
ftp> put kernel.img rhel6.kernel
...
8016384 bytes sent in 00:01 (6.01 MB/s)
ftp> quit
```

3. Go back to your 3270 session. Log off of MAINT and log on to LNXMAINT.
4. The SAMPLE PARM-RH6, SAMPLE CONF-RH6, and RHEL6 EXEC files should be on the LNXMAINT 192 (D) disk, as they were copied in 4.7.5, “Copying the files associated with this book to LNXMAINT” on page 61. Use the FILELIST command to verify that the files were copied, and that the kernel and initial RAM disk were copied in fixed 80 byte record format. You should see the following files (the number of records and blocks may vary):

```
==> filel * * d
LNXMAINT FILELIST A0  V 169  Trunc=169 Size=10 Line=1 Col=1 Alt=0
Cmd   Filename Filetype Fm Format Lrecl    Records     Blocks   Date     Time
      RHEL6    EXEC     D1 V         69         10          1  9/23/10 12:55:22
      RHEL6    KERNEL   D1 F         80     100205       1642  9/23/10 12:52:07
      RHEL6    INITRD   D1 F         80     295649       5775  9/23/10 12:51:29
      CHPW610  XEDIT    D1 V         72        190          3  9/23/10  9:13:31
      CPFORMAT EXEC     D1 V         79        252          3  9/23/10  9:13:31
      PROFILE  EXEC     D1 V         63         17          1  9/23/10  9:13:31
      SAMPLE   CONF-RH6 D1 V         38         13          1  9/23/10  9:13:31
      SAMPLE   PARM-RH6 D1 V         80          3          1  9/23/10  9:13:31
      SWAPGEN  EXEC     D1 V         72        467          6  9/23/10  9:13:31
      PROFILE  XEDIT    D1 V         45         17          1  9/23/10  8:41:19
```

5. Quit by pressing F3.

6. Verify that the RHEL6 EXEC file has the correct information. Note the kernel and RAM disk have hardcoded file names (RHEL6), but the file name of the parameter file will be the user ID (userid() function) of the user running the EXEC:

```
==> type rhel6 exec d

/* EXEC to punch a RHEL 6 install system to reader and IPL from it */
Address 'COMMAND'
'CP SPOOL PUN *'
'CP CLOSE RDR'
'CP PURGE RDR ALL'
'PUNCH RHEL6 KERNEL * (NOHEADER'
'PUNCH' Userid() 'PARM-RH6 * (NOHEADER'
'PUNCH RHEL6 INITRD * (NOHEADER'
'CP CHANGE RDR ALL KEEP'
'CP IPL 00C CLEAR'
```

7. There are two text files that are needed to install RHEL 6: a parameter file and a configuration file. A sample parameter file is provided and is named SAMPLE PARM-RH6. It has some values, the most important value of which, the CMSCONFFILE variable, points to the configuration file that remains on a CMS minidisk. Copy the sample parameter file to a new file named RH6CLONE. Change the configuration file variable to point to a file with the same file name:

```
==> copy sample parm-rh6 d rh6clone = =
==> x rh6clone parm-rh6 d
root=/dev/ram0 ro ip=off ramdisk_size=40000
CMSDASD=191 CMSCONFFILE=RH6CLONE.CONF-RH6
vnc vncpassword=lnx4vm
```

8. Copy the sample configuration file and modify the appropriate fields. Refer to the worksheet in 2.7.4, “Linux user ID worksheet” on page 18. Here are the values used for the example in this book.

```
==> copy sample conf-rh6 d rh6clone = =
==> x rh6clone conf-rh6
DASD=100-105,300-301
HOSTNAME=gpok223.endicott.ibm.com
NETTYPE=qeth
IPADDR=9.60.18.223
SUBCHANNELS=0.0.0600,0.0.0601,0.0.0602
NETMASK=255.255.255.128
SEARCHDNS=endicott.ibm.com
GATEWAY=9.60.18.129
DNS=9.0.3.1
MTU=1500
PORTNAME=DONTCARE
PORTNO=0
LAYER2=0
```

Note: The RHEL 6 installer supports OSA/NIC in layer 2 (Ethernet) mode. In the example above, the Linux virtual machine is connecting to a layer 3 VSWITCH, so the parameter LAYER2=0 is set. When connecting in layer 2 mode, set LAYER2=1. Then, if this guest is connected to a VSWITCH, set VSWITCH=1, signifying that the VSWITCH will provide the MAC address. If this guest is not connected to a VSWITCH, set VSWITCH=0 and add the parameter MACADDR= followed by the MAC address for this guest.

9. Linux user IDs will obtain their `PROFILE EXEC file` from LNXMAINT 192. This file runs when you press Enter at the `VM READ` prompt. It creates two VDISKs with the `SWAPGEN EXEC` file, which will be used later to swap spaces. It also performs a few other functions, including performing an IPL of Linux automatically if the virtual machine is logged on disconnected. You can view the contents of the `PROFILE EXEC` file by running the CMS TYPE command:

```
==> type profile exec d
/* PROFILE EXEC for Linux virtual servers */
'CP SET RUN ON'
'CP SET PF11 RETRIEVE FORWARD'
'CP SET PF12 RETRIEVE'
'ACC 592 C'
'SWAPGEN 300 524288' /* create a 256M VDISK disk swap space */
'SWAPGEN 301 1048576' /* create a 512M VDISK disk swap space */
'PIPE CP QUERY' userid() '| var user'
parse value user with id . dsc .
if (dsc = 'DSC') then /* user is disconnected */
  'CP IPL 100'
else  /* user is interactive -> prompt */
 do
  say 'Do you want to IPL Linux from minidisk 100? y/n'
  parse upper pull answer .
  if (answer = 'Y') then 'CP IPL 100'
 end /* else */
```

7.1.4 Beginning the Linux installation

Perform the following steps to begin the Linux installation:

1. Log on to RH6CLONE. The `PROFILE EXEC` file from the LNXMAINT 192 disk should prompt you to perform an IPL of minidisk 100. Because 100 is not installed yet, answer no.

```
LOGON RH6CLONE
NIC 0600 is created; devices 0600-0602 defined
z/VM Version 6 Release 1.0, Service Level 1002 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES: 0003 RDR,   NO PRT,   NO PUN
LOGON AT 07:41:38 EDT WEDNESDAY 09/29/10
z/VM V6.1.0    2010-09-23 11:31

DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

2. Set the memory size to 1 GB with the CP DEFINE STORAGE command:

```
==> def stor 1g
00: STORAGE = 1G
00: Storage cleared - system reset.
```

3. Perform an IPL of CMS, and again answer no:

```
==> ipl cms
z/VM V6.1.0    2010-09-23 11:31
```

```
DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

4. To begin the installation program, run the RHEL6 EXEC command. You should see many panels of questions and answers scrolling by. If you use the default parameter file shipped with RHEL 6, you would have had to answer all the networking questions manually. With the proper parameters set in `RH6CLONE CONF-RH6`, the installation process should proceed to the point where you have to use a browser to VNC client to access the installation program.

```
==> rhel6
   RDR FILE 0004 SENT FROM RH6CLONE PUN WAS 0004 RECS 100K CPY  001 A NOHOLD
   NOKEEP
   RDR FILE 0005 SENT FROM RH6CLONE PUN WAS 0005 RECS 0003 CPY  001 A NOHOLD
   NOKEEP
   RDR FILE 0006 SENT FROM RH6CLONE PUN WAS 0006 RECS 296K CPY  001 A NOHOLD
   NOKEEP
   0000003 FILES CHANGED
   0000003 FILES CHANGED
   Initializing cgroup subsys cpuset
   Initializing cgroup subsys cpu
   Linux version 2.6.32-71.el6.s390x (mockbuild@s390-004.build.bos.redhat.com)
   (gcc
    version 4.4.4 20100726 (Red Hat 4.4.4-13) (GCC) ) #1 SMP Wed Sep 1 01:38:33
   EDT
    2010
   setup: Linux is running as a z/VM guest operating system in 64-bit mode
   Zone PFN ranges:
     DMA      0x00000000 -> 0x00080000
     Normal   0x00080000 -> 0x00080000
   Movable zone start PFN for each node
   early_node_mapÝ1¨ active PFN ranges
       0: 0x00000000 -> 0x00020000
   PERCPU: Embedded 12 pages/cpu @000000000266d000 s16896 r8192 d24064 u65536
   pcpu-alloc: s16896 r8192 d24064 u65536 alloc=16*4096
   pcpu-alloc: Ý0¨ 00 Ý0¨ 01 Ý0¨ 02 Ý0¨ 03 Ý0¨ 04 Ý0¨ 05 Ý0¨ 06 Ý0¨ 07
   pcpu-alloc: Ý0¨ 08 Ý0¨ 09 Ý0¨ 10 Ý0¨ 11 Ý0¨ 12 Ý0¨ 13 Ý0¨ 14 Ý0¨ 15
   pcpu-alloc: Ý0¨ 16 Ý0¨ 17 Ý0¨ 18 Ý0¨ 19 Ý0¨ 20 Ý0¨ 21 Ý0¨ 22 Ý0¨ 23
   pcpu-alloc: Ý0¨ 24 Ý0¨ 25 Ý0¨ 26 Ý0¨ 27 Ý0¨ 28 Ý0¨ 29 Ý0¨ 30 Ý0¨ 31
   pcpu-alloc: Ý0¨ 32 Ý0¨ 33 Ý0¨ 34 Ý0¨ 35 Ý0¨ 36 Ý0¨ 37 Ý0¨ 38 Ý0¨ 39
   pcpu-alloc: Ý0¨ 40 Ý0¨ 41 Ý0¨ 42 Ý0¨ 43 Ý0¨ 44 Ý0¨ 45 Ý0¨ 46 Ý0¨ 47
   pcpu-alloc: Ý0¨ 48 Ý0¨ 49 Ý0¨ 50 Ý0¨ 51 Ý0¨ 52 Ý0¨ 53 Ý0¨ 54 Ý0¨ 55
   pcpu-alloc: Ý0¨ 56 Ý0¨ 57 Ý0¨ 58 Ý0¨ 59 Ý0¨ 60 Ý0¨ 61 Ý0¨ 62 Ý0¨ 63
   Built 1 zonelists in Zone order, mobility grouping on.  Total pages: 129280
   Kernel command line: root=/dev/ram0 ro ip=off ramdisk_size=40000
                        CMSDASD=191 CMSCONFFILE=RH6CLONE.CONF-RH6
                        vnc vncpassword=lnx4vm
   ...
```

Important: If the DASD you are using has never been formatted for Linux, you may get many screens of warning messages similar to the following on your 3270 session:

```
dasd(eckd): I/O status report for device 0.0.0100:
dasd(eckd): in req: 000000000e027ee8 CS: 0x40 DS: 0x0E
dasd(eckd): device 0.0.0100: Failing CCW: 000000000e027fd0
dasd(eckd): Sense(hex)  0- 7: 00 08 00 00 04 ff ff 00
```

This is not a problem, as you just have to clear the panel many times or the installation process will freeze. An alternative to clearing the panel many times is to issue the following CP TERM command:

```
#cp term more 0 0
```

Press Enter and the panel should scroll freely. The downside of this option is that you may miss some messages that are important. You may later want to set the value back to the default of waiting 50 seconds to beep and then another 10 seconds to clear the panel with the following command:

```
#cp term more 50 10
```

5. You *might* see warnings about systems that cannot be reached:

   ```
   Trying to reach gateway 9.60.18.129...
   Could not reach your default gateway 9.60.18.129
   0) redo this parameter, 1) continue, 2) restart dialog, 3) halt, 4) shell
   ```

   If so, be sure the IP address you are using is not already in use.

6. The kernel should continue to boot until you see the following messages:

   ```
   ...
   Starting sshd to allow login over the network.

   Connect now to 9.60.18.223 and log in as user install to start the
   installation.

   E.g. using: ssh -x install@9.60.18.223
   You may log in as the root user to start an interactive shell.
   ```

7. From your workstation, use your SSH client (for example, PuTTY) to connect to the IP address and begin the installation. When prompted for a user name, enter `install`. A password will not be required. Figure 7-1 shows the initial panel of the installer. Use the Tab key to move between fields. Use the arrow keys to move among choices and Enter to select a choice.

Figure 7-1 Initial panel of installer

8. The Choose a Language panel should appear. Select your language, press Tab to select **OK**, and press Enter.
9. The Installation Method panel should appear. Choose **NFS image** for the installation method, select **OK**, and press Enter.
10. The NFS Setup panel should appear. Enter the IP address of the PC NFS server on the first line, then the path to the installation tree on the second line, and select **OK**. See the example in Figure 7-2, which uses the NFS server at IP address 9.60.18.240.

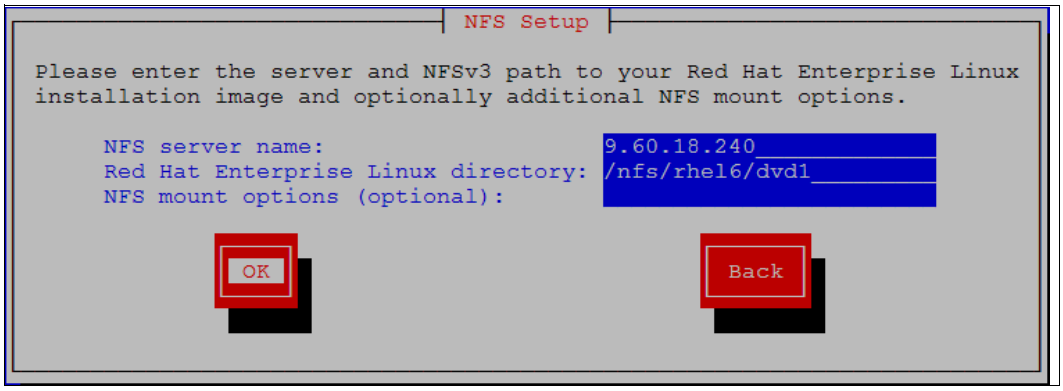


Figure 7-2 NFS setup panel

11. Now the curses windows should end and the installation program (anaconda) should start a VNC server. You should see messages similar to the following:

```
Welcome to the anaconda install environment 1.2 for zSeries

detecting hardware...
waiting for hardware to initialize...
detecting hardware...
```

```
waiting for hardware to initialize...
Running anaconda 13.21.82, the Red Hat Enterprise Linux system installer -
please wait.
14:55:55 Starting VNC...
14:55:56 The VNC server is now running.
14:55:57

You chose to execute vnc with a password.


14:55:57 Please manually connect your vnc client to gpok223.endicott.ibm.com:1
(9.60.18.223) to begin the install.
14:55:57 Starting graphical installation.
```

12. Start a VNC client (for example, RealVNC) and connect to the server with your IP address with a :1 appended to the end, as shown in Figure 7-3. When prompted for a password, enter the password specified in the `RH6CLONE PARM-RH6` file (lnx4vm in the sample file). In the following example, Linux is being installed with the IP address 9.60.18.223.

Figure 7-3 Connecting with VNC client

7.1.5 Stage 2 of the RHEL 6 installation

After you have connected using VNC, perform the following steps:

1. A splash window appears, as shown in the top half of Figure 7-4. Click **Next**.
2. You will be asked what type of devices to use, as shown in the bottom half of Figure 7-4. Choose **Basic Storage Devices** and click **Next**.

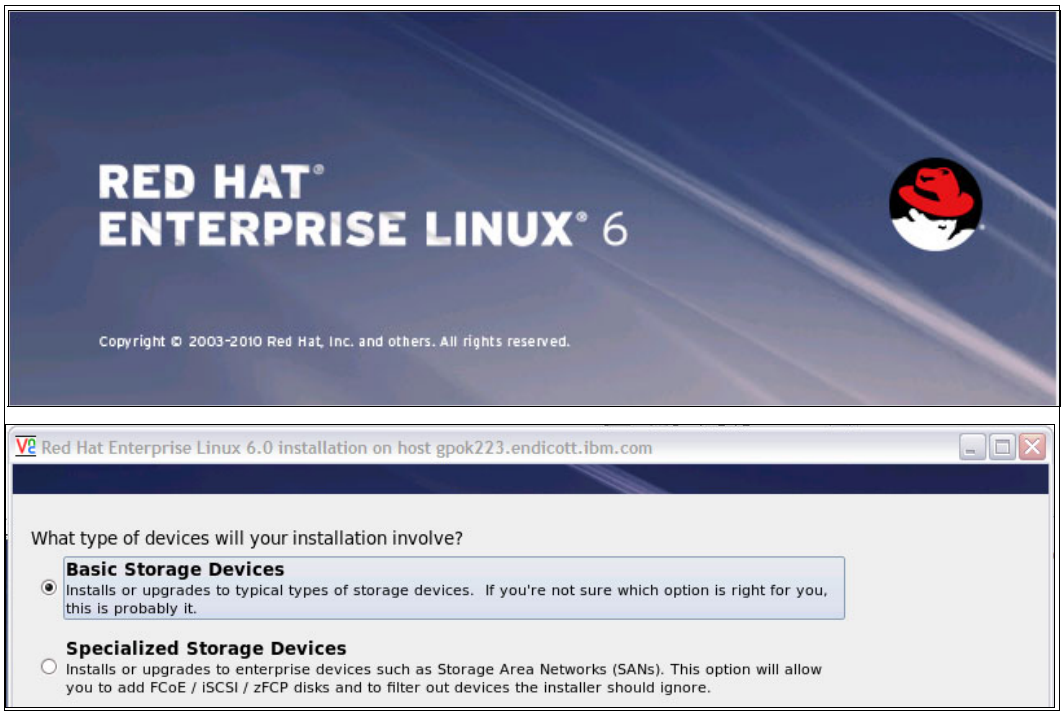


Figure 7-4 Splash window and device type window

3. You might see the Unformatted DASD Devices Found window, as shown in Figure 7-5. If the disks you are installing onto have been previously formatted by **dasdfmt**, you will not see this window.

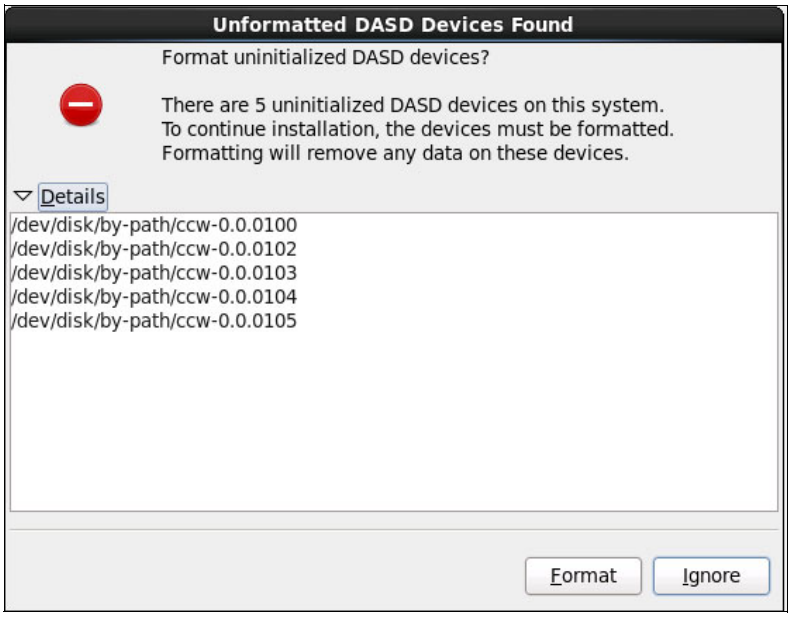


Figure 7-5 An example of the Unformatted DASD Devices Found window

7.1.6 Working around a known issue

Important: If the minidisks 100-102 (dasdb-dasdd) have not been formatted for Linux by **dasdfmt** before this installation, you should see the window shown in Figure 7-5 on page 118. However, there is a known issue in RHEL 6 where this window does not open and you do not have the ability to format the disks through the installer. If you proceed without formatting the disks with **dasdfmt**, the installation process will fail later.

If this is the case, perform the following steps:

1. Start a second SSH session, this time logging in as root:

```
login as: root
Welcome to the anaconda install environment 1.2 for zSeries
```

- Issue the **lsdasd** command. The three minidisks should be dasdb, dasdc, and dasdd:

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
================================================================================
==
0.0.0100   active      dasdb     94:4    ECKD  4096   2347MB    600840
0.0.0101   active      dasdc     94:8    ECKD  4096   2347MB    600840
0.0.0102   active      dasdd     94:12   ECKD  4096   2347MB    600840
0.0.0300   active      dasde     94:16   FBA   512    256MB     524288
0.0.0301   active      dasdf     94:20   FBA   512    512MB     1048576
```

- Format the minidisks in parallel with the following `for` loop:

```
# for i in b c d
> do
>   dasdfmt -b 4096 -y -f /dev/dasd$i &
> done
```

- You may need to press Enter to see the jobs in the background complete. After the `for` loop completes, return to the VNC session and complete the installation.

7.1.7 Continuing the installation

Continue your installation by performing the following steps:

1. Click the **Reinitialize All** button when prompted to initialize the VDISK as 300, as shown in Figure 7-6.

Figure 7-6 Reinitializing disks

2. In the next window, you set the host name. This should be read from the configuration file. Click **Next**.
3. Select your time zone and click **Next**.
4. Set the root password and click **Next**.

5. The installer now searches for a previous installation. *It is important* to select the **Create Custom Layout** radio button, as shown in Figure 7-7, as other choices will use VDISKs as physical volumes for a large volume group. VDISK data is not persistent across reboots. Click **Next**.

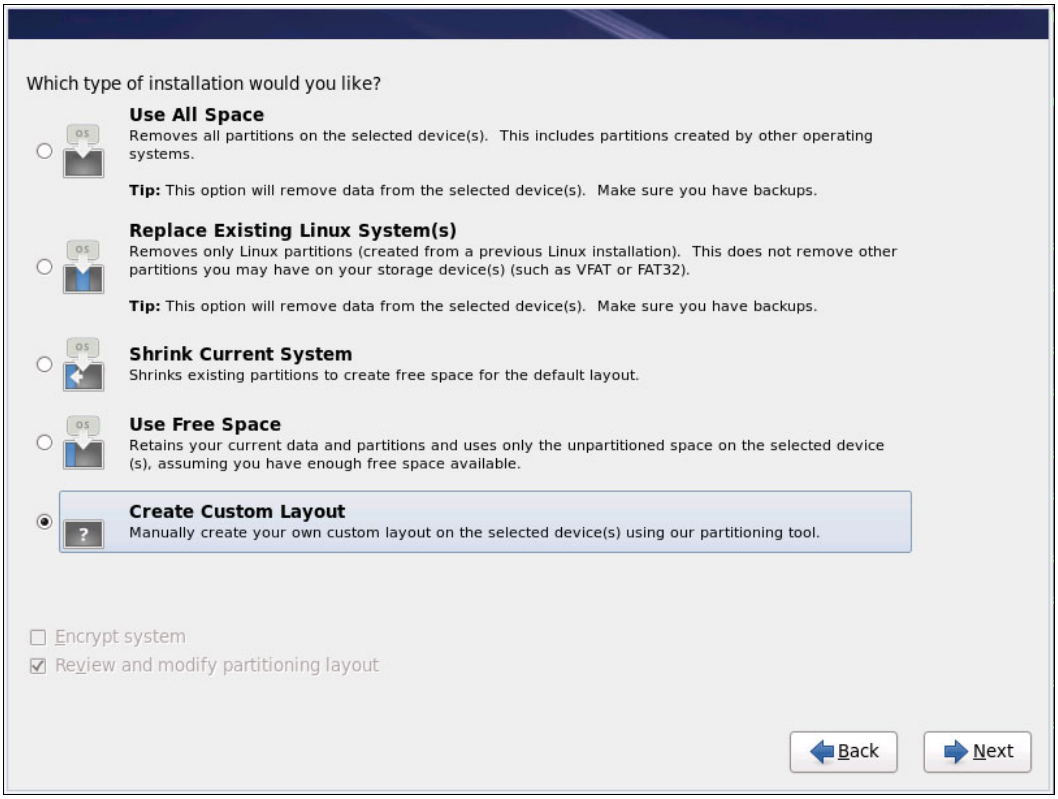


Figure 7-7 Creating custom disk layout

6. The next window that opens requires you to move disks from data storage devices to installation target devices, as shown in Figure 7-8. Move all disks to the right by selecting and clicking the right arrow, or by simply double-clicking each disk. When you are finished, click **Next**.

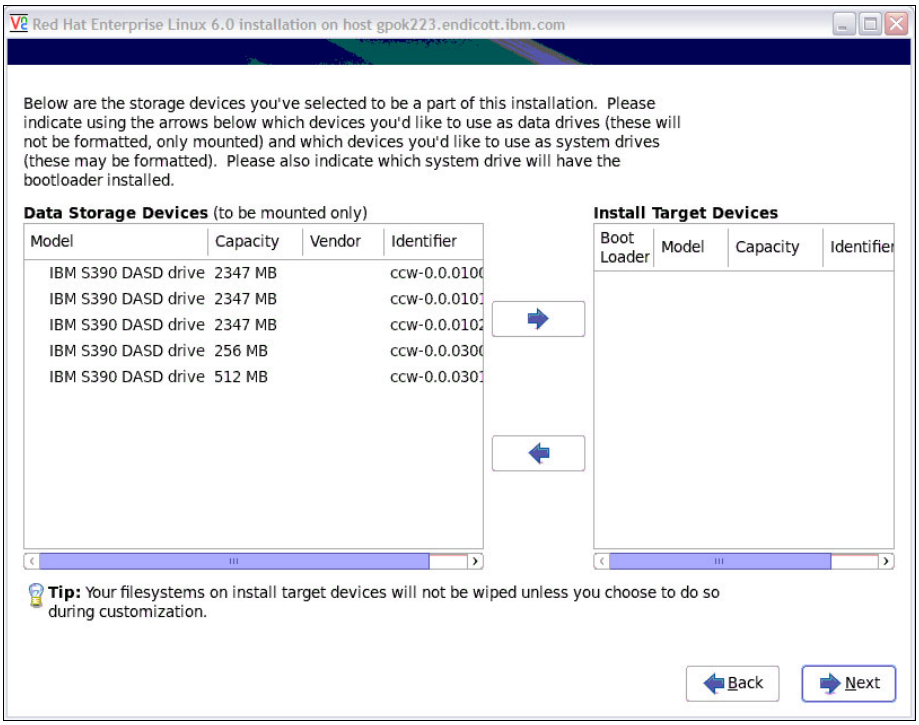


Figure 7-8 Moving disks to become installation targets

7. The Please Select A Device window allows you to set up minidisks and VDISKs. Click the **Create** button and the Create Storage window opens, as shown in the right side of Figure 7-9. Accept the default of **Standard Partition** and click **Create**.

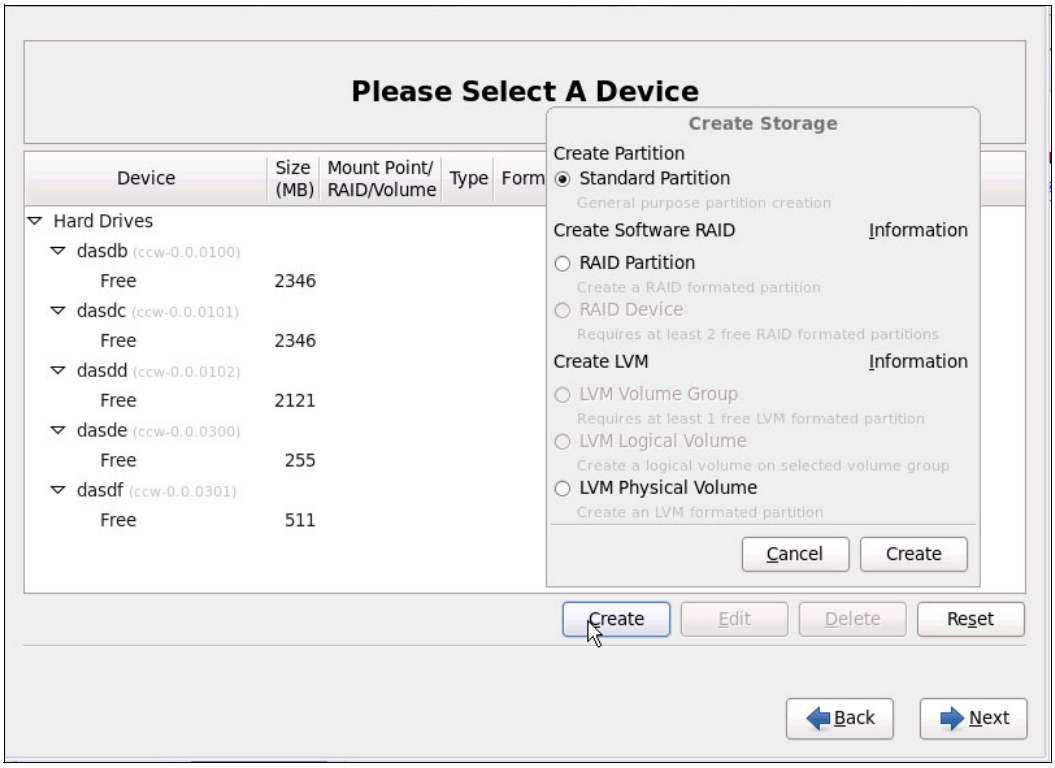


Figure 7-9 Disk setup before creating a volume group

8. In the Add Partition window, create a swap space on `/dev/dasdb` with a size of 512 MB by choosing the selections shown in the left half of Figure 7-10 and click **OK**.

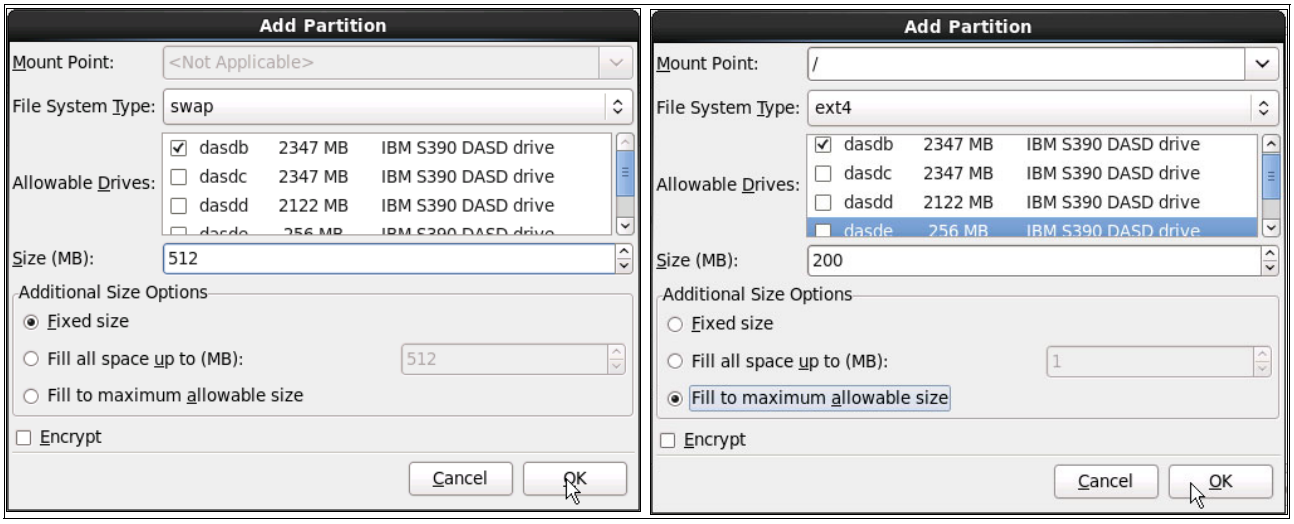


Figure 7-10 Creating a swap partition and the root file system

9. Back at the Please Select a Device window, click **Create** again, and use the remaining space on `/dev/dasdb` for the root file system, as shown on the right half of Figure 7-10.

10. Use the **Create** button to create a LVM physical volume from `/dev/dasdc` by performing the following steps:
    a. Select the **LVM Physical Volume** radio button on the Create Storage window and click **Create**.
    b. On the Add a Partition window, select the allowable drive (**dasdc**).
    c. On the Additional Size Options window, select the **Fill to maximum allowable size** radio button.
    d. Click **OK**.
11. Repeat the previous step and create an LVM physical volume from `/dev/dasdd`.
12. Finally, create two more swap spaces from the VDISKs, using the maximum allowable size, on the `/dev/dasde` and `/dev/dasdf` devices. After you have done these steps, your setup should look like what is shown in Figure 7-11.

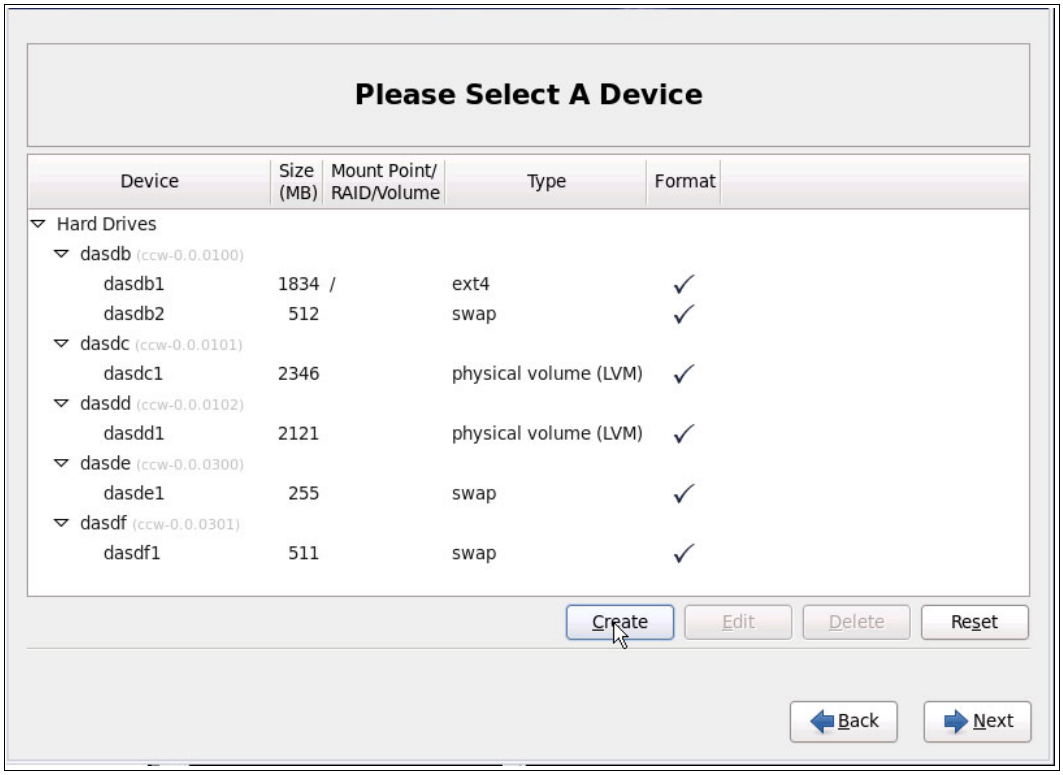


Figure 7-11 Disks and swap spaces before creating a volume group

13. The next step is to set up LVM. Perform the following steps:
    a. Click **Create** and the Create Storage window opens.
    b. Select the **LVM Volume Group** radio button and click **Create**. The Make LVM Volume Group window opens, as shown on the left side of Figure 7-12.
    c. Set the Volume Group Name to nfs_vg.
    d. Click **Add** under the Logical Volumes section. The Make Logical Volume window opens.
    e. Set the Mount Point to /nfs and the Logical Volume Name to nfs_lv, as shown on the right side of Figure 7-12. Click **OK**.
    f. In the Make LVM Volume Group window, click **OK**.

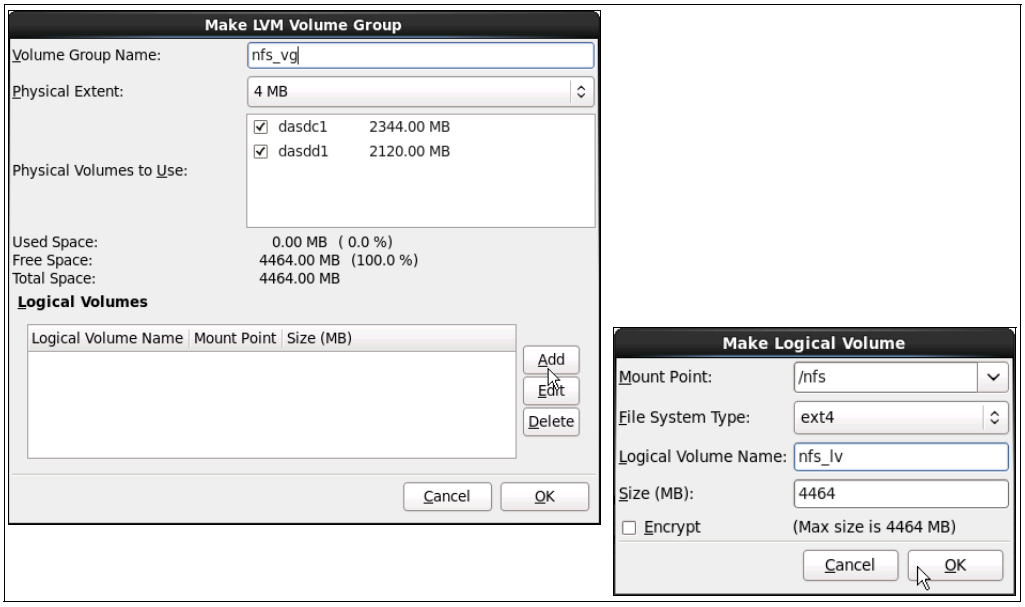


Figure 7-12 Creating a volume group and a logical volume

14. You will be returned to the Please Select A Device window. Click **Next**.
15. On the Format Warnings window, click **Format**.
16. On the Writing storage confirmation to disk window, click **Write changes to disk**.

Important: If you see the window shown in Figure 7-13 on page 126, you have to start the installation over, this time using **dasdfmt** to format the minidisks. See 7.1.6, “Working around a known issue” on page 119.

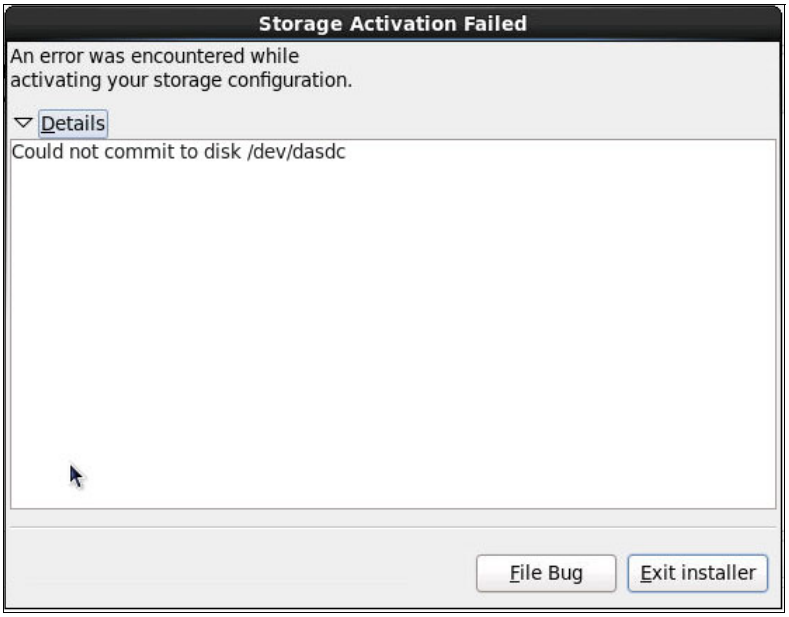


Figure 7-13 Symptom of a known issue

17. You will be prompted for the type of software to be installed. Accept the default of **Basic Server** and click **Next**. The installation process will start. This will run for 5 to 10 minutes
18. You will be prompted to reboot. Click **Reboot.**

7.1.8 Booting your new Linux system from disk

A minimal system should now be installed onto minidisk 100. Return to your z/VM 3270 session and perform an IPL of the newly installed system by running the #CP IPL 100 command:

```
 /mnt/sysimage/dev done
 /mnt/sysimage done
you may safely reboot your system
==> #cp ipl 100
CP IPL 100
zIPL v1.3.2 interactive boot menu
  0. default (linux)
  1. linux
Note: VM users please use '#cp vi vmsg <input>'
Please choose (default will boot in 15 seconds):
...
```

Linux will boot after 15 seconds if you take no action. To boot immediately, issue the following command:

```
==> #cp vi vmsg 0
```

You system should continue to boot until a login prompt is presented. Start an SSH session to the master image as root. At this point, you can disconnect from the 3270 session by running the following command:

```
==> #cp disc
```

7.2 Configuring the cloner

Now that your cloner is installed, it must be configured. You must perform the following steps:

7.2.1 Copying files to the cloner

Copy the RHEL 6 installation tree to the cloner, along with the other files associated with this book, by performing the following steps:

1. Mount the `/nfs/rhel6/` directory on the NFS server over the `/mnt/` directory. In this example, the NFS server is at IP address 9.60.18.240:

   ```
   # mount 9.60.18.240:/nfs/rhel6/dvd1 /mnt
   # ls /mnt
   boot.cat                  RELEASE-NOTES-es-ES.html  RELEASE-NOTES-pt-BR.html
   EULA                      RELEASE-NOTES-fr-FR.html  RELEASE-NOTES-ru-RU.html
   ...
   ```

2. Create a local directory of the same name and recursively copy the tree with the **`cp -a`** command:

   ```
   # mkdir -p /nfs/rhel6
   # cd /mnt
   # rsync -av * /nfs/rhel6
   sending incremental file list
   EULA
   GPL
   ...
   sent 2758827676 bytes  received 56977 bytes  9180980.54 bytes/sec
   total size is 2758270745  speedup is 1.00
   ```

   This command will take some time, perhaps 5 to 10 minutes, depending on network speeds.

3. Unmount the RHEL 6 installation tree and repeat the process to copy the files associated with this book:

```
# cd /
# umount /mnt
# mount 9.60.18.240:/nfs/virt-cookbook-RH6 /mnt
# mkdir /nfs/virt-cookbook-RH6
# cd /mnt
# rsync -av * /nfs/virt-cookbook-RH6
sending incremental file list
README.txt
clone.sh
vm/
vm/chpw610.xedit
vm/cpformat.exec
vm/profile.exec
vm/sample.conf-rh6
vm/sample.parm-rh6
vm/swapgen.exec

sent 65178 bytes  received 168 bytes  130692.00 bytes/sec
total size is 64620  speedup is 0.99
```

- Now that the files are copied, unmount the `/mnt/` directory. View the files that you copied:

```
# cd ..
# umount /mnt/
# cd /nfs/virt-cookbook-RH6
# ls -F
README.txt  clone-1.0-10.s390x.rpm  vm/
```

The `clone-1.0-10.s390x.rpm` RPM contains files that you will use in Chapter 9, “Configuring RHEL 6 for cloning” on page 155.

7.2.2 Retiring the NFS server

You have now copied all the files related to this book to the cloner. You should be in a position to retire your NFS server, if you desire. The remainder of the book will use files located on the cloner instead of the files on the NFS server.

7.2.3 Configuring the yum command

You will now configure **`yum`** so it can install RPMs from the local installation tree.

Perform the following steps:

1. Create a file named `rhel6.repo` in the `/etc/yum.repos.d` directory:

```
# cd /etc/yum.repos.d
# vi rhel6.repo
[RHEL6]
name=Red Hat Enterprise Linux 6
baseurl=file:///nfs/rhel6/Server
```

2. Import the RPM key, which is included in the RHEL 6 DVD root directory:

```
# cd /nfs/rhel6
# rpm --import RPM-GPG-KEY-redhat-release
```

Note: Red Hat signs each RPM with a private GPG key, which is compared to your public key every time a package is installed. This method ensures that the RPM is a genuine, unaltered package. When installing an RPM, if you ever see a message similar to `Header V3 DSA signature: NOKEY, key ID 897da07a`, then either the correct GPG key has not been imported, or the package itself has been altered.

You are now ready to use **yum** to install or upgrade an RPM package. To install a package, run **yum install <packagename>**. The **yum** command will conveniently install the packages specified and automatically resolve dependencies for you. Note that you should not specify the package version on the command line, only the package name.

7.2.4 Turning off unneeded services

There are a number of services that are started in a RHEL 6 minimum system. To keep the cloner as efficient as possible, some of these services can be turned off by performing the following steps:

1. Turn off the following services with the **chkconfig** command:

```
# chkconfig iptables off
# chkconfig ip6tables off
# chkconfig auditd off
# chkconfig abrtd off
# chkconfig atd off
# chkconfig mdmonitor off
```

Note: You should only disable the iptables service if you are on a trusted network. Otherwise, you will need to configure iptables to allow network traffic for the VNC server and NFS, as well as any other services that require network access.

For more information about configuring iptables for NFS traffic, see the article located at the following address:

http://www.redhat.com/magazine/010aug05/departments/tips_tricks/

Also, turning on and tuning a firewall is briefly discussed in 11.1.3, “Turning on a firewall” on page 183.

2. You may choose to leave these services on, or turn others off. You can review which services are now configured to start in run level 3 by running the following **chkconfig** command:

```
# chkconfig --list | grep 3:on
abrtd           0:off   1:off   2:off   3:on    4:off   5:on    6:off
cpi             0:off   1:on    2:on    3:on    4:on    5:on    6:off
cpuplugd        0:off   1:off   2:on    3:on    4:on    5:on    6:off
crond           0:off   1:off   2:on    3:on    4:on    5:on    6:off
dumpconf        0:on    1:on    2:on    3:on    4:on    5:on    6:on
lvm2-monitor    0:off   1:on    2:on    3:on    4:on    5:on    6:off
messagebus      0:off   1:off   2:on    3:on    4:on    5:on    6:off
mon_statd       0:off   1:off   2:on    3:on    4:on    5:on    6:off
netfs           0:off   1:off   2:off   3:on    4:on    5:on    6:off
network         0:off   1:off   2:on    3:on    4:on    5:on    6:off
postfix         0:off   1:off   2:on    3:on    4:on    5:on    6:off
rhnsd           0:off   1:off   2:on    3:on    4:on    5:on    6:off
```

```
rsyslog         0:off   1:off   2:on    3:on    4:on    5:on    6:off
sshd            0:off   1:off   2:on    3:on    4:on    5:on    6:off
sysstat         0:off   1:on    2:on    3:on    4:on    5:on    6:off
udev-post       0:off   1:on    2:on    3:on    4:on    5:on    6:off
xinetd          0:off   1:off   2:off   3:on    4:on    5:on    6:off
```

7.2.5 Configuring the VNC server

Often, applications require a graphical environment. The Virtual Network Computing (VNC) server allows for a graphical environment to be set up easily by starting the vncserver service.

Perform the following steps:

1. RHEL 6 configures the VNC server by using the `/etc/sysconfig/vncservers` configuration file. Add a line at the bottom of this file to specify the VNC user:

   ```
   # yum -y install tigervnc-server openmotif xterm xsetroot xorg-x11-xauth
   ...
   ```

2. Edit the `vncservers` file and add one line at the bottom:

   ```
   # cd /etc/sysconfig
   # vi vncservers
   ...
   # VNCSERVERS="2:myusername"
   # VNCSERVERARGS[2]="-geometry 800x600 -nolisten tcp -localhost"
   VNCSERVERS="1:root"
   ```

3. Set a VNC password with the **vncpasswd** command. This password will be needed to connect to the VNC server:

   ```
   # vncpasswd
   Password: lnx4vm
   Verify: lnx4vm
   ```

4. Stop the firewall:

   ```
   # service iptables stop
   iptables: Flushing firewall rules: [  OK  ]
   iptables: Setting chains to policy ACCEPT: filter [  OK  ]
   iptables: Unloading modules: [  OK  ]
   ```

5. Start the VNC server. This will create some initial configuration files under the `/root/.vnc/` directory:

   ```
   # service vncserver start
   Starting VNC server: 1:root xauth:  creating new authority file
   /root/.Xauthority

   New 'gpok223.endicott.ibm.com:1 (root)' desktop is gpok223.endicott.ibm.com:1

   Creating default startup script /root/.vnc/xstartup
   Starting applications specified in /root/.vnc/xstartup
   Log file is /root/.vnc/gpok223.endicott.ibm.com:1.log

   [  OK  ]
   ```

6. There is one more configuration to be done. Change from the Tiny window manager (twm), to the Motif window manager (mwm):

   ```
   # cd /root/.vnc
   # vi xstartup   // change last line
   ```

```
...
xsetroot -solid grey
vncconfig -iconic &
xterm -geometry 80x24+10+10 -ls -title "$VNCDESKTOP Desktop" &
mwm &
```

7. Restart the VNC server with the **service** command:

```
# service vncserver restart
Shutting down VNC server: 1:root [  OK  ]
Starting VNC server: 1:root
New 'gpok223.endicott.ibm.com:1 (root)' desktop is gpok223.endicott.ibm.com:1

Starting applications specified in /root/.vnc/xstartup
Log file is /root/.vnc/gpok223.endicott.ibm.com:1.log

[  OK  ]
```

8. You should now be able to use the VNC client to connect to the IP address of the cloner with a :1 appended. A sample session is shown in Figure 7-14.

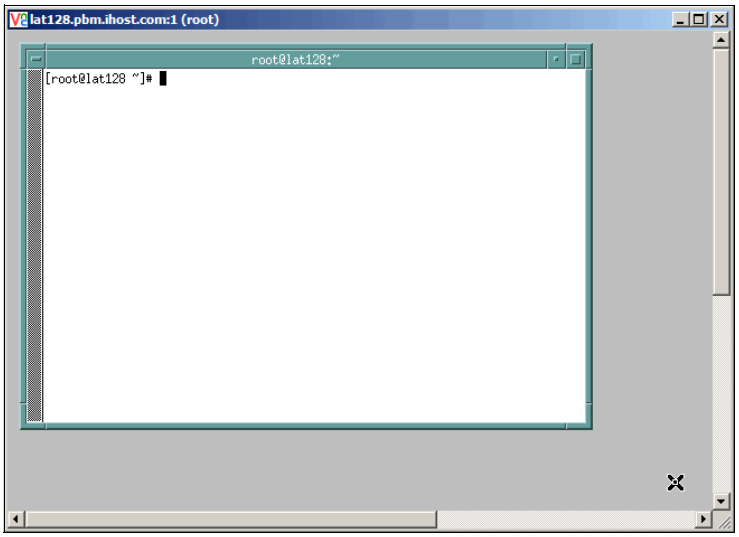


Figure 7-14 VNC client session to the VNC server

Note that the VNC server will not be started automatically across reboots. When you need a graphical environment, you can either to start the vncserver process manually (recommended), or you can use chkconfig to enable automatic startup.

7.2.6 Setting a system to halt on SIGNAL SHUTDOWN

By default, RHEL 6 reboots when a Ctrl-Alt-Del key sequence is used. This key sequence is simulated by z/VM when it issues a SIGNAL SHUTDOWN command. Rather than rebooting, you want your system to halt. To set the system to halt, edit `/etc/init/control-alt-delete.conf` and change **`shutdown -r`** (reboot) to **`shutdown -h`** (halt):

```
# cd /etc/init
# vi control-alt-delete.conf
# control-alt-delete - emergency keypress handling
#
# This task is run whenever the Control-Alt-Delete key combination is
```

```
# pressed.  Usually used to shut down the machine.

start on control-alt-delete

exec /sbin/shutdown -h now "Control-Alt-Delete pressed"
```

After that change, when the system receives a SIGNAL SHUTDOWN from z/VM, the following message will be displayed:

```
The system is going down for halt NOW!
```

7.2.7 Turning on the NFS server

The NFS server will be needed to export the RHEL 6 installation tree and the files associated with this book to the other virtual servers.

Enable NFS by performing the following steps:

1. Edit the empty `/etc/exports` file and add the following two lines:

   ```
   # cd /etc
   # vi exports
   /nfs/rhel6             *(ro,sync)
   /nfs/virt-cookbook-RH6 *(ro,sync)
   ```

   These two lines will cause NFS to export:

   - The `/nfs/rhel6/` directory, which contains the Red Hat Enterprise Linux 6 installation.
   - The `/nfs/virt-cookbook-RH6/` directory, which has the files associated with this book.

2. Set the NFS server to start at boot time and for this session:

   ```
   # service nfs start
   Starting NFS services:  [  OK  ]
   Starting NFS quotas: [  OK  ]
   Starting NFS daemon: [  OK  ]
   Starting NFS mountd: [  OK  ]
   Starting RPC idmapd: [  OK  ]
   # chkconfig nfs on
   ```

3. Test mount the directories locally:

   ```
   # mount localhost:/nfs/rhel6 /mnt
   # ls /mnt
   boot.cat                  RELEASE-NOTES-es-ES.html  RELEASE-NOTES-pt-BR.html
   EULA                      RELEASE-NOTES-fr-FR.html  RELEASE-NOTES-ru-RU.html
   ...
   # umount /mnt
   # mount localhost:/nfs/virt-cookbook-RH6 /mnt
   # ls /mnt
   clone.sh  README.txt  vm
   # umount /mnt
   ```

In this section, you have turned the NFS server on and exported the RHEL 6 installation directory and the files associated with this book.

7.2.8 Configuring SSH keys

SSH sessions are typically authenticated with passwords entered on the keyboard. With SSH *key-based authentication*, sessions can be authenticated with public and private keys so that no password is needed. SSH key-based authentication can be set up from the cloner (client) to the virtual servers. If the master image has a copy of cloner's public key in the `/etc/ssh/authorized_keys` file, then key-based authentication will work on the cloned virtual servers. Create a new DSA key in the `/root/.ssh/` directory. If the `/root/.ssh/` directory does not yet exist, create it by running the **`mkdir`** command:

```
# cd /root/.ssh
# ssh-keygen -t dsa -P "" -f id_dsa
Generating public/private dsa key pair.
Your identification has been saved in id_dsa.
Your public key has been saved in id_dsa.pub.
The key fingerprint is:
96:19:83:28:27:84:45:01:fa:e0:c8:8e:62:b8:01:30 root@gpok222.endicott.ibm.com
The key's randomart image is:
+--[ DSA 1024]----+
|.==.             |
|o.   . .         |
|E o o . o        |
|=+ +     =       |
|oo.     S        |
|=      .         |
|=o               |
|oo               |
|.                |
+-----------------+
```

This command creates a key pair where the file with the `.pub` suffix is the public key and the other file is the private key. Note that the private key is only readable by root:

```
# ls -l id_dsa*
-rw-------. 1 root root 668 Oct 19 16:49 id_dsa
-rw-r--r--. 1 root root 619 Oct 19 16:49 id_dsa.pub
```

These files will be copied to the golden image Chapter 8, “Installing and configuring the golden image” on page 137.

7.2.9 Inserting the vmcp module

To issue CP commands, the vmcp module is needed. By default, it is not loaded at boot time. If you would like it to run at boot time, add the **`modprobe vmcp`** command, which will insert the module, to the `/etc/rc.d/rc.local`, file, which is run at boot time:

```
# cd /etc/rc.d
# vi rc.local   // add one line
...
touch /var/lock/subsys/local
modprobe vmcp
```

The **`vmcp`** command will now be available after the next reboot.

7.2.10 Changing the order of the swap disks

It is likely that the order of swap space priority is not optimal. Perform the following commands:

1. View the order of the swap space with the **swapon -s** command:

```
# swapon -s
Filename                                Type            Size    Used
Priority
/dev/dasda2                             partition       524296  0       -1
/dev/dasdb1                             partition       262132  0       -2
/dev/dasdc1                             partition       524276  0       -3
```

   This shows that the minidisk swap space will be used before the VDISK. As VDISKs are in-memory, they should be first in the priority, from smallest to largest.

- Make a backup of the `/etc/fstab` file by running the following commands:

```
# cd /etc
# cp fstab fstab.orig
```

- Modify the swap order by moving the line in `/etc/fstab` by placing the minidisk swap space below the lines with VDISK swap spaces:

```
# vi fstab
...
/dev/disk/by-path/ccw-0.0.0300-part1 swap                swap    defaults
0 0
/dev/disk/by-path/ccw-0.0.0301-part1 swap                swap    defaults
0 0
/dev/disk/by-path/ccw-0.0.0100-part2 swap                swap    defaults
0 0
...
```

After a reboot, the minidisk swap space should come back with the lowest priority.

7.2.11 Setting the system to log off when Linux is shut down

When Linux is shut down, the default is for the virtual machine to remain logged on, even though it is not running an operating system. It is more convenient for the user ID to be logged off, both at z/VM SHUTDOWN time and for obtaining a refreshed 3270 emulator session. Edit the `/etc/rc.d/rc.local` file and add two lines at the end of the file:

```
# cd /etc/rc.d
# vi rc.local
#!/bin/sh
#
# This script will be executed *after* all the other init scripts.
# You can put your own initialization stuff in here if you don't
# want to do the full Sys V style init stuff.

touch /var/lock/subsys/local
chshut halt vmcmd logoff
chshut poff vmcmd logoff
```

The z/VM user ID should now be logged off when you halt or power off Linux.

7.2.12 Rebooting the system

You should now reboot the system to test the changes:

```
# reboot
Broadcast message from root@gpok223.endicott.ibm.com
        (/dev/pts/0) at 7:27 ...

The system is going down for reboot NOW!
```

After your system comes back online in a couple of minutes, start a new SSH session to the cloner.

7.2.13 Verifying the changes

You are now done customizing the Linux cloner. SSH back into the cloner and check a few settings. Test the **vmcp** command with a CP command, such as QUERY NAMES:

```
# vmcp q n
FTPSERVE - DSC , DTCVSW2  - DSC , DTCVSW1  - DSC , VMSERVR  - DSC
VMSERVU  - DSC , VMSERVS  - DSC , TCPIP    - DSC , OPERSYMP - DSC
DISKACNT - DSC , EREP     - DSC , OPERATOR - DSC , RH55GOLD - DSC
RH6CLONE - DSC
VSM     - TCPIP
```

Confirm that three swap spaces are operational and that the minidisk swap space is last in the priority:

```
# swapon -s
Filename                                Type            Size    Used    Priority
/dev/dasdb1                             partition       262132  0       -1
/dev/dasdc1                             partition       524276  0       -2
/dev/dasda2                             partition       524296  0       -3
```

Verify that the NFS server is running:

```
# service nfs status
rpc.mountd (pid 6776) is running...
nfsd (pid 6770 6769 6768 6767 6766 6765 6764 6763) is running...
rpc.rquotad (pid 6748) is running...
```

8

Installing and configuring the golden image

In this chapter, you install the copy of Linux that will be cloned. This copy of Linux is called the *golden image*. This copy should be as basic as possible so that it can be used as a generic virtual server and fit comfortably on two 3390-3 DASD.

In this chapter, you perform following tasks:

- “Installing the golden image” on page 138
- “Configuring the golden image” on page 148

Chapter 4, “Installing and configuring z/VM” on page 27, Chapter 5, “Servicing z/VM” on page 73, Chapter 6, “Configuring an NFS/FTP server” on page 97, and Chapter 7, “Installing RHEL 6 on the cloner” on page 105 must be completed before proceeding.

8.1 Installing the golden image

In this section, you will install the RHEL 6 golden image under the RH6GOLD user ID.

8.1.1 Creating the RH6GOLD user ID

In this section, you define the `RH6GOLD` user ID to z/VM.

Perform the following steps:

1. Log on to MAINT and edit the `USER DIRECT` file:

```
==> x user direct c
```

2. Go to the bottom of the file and add the definition for a new user ID named RH6GOLD. This user ID is given class G privileges only. Be sure to replace the volume labels (UM3F06 and UM63A9 in this example) with the labels of your DASD:

```
USER RH6GOLD 256M 1G G
 INCLUDE LNXDFLT
 OPTION LNKNOPAS APPLMON
 MDISK 100 3390 0001 3338 UM63A2 MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 0001 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
*
```

   This Linux user ID ha the minidisks and virtual disks (VDISKs) shown in Table 8-1.

Table 8-1 Minidisks to be defined

Minidisk	Description
100-101	Minidisks used to create the root file system, plus a logical volume containing the other file systems of the Linux golden image.
300-301	These are virtual disk (VDISK) swap spaces that are not defined in the `USER DIRECT` file, but defined by calls to the `SWAPGEN EXEC` file in the user's `PROFILE EXEC` file so that when the user ID logs on the VDISKs are created.

3. Go back to the top of the file and search for the `USER $ALLOC$` string. Add cylinder 0 of the new volume (or volumes) to this dummy user ID so these volumes do not show up as gaps in the `USER DISKMAP` report file. In this example, one new volume is being used, that is, UM63A9:

```
====> top
====> /user $alloc$
USER $ALLOC$  NOLOG
 MDISK A01 3390 000 001 610RES R
 MDISK A02 3390 000 001 UV6283 R
 MDISK A03 3390 000 001 UV6284 R
 MDISK A04 3390 000 001 UM6289 R
 MDISK A05 3390 000 001 UM6290 R
 MDISK A06 3390 000 001 UM6293 R
 MDISK A07 3390 000 001 UM6294 R
 MDISK A08 3390 000 001 UM63A2 R
 MDISK A09 3390 000 001 UM63A9 R
 ...
====> file
```

4. Run DISKMAP to check for overlaps and gaps. You should only see the single 501 cylinder gap:

```
==> diskmap user
==> x user diskmap
====> pre off
====> all /gap/|/overlap/
                                              0         500         501    GAP
--------------------  6  line(s) not displayed --------------------
                                              0           0           1    GAP
--------------------  391  line(s) not displayed --------------------
====> quit
```

5. When the disk layout is correct, run DIRECTXA to bring the changes online:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 5 RELEASE 3.0
EOJ DIRECTORY UPDATED AND ON LINE
```

You have now defined the user ID that will contain the master Linux image.

8.1.2 Adding RH6GOLD to AUTOLOG1 PROFILE EXEC

The new Linux ID you defined needs access to the VSWITCH. Just as with the RH6CLONE user, a SET VSWITCH command with the GRANT parameter will now be added to `AUTOLOG1 PROFILE EXEC`. Also, an `XAUTOLOG` statement is added so that the RH6GOLD user ID is automatically logged on when you perform an IPL of z/VM.

Perform the following steps:

1. Link and access the AUTOLOG1 191 disk in read/write mode and edit the PROFILE EXEC field. Add the RH6GOLD user ID to the section that grants access to the VSWITCH. Note that you do not want to add RH6GOLD to the XAUTOLOG section, as this Linux user ID will not normally be logged on:

```
==> link autolog1 191 1191 mr
==> acc 1191 f
==> x profile exec f   // add two lines
/***************************/
/*  Autolog1 Profile Exec  */
/***************************/
'cp xautolog tcpip'                 /* start up TCPIP */
'CP XAUTOLOG DTCVSW1'               /* start VSWITCH controller 1 */
'CP XAUTOLOG DTCVSW2'               /* start VSWITCH controller 2 */
'cp set pf12 ret'                   /* set the retrieve key */
'cp set mdc stor 0m 128m'           /* Limit minidisk cache in CSTOR */
'cp set mdc xstore 0m 0m'           /* Disable minidisk cache in XSTOR */
'cp set srm storbuf 300% 250% 200%' /* Overcommit memory */
'cp set signal shutdown 300'        /* Allow guests 5 min to shut down */

/* Grant access to VSWITCH for each Linux user */
'cp set vswitch vsw1 grant rh6clone'
'cp set vswitch vsw1 grant rh6gold'

/* XAUTOLOG each Linux user that should be started */
'cp xautolog rh6clone'

'cp logoff'                          /* logoff when done */
====> file
```

2. These changes will not take effect until the next IPL, so you must grant this user ID access to the VSWITCH for this z/VM session:

```
==> set vswitch vsw1 grant rh6gold
Command complete
```

8.1.3 Preparing the RH6GOLD bootstrap files

Now that the RH6GOLD user is defined, you must create the PARM and CONF configuration files used by the RHEL 6 installer. To save time, you should copy the RH6CLONE PARM-RH6 and RH6CLONE CONF-RH6 files, then make the necessary changes.

Perform the following steps:

1. In your 3270 session, log off of MAINT and log on to LNXMAINT.
2. The RH6CLONE PARM-RH6, RH6CLONE CONF-RH6, and RHEL6 EXEC files should be on the LNXMAINT 192 (D) disk as they were copied in 4.7.5, “Copying the files associated with this book to LNXMAINT” on page 61. Copy these files to a new file named RH6GOLD:

```
==> copy rh6clone * d rh6gold = =
```

3. Change the CMSCONFFILE variable in the PARM-RH6 file to point to the new CONF file:

```
==> x rh6gold parm-rh6
root=/dev/ram0 ro ip=off ramdisk_size=40000
CMSDASD=191 CMSCONFFILE=RH6GOLD.CONF-RH6
vnc vncpassword=lnx4vm
```

4. Change the DASD, HOSTNAME, and IPADDR variables in the RH6GOLD CONF-RH6 configuration file. For these values, you might want to refer to the worksheet in 2.7.4, “Linux user ID worksheet” on page 18. Also, add one line with the METHOD= parameter pointing to the NFS server directory you just set up on the cloner. This action will preclude you from having to enter the NFS server information in the install SSH session. Here is an example of the values used in this book:

```
==> x rh6gold conf-rh6
DASD=100-101,300-301
HOSTNAME=gpok222.endicott.ibm.com
NETTYPE=qeth
IPADDR=9.60.18.222
SUBCHANNELS=0.0.0600,0.0.0601,0.0.0602
NETMASK=255.255.255.128
SEARCHDNS=endicott.ibm.com
METHOD=nfs:9.60.18.223:/nfs/rhel6
GATEWAY=9.60.18.129
DNS=9.0.3.1
MTU=1500
PORTNAME=DONTCARE
PORTNO=0
LAYER2=0
```

You are now ready to start the golden image installation.

8.1.4 Installing RHEL 6 on the golden image

In this section, you install Linux onto the RH6GOLD virtual machine. Because the cloner is running and NFS is configured, install RHEL 6 using the installation tree exported from the cloner.

Perform the following steps:

1. Log on to RH6GOLD. The `PROFILE EXEC` file from the LNXMAINT 192 disk should prompt you to perform an IPL of the 100 minidisk. Because there is nothing installed yet, answer no.

```
LOGON RH6GOLD
NIC 0600 is created; devices 0600-0602 defined
z/VM Version 6 Release 1.0, Service Level 1002 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES: 0003 RDR,   NO PRT,   NO PUN
LOGON AT 07:41:38 EDT WEDNESDAY 09/29/10
z/VM V6.1.0    2010-09-23 11:31

DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

2. The default memory size of 256 MB is not enough to install RHEL 6. Set the memory size to 1 GB using the CP DEFINE STORAGE command:

```
==> def stor 1g
00: STORAGE = 1G
00: Storage cleared - system reset.
```

3. Perform an IPL of CMS and answer no:

```
==> ipl cms
z/VM V6.1.0    2010-09-23 11:31

DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

4. To begin the installation program, run the RHEL6 EXEC:

```
==> rhel6
RDR FILE 0001 SENT FROM RH6GOLD  PUN WAS 0004 RECS 100K CPY  001 A NOHOLD
NOKEEP
RDR FILE 0002 SENT FROM RH6GOLD  PUN WAS 0005 RECS 0003 CPY  001 A NOHOLD
NOKEEP
RDR FILE 0003 SENT FROM RH6GOLD  PUN WAS 0006 RECS 296K CPY  001 A NOHOLD
NOKEEP
0000003 FILES CHANGED
0000003 FILES CHANGED
Initializing cgroup subsys cpuset
Initializing cgroup subsys cpu
Linux version 2.6.32-71.el6.s390x (mockbuild@s390-004.build.bos.redhat.com)
(gcc
 version 4.4.4 20100726 (Red Hat 4.4.4-13) (GCC) ) #1 SMP Wed Sep 1 01:38:33
EDT
 2010
...
```

5. There will be many, many panels of DASD I/O messages. Use the CP TERM MORE command to make the 3270 panel clear instantly:

   ```
   ==> #cp term more 0 0
   ```

   You should see the following message:

   ```
   Initial configuration completed.

   Starting sshd to allow login over the network.

   Connect now to 9.60.18.222 and log in as user install to start the
   installation.

   E.g. using: ssh -x install@9.60.18.222
   You may log in as the root user to start an interactive shell.
   ```

6. Start an SSH session to the new in-memory Linux installer and log on as install:

   ```
   login as: install
   Welcome to the anaconda install environment 1.2 for zSeries
   ...
   ```

7. Set your language. In this example, the default of English is used.
8. When you installed the cloner, a panel prompting you for the network installation information opened. In this installation, it should not be shown, because you added the method= parameter to the RHEL 6 parameter file.
9. If all is well with the new NFS server on the cloner, you will see the following message. Start a VNC client session:

   ```
   11:52:02 Please manually connect your vnc client to gpok222.endicott.ibm.com:1
   (9.60.18.222) to begin the install.
   11:52:02 Starting graphical installation.
   ```

10. At the window asking for the type of devices, select **Basic Storage Devices** and click **Next**.

> **Important:** Again, as with the installation of the cloner, if the minidisks have not been formatted for Linux by **dasdfmt**, you should format them now, as described in 7.1.6, “Working around a known issue” on page 119. However, this time you only need to format dasdb and dasdc.

11. A warning window opens, as shown in Figure 8-1. Click **Re-initialize all**. The mindisks are formatted before Linux is copied to them.

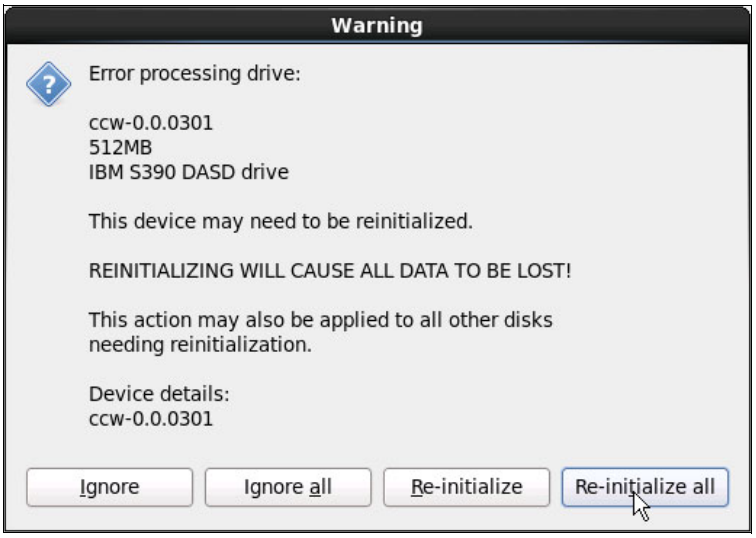


Figure 8-1 Disk initialization window

12. In the window that sets the host name, the value read from the configuration file should be correct. Click **Next**.
13. Set the time zone and click **Next**.
14. Set the root password and click **Next**.
15. In the type of installation window, select **Create Custom Layout** and click **Next**. It is important the you choose this option as described earlier.
16. In the Data Storage Devices and Install Target Devices window, move all disks to the Install Target Devices side by selecting each disk and clicking the right arrow. Click **Next**.
17. In the Please Select A Device window, click **Create**.
18. In the Create Storage window, choose **Standard Partition** and click **Create**.

19. In the Add Partition window, shown in Figure 8-2, set the Mount Point to the root file system (/), clear all drives except dasdb, and set the Size (MB) to 512. Click **OK**.

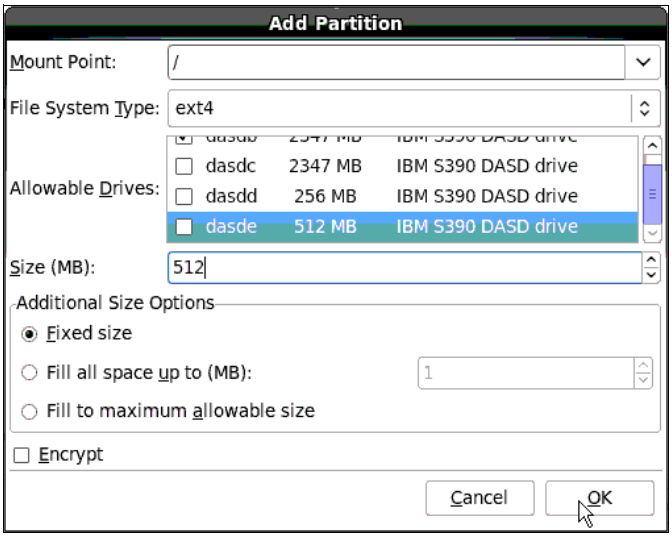


Figure 8-2 Defining the root file system

20. In the Create Storage window, choose **Standard Partition** and click **Create** again and create a 512 MB swap space, which is also on dasdb.
21. Again in the Create Storage window, click the partitions with a File System Type of physical volume (LVM) with the remainder of the space in dasdb (minidisk 100) and dasdc (minidisk 101).

22. Create partitions with a File System Type of swap with dasdd (virtual disk 300) and dasde (virtual disk 301). When you return to the Please Select A Device window, you should see the window shown in Figure 8-3.

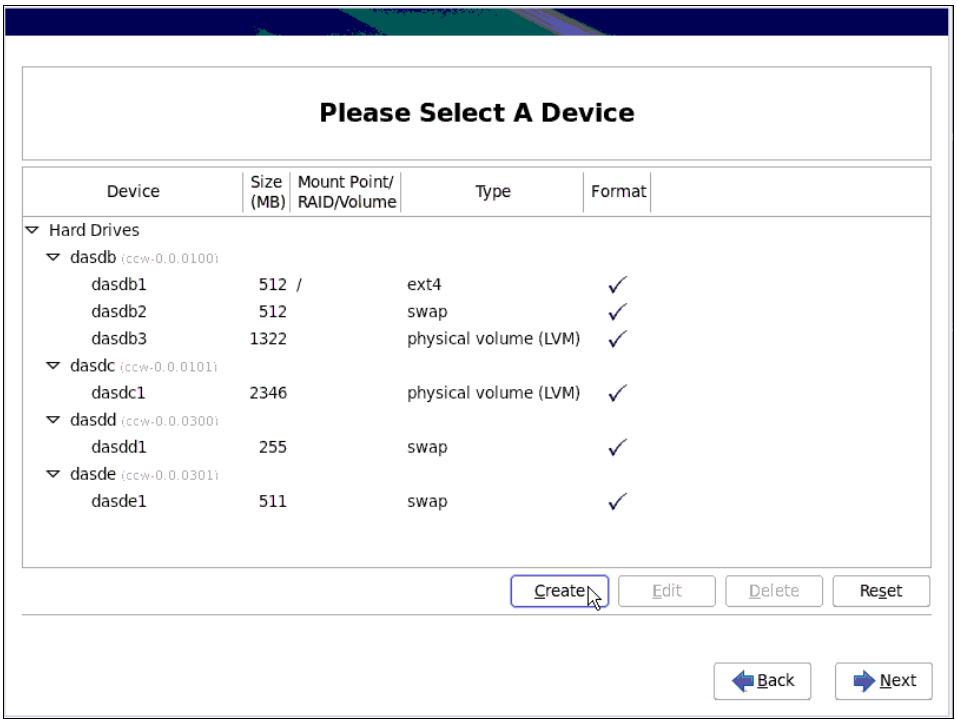


Figure 8-3 Defining file systems for logical volumes and swap spaces

23. Click **Create** and in the resulting Create Storage window, choose the **LVM** Volume Group and click **Create** again.

24. In the Make LVM Volume Group window, set the Volume Group Name to system_vg and click **Add**. Create logical volumes for file systems mounted at `/tmp`, `/opt`, `/var`, `/usr`, and `/`. See Table 8-2 for the recommended logical volume layout and sizes to be used for the golden image.

Table 8-2 LVM logical volume layout

Mount point	Logical Volume Name	Size (MB)
`/tmp/`	tmp_lv	384
`/opt/`	opt_lv	384
`/var/`	var_lv	384
`/usr/`	usr_lv	1536

This results in about 1 GB of free space remaining in the volume group, as shown in Figure 8-4.

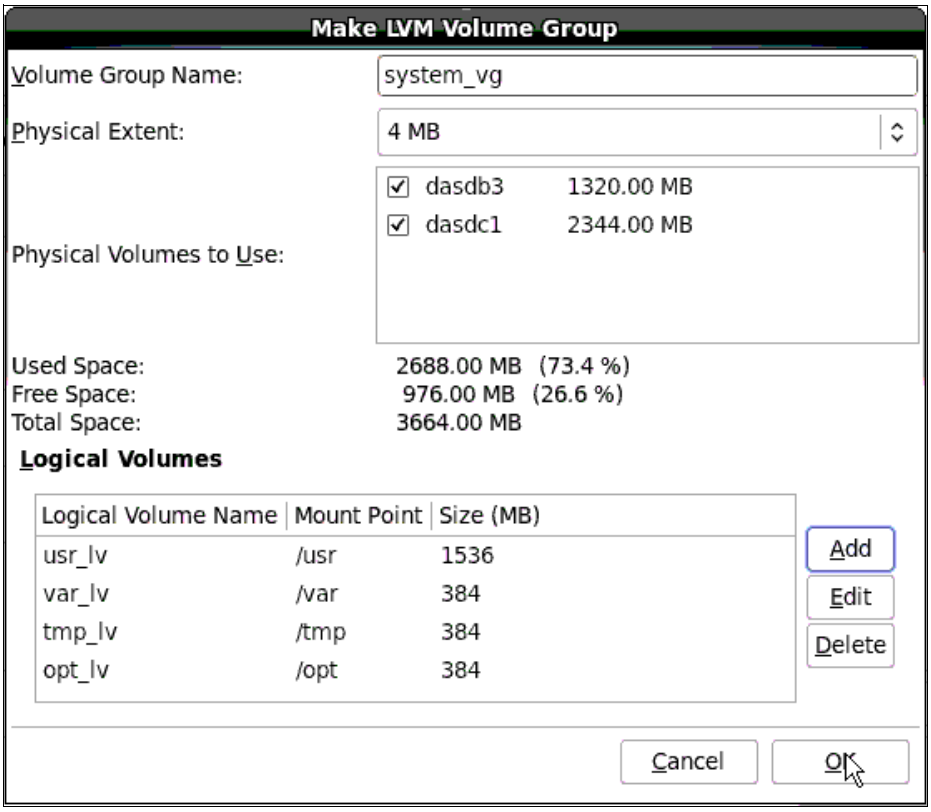


Figure 8-4 Defining a volume group and logical volumes

25. In the Please Select A Device window, click **Next** (Figure 8-5). You see a Format Warnings window. Click **Format**.

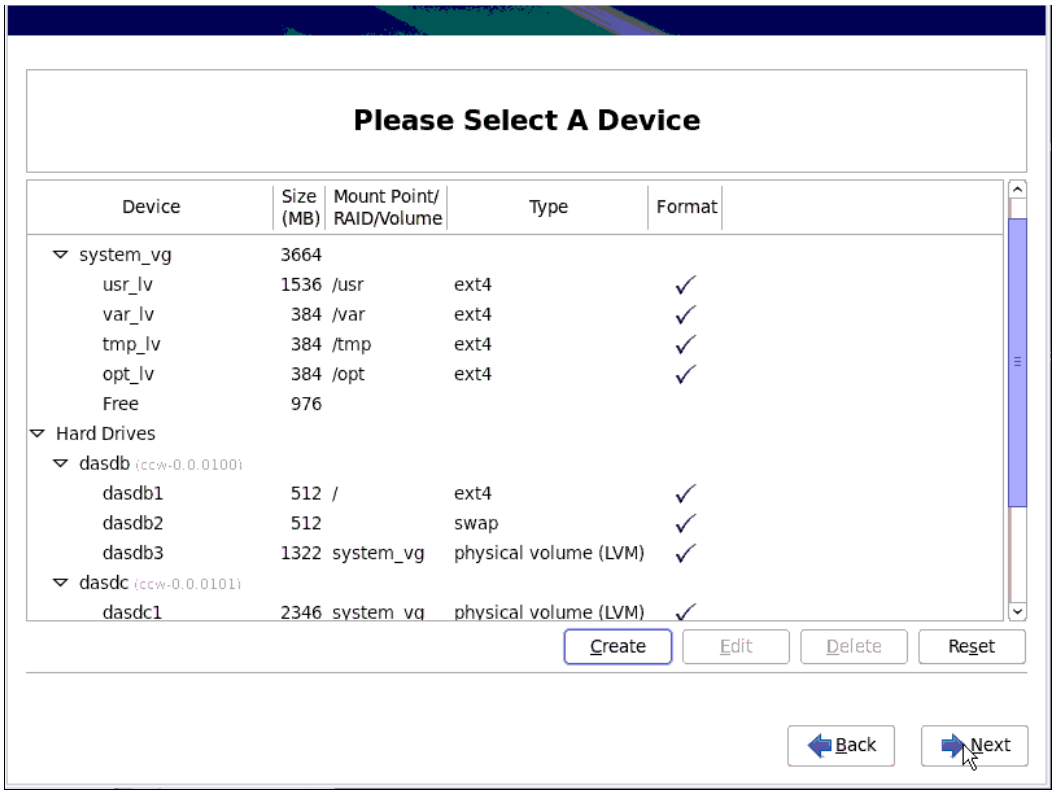


Figure 8-5 Summary of file systems and swap spaces

26. In the Writing storage configuration to disk window, click **Write changes to disk**.
27. In the Software options window, accept the default of **Basic Server** and click **Next**.
28. The installer will take about 5 to 10 minutes to install Linux. When complete, click **Reboot**. The system should be restarted from disk.
29. Start an SSH session to the golden image. You may see a warning from PuTTY about a “POTENTIAL SECURITY BREACH”. This is expected because a new set of SSH keys were generated for the same IP address. Click **Yes** to begin the session.

8.1.5 Verifying the installation

In this section, you verify some settings with the following commands. You should see an output similar to the following:

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0300   active      dasdb     94:4    FBA   512    256MB     524288
0.0.0301   active      dasdc     94:8    FBA   512    512MB     1048576
0.0.0101   active      dasdd     94:12   ECKD  4096   2347MB    600840
# swapon -s
Filename                                Type            Size    Used    Priority
/dev/dasda2                             partition       524296  0       -1
/dev/dasdb1                             partition       262132  0       -2
```

```
/dev/dasdc1                              partition       524276  0       -3
# mount
/dev/dasda1 on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/mapper/system_vg-opt_lv on /opt type ext4 (rw)
/dev/mapper/system_vg-tmp_lv on /tmp type ext4 (rw)
/dev/mapper/system_vg-usr_lv on /usr type ext4 (rw)
/dev/mapper/system_vg-var_lv on /var type ext4 (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           504M  146M  334M  31% /
tmpfs                 498M     0  498M   0% /dev/shm
/dev/mapper/system_vg-opt_lv
                      372M   17M  337M   5% /opt
/dev/mapper/system_vg-tmp_lv
                      372M   17M  337M   5% /tmp
/dev/mapper/system_vg-usr_lv
                      1.5G  789M  647M  55% /usr
/dev/mapper/system_vg-var_lv
                      372M   56M  298M  16% /var
```

This shows that the three swap spaces are active and all file systems are about half full or less.

8.2 Configuring the golden image

Now you want to customize the golden image as much as possible before cloning. The following high level steps are recommended, although you may add or omit some steps:

- “Configuring the automount of the installation tree” on page 148
- “Configuring the yum command for online updates” on page 149
- “Turning off unneeded services” on page 150
- “Configuring the VNC server” on page 151
- “Setting system to halt on SIGNAL SHUTDOWN” on page 151
- “Setting the system to log off when Linux is shut down” on page 151
- “Configuring SSH keys” on page 152
- “Changing the order of the swap disks” on page 152
- “Rebooting the system” on page 153
- “Verifying the changes” on page 153

8.2.1 Configuring the automount of the installation tree

You will now configure the Linux automount service to mount the installation tree on demand. The automounter automatically mounts a remote directory when it is accessed, and automatically unmount it after a period of inactivity.

To configure automount, perform the following steps:

1. Make a backup copy of the /etc/auto.master file and add the following line at the bottom:

```
# cd /etc
# cp auto.master auto.master.orig
# vi auto.master   // add one line at the bottom
...
#
+auto.master
/nfs    /etc/auto.cloner
```

2. The new line specifies that the file system mounted under the /nfs/ directory will be configured in the /etc/auto.cloner file. Now create the /etc/auto.cloner file, and add one line that points to the RHEL 6 installation tree that is NFS-exported from the cloner:

```
# vi auto.cloner
rhel6     -ro,hard,intr 9.60.18.223:/nfs/rhel6
```

   This line specifies that under /nfs/ (in auto.master), when the rhel6/ directory (field 1) is accessed, the automounter will use the specified options (field 2) to mount the directory (field 3).

3. Create the /nfs/ directory. Restart the autofs service to pick up the new configuration. List the contents of the /nfs/rhel6/ directory. Even though this directory does not exist as a local file system, it is automatically mounted when referenced:

```
# mkdir /nfs
# service autofs reload
Reloading maps
```

4. Show that the /nfs/rhel6/ directory is automatically mounted:

```
# ls /nfs/rhel6
boot.cat                  RELEASE-NOTES-es-ES.html  RELEASE-NOTES-pt-BR.html
EULA                      RELEASE-NOTES-fr-FR.html  RELEASE-NOTES-ru-RU.html
...
```

8.2.2 Configuring the yum command for online updates

You now configure the **yum** command so it can install RPMs from the automounted installation tree. The configuration is identical to the cloner because in both instances the installation tree is in the /nfs/rhel6/ directory. However, on the cloner, this directory is local, while on the golden image (and later the clones), the directory is automounted.

To configure the **yum** command, perform the following steps:

1. You could create a file named rhel6.repo in the /etc/yum.repos.d directory again, or you could copy the same file from the cloner that you created previously. In this example, the **scp** command is used to copy the file:

```
# cd /etc/yum.repos.d
# scp gpok223:/etc/yum.repos.d/rhel6.repo .
The authenticity of host 'gpok223 (9.60.18.223)' can't be established.
RSA key fingerprint is 37:5f:83:99:ba:9e:10:14:04:65:06:e1:11:d9:d9:cd.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'gpok223,9.60.18.223' (RSA) to the list of known
hosts.
root@gpok223's password:
rhel6.repo                                    100%   73     0.1KB/s   00:00
```

2. Enter the file to verify the contents:

```
# cat rhel6.repo
[RHEL6]
name=Red Hat Enterprise Linux 6
baseurl=file:///nfs/rhel6/Server
```

3. Import the RPM GPG key so that the **yum** command knows you are installing official Red Hat packages. The Red Hat GPG key is located in the installation tree. Import the key by using the following command:

```
# rpm --import /nfs/rhel6/RPM-GPG-KEY-redhat-release
```

The **yum** command should now be configured. It will be tested in the next section.

8.2.3 Turning off unneeded services

As with the golden image, perform the steps in 7.2.4, “Turning off unneeded services” on page 129.

Here is a summary:

```
# chkconfig iptables off
# chkconfig ip6tables off
# chkconfig auditd off
# chkconfig abrtd off
# chkconfig atd off
# chkconfig mdmonitor off
```

Verify that these service are turned off by using the **chkconfig --list** command:

```
# chkconfig --list | grep 3:on
autofs          0:off   1:off   2:off   3:on    4:on    5:on    6:off
cpi             0:off   1:on    2:on    3:on    4:on    5:on    6:off
cpuplugd        0:off   1:off   2:on    3:on    4:on    5:on    6:off
crond           0:off   1:off   2:on    3:on    4:on    5:on    6:off
dumpconf        0:on    1:on    2:on    3:on    4:on    5:on    6:on
haldaemon       0:off   1:off   2:off   3:on    4:on    5:on    6:off
lvm2-monitor    0:off   1:on    2:on    3:on    4:on    5:on    6:off
messagebus      0:off   1:off   2:on    3:on    4:on    5:on    6:off
mon_statd       0:off   1:off   2:on    3:on    4:on    5:on    6:off
netfs           0:off   1:off   2:off   3:on    4:on    5:on    6:off
network         0:off   1:off   2:on    3:on    4:on    5:on    6:off
nfslock         0:off   1:off   2:off   3:on    4:on    5:on    6:off
postfix         0:off   1:off   2:on    3:on    4:on    5:on    6:off
rhnsd           0:off   1:off   2:on    3:on    4:on    5:on    6:off
rpcbind         0:off   1:off   2:on    3:on    4:on    5:on    6:off
rpcgssd         0:off   1:off   2:off   3:on    4:on    5:on    6:off
rpcidmapd       0:off   1:off   2:off   3:on    4:on    5:on    6:off
rsyslog         0:off   1:off   2:on    3:on    4:on    5:on    6:off
sshd            0:off   1:off   2:on    3:on    4:on    5:on    6:off
sysstat         0:off   1:on    2:on    3:on    4:on    5:on    6:off
udev-post       0:off   1:on    2:on    3:on    4:on    5:on    6:off
```

8.2.4 Configuring the VNC server

Configure the VNC server the same way as you did on the cloner. Perform the same steps described in 7.2.5, “Configuring the VNC server” on page 130.

8.2.5 Setting system to halt on SIGNAL SHUTDOWN

Again, RHEL 6 reboots when a Ctrl-Alt-Del key sequence is pressed. This key sequence is simulated by z/VM when a SIGNAL SHUTDOWN command is issued. Rather than rebooting, you want your system to halt (shutdown).

Edit `/etc/init/control-alt-delete.conf` and change **`shutdown -r`** (reboot) to **`shutdown -h`** (halt):

```
# cd /etc/init
# vi control-alt-delete.conf
# control-alt-delete - emergency keypress handling
#
# This task is run whenever the Control-Alt-Delete key combination is
# pressed.  Usually used to shut down the machine.

start on control-alt-delete

exec /sbin/shutdown -h now "Control-Alt-Delete pressed"
```

This change will be processed when the system is rebooted.

8.2.6 Setting the system to log off when Linux is shut down

When Linux is shut down, the default is for the virtual machine to remain logged on even though it is not running an operating system. It is more convenient for the user ID to be logged off, both at z/VM SHUTDOWN time and to obtain a refreshed 3270 emulator session.

Edit the `/etc/rc.d/rc.local` file and add two lines at the end as follows:

```
# cd /etc/rc.d
# vi rc.local
#!/bin/sh
#
# This script will be executed *after* all the other init scripts.
# You can put your own initialization stuff in here if you don't
# want to do the full Sys V style init stuff.

touch /var/lock/subsys/local
chshut halt vmcmd logoff
chshut poff vmcmd logoff
```

The z/VM user ID should now be logged off when you halt or power off Linux.

8.2.7 Configuring SSH keys

Recall that you generated SSH keys on the cloner in 7.2.8, “Configuring SSH keys” on page 133. Now it is time to copy these keys from the cloner to the golden image.

Perform the following steps:

1. Create a new directory (if one does not already exist) on the golden image where the public key will be copied:

```
# cd /root
# mkdir .ssh
```

2. Set the permissions to 700 so that it can only be accessed by root:

```
# chmod 700 .ssh
```

3. Copy the public key to the authorized_keys name using the secure copy command (**scp**):

```
# scp 9.60.18.223:/etc/ssh/ssh_host_dsa_key.pub /root/.ssh/authorized_keys
The authenticity of host '9.60.18.223 (9.60.18.223)' can't be established.
RSA key fingerprint is c7:d6:3b:8c:20:57:06:fc:8c:71:80:a5:4f:72:47:38.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '9.60.18.223' (RSA) to the list of known hosts.
root@9.60.18.223's password:
ssh_host_dsa_key.pub                          100%  590     0.6KB/s   00:00
```

This action allows the cloner to initiate an encrypted SSH connection to the Linux server without needing to enter the root password.

8.2.8 Changing the order of the swap disks

It is likely that the order of swap space priority is not optimal. To change this configuration, perform the following commands:

1. View your order with the **swapon -s** command:

```
# swapon -s
Filename                                Type            Size    Used
Priority
/dev/dasda2                             partition       524296  0       -1
/dev/dasdb1                             partition       262132  0       -2
/dev/dasdc1                             partition       524276  0       -3
```

This output shows that the minidisk swap space will be used before the VDISK. As VDISKs are in-memory, they should be first in the priority, from smallest to largest.

2. Make a backup of the `/etc/fstab` file:

```
# cd /etc
# cp fstab fstab.orig
```

3. Modify the order by moving the line in `/etc/fstab` in the minidisk swap space below the lines with VDISK swap spaces:

```
# vi fstab
...
/dev/disk/by-path/ccw-0.0.0300-part1 swap                swap    defaults
0 0
/dev/disk/by-path/ccw-0.0.0301-part1 swap                swap    defaults
0 0
```

```
/dev/disk/by-path/ccw-0.0.0100-part2 swap                swap    defaults
0 0
...
```

After a reboot, the minidisk swap space should come back with the lowest priority.

8.2.9 Other configuration changes

You might consider other configuration changes. Of course, you can take an iterative approach: Start with this set of changes, clone some Linux images and test, then bring the golden image back up, make more changes, and re-clone.

Whether you are on the first pass of configuration or not, refer to the following sections to consider other changes for performance and availability related issues:

- 12.1, “Registering your system with RHN” on page 200
- 13.6, “Setting up Linux Memory Hotplugging” on page 222
- 13.8, “Hardware cryptographic support for OpenSSH” on page 227

8.2.10 Rebooting the system

Run the **reboot** command to test your changes:

```
# reboot
Broadcast message from root (pts/0) (Sun Nov 19 08:57:32 2006):

The system is going down for reboot NOW!
```

8.2.11 Verifying the changes

You are now done customizing the master Linux image. When the system comes back online, you should verify the changes that you made:

1. SSH back into the cloner and check a few settings.
2. Use the **df** command to display your file systems. Your output may differ:

```
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           504M  147M  332M  31% /
tmpfs                 498M     0  498M   0% /dev/shm
/dev/mapper/system_vg-opt_lv
                      372M   17M  337M   5% /opt
/dev/mapper/system_vg-tmp_lv
                      372M   17M  337M   5% /tmp
/dev/mapper/system_vg-usr_lv
                      1.5G  817M  619M  57% /usr
/dev/mapper/system_vg-var_lv
                      372M   85M  269M  24% /var
```

3. Confirm that both of your swap spaces are operational:

```
# swapon -s
Filename                                Type            Size    Used
Priority
/dev/dasdb1                             partition       262132  0       -1
/dev/dasdc1                             partition       524276  0       -2
/dev/dasda2                             partition       524296  0       -3
```

4. Verify the shutdown settings with the **lsshut** command:

```
# lsshut
Trigger          Action
=======================
Halt             vmcmd ("logoff")
Panic            stop
Power off        vmcmd ("logoff")
Reboot           reipl
```

5. You might choose to confirm other settings.

Congratulations! You have now successfully installed the golden image. This image will normally be shut down or quiesced. You are now ready to clone the golden image to a new virtual server.

9

Configuring RHEL 6 for cloning

At this point, you have completed the installation of RH6CLONE, the Linux cloner, and RH6GOLD, the golden image. The cloner must be up and running.

In this chapter, you perform the following steps:

9.1 Formatting DASD for minidisks

In 4.6.2, “Formatting DASD for minidisks” on page 53, DASD was formatted to become minidisks for the cloner and the golden image. The CPFMTXA command can be used to format one DASD at a time, but the CPFORMAT EXEC is a wrapper around CPFMTXA that allows the formatting of multiple DASD.

To have access to enough DASDs to define four more user IDs, LINUX01 - LINUX04, with two 3390-3 volumes each, eight 3390-3s will be needed. In the examples used in this book, 3390-9s are being used, and two thirds of the 63A9 volume is available. So only two more volumes are needed: 63AA and 63AB. Consult your worksheets in 2.7.2, “z/VM DASD worksheet” on page 17 to determine how many volumes you need for four new virtual machines.

To format DASD for minidisks, perform the following steps:

1. Logon to a 3270 session as MAINT.
2. Query the devices that will be used for the remaining Linux user IDs:

```
==> q 63aa-63ab
DASD 63AA FR63AA , DASD 63AB FR63AB
```

3. Attach the volumes to MAINT using the * wildcard:

```
==> att 63aa-63ab *
63AA-63AB ATTACHED TO MAINT
```

4. Invoke the CPFORMAT command against these volumes using the as perm parameter:

```
==> cpformat 63aa-63ab as perm
...

DASD status after:
TargetID Tdev OwnerID  Odev Dtype Vol-ID Rdev   StartLoc       Size
MAINT    63AA MAINT    63AA 3390  UM63AA 63AA          0      10017
MAINT    63AB MAINT    63AB 3390  UM63AB 63AB          0      10017
```

5. Detach the seven volumes from MAINT with the DETACH command:

```
==> det 63aa-63ab
63AA-63AB DETACHED
```

6. Attach the newly formatted DASDs to SYSTEM so they can be used for minidisks:

```
==> att 63aa-63ab system
DASD 63AA ATTACHED TO SYSTEM UM63AA
DASD 63AB ATTACHED TO SYSTEM UM63AB
```

The volumes will now be available to be used for minidisks in the `USER DIRECT` file. They will also be available after the next IPL because their new labels match the pattern specified by the `User_Volume_Include UM*` statement in the `SYSTEM CONFIG` file.

9.2 Defining a new user ID for a virtual server

In this section, you define a new user ID, LINUX01, in z/VM and clone the golden image to it. To do so, perform the following steps:

1. Logon to MAINT and edit the `USER DIRECT` file to add more Linux IDs:

   ```
   ==> x user direct c
   ```

2. Go to the bottom of the file and add the following five lines. In this example, the user ID is LINUX01 with a password of LNX4VM. It defaults to 256 MB of memory, but can be set up to 1 GB. It has only G (General user) privileges. It has two 3338 cylinder (about 2.2 GB each) minidisks. In this example, they are located at the 63A9 device address, which was formatted and given a label of UM63A9:

   ```
   USER LINUX01 LNX4VM 256M 1G G
    INCLUDE LNXDFLT
    OPTION APPLMON
    MDISK 100 3390 3339 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
    MDISK 101 3390 6677 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
   ```

3. You might need to add the new volumes to the $ALLOC$ user ID so cylinder 0 will not show up in the disk map as a gap.

4. Again, check for gaps and overlaps. You can use the ALL subcommand with the logical OR operator “|” to check for both strings. You should see only one 501 cylinder gap.

   ```
   ==> diskmap user
   ==> x user diskmap
   ====> all /gap/|/overlap/
   -------------------  4  line(s) not displayed --------------------
                                              0         500         501    GAP
   -------------------  368  line(s) not displayed --------------------
   ====> quit
   ```

5. Bring the changes online using the DIRECTXA command:

   ```
   ==> directxa user
   z/VM USER DIRECTORY CREATION PROGRAM - VERSION 5 RELEASE 3.0
   EOJ DIRECTORY UPDATED AND ON LINE
   ```

The new Linux user ID has now been defined.

9.2.1 Adding LINUX01 to AUTOLOG1’s PROFILE EXEC

The new Linux ID you defined needs access to the VSWITCH. A SET VSWITCH command with the GRANT parameter can be added to AUTOLOG1 PROFILE EXEC to accomplish this task. Also, an XAUTOLOG statement can be added if the user ID is automatically logged on at z/VM IPL time.

Link and access the AUTOLOG1 191 disk in read/write mode and edit the `PROFILE EXEC` file. Add LINUX01 to the sections that grant access to the VSWITCH and that use XAUTOLOG on the Linux user IDs:

```
==> link autolog1 191 1191 mr
==> acc 1191 f
==> x profile exec f   // add two lines
/*************************/
/*  Autolog1 Profile Exec  */
/*************************/
```

```
'cp xautolog tcpip'                /* start up TCPIP */
'CP XAUTOLOG DTCVSW1'              /* start VSWITCH controller 1 */
'CP XAUTOLOG DTCVSW2'              /* start VSWITCH controller 2 */
'cp set pf12 ret'                  /* set the retrieve key */
'cp set mdc stor 0m 128m'          /* Limit minidisk cache in CSTOR */
'cp set mdc xstore 0m 0m'          /* Disable minidisk cache in XSTOR */
'cp set srm storbuf 300% 250% 200%' /* Overcommit memory */
'cp set signal shutdown 300'       /* Allow guests 5 min to shut down */

/* Grant access to VSWITCH for each Linux user */
'cp set vswitch vsw1 grant rh6clone'
'cp set vswitch vsw1 grant rh6gold'
'cp set vswitch vsw1 grant linux01'

/* XAUTOLOG each Linux user that should be started */
'cp xautolog rh6clone'
'cp xautolog linux01'

'cp logoff'                         /* logoff when done */
====> file
```

These changes will not take effect until the next IPL, so you must grant this user ID access to the VSWITCH for this z/VM session:

```
==> set vswitch vsw1 grant linux01
Command complete
```

9.3 Cloning a virtual server manually

Before using the clone script to clone a server, you should clone a server manually to better understand the process.

There are many ways to clone Linux under z/VM. The steps in this section are just one way to do it. The following assumptions are made based on what you have done so far:

- The source user ID, RH6GOLD in this example, has a root file system on LVM, located on minidisks 100-101.
- The target user ID, LINUX01 in this example, has identically sized mindisks 100-101.
- The **vmcp** command is available to issue z/VM CP commands
- The z/VM FLASHCOPY command can be used, but if you do not have that support, the Linux **dd command** will work.

Given these assumptions, one set of steps that can be used to clone a system is as follows:

1. Link the source disks as read-only.
2. Link the target disks as read/write.
3. Copy the source to the target disk with FLASHCOPY or the Linux **dd** command.
4. Detach the source disks.
5. Bring the newly copied LVM online.
6. Mount the newly copied root file system.
7. Modify the networking information on the target system.

8. Detach the target disks.
9. Perform an IPL of the target system.
10. Modify the SSH keys on the target system.

Linking the source and target disks

Start an SSH session to the cloner as root.

The source disks, RH6GOLD 100-101, are linked as read-only virtual devices 1100 and 1101 with the CP LINK command:

```
# vmcp link rh6gold 100 1100 rr
# vmcp link rh6gold 101 1101 rr
```

The target disks, LINUX01 100-101, are linked as multi-read (read/write if no other user ID has write access) as virtual devices 2100 and 2101:

```
# vmcp link linux01 100 2100 mr
# vmcp link linux01 101 2101 mr
```

Copying the source to the target disk with FLASHCOPY

The two disks are copied with the CP FLASHCOPY command:

```
# vmcp flashcopy 1100 0 end to 2100 0 end
Command complete: FLASHCOPY 1100 0 END TO 2100 0 END
# vmcp flashcopy 1101 0 end to 2101 0 end
Command complete: FLASHCOPY 1101 0 END TO 2101 0 END
```

Attention: If you do not have FLASHCOPY support, you can use the Linux **dasdfmt** and **dd** commands. You must first enable the 1100-1101 and 2100-2101 disks with the **chccwdev -e** command, then determine the newly created device nodes with the **lsdasd command**:

```
# chccwdev -e 1100-1101,2100-2101
Setting device 0.0.1100 online
Done
...
# lsdasd
...
0.0.1100   active      dasdf     94:20   ECKD  4096   2347MB    600840
0.0.1101   active      dasdg     94:24   ECKD  4096   2347MB    600840
0.0.2100   active      dasdh     94:28   ECKD  4096   2347MB    600840
0.0.2101   active      dasdi     94:32   ECKD  4096   2347MB    600840
```

In this example, the source minidisks (1100-1101) are named `/dev/dasdf` and `/dev/dasdg`, while the target minidisks (2100-2101) are named `/dev/dasdh` and `/dev/dasdi`. Format the target devices with the **dasdfmt** command using a 4096 byte (4 KB) block size:

```
# dasdfmt -b 4096 -y -f /dev/dasdh
Finished formatting the device.
Rereading the partition table... ok
# dasdfmt -b 4096 -y -f /dev/dasdi
...
```

Now that the devices have been formatted, you can copy the volumes of the golden image with the **dd** command, again using a block size of 4 KB (4096) bytes:

```
# dd if=/dev/dasdf of=/dev/dasdh bs=4096
...
# dd if=/dev/dasdg of=/dev/dasdi bs=4096
...
```

Bring the devices offline so the new file systems will be recognized when brought back online:

```
# chccwdev -d 1100-1101,2100-2101
...
```

Detaching the source disks

Now that you no longer need the source disks linked, detach them:

```
# vmcp det 1100-1101
1100-1101 DETACHED
```

Activating the target disk with the root file system

Activate the minidisk at real device address 2100, which has the root file system in the first partition:

```
# chccwdev -e 2100
Setting device 0.0.2100 online
Done
```

Mounting the newly copied root file system

To mount the newly copied root file system, perform the following steps:

1. Use the **lsdasd** command to show the minidisks that are accessible. The target root file system is on the disk accessed as virtual device address 2100.

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0300   active      dasdb     94:4    FBA   512    256MB     524288
0.0.0301   active      dasdc     94:8    FBA   512    512MB     1048576
0.0.0101   active      dasdd     94:12   ECKD  4096   2347MB    600840
0.0.0102   active      dasde     94:16   ECKD  4096   2347MB    600840
0.0.2100   active      dasdf     94:20   ECKD  4096   2347MB    600840
0.0.2101   active      dasdg     94:24   ECKD  4096   2347MB    600840
```

2. The device is `/dev/dasdf` and the first partition is `/dev/dasdf1`. Make a new mount point, `/mnt/linux01`, for the LINUX01 root file system and mount it there:

```
# cd /mnt
# mkdir linux01
# mount /dev/dasdf1 linux01/
```

Observe that this appears to be a root file system:

```
# cd linux01
# ls
bin   cgroup  etc   lib    lost+found  misc  net  opt   root  selinux  sys  usr
boot  dev     home  lib64  media       mnt   nfs  proc  sbin  srv      tmp  var
```

Modifying networking information about the target system

In this example, the only two pieces of networking information that are modified are the IP address and the host name. The two important files are `/etc/sysconfig/network` and `/etc/sysconfig/network-scripts/ifcfg-eth0`.

Perform the following steps:

1. Observe the contents of these files:

```
# cat /etc/sysconfig/network
NETWORKING=yes
HOSTNAME=gpok223.endicott.ibm.com
GATEWAY=9.60.18.129
# cat /etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE="eth0"
BOOTPROTO="static"
DNS1="9.0.3.1"
DOMAIN="endicott.ibm.com"
GATEWAY="9.60.18.129"
IPADDR="9.60.18.223"
MTU="1500"
NETMASK="255.255.255.128"
NETTYPE="qeth"
NM_CONTROLLED="yes"
ONBOOT="yes"
OPTIONS="layer2=0 portno=0"
PORTNAME="DONTCARE"
SUBCHANNELS="0.0.0600,0.0.0601,0.0.0602"
```

2. Change the host name in the /etc/hosts file:

```
# cd /mnt/linux01/etc/sysconfig
# vi network
NETWORKING=yes
HOSTNAME=gpok224.endicott.ibm.com
GATEWAY=9.60.18.129
```

3. Change the IP address in the /etc/sysconfig/network-scripts/ifcfg-eth0 file:

```
# cd network-scripts
# vi ifcfg-eth0
DEVICE="eth0"
BOOTPROTO="static"
DNS1="9.0.3.1"
DOMAIN="endicott.ibm.com"
GATEWAY="9.60.18.129"
IPADDR="9.60.18.224"
MTU="1500"
NETMASK="255.255.255.128"
NETTYPE="qeth"
NM_CONTROLLED="yes"
ONBOOT="yes"
OPTIONS="layer2=0 portno=0"
PORTNAME="DONTCARE"
SUBCHANNELS="0.0.0600,0.0.0601,0.0.0602"
```

Unmounting and detaching the target disk

Now that the target disks have been copied and modified, they can be detached. Perform the following steps:

1. Change to the default directory with the **cd** command, use the **sync** command to flush the disks, and use the **umount** command to unmount the modified root file system:

```
# cd
# sync
# umount /mnt/linux01
```

2. Set the LINUX01 1100-1101 disks offline with the **chccwdev** command and detach them using the CP DETACH command:

```
# vmcp det 2100
2100 DETACHED
```

You should now be ready to perform an IPL of the manually cloned system.

Performing an IPL of the target system

Log on to a 3270 session as LINUX01. CMS will undergo an IPL and the PROFILE EXEC file will ask you if you want to perform an IPL from minidisk 100. Type y for yes and Linux should boot. Look for the modified host name (gpok224 in this example):

```
LOGON LINUX01
NIC 0600 is created; devices 0600-0602 defined
z/VM Version 6 Release 1.0, Service Level 1002 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 15:27:24 EDT MONDAY 10/04/10
z/VM V6.1.0    2010-09-23 11:31
```

```
DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
y
zIPL v1.8.2-28.el6 interactive boot menu

 0. default (linux)

 1. linux

Note: VM users please use '#cp vi vmsg <input>'

Please choose (default will boot in 5 seconds):
Booting default (linux)...
Initializing cgroup subsys cpuset
Initializing cgroup subsys cpu
Linux version 2.6.32-71.el6.s390x (mockbuild@s390-004.build.bos.redhat.com) (gcc
 version 4.4.4 20100726 (Red Hat 4.4.4-13) (GCC) ) #1 SMP Wed Sep 1 01:38:33 EDT
 2010
setup: Linux is running as a z/VM guest operating system in 64-bit mode
...
gpok224 login:
```

Your new system should come up cleanly using the modified IP address and host name. If it does, then congratulations! You have now cloned a Linux system manually. You can look around the new system. It should be identical to the golden image except for the IP address and host name.

Next you will learn how to clone a Linux system automatically. You will use the LINUX01 user ID again. To clone, the target user ID must be logged off. You could shut the new system down cleanly, but because you will be cloning again, it does not matter. Go to the 3270 session and log off the LINUX01 user ID:

```
==> #cp log
```

9.4 Cloning a new virtual server

Now that you have cloned a server manually and better understand the steps, you can use the clone script to clone automatically.

9.4.1 Using the /etc/sysconfig/clone configuration file

The `/etc/sysconfig/clone` configuration file can be used to change global settings. The following variables can be set:

```
# cat /etc/sysconfig/clone
# AUTOLOG - If set to "y" the script will autolog the cloned
#           image after the cloning is completed.  If it is
#           set to "n" the image will not autolog the cloned
#           image.
AUTOLOG=y
```

```
# PROMPT  - This will set if the script should prompt the user for
#           confirmation before cloning.  If set to "y" the user
#           will be prompted to continue.  If set to "n" the script
#           will run without confirmation.
PROMPT=y

# CLONE_MNT_PT - This specifies the location on the filesystem
#                that the cloned root filesystem should be mounted
#                to.  If the directory does not exist it will be
#                created the first run.
CLONE_MNT_PT=/mnt/clone

# CLONE_METHOD - This is used to determine what method you want to use
#                for cloning.  It can have a value of AUTO, which will first
#                attempt FLASHCOPY then fall back to dd, or DD which will
#                only try to perform a Linux dd command.
CLONE_METHOD=auto

# BLACKLIST    - List of z/VM user IDs forbidden to be used as clone targets.
#                It's a good idea to add your master server here, so it doesn't
#                become a clone target by mistake.
#                Format: BLACKLIST="userA userB userC ..."
BLACKLIST=""
```

In the following example, this file is not modified, so all the defaults are present.

9.4.2 Creating a configuration file for LINUX01

For each Linux guest you want to clone, you must create a configuration file that you can use to customize the image after cloning. Perform the following steps on the RH6CLONE installation server:

1. Open an SSH session to RH6CLONE as root.
2. Install the clone script RPM:

```
# rpm -ivh /nfs/virt-cookbook-RH6/clone-1.0-10.s390x.rpm
Preparing...                ########################################### [100%]
   1:clone                  ########################################### [100%]
```

3. Copy and then edit the supplied sample configuration file to reflect the values of the new Linux system:

```
# cd /etc/clone
# cp rhel.conf.sample linux01.conf
```

4. Edit the new configuration file with the appropriate values for your system. If the new Linux image is going to be on the same network as the golden image, you are likely to only have to change two variables: the Internet Protocol (IP) address (IPADDR) and the Domain Name System (DNS) name (HOSTNAME). In the following example, the IP address is set to 9.60.18.224 and the DNS name to gpok224.endicott.ibm.com.

```
# vi linux01.conf
# Define the DASD that should be included as a part
# of the clone.
DASD=100,101            1
DASD_ROOT=100           2
VG_NAME=                3
LV_ROOT=                4
```

```
# Define networking information that will be used for the host.
IPADDR=9.60.18.224
SUBCHANNELS=0.0.0600,0.0.0601,0.0.0602
HOSTNAME=gpok224.endicott.ibm.com
NETTYPE=qeth
NETMASK=255.255.255.128
NETWORK=9.60.18.128
SEARCHDNS=endicott.ibm.com
BROADCAST=9.60.18.255
GATEWAY=9.60.18.129
DNS=9.0.2.11
MTU=1500
```

Note the following points for the numbers in black above:

1 This is the range of minidisks that will be copied. You can enter dashes (-) or commas (,) to specify address ranges or specific disks, respectively. Make sure that the range following `DASD=` is one continuous block of text with no spaces added.

2 This is the minidisk that contains the root file system.

3 If the root file system of the golden image is on a logical volume, specify the volume group name here.

4 If you specified a value for **3** above (`VG_NAME`), specify the logical volume name of the root file system.

5. Save the file and log off root.
6. Log in to LINUX01.
7. Answer `n` to the question `Do you want to IPL Linux from minidisk 100? y/n`. Verify that the minidisks at addresses 100 and 101 and the VDISK at addresses 300 and 301 are set to read/write with the QUERY DASD command:

```
==> q da
00: DASD 0100 3390 UM63A9 R/W       3338 CYL ON DASD  63A9 SUBCHANNEL = 0000
00: DASD 0101 3390 UM63A9 R/W       3338 CYL ON DASD  63A9 SUBCHANNEL = 0001
00: DASD 0190 3390 610RES R/O        107 CYL ON DASD  6280 SUBCHANNEL = 0009
00: DASD 0191 3390 UM6289 R/O        300 CYL ON DASD  6289 SUBCHANNEL = 000C
00: DASD 019D 3390 UV6283 R/O        146 CYL ON DASD  6283 SUBCHANNEL = 000A
00: DASD 019E 3390 UV6283 R/O        250 CYL ON DASD  6283 SUBCHANNEL = 000B
00: DASD 0300 9336 (VDSK) R/W     524288 BLK ON DASD  VDSK SUBCHANNEL = 000E
00: DASD 0301 9336 (VDSK) R/W    1048576 BLK ON DASD  VDSK SUBCHANNEL = 000F
00: DASD 0592 3390 UV6284 R/O         70 CYL ON DASD  6284 SUBCHANNEL = 000D
```

8. Log off LINUX01.

You are now be ready to clone Linux to this new user ID.

9.4.3 Using the clone script

To use the clone script, perform the following steps:

1. Go back to your SSH session to the controller.
2. Verify that the clone script is in your PATH using the **`which`** command:

```
# which clone
/usr/sbin/clone
```

The clone script can operate in two modes: where the DASD information is provided on the command line, and where the DASD information is included in the new user ID's configuration file. Running **clone** with no arguments prints a usage message as follows:

```
# clone
Usage: clone [-v] sourceID targetID [rootMinidisk [minidisk1 minidisk2..]]
    Switches
       -v Verbose output
    Required
       sourceID the z/VM user id you want to clone from
       targetID  the z/VM user id you want to clone to
    Optional
       rootMinidisk the minidisk address that contains the root filesystem
       minidisk1..n additional minidisks that should be copied
```

The sourceID is the z/VM ID of the master Linux image and targetID is the z/VM ID of the target (LINUX01 in this example). These values are *always* required.

In the following examples, DASD is set to 100-101, which implies that minidisks located at virtual addresses 100 and 101 are copied. The 300 and 301 VDISKs are omitted because SWAPGEN automatically creates them each time the user logs on. The DASD_ROOT value specifies which one of these minidisks contains the Linux root file system (/).

The script exits if either the golden image or the clone image is logged in. The script first attempts to copy the disks with FLASHCOPY via the **vmcp module** command. If an error is returned, the script falls back to using Linux **dasdfmt** and **dd** commands. Finally, the script boots the new Linux image via the **xautolog** command.

It takes less than a minute to clone with FLASHCOPY support and 3 to 20 minutes with **dd**. Here is an example of cloning from RHEL52 to LINUX01 with FLASHCOPY support. The example uses the verbose switch (-v) to clarify its actions.

```
# clone -v rh6gold linux01
Invoking CP command: QUERY rh6gold
Invoking CP command: QUERY linux01

This will copy disks from rh6gold to linux01
Host name will be:  gpok224.endicott.ibm.com
IP address will be: 9.60.18.224
Do you want to continue? (y/n): y
```

The script makes sure the golden image (source) user ID and the target user ID exist and are logged off. It then confirms the order of the cloning and displays information collected from the `/etc/clone/linux01.conf` file. It then asks if you are sure you want to overwrite the disks on the target user ID.

Next, the script links to the master clone minidisk and the target minidisk. The master minidisks are linked to RH6CLONE at virtual address FFFE, and the target minidisks are linked as FFFF. The FFFE links are read-only and the FFFF links are read-write. With the links in place, the script issues a FLASHCOPY command to copy the source 100 and 101 minidisks to the target 100 and 101 minidisks. The script then detaches the links. If FLASHCOPY fails, the script falls back to the Linux **dasdfmt** and **dd** commands.

```
Cloning rh6gold to linux01 ...
Copying minidisks...
Invoking CP command: QUERY VIRTUAL fffe
Invoking CP command: LINK rh6gold 100 fffe RR
Invoking CP command: QUERY VIRTUAL ffff
```

```
Invoking CP command: LINK linux01 100 ffff W
Invoking CP command: FLASHCOPY fffe 0 END ffff 0 END
100 disk copied ...
Invoking CP command: DETACH fffe
Invoking CP command: DETACH ffff
Invoking CP command: QUERY VIRTUAL fffe
Invoking CP command: LINK rh6gold 101 fffe RR
Invoking CP command: QUERY VIRTUAL ffff
Invoking CP command: LINK linux01 101 ffff W
Invoking CP command: FLASHCOPY fffe 0 END ffff 0 END
101 disk copied ...
Invoking CP command: DETACH fffe
Invoking CP command: DETACH ffff
```

The root file system is mounted to `/mnt/clone` and the networking information is modified in `/mnt/clone/etc/sysconfig/network/ifcfg-eth0`, `/mnt/clone/etc/sysconfig/network`, and `/mnt/clone/etc/hosts`:

```
Updating cloned image ...
Invoking CP command: QUERY VIRTUAL ffff
Invoking CP command: LINK linux01 100 ffff W
Modifying networking info under /mnt/clone...
Regenerating SSH keys in /mnt/clone/etc/ssh/ ...
Invoking CP command: DETACH ffff
Invoking CP command: XAUTOLOG linux01
Booting linux01
Successfully cloned rh6gold to linux01
```

Then the SSH keys are regenerated in such a way that they are unique for the new virtual server. The new root file system is then unmounted, set offline, and detached. In the final section, the LINUX01 user ID is logged on via XAUTOLOG. Because the shared `PROFILE EXEC` file detects that the user ID is in a disconnected mode, it carries out an IPL of Linux from minidisk 100.

You may want to SSH into the newly cloned Linux server.

Note: If the clone script fails, you can check that:

- The configuration contains all of the correct information in `/etc/clone/`.
- No other users have links to the clone's read-write disks.

A block diagram of this process is shown in Figure 9-1.

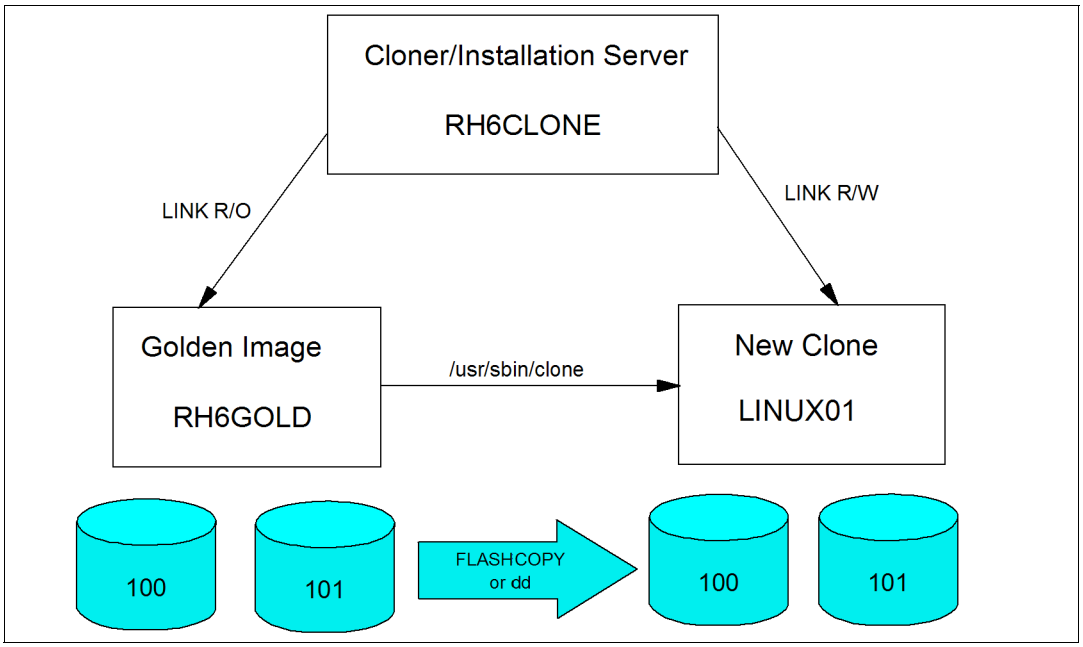


Figure 9-1 Cloning block diagram

The top of the figure shows the Linux cloner/installation server that is running on the RH6CLONE user ID. To use FLASHCOPY or **dd**, the RH6CLONE user ID requires a LINK to the source minidisks that RH6GOLD owns and the destination minidisks that LINUX01 owns. The figure shows that the LINK statement is issued as read-only (RR) for the source and read/write (W) for the target. The VDISK-based swap spaces at virtual addresses 300 and 301 are defined in-memory, so they do not need to be copied.

9.5 Defining three more virtual machines

So far, you have installed Linux manually twice onto RH6CLONE and RH6GOLD. You have created a new user ID named LINUX01 and cloned to it. Now it is time to prepare for more cloning of each of the virtual servers described in the remaining chapters.

The following steps are performed:

- “Defining three more user IDs” on page 168
- “Creating three new configuration files” on page 170
- “Adding new virtual machines to the startup process” on page 171
- “Testing logging on to a new user ID” on page 172

9.5.1 Defining three more user IDs

Define three more user IDs for Linux virtual servers. Perform the following steps:

1. Log on to MAINT.

2. Edit the `USER DIRECT` file and create three new sections, that is, LINUX02, LINUX03, and LINUX04. You need to use the DASD volumes you just formatted, with two for each virtual server. You can repeat the definition of LINUX01 three times with the block copy **""3** prefix command. For example:

```
==> x user direct
====> /user linux01
...
""3   *
02142 USER LINUX01 LNX4VM 256M 1G G
02143  INCLUDE LNXDFLT
02144  OPTION APPLMON
02145  MDISK 100 3390 0001 3338 <UM63A9> MR LNX4VM LNX4VM LNX4VM
""     MDISK 101 3390 0001 3338 <UM3F09> MR LNX4VM LNX4VM LNX4VM
```

3. This will create three more copies of the LINUX01 user definition. Modify them to have a user ID of LINUX02, LINUX03, and LINUX04, and give each one the correct DASD labels:

```
USER LINUX02 LNX4VM 256M 1G G
 INCLUDE LNXDFLT
 OPTION APPLMON
 MDISK 100 3390 0001 3338 UM63AA MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 3339 3338 UM63AA MR LNX4VM LNX4VM LNX4VM
*
USER LINUX03 LNX4VM 256M 1G G
 INCLUDE LNXDFLT
 OPTION APPLMON
 MDISK 100 3390 6677 3338 UM63AA MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 0001 3338 UM63AB MR LNX4VM LNX4VM LNX4VM
*
USER LINUX04 LNX4VM 256M 1G G
 INCLUDE LNXDFLT
 OPTION APPLMON
 MDISK 100 3390 3339 3338 UM63AB MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 6677 3338 UM63AB MR LNX4VM LNX4VM LNX4VM
*
```

4. Go to the top of the file and find the definition for the $ALLOC$ user. Add dummy definitions for cylinder 0 of each of the new volumes and save the changes. In this example, two volumes are added, UM63AA and UM63AB:

```
====> top
====> /alloc
USER $ALLOC$  NOLOG
 MDISK A01 3390 000 001 610RES R
 MDISK A02 3390 000 001 UV6283 R
 MDISK A03 3390 000 001 UV6284 R
 MDISK A04 3390 000 001 UM6289 R
 MDISK A05 3390 000 001 UM6290 R
 MDISK A06 3390 000 001 UM6293 R
 MDISK A07 3390 000 001 UM6294 R
 MDISK A08 3390 000 001 UM63A2 R
 MDISK A09 3390 000 001 UM63A9 R
 MDISK A0A 3390 000 001 UM63AA R
 MDISK A0B 3390 000 001 UM63AB R
====> file
```

5. Check for overlaps and the single gap. Run **quit** to leave the USER DISKMAP file:

```
==> diskmap user
==> x user diskmap
====> pre off
====> all /gap/|/overlap/
                                          0         500         501    GAP
--------------------  6  line(s) not displayed --------------------
                                          0           0           1    GAP
--------------------  388  line(s) not displayed --------------------
====> quit
```

6. Bring the changes online using the DIRECTXA USER command:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 45 disk pages
```

You have now created three new user IDs that can be cloned to.

9.5.2 Creating three new configuration files

A new parameter must be created for each of the user IDs with the proper networking information. Perform the following steps:

1. Log off of MAINT and log on to LNXMAINT.
2. Copy the RH6GOLD parameter file three times:

```
==> copy rh6gold parm-rh6 d linux02 = =
==> copy rh6gold parm-rh6 d linux03 = =
==> copy rh6gold parm-rh6 d linux04 = =
```

3. Edit each of the three files and replace the name of the configuration file:

```
==> x linux02 parm-rh6 d
root=/dev/ram0 ro ip=off ramdisk_size=40000
CMSDASD=191 CMSCONFFILE=LINUX02.CONF-RH6
vnc
```

4. Copy the RH6GOLD configuration file three times:

```
==> copy rh6gold conf-rh6 d linux02 = =
==> copy rh6gold conf-rh6 d linux03 = =
==> copy rh6gold conf-rh6 d linux04 = =
```

5. Edit each of the three files replacing the host name and IP address. In the following example, the LINUX02 CONF-RH6 file is modified:

```
==> x linux02 conf-rh6 d
DASD=100-101,300-301
HOSTNAME=gpok225.endicott.ibm.com
NETTYPE=qeth
IPADDR=9.60.18.225
SUBCHANNELS=0.0.0600,0.0.0601,0.0.0602
NETMASK=255.255.255.128
SEARCHDNS=endicott.ibm.com
GATEWAY=9.60.18.129
DNS=9.0.3.1
MTU=1500
PORTNAME=DONTCARE
```

```
PORTNO=0
LAYER2=0
```

You should now have three new parameter files and three new configuration files.

9.5.3 Adding new virtual machines to the startup process

Modify the `PROFILE EXEC` file on AUTOLOG1 191 to grant access to the VSWITCH for the three new user IDs and add XAUTOLOG commands so they boot when you perform an IPL of z/VM system.

Perform the following steps:

1. Link and access the AUTOLOG1 191 disk so the file can be modified from MAINT:

```
==> link autolog1 191 1191 mr
==> acc 1191 f
```

- Edit the `PROFILE EXEC` file and add three new SET VSWITCH commands and three new XAUTOLOG commands:

```
==> x profile exec f
...
/* Grant access to VSWITCH for each Linux user */
'cp set vswitch vsw1 grant rh6clone'
'cp set vswitch vsw1 grant rh6gold'
'cp set vswitch vsw1 grant rh6gold2'
'cp set vswitch vsw1 grant linux01'
'cp set vswitch vsw1 grant linux02'
'cp set vswitch vsw1 grant linux03'
'cp set vswitch vsw1 grant linux04'

/* XAUTOLOG each Linux user that should be started */
'cp xautolog rh6clone'
'cp xautolog linux01'
'cp xautolog linux02'
'cp xautolog linux03'
'cp xautolog linux04'

'cp logoff'                          /* logoff when done */
* * * End of File * * *

====> file
```

2. Grant access to the new user IDs for the current z/VM session with the SET VSWITCH command:

```
==> set vswitch vsw1 grant linux02
Command complete
==> set vswitch vsw1 grant linux03
Command complete
==> set vswitch vsw1 grant linux04
Command complete
```

3. Verify that the new user IDs have access with the QUERY VSWITCH ACCESSLIST command:

```
==> query vswitch vsw1 acc
VSWITCH SYSTEM VSW1     Type: VSWITCH Connected: 4 Maxconn: INFINITE
  PERSISTENT  RESTRICTED    NONROUTER                 Accounting: OFF
```

```
  VLAN Unaware
  State: Ready
  IPTimeout: 5         QueueStorage: 8
Portname: UNASSIGNED RDEV: 3004 Controller: DTCVSW1 VDEV:  3004
  Portname: UNASSIGNED RDEV: 3008 Controller: DTCVSW2 VDEV:  3008 BACKUP
    Authorized userids:
      LINUX01  LINUX02  LINUX03  LINUX04 RH6CLONE RH6GOLD
      SYSTEM
    ...
```

9.5.4 Testing logging on to a new user ID

You should now be able to log on to a new user ID and verify the integrity of the definitions.

Perform the following steps

1. Log on to LINUX02 and you should first notice that a NIC is created as well as two VDISKs:

```
LOGON  LINUX02
00: NIC 0600 is created; devices 0600-0602 defined
z/VM Version 6 Release 1.0, Service Level 1002 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 11:05:06 EDT TUESDAY 10/05/10
z/VM V6.1.0    2010-09-23 11:31

DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

   If you forgot to grant access to the VSWITCH you will see an error message.

2. Verify that you have two read/write devices at addresses 100-101 with the QUERY DASD command:

```
==> q da
DASD 0100 3390 UM63AA R/W       3338 CYL ON DASD  63AA SUBCHANNEL = 0000
DASD 0101 3390 UM63AA R/W       3338 CYL ON DASD  63AA SUBCHANNEL = 0001
...
```

3. Log off of LINUX02.

Congratulations, you have cloned one Linux virtual server and defined three more user IDs that should now be ready for cloning to. You will clone to these user IDs in Chapter 10, “Installing Linux with kickstart” on page 175. In addition to cloning, the Red Hat kickstart tool can also be used. That is discussed in Chapter 10, “Installing Linux with kickstart” on page 175 as well.

9.6 Reviewing system status

You can step back now and view your system from a DASD point of view, as shown in Figure 9-2. If you have followed all the sections in this book so far, you should have used the equivalent of 23 3390-3 volumes: eight for the z/VM system, seven for the Linux cloner and golden image, and eight for the four virtual servers.

You can also view the system from an administrator's and user's point of view, as shown by the horizontal lines and the italicized text on the right side of the figure. The z/VM and Linux system administration roles may be performed by the same person, but these roles can also be done by different administrators. The Linux users may not care that their servers are virtual machines and may be oblivious to the fact that they might have been cloned in a matter of minutes.

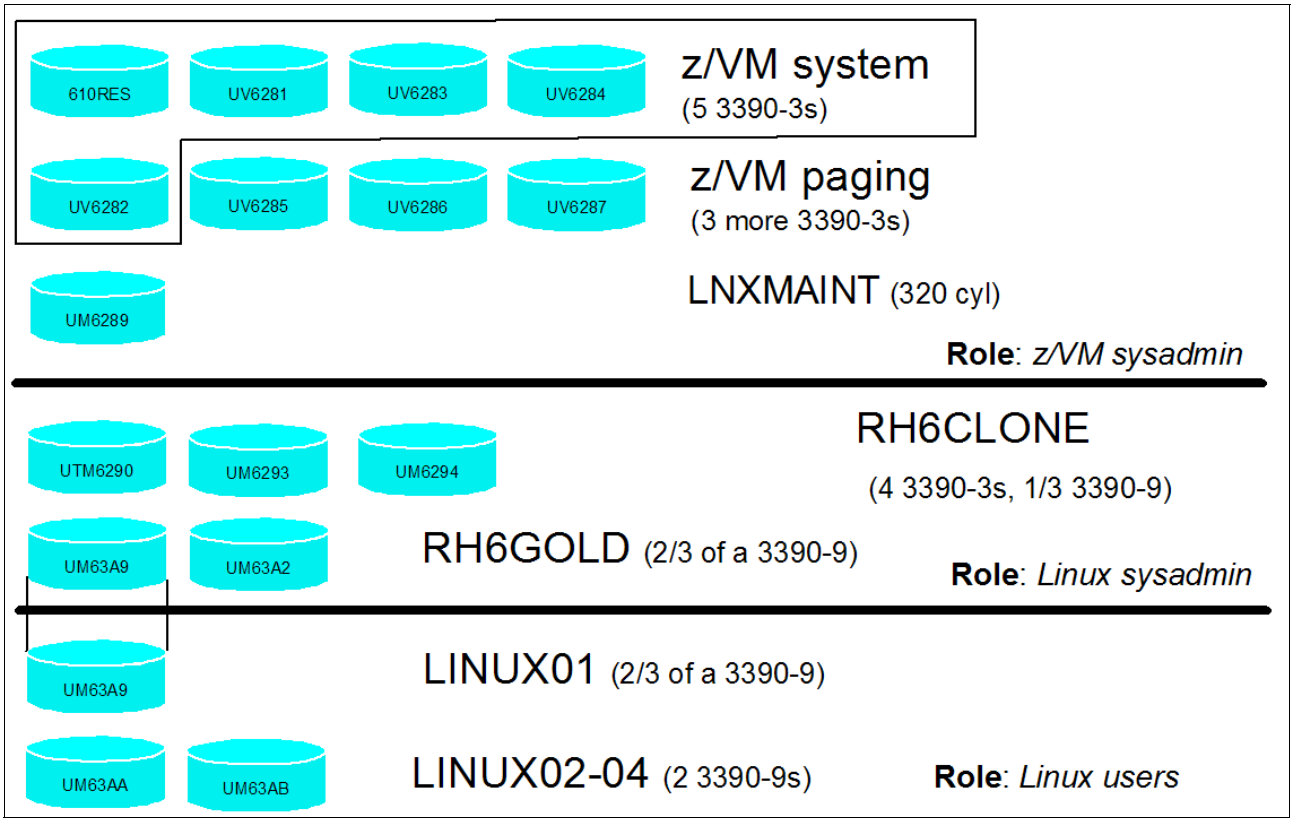


Figure 9-2 Linux virtual server system: DASD view and role view

10

Installing Linux with kickstart

Kickstart is an automated way of installing RHEL 6. Using kickstart, you can create a single file that answers all of the questions usually asked during an interactive installation.

In Chapter 9, “Configuring RHEL 6 for cloning” on page 155, you cloned to LINUX01 and created three new user IDs for virtual servers. In this chapter, you kickstart a RHEL 6 system to LINUX02. In comparison, cloning a server is faster, assuming the FLASHCOPY command is available. However, kickstarting a server is more flexible, as it allows for different package configurations and pre-installation and post-installation scripting.

The cloner is now configured as an installation server using NFS to share the installation tree. You will now configure it as a kickstart server to perform automated installations over the network. The following steps are involved in installing Linux with kickstart:

10.1 Configuring the cloner for kickstart

The installer generates a kickstart file at the end of every installation. It is based on the answers provided during the interactive installation. This kickstart file is named `anaconda-ks.cfg` and is located in the `/root/` directory. This file on RH6CLONE will be used as a template for LINUX02.

Perform the following steps:

1. Start an SSH session on the cloner (`RH6CLONE`) as root.
2. Start the golden image (RH6GOLD). You could log on to a 3270 session, but you can also start it from the cloner with the CP XAUTOLOG command:

```
# vmcp xautolog rh6gold
Command accepted
```

3. Create the `/nfs/ks/` directory for the kickstart file:

```
# cd /nfs
# mkdir ks
# cd ks
```

4. Copy the sample kickstart file from the golden image:

```
# scp 9.60.18.222:/root/anaconda-ks.cfg linux02-ks.cfg
anaconda-ks.cfg                               100% 1813     1.8KB/s   00:00
# chmod +r linux02-ks.cfg
```

5. Edit the kickstart configuration file as follows. After the first four changes, which are in bold, remove the comments from the part, volgroup, and logvol lines. Edit the lines in bold to customize this kickstart for LINUX02:

```
# vi linux02-ks.cfg
# Kickstart file automatically generated by anaconda.

#version=RHEL6
install
reboot
nfs --server=9.60.18.223 --dir=/nfs/rhel6
lang en_US.UTF-8
rootpw  --iscrypted
$6$jiFGqyU1FwxWWQ6t$7qnsOSsUsNOyGnjtIpR63z2O4RDjL1q6M//lxfA.E5SbQ.M2gNKCJpahQ.m
O7JCm.56yH3vKbxc5bVtvRERwdO
firewall --disabled
authconfig --enableshadow --passalgo=sha512 --enablefingerprint
selinux --enforcing
timezone --utc America/New_York
bootloader --location=mbr --driveorder=dasdb,dasdc,dasdd,dasde
--append="crashkernel=auto"
# The following is the partition information you requested
# Note that any partitions you deleted are not expressed
# here so unless you clear all partitions first, this is
# not guaranteed to work
clearpart --all --initlabel --drives=dasdb,dasdc,dasdd,dasde


part / --fstype=ext4 --size=512
part swap --size=512
part pv.Al9FUC-feWq-uHGF-Jaui-RxZQ-Kq9t-pi5zlC --grow --size=200
```

```
part pv.uB82Dq-ajP3-QEln-dcsJ-XHds-tCxx-BRjxOc --grow --size=200
part swap --grow --size=200
part swap --grow --size=200
volgroup system_vg --pesize=4096 pv.Al9FUC-feWq-uHGF-Jaui-RxZQ-Kq9t-pi5zlC
pv.uB82Dq-ajP3-QEln-dcsJ-XHds-tCxx-BRjxOc
logvol /opt --fstype=ext4 --name=opt_lv --vgname=system_vg --size=384
logvol /tmp --fstype=ext4 --name=tmp_lv --vgname=system_vg --size=384
logvol /usr --fstype=ext4 --name=usr_lv --vgname=system_vg --size=1536
logvol /var --fstype=ext4 --name=var_lv --vgname=system_vg --size=384
repo --name="Red Hat Enterprise Linux"  --baseurl=file:///mnt/source/
--cost=100

%packages
@base
...
%end
```

Here are clarifications to some of the values:

- The line `reboot` is added to set the server to automatically shut down after kickstart.
- The line starting with `nfs --server=` sets the IP address of the installation server and path to the installation tree.
- The line starting with `firewall` disables the firewall. Do *not* make this change if the server is on an external network.
- The line starting with `bootloader` removes references to additional drives only available to the cloner.
- The line starting with `clearpart --all` removes all existing partitions.
- The line starting with `part /` defines the root partition to be 512 MB of type ext4.
- The line starting with `part swap` defines a swap partition of size 512 MB.
- The two lines starting with `part pv` specify making physical volumes.
- The next two lines starting with `part swap` define partitions. Because they have the --grow parameter, all of the VDISK will be used for swap, regardless of the size specified. Anaconda creates the swap devices based on the order in the kickstart file, so the first 512 MB swap space will be created on the first minidisk while the last two will be created on VDISKs 300 and 301.
- The line starting with `volgroup` creates a volume group.
- The next four lines starting with logvol defines logical volumes based on the information given in Table 2-1 on page 11.
- The line `@base` specifies a default set of packages for the installation. These can be customized later by adding or removing specific packages from the `%packages` section.

6. Add the path to the kickstart folder to `/etc/exports`:

```
# vi /etc/exports
/nfs/rhel6/            *(ro,sync)
/nfs/virt-cookbook-RH6   *(ro,sync)
/nfs/ks                  *(ro,sync)
```

7. Restart the NFS service on the cloner. The **showmount -e** command should show the exported file systems:

```
# service nfs reload
# showmount -e
Export list for gpok223.endicott.ibm.com:
```

```
/nfs/ks                *
/nfs/virt-cookbook-RH6 *
/nfs/rhel6             *
```

10.2 Configuring the LINUX02 user for kickstart

Earlier, you should have created the LINUX02 user ID. It is now time to configure it for kickstart. LINUX02 must have its own parameter and configuration files, which are again based on the RH6GOLD user ID.

Perform the following steps:

1. Log off of MAINT and log on to LNXMAINT. Copy the parameter and configuration files from RH6GOLD to LINUX02 as follows:

   ```
   ==> copy rh6gold * d linux02 = =
   ```

2. Edit the `LINUX02 PARM-RH6 file`. Because this is a non-interactive installation, the vnc options are no longer required. The ks= line directs the installer to get the kickstart file from the installation server. RUNKS=1 is required for kickstarts, and the cmdline option prevents the installer's text-based user interface from opening on the 3270 console.

   ```
   ==> x linux02 parm-rh6 d
   ramdisk_size=40000 root=/dev/ram0 ro ip=off
   CMSDASD=191 CMSCONFFILE=linux02.conf-rh6
   ks=nfs:9.60.18.223:/nfs/ks/linux02-ks.cfg
   RUNKS=1 cmdline
   ====> file
   ```

3. Next, edit the `LINUX02 CONF` file, and change the DASD range and networking information:

   ```
   ==> x linux02 conf-rh6 d
   DASD=100-101,300-301
   HOSTNAME=gpok225.endicott.ibm.com
   NETTYPE=qeth
   IPADDR=9.60.18.225
   ...
   ====> file
   ```

4. Log off of `LNXMAINT`.

10.3 Kickstarting the LINUX02 user

Perform the following steps to kickstart the LINUX02 user:

1. Log on to LINUX02. When asked to perform an IPL from disk 100, answer `n`:

   ```
   LOGON LINUX02
   ...
   Do you want to IPL Linux from minidisk 100? y/n
   n
   ```

2. Add more memory for the installation process. Temporarily modify the storage up to 512 MB with the DEFINE STORAGE command. Then run **`ipl cms`** and again answer `n` to the question of performing an IPL of Linux:

   ```
   ==> def stor 1g
   00: STORAGE = 1G
   ```

```
00: Storage cleared - system reset.
==> ipl cms
...
Do you want to IPL Linux from minidisk 100? y/n
n
```

Verify that you have a 512 MB virtual machine:

```
==> q v stor
00: STORAGE = 512M
```

This change is for the duration of the user ID session. When you log off and log back on this user ID, the storage will go back to 256 MB.

3. Run **rhel6 exec** to initiate the kickstart. You see some initial kernel messages, followed by the file system format and Red Hat Package Manager (RPM) package installation.

> **Note:** Towards the end of the kickstart, it is normal to see some unrecognized characters on the panel. This is because the 3270 console cannot display the progress meter during the post installation phase. To automatically clear the 3270 console and avoid multiple panels of unreadable messages, issue the **#cp term more 0 0** command before running RHEL6 EXEC.

```
==> rhel6
...
Kernel command line: ramdisk_size=40000 root=/dev/ram0 ro ip=off
                     CMSDASD=191 CMSCONFFILE=linux02.conf-rh6
                     ks=nfs:9.60.18.223:/nfs/ks/linux02-ks.cfg
                     RUNKS=1 cmdline
...
```

4. The first time kickstart is run, the installer must format the DASD for Linux use. It is normal to see error messages of the following format if the DASD you are using has never been formatted. In subsequent kickstart installs, you should not see these errors:

```
end_request: I/O error, dev dasda, sector 0
Buffer I/O error on device dasda, logical block 0
Please wait while formatting drive dasda...
```

5. At the end of the kickstart, perform an IPL of the 100 disk to make any changes to your RHEL 6 golden image:

```
 /mnt/sysimage/dev done
 /mnt/sysimage done
you may safely reboot your system
==> #cp ipl 100
00: zIPL v1.5.3 interactive boot menu
00:  0. default (linux)
00:  1. linux
...
```

Congratulations! You have now installed Linux onto the virtual server using kickstart. This process can be repeated in the future for other Linux guests. For the purpose of this book, we present a minimal installation with kickstart. However, you can completely customize the kickstart file to install different packages based on your requirements. For more information regarding kickstart options, see the documentation located at the following address:

http://www.redhat.com/docs/manuals/enterprise/

From there, click **Installation Guide**, then **28. Kickstart Installations**.

11

Cloning open source virtual servers

This chapter describes how to clone and customize the following Linux virtual servers:

The sections that follow do not go into the theory or detail of the four types of servers. Rather, they are just a reference to get the servers quickly installed and configured. There are many other resources that go into further depth about these types of servers.

11.1 Creating a virtual web server

The example in this section uses the LINUX01 user ID to create a virtual web server. You should have a virtual server cloned to the LINUX01 user ID, as described in Chapter 9, “Configuring RHEL 6 for cloning” on page 155.

11.1.1 Installing Apache RPMs

To accomplish this task, perform the following steps:

1. SSH into the IP address of the new LINUX01 server. Install the following Apache RPMs with the **yum -y install** command. The -y flag prevents the “Is this OK” question:

```
# yum -y install httpd httpd-manual
...
Installed:
  httpd.s390x 0:2.2.15-5.el6         httpd-manual.noarch 0:2.2.15-5.el6

Dependency Installed:
  apr.s390x 0:1.3.9-3.el6                 apr-util.s390x 0:1.3.9-3.el6
  apr-util-ldap.s390x 0:1.3.9-3.el6       httpd-tools.s390x 0:2.2.15-5.el6

Complete!
```

2. Verify that the RPMs were installed:

```
# rpm -qa | grep httpd
httpd-tools-2.2.15-5.el6.s390x
httpd-manual-2.2.15-5.el6.noarch
httpd-2.2.15-5.el6.s390x
```

- Before starting the Apache web server, use the **chkconfig** command to set the service to start at boot time:

```
# chkconfig --list httpd
httpd           0:off   1:off   2:off   3:off   4:off   5:off   6:off
# chkconfig httpd on
# chkconfig --list httpd
httpd           0:off   1:off   2:on    3:on    4:on    5:on    6:off
```

11.1.2 Testing Apache

Start the Apache web server to verify that it installed successfully:

```
# service httpd start
Starting httpd: [  OK  ]
```

To verify that Apache is installed correctly, after it has started, open a web browser and use it to access the server. For example, the virtual server running on LINUX01 can be reached by using the following URL:

```
http://9.60.18.224/
```

You should see the test page shown in Figure 11-1, which verifies that the web server is working.

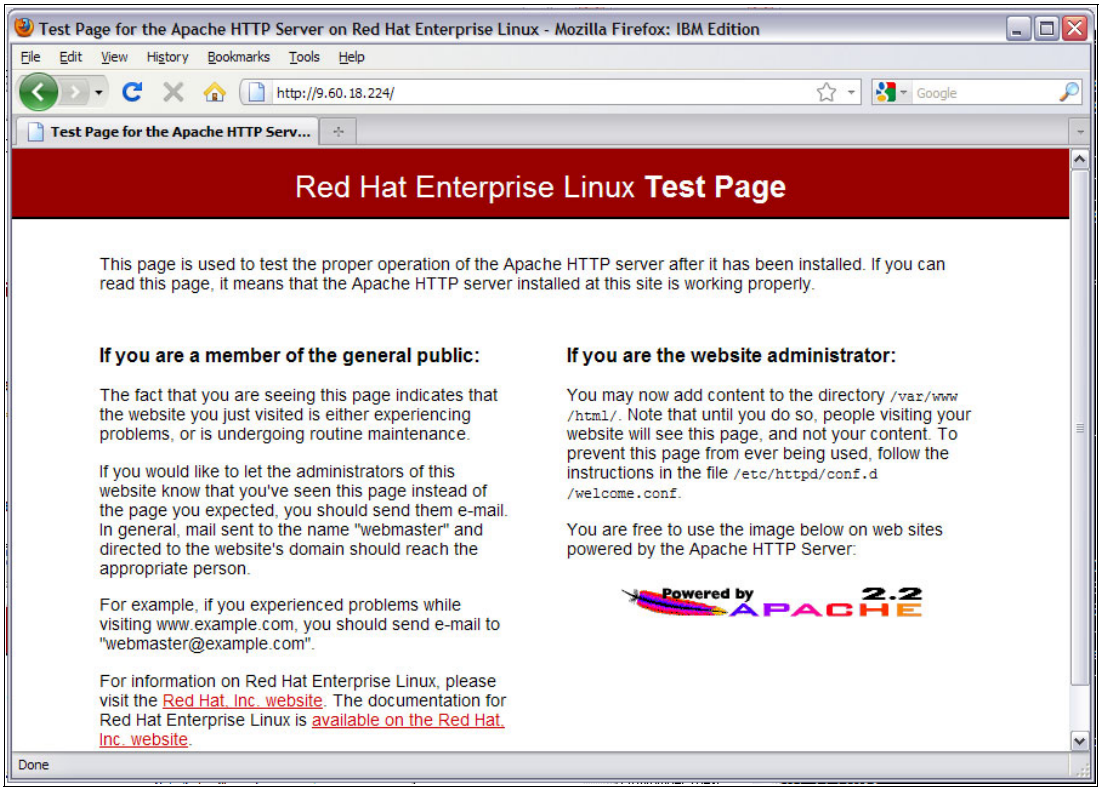


Figure 11-1 Apache test page

If you get an error when starting Apache, look in the `/var/log/httpd/error-log` log file for clues. If Apache started successfully, but you cannot reach the test page from a browser, try accessing it using the IP address rather than the DNS name.

11.1.3 Turning on a firewall

RHEL 6 comes with an IP tables firewall. In 8.2.3, “Turning off unneeded services” on page 150, it was recommended that you turn off the iptables service. If you did this on the golden image, the firewall is turned off on this clone. This section describes how to quickly enable an IP tables firewall and configure it to allow web traffic through.

Perform the following steps:

1. Verify that the firewall is off using the **`chkconfig --list`** command. The service name is iptables:

```
# chkconfig --list iptables
iptables        0:off   1:off   2:off   3:off   4:off   5:off   6:off
```

2. Turn on the firewall at boot time using the **`chkconfig`** command, and for this session with the **`service`** command:

```
# chkconfig iptables on
# service iptables start
Applying iptables firewall rules: [  OK  ]
Loading additional iptables modules: ip_conntrack_netbios_ns [  OK  ]
```

3. Go back to your browser and click **Refresh**. You should get an error that the server is not responding (or Unable to connect). This is because the packets for the http: and https: ports (80 and 443) are dropped by default.
4. To allow web traffic through, you can modify the `/etc/sysconfig/iptables` file. First, make a backup copy, add two rules (in bold) to allow these ports, and save your changes:

```
# cd /etc/sysconfig
# cp iptables iptables.orig
# vi iptables
# Firewall configuration written by system-config-firewall
# Manual customization of this file is not recommended.
*filter
:INPUT ACCEPT [0:0]
:FORWARD ACCEPT [0:0]
:OUTPUT ACCEPT [0:0]
-A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
-A INPUT -p icmp -j ACCEPT
-A INPUT -i lo -j ACCEPT
-A INPUT -m state --state NEW -m tcp -p tcp --dport 22 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 80 -j ACCEPT
-A INPUT -p tcp -m tcp --dport 443 -j ACCEPT
-A INPUT -j REJECT --reject-with icmp-host-prohibited
-A FORWARD -j REJECT --reject-with icmp-host-prohibited
COMMIT
```

5. Restart the firewall to enable the new rules:

```
# service iptables restart
iptables: Flushing firewall rules: [  OK  ]
iptables: Setting chains to policy ACCEPT: filter [  OK  ]
iptables: Unloading modules: [  OK  ]
iptables: Applying firewall rules: [  OK  ]
```

6. Go back to your browser and click **Refresh** again. You should not get an error this time. You should now have a firewall that allows web traffic.

11.1.4 Configuring SSL for Apache

Use the Secure Sockets Layer (SSL) to encrypt data between the client (browser) and the server. This is done by specifying an `https` prefix in the URL, which uses port 443 rather than using the conventional `http` prefix, which uses port 80.

Perform the following steps:

1. To use SSL, you must use the mod_ssl package. You can demonstrate that SSL communication do *not* work by changing `http` to `https` in the URL entered into your browser:

   ```
   https://9.60.18.224/
   ```

   You should see a communications error.
2. Install the mod_ssl RPM using the **`yum -y install`** command:

```
# yum -y install mod_ssl
...
Installed:
  mod_ssl.s390x 1:2.2.15-5.el6

Complete!
```

3. Verify that the RPM was added:

```
# rpm -qa | grep mod_ssl
mod_ssl-2.2.15-5.el6.s390x
```

4. Restart the web server:

```
# service httpd restart
Stopping httpd: [  OK  ]
Starting httpd: [  OK  ]
```

5. Go back to your browser and click **Restart** again.

This time you should get a warning about a self-signed certificate, which is acceptable for a test system. For a production website, you will probably want to obtain a certificate signed by a certificate authority.

11.1.5 Populating your website

You can begin to put your web pages in the `/var/www/html/` directory, which is the default web root.

11.1.6 Apache resources

The following websites contain additional information about Apache:

http://www.samspublishing.com/articles/article.asp?p=30115&seqNum=4
http://www.sitepoint.com/article/securing-apache-2-server-ssl
http://www.securityfocus.com/infocus/1786

11.2 Creating a virtual LDAP server

The Lightweight Directory Access Protocol (LDAP) is commonly implemented with the OpenLDAP package, which comes standard with most Linux distributions. Among other directory functions, OpenLDAP allows for centralized login authentication and user and group ID resolution.

In this section, you install Linux manually and set up login authentication to a new virtual LDAP server. Then you go back to the virtual web server you just created and point it to the new LDAP server.

The steps in this section are as follows:

- "Installing the OpenLDAP server" on page 185
- "Configuring the OpenLDAP server" on page 186
- "Configuring an LDAP client" on page 189

11.2.1 Installing the OpenLDAP server

You should have created a RHEL 6 server on LINUX02 using kickstart. This server will not have the **yum** command configured for online updates. Perform the following steps to create an OpenLDAP server

1. Update the Linux system running on LINUX02 to configure the **yum** command, as described in 8.2.2, "Configuring the yum command for online updates" on page 149. You could also use the clone script to clone the golden image over the kickstarted Linux.

2. Start an SSH session to the IP address of the new virtual server running on LINUX02. Use the **yum** command to install the OpenLDAP client and server RPMs:

```
# yum -y install openldap-clients openldap-servers
...
Installed:
  openldap-clients.s390x 0:2.4.19-15.el6 openldap-servers.s390x 0:2.4.19-15.el6

Dependency Installed:
  libtool-ltdl.s390x 0:2.2.6-15.5.el6

Complete!
```

OpenLDAP should now be installed on LINUX02.

11.2.2 Configuring the OpenLDAP server

Any detailed description of LDAP is outside the scope of this book. Only short configuration recommendations are given in this section.

There are two important configuration values that must be chosen.

- The suffix or base distinguished name of the LDAP Domain Information Tree (DIT). The most common suffix is to use your company's DNS name.
- The LDAP administrator or root name and password.

Perform the following steps:

1. Choose an administrative password and run the **slappasswd** command, which displays an encrypted version of it. The output of this command will be used shortly in a configuration file, so you may want to make a copy of it.

```
# slappasswd
New password: lnx4vm
Re-enter new password: lnx4vm
{SSHA}6KT4R+YjZqDidFUNGUa4jrWFGaqEFfkV
```

2. The OpenLDAP server configuration file that contains the LDAP manager (root) password is `/etc/openldap/slapd.d/cn=config/olcDatabase={1}bdb.ldif`. Make a backup copy of that file:

```
# cd /etc/openldap/slapd.d/cn=config
# cp olcDatabase={1}bdb.ldif olcDatabase={1}bdb.ldif.orig
```

3. Edit the file and add one line to set the LDAP manager's password. Use the variable `olcRootPW` and set the password to the output of the previous **slappasswd** command:

```
# vi olcDatabase={1}bdb.ldif
dn: olcDatabase={1}bdb
objectClass: olcDatabaseConfig
objectClass: olcBdbConfig
olcDatabase: {1}bdb
olcSuffix: dc=my-domain,dc=com
olcAddContentAcl: FALSE
olcLastMod: TRUE
olcMaxDerefDepth: 15
olcReadOnly: FALSE
olcRootDN: cn=Manager,dc=my-domain,dc=com
olcRootPW: {SSHA}6KT4R+YjZqDidFUNGUa4jrWFGaqEFfkV
```

```
olcMonitoring: TRUE
olcDbDirectory: /var/lib/ldap
...
```

4. Save the file. Your LDAP server should now be minimally configured.

Start the LDAP service

To start the LDAP server, perform the following steps:

1. Start LDAP at boot time by running the **chkconfig** command and, for this session, using the **service** command:

```
# chkconfig slapd on
# service slapd start
Starting slapd: [  OK  ]
```

2. Query the LDAP database with the **ldapsearch** command. The -x flag specifies that simple authentication is used:

```
# ldapsearch -x
# extended LDIF
#
# LDAPv3
# base <> with scope subtree
# filter: (objectclass=*)
# requesting: ALL
#

# search result
search: 2
result: 32 No such object
```

The result shows that the LDAP directory can be searched, but that it is empty. This is expected, as no data has been added to it.

11.2.3 Adding an LDAP user

When the golden image was installed, it was recommended that a non-root user ID be added. In this example, it was named mikemac.

To add an LDAP user, perform the following steps:

1. Choose an LDAP user name. In this example, mikemac will be used. Verify that there is no such local user by running the **id** command:

```
# id mikemac
id: mikemac: No such user
```

2. An LDIF (LDAP Interchange Format) file is created to add an organizational unit named People and a user ID named mikemac. Create a similar file for your system's values.

```
# cd /tmp
# vi initial.ldif // create the input file ...
dn: dc=my-domain,dc=com
objectClass: dcObject
objectClass: organization
description: my-domain domain
o: my-domain
dc: my-domain
```

```
dn: cn=Manager,dc=my-domain,dc=com
objectClass: organizationalRole
cn: Manager

dn: ou=People,dc=my-domain,dc=com
ou: People
objectClass: top
objectClass: organizationalUnit

dn: uid=mikemac,ou=People,dc=my-domain,dc=com
uid: mikemac
cn: mikemac
objectClass: account
objectClass: posixAccount
objectClass: top
objectClass: shadowAccount
loginShell: /bin/bash
uidNumber: 10000
gidNumber: 10000
homeDirectory: /home/mikemac

dn: ou=Group,dc=my-domain,dc=com
objectClass: top
objectClass: organizationalUnit
ou: Group

dn: cn=mikemac,ou=Group,dc=my-domain,dc=com
objectClass: posixGroup
objectClass: top
cn: mikemac
userPassword: {crypt}x
gidNumber: 10000
```

3. Add the contents of the LDIF file to the LDAP server by using the **ldapadd** command:

```
# ldapadd -x -h localhost -D "cn=Manager,dc=my-domain,dc=com" -f
/tmp/initial.ldif -W
Enter LDAP Password:
adding new entry "dc=my-domain,dc=com"

adding new entry "cn=Manager,dc=my-domain,dc=com"

adding new entry "ou=People,dc=my-domain,dc=com"

adding new entry "uid=mikemac,ou=People,dc=my-domain,dc=com"

adding new entry "ou=Group,dc=my-domain,dc=com"

adding new entry "cn=mikemac,ou=Group,dc=my-domain,dc=com"
```

4. Set the base distinguished name to `dc=my-domain,dc=com`. This is set in the `BASE` variable in the `/etc/openldap/ldap.conf` LDAP client configuration file:

```
# cd /etc/openldap
# cp ldap.conf ldap.conf.orig
# vi ldap.conf
#
# LDAP Defaults
```

```
#

# See ldap.conf(5) for details
# This file should be world readable but not world writable.

BASE dc=my-domain,dc=com
...
```

5. Search for the new user ID just added by using the **ldapsearch** command:

```
# ldapsearch -x uid=mikemac
...
# mikemac, People, my-domain.com
dn: uid=mikemac,ou=People,dc=my-domain,dc=com
uid: mikemac
cn:: bWlrZW1hYyA=
objectClass: account
objectClass: posixAccount
objectClass: top
objectClass: shadowAccount
loginShell: /bin/bash
uidNumber: 10000
gidNumber: 10000
homeDirectory: /home/mikemac
userPassword:: e1NTSEF9Q1hhSGMwU1NnQlkzTEZ6ZlJ5ZHV2aVhkQkhuaUxqNC8=

# search result
search: 2
result: 0 Success

# numResponses: 2
# numEntries: 1
```

6. The output shows that the user ID exists in the LDAP database. Now you may want to set the password with the **ldappasswd** command. You need to provide a new password for the new user and you also need to provide the LDAP administrator password.

```
# ldappasswd -x -D "cn=Manager,dc=my-domain,dc=com" -W -S
"uid=mikemac,ou=People,dc=my-domain,dc=com"
New password:
Re-enter new password:
Enter LDAP Password:
Result: Success (0)
```

You have now deleted a local user, added a new LDAP user using an LDIF file, and have set the new LDAP user's password.

You should now have an OpenLDAP server installed, configured, and populated with users and groups.

11.2.4 Configuring an LDAP client

You are now ready to configure a system to authenticate users using the new LDAP server. You first go to a different virtual server, running under the LINUX01 user ID, and configure it to point to this LDAP server. Perform the following steps:

1. Start an SSH session to the Linux running under LINUX01.

2. Invoke the **authconfig-tui** command. Use the Tab key to move between fields, the space bar to change selections, and the Enter key to select. Set the Use LDAP under User Information, and Use LDAP Authentication under Authentication. Click Next.

```
# authconfig-tui
      ------------------ Authentication Configuration ------------------¦
      ¦                                                                  ¦
      ¦  User Information        Authentication                          ¦
      ¦  [ ] Cache Information   [ ] Use MD5 Passwords                   ¦
      ¦  [ ] Use Hesiod          [*] Use Shadow Passwords                ¦
      ¦  [*] Use LDAP            [*] Use LDAP Authentication             ¦
      ¦  [ ] Use NIS             [ ] Use Kerberos                        ¦
      ¦  [ ] Use Winbind         [*] Use Fingerprint reader              ¦
      ¦                          [ ] Use Winbind Authentication          ¦
      ¦                          [*] Local authorization is sufficient   ¦
      ¦                                                                  ¦
      ¦            ----------                    --------                ¦
      ¦            ¦ Cancel ¦                    ¦ Next ¦                ¦
      ¦            ----------                    --------                ¦
      ¦                                                                  ¦
      ¦                                                                  ¦
      ------------------------------------------------------------------¦
```

3. On the next panel, set the Server value to point to the LDAP server. In this example, it is `ldap://9.60.18.225/`. Set the Base DN to your suffix value. In this example, it is `dc=my-domain,dc=com`. Click OK.

```
            ------------------- LDAP Settings ------------------¦
            ¦                                                   ¦
            ¦          [ ] Use TLS                              ¦
            ¦  Server: ldap://9.60.18.225_____________________  ¦
            ¦ Base DN: dc=my-domain,dc=com____________________  ¦
            ¦                                                   ¦
            ¦         --------                  ------          ¦
            ¦         ¦ Back ¦                  ¦ Ok ¦          ¦
            ¦         --------                  ------          ¦
            ¦                                                   ¦
            ¦                                                   ¦
            -----------------------------------------------------¦
```

Your LDAP client should now be pointing to the LDAP server. Test it by running the **id ldapuser1** command:

```
# id ldapuser1
uid=500(ldapuser1) gid=500(ldapuser1) groups=500(ldapuser1)
context=root:system_r:unconfined_t:s0-s0:c0.c1023
```

In RHEL 6, you can no longer authenticate over SSH without using TLS. This section has not described how to set up TLS. To perform that setup, you need a signed certificate that corresponds to your enterprise's DNS domain name. Refer to the OpenLDAP website at the following address for more information:

http://www.openldap.org/pub/ksoper/OpenLDAP_TLS.html

More details about the `cn=config/` directory replacing the `/etc/openldap/slapd.conf` file can be found at the following Red Hat website (you need a subscription to get to it):

https://access.redhat.com/kb/docs/DOC-3637

11.3 Creating a virtual file and print server

Samba allows Windows clients to map Linux file systems as shared drives. Samba can also act as a middleman between Windows clients and a Linux print server. The recommended Linux print server is the Common UNIX Printing System (CUPS). This section does not describe the configuration of CUPS, but it does describe how the necessary RPMs are installed.

The steps in this section are as follows:

11.3.1 Cloning a Linux virtual server

To clone a new Linux server, perform the following steps:

1. Start an SSH session as root to the cloner.
2. Copy a Linux cloning configuration file and modify the IP address and host name variables:

```
# cd /etc/clone
# cp linux01.conf linux03.conf
# vi linux03.conf
// ... modify IPADDR and HOSTNAME variables
```

3. Clone a basic virtual server. In this example, the LINUX03 user ID is used.

```
# clone -v rh6gold linux03
Invoking CP command: QUERY rh6gold
Invoking CP command: QUERY linux03

This will copy disks from rh6gold to linux03
Host name will be: 6.endicott.ibm.com
IP address will be: 9.60.18.224
Do you want to continue? (y/n): y
...
```

4. When the new system comes up, start an SSH session to the new virtual server.

11.3.2 Installing the necessary RPMs

Perform the following steps:

1. Add the following RPMs by using the **yum -y** command:

```
# yum -y install samba
...
Installed:
  samba.s390x 0:3.5.4-68.el6
```

2. Confirm that the RPMs were added:

```
# rpm -qa | grep samba
samba-common-3.0.28-0.el5.8
samba-client-3.0.28-0.el5.8
samba-3.0.28-0.el5.8
samba-common-3.0.28-0.el5.8
```

11.3.3 Configuring the Samba configuration file

The one configuration file for Samba is `/etc/samba/smb.conf`. It is easy to add an SMB share that will be made available by the Samba server. A good test directory is `/usr/share/doc`,/ as it has good Linux documentation. The following example creates a file *share* named `sharedoc`:

```
# cd /etc/samba
# cp smb.conf smb.conf.orig
# vi smb.conf    // add three lines at the bottom of the file:
...
[sharedoc]
  comment = RHEL 6 on System z documentation
  path = /usr/share/doc/
```

You can verify the syntax of your changes by using the **testparm** command:

```
# testparm smb.conf
Load smb config files from smb.conf
Processing section "[homes]"
Processing section "[printers]"
Processing section "[sharedoc]"
Loaded services file OK.
Server role: ROLE_STANDALONE
Press enter to see a dump of your service definitions
...
```

This change creates an SMB share named `sharedoc` that contains the contents of the `/usr/share/doc` directory and its subdirectories.

11.3.4 Adding a Samba user

The default method that Samba uses to determines users' credentials is to look in the `/etc/samba/smbpasswd` file. That user must first exist in the Linux file system (`/etc/passwd`, `/etc/shadow`, and so on).

Perform the following steps:

1. To create a new Samba user, run the **smbpasswd -a** command. First, use the **useradd** and **passwd** commands to add a user locally. In this example, the user sambauser1 is used:

```
# id sambauser1
id: sambauser1: No such user
# useradd sambauser1
# passwd sambauser1
Changing password for sambauser1.
New password: lnx4vm
BAD PASSWORD: it is based on a dictionary word
BAD PASSWORD: is too simple
Retype new password: lnx4vm
passwd: all authentication tokens updated successfully.
```

2. Add the sambauser1 user to the smbpasswd file by using the **smbpasswd -a** command:

```
# smbpasswd -a sambauser1
New SMB password: lnx4vm
Retype new SMB password: lnx4vm

startsmbfilepwent_internal: file /etc/samba/smbpasswd did not exist. File
successfully created.
account_policy_get: tdb_fetch_uint32 failed for field 1 (min passwd length),
returning 0
...
Added user sambauser1.
```

This method of maintaining Samba users, groups, and passwords is good for a small number of users. For a larger number of users, merging Samba and LDAP is recommended. It is not a simple as pointing the virtual file and print server at the virtual LDAP server, as described in 11.2, “Creating a virtual LDAP server” on page 185, because the Samba schema must first be added to LDAP. The details of this process are outside the scope of this book.

11.3.5 Starting Samba at boot time

Samba can be started for the current session by using the **service** command and at boot time by using the **chkconfig** command. Do this for both the smb and nmb services:

```
# service smb start
Starting SMB services: [  OK  ]
# service nmb start
Starting NMB services: [  OK  ]
# chkconfig smb on
# chkconfig nmb on
```

Samba should now be running and configured to start at boot time.

11.3.6 Testing your changes

You can verify that Samba is running by using the following **service** command:

```
# service smb status
smbd (pid 6987 6982) is running...
```

You can verify that the shares that are available by using the following **smbclient** command:

```
# smbclient -U sambauser1 -L localhost
Domain=[MYGROUP] OS=[Unix] Server=[Samba 3.5.4-68.el6]

        Sharename       Type      Comment
        ---------       ----      -------
        sharedoc        Disk      RHEL 6 on System z documentation
        IPC$            IPC       IPC Service (Samba Server Version 3.5.4-68.el6)
        sambauser1      Disk      Home Directories
Domain=[MYGROUP] OS=[Unix] Server=[Samba 3.5.4-68.el6]

        Server               Comment
        ---------            -------
        GPOK226              Samba Server Version 3.5.4-68.el6

        Workgroup            Master
```

```
---------              -------
MYGROUP                GPOK226
...
```

You can test getting a Samba share from a Windows desktop. Perform the following steps

1. Go to any Windows Explorer window (such as My Computer) and select **Tools** → **Map Network Drive**.
2. Use the Universal Naming Convention (UNC) to specify the Samba server and share name, as shown in the upper left of Figure 11-2. In this example, the UNC is \\9.60.18.226\sharedoc.
3. You may have to click **different user name** if the user or password on the new Samba server is different from the Windows system from which you are connecting.
4. Click **Finish**.

If all the steps were done correctly, you should see the files in a new Explorer window, as shown in the bottom right of Figure 11-2.

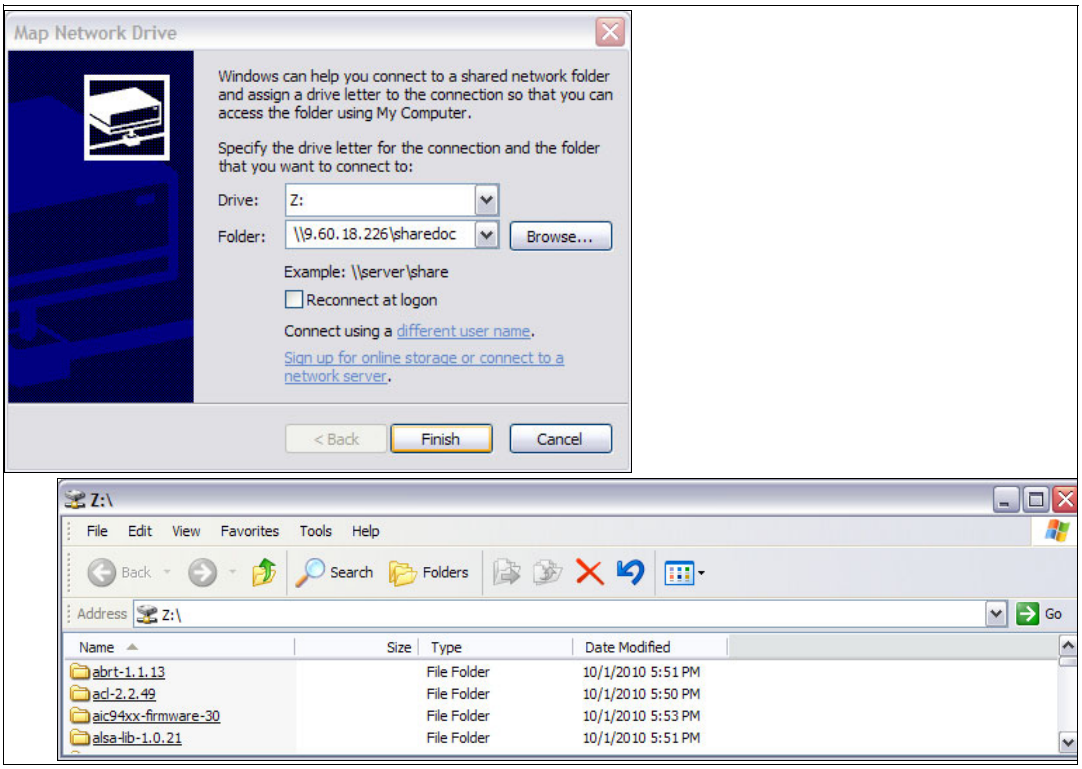


Figure 11-2 Mapping a network drive to the Samba server

You should now have Samba configured and running with one new share available.

If you prefer a DOS command line, you can also link to the share by using the **`net use`** command:

```
c:\>net use y: \\9.60.18.226\sharedoc
The command completed successfully.
```

You can detach the share by using the following **`net use`** command:

```
c:\>net use y: /delete
y: was deleted successfully.
```

11.3.7 Configuring printing

Configuring printing is beyond the scope of this book. For more details about printing, refer to *Printing with Linux on zSeriesPrinting with Linux on zSeries Using CUPS and Samba*, REDP-3864.

11.4 Creating a virtual application development server

Most Linux distributions come with a basic set of application development tools, making Linux one of the most versatile development systems. These basic tools are ideal for projects of any size.

The development languages used in implementation range from scripting languages, such as Python or Tcl, to compiled languages, such as C/C++ and Java™. There are software available on Linux to help form a development system for developers to create integrated applications. MySQL and Apache are among them. A popular open source web platform is LAMP, which stands for the open source software and programming languages used to make up the platform: Linux, Apache, MySQL, and Python or PHP.

To create a virtual application development server, perform the following steps:

1. Start an SSH session as root to the cloner.
2. Copy a Linux cloning configuration file and modify the IP address and host name variables:

```
# cd /etc/clone
# cp linux01.conf linux04.conf
# vi linux04.conf
// ... modify IPADDR and HOSTNAME variables
```

3. Clone a basic virtual server. In this example, the LINUX03 user ID is used.

```
# clone -v rh6gold linux03
Invoking CP command: QUERY rh6gold
Invoking CP command: QUERY linux03

This will copy disks from rh6gold to linux03
Host name will be: 6.endicott.ibm.com
IP address will be: 9.60.18.224
Do you want to continue? (y/n): y
...
```

4. When the new system comes up, start an SSH session as root to it.
5. Before installing the development tools, note how full the root and /usr/ file systems are:

```
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           504M  147M  332M  31% /
tmpfs                 121M     0  121M   0% /dev/shm
/dev/mapper/system_vg-opt_lv
                      372M   17M  337M   5% /opt
/dev/mapper/system_vg-tmp_lv
                      372M   17M  337M   5% /tmp
/dev/mapper/system_vg-usr_lv
                      1.5G  798M  638M  56% /usr
/dev/mapper/system_vg-var_lv
```

```
                      372M   86M  267M  25% /var
```

In this example, they are 31% and 56% full.

6. You can use the **yum -y groupinstall** command to install the groups named development-tools and development-libs. This command adds about 45 packages, which requires a number of minutes to complete:

```
# yum -y groupinstall "Development tools" "Development libs"
Installed:
  autoconf.noarch 0:2.63-5.1.el6            automake.noarch 0:1.11.1-1.2.el6
  bison.s390x 0:2.4.1-5.el6                 byacc.s390x 0:1.9.20070509-6.1.el6
  cscope.s390x 0:15.6-6.el6                 ctags.s390x 0:5.8-2.el6
  diffstat.s390x 0:1.51-2.el6               doxygen.s390x 1:1.6.1-4.el6
  flex.s390x 0:2.5.35-8.el6                 gcc.s390x 0:4.4.4-13.el6
  gcc-c++.s390x 0:4.4.4-13.el6              gcc-gfortran.s390x 0:4.4.4-13.el6
  git.s390x 0:1.7.1-2.el6                   indent.s390x 0:2.2.10-5.1.el6
  intltool.noarch 0:0.41.0-1.1.el6          libtool.s390x 0:2.2.6-15.5.el6
  patchutils.s390x 0:0.3.1-3.1.el6          rcs.s390x 0:5.7-37.el6
  redhat-rpm-config.noarch 0:9.0.3-25.el6   rpm-build.s390x 0:4.8.0-12.el6
  subversion.s390x 0:1.6.11-2.el6           swig.s390x 0:1.3.40-5.el6
  systemtap.s390x 0:1.2-9.el6

Dependency Installed:
  apr.s390x 0:1.3.9-3.el6                apr-util.s390x 0:1.3.9-3.el6
  cloog-ppl.s390x 0:0.15.7-1.2.el6       cpp.s390x 0:4.4.4-13.el6
  gettext-devel.s390x 0:0.17-16.el6      gettext-libs.s390x 0:0.17-16.el6
  glibc-devel.s390x 0:2.12-1.7.el6       glibc-headers.s390x 0:2.12-1.7.el6
  kernel-devel.s390x 0:2.6.32-71.el6     kernel-headers.s390x 0:2.6.32-71.el6
  libXtst.s390x 0:1.0.99.2-3.el6         libart_lgpl.s390x 0:2.3.20-5.1.el6
  libgcj.s390x 0:4.4.4-13.el6            libproxy.s390x 0:0.3.0-2.el6
  libproxy-bin.s390x 0:0.3.0-2.el6       libproxy-python.s390x 0:0.3.0-2.el6
  libstdc++-devel.s390x 0:4.4.4-13.el6   mpfr.s390x 0:2.4.1-6.el6
  neon.s390x 0:0.29.3-1.2.el6            pakchois.s390x 0:0.4-3.2.el6
  perl-Error.noarch 1:0.17015-4.el6      perl-Git.noarch 0:1.7.1-2.el6
  ppl.s390x 0:0.10.2-11.el6

Complete!
```

Your application development server is now ready to use. You may choose to add or remove different packages.

7. Run **df -h** command to show your file systems. In this example, the root file system was not changed, but /usr/ is now 73% full:

```
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           504M  147M  332M  31% /
tmpfs                 121M     0  121M   0% /dev/shm
/dev/mapper/system_vg-opt_lv
                      372M   17M  337M   5% /opt
/dev/mapper/system_vg-tmp_lv
                      372M   17M  337M   5% /tmp
/dev/mapper/system_vg-usr_lv
                      1.5G  1.1G  394M  73% /usr
/dev/mapper/system_vg-var_lv
                      372M   94M  260M  27% /var
9.60.18.223:/nfs/rhel6
                       11G  5.2G  5.0G  52% /nfs/rhel6
```

11.4.1 Additional resources

The following websites provide additional information about application development topics:

- Scripting languages

  http://www.perl.com/
  http://www.python.org/
  http://www.freeos.com/guides/lsst/

- C/C++

  http://gcc.gnu.org/onlinedocs/gcc/
  http://en.wikipedia.org/wiki/GNU_Compiler_Collection#External_links
  http://vertigo.hsrl.rutgers.edu/ug/make_help.html
  http://www.gnu.org/software/make/manual/html_chapter/make_toc.html

- Java

  http://www-130.ibm.com/developerworks/java/
  http://java.sun.com/
  http://csdl.ics.hawaii.edu/~johnson/613f99/modules/04/jar-files.html
  http://java.sun.com/j2se/1.3/docs/tooldocs/solaris/jdb.html

- Linux kernel development

  http://www.kernel.org/pub/linux/docs/lkml/#blkd

- Web development

  http://www.onlamp.com/
  http://cgi.resourceindex.com/
  http://www.perl.com/

12

Servicing Linux with Red Hat Network

This chapter describes Red Hat Network (RHN) and its ability to manage the virtual servers. Using the **yum** command, the virtual servers can be updated when new packages are released. You can also use **yum** to install new packages with automatic dependency resolution.

You can find RHN at the following address:

http://rhn.redhat.com/

The following sections describe how to configure a Linux guest to use the **yum** command and manage the guest through RHN:

12.1 Registering your system with RHN

This section assumes you have already obtained a valid entitlement for RHEL 6 on IBM System z, or have completed the steps to obtain an evaluation copy. To receive a no cost 90-day evaluation, go to the following address:

http://www.redhat.com/z

Select the **Free Evaluation** link under the Try section on the left and create an account if you do not already have one. After completing the form, you receive an email in a short while with the activation instructions.

12.2 Installing and updating packages using yum

You may choose to perform these steps first on a clone, such as LINUX01, and then later on the golden image. In this fashion, you can test the process on an appliance that can be discarded, and later when all is tested and working, update the golden image so that all clones created thereafter are enabled for RHN.

Before using the **yum** command for the first time, you must import the Red Hat GPG key and register your Linux guest with RHN. Use the following commands, substituting your RHN user name, password, and host name of the Linux guest:

```
# rpm --import /etc/pki/rpm-gpg/RPM-GPG-KEY-redhat-release
# rhnreg_ks --username=myuser --password=mypw
--profilename=linux01.endicott.ibm.com
```

Now that your system is registered with RHN, you can use the **yum** command to keep the system updated. You can download and install the latest version of a package by running **yum** with the RPM package name. You can also specify multiple packages on the command line separated by spaces. The **yum install** command installs the package if it is not present, and the **yum upgrade** command updates to the latest version if it is already installed. If a package has any dependencies, **yum** automatically downloads and installs them for you.

Update the cpp package to get the latest security fixes:

```
# rpm -q cpp
cpp-4.1.1-30
# yum upgrade cpp
Loading "rhnplugin" plugin
Loading "installonlyn" plugin
Setting up Upgrade Process
Setting up repositories
rhel-s390x-server-5-beta  100% |=========================|  950 B    00:00
...
================================================================================
 Package                 Arch       Version          Repository        Size
================================================================================
Updating:
 cpp                     s390x      4.1.1-43.el5     RHEL5             2.6 M

Transaction Summary
================================================================================
Install      0 Package(s)
Update       1 Package(s)
```

```
Remove       0 Package(s)

Total download size: 2.6 M
Is this ok [y/N]: y
Downloading Packages:
Running Transaction Test
Finished Transaction Test
Transaction Test Succeeded
Running Transaction
  Updating  : cpp                          ######################### [1/2]
  Cleanup   : cpp                          ######################### [2/2]

Updated: cpp.s390x 0:4.1.1-43.el5
Complete!
```

Now query the `cpp` package and you should see that it has been updated.

```
# rpm -q cpp
cpp-4.1.1-43.el5
```

To update every installed package on the system, run:

```
# yum upgrade
```

For more information about the **`yum`** command, see the yum(8) man page.

12.3 Managing your Linux guest through RHN

You can also manage the packages on this Linux guest through the web interface found at the following address:

`http://rhn.redhat.com/`

When you first log in to RHN, you see the system that you registered under the **Systems** tab, as shown in Figure 12-1. If there is a red exclamation point next to your system, there are errata waiting to be applied. The number of relevant errata and the corresponding number of packages are visible to the left of the system name. Click the number beneath Errata or Packages to get a detailed list. If there is a blue check-mark, then the system is fully updated.

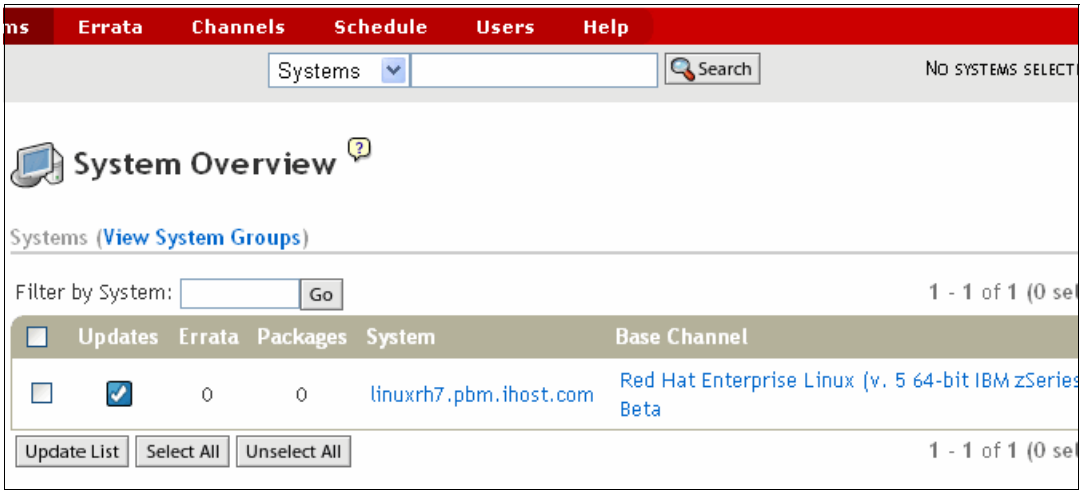


Figure 12-1 RHN system overview

Next, click the link that is the system name. This opens a detailed overview, where you can see the system properties, as shown in Figure 12-2. Click the **Packages** tab to view all the packages installed on this system. From this tab, you can also update, remove, or install new packages onto the system.

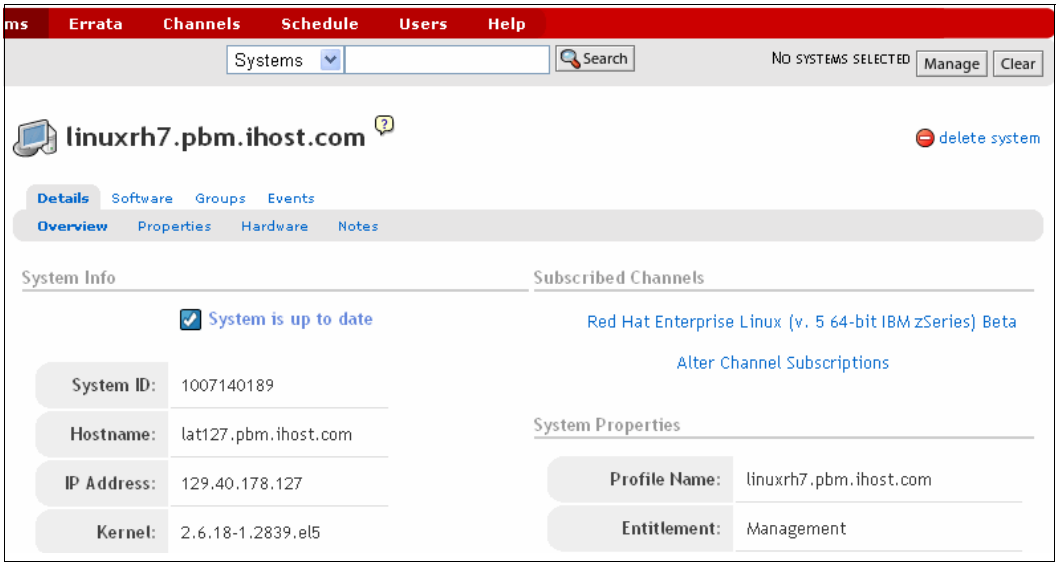


Figure 12-2 RHN system details

For more information about managing your systems through RHN, including usage guides and frequently asked questions, go to the following address:

`http://rhn.redhat.com/help`

13

Miscellaneous tasks

This chapter describes the following miscellaneous tasks that you might want to perform:

13.1 Adding DASD

The process in this section describes how to add an additional DASD to a Linux guest. The overall steps are:

- “Adding minidisks to a virtual machine” on page 204
- “Making new minidisks available to RHEL 6” on page 204
- “Creating a logical volume and file system” on page 206
- “Updating the file system table” on page 209

13.1.1 Adding minidisks to a virtual machine

Here are the high level steps that you perform to add two new 3390-3-sized minidisks to LINUX02:

1. Determine the volume or volumes that will be added. In this example, a 3390-3 at real device address 6339 is added. Its space is split in half.
2. Add minidisk statements to define minidisks. In this example, two minidisks at virtual addresses 102 and 103 are defined at a size of 1669 cylinders to the LINUX02 user ID.
3. Create the `USER DISKMAP file` to verify the disk layout
4. Bring the changes online by using the DIRECTXA command.
5. Shut down the Linux system
6. Log off the user ID
7. Log back on to it and perform an IPL of Linux.

Here is the updated directory entry:

```
USER LINUXO2 LNX4VM 256M 1G G
 INCLUDE LNXDFLT
 OPTION APPLMON
 MDISK 1OO 3390 OOO1 3338 UM63AA MR LNX4VM LNX4VM LNX4VM
 MDISK 1O1 3390 3339 3338 UM63AA MR LNX4VM LNX4VM LNX4VM
 MDISK 102 3390 0001 1669 UM6339 MR LNX4VM LNX4VM LNX4VM
 MDISK 103 3390 1670 1669 UM6339 MR LNX4VM LNX4VM LNX4VM
```

13.1.2 Making new minidisks available to RHEL 6

To make the new minidisks available, perform the following steps:

1. When your system comes back up, start an SSH session to it. Use the **`lsdasd command`** to verify that the new minidisks are not seen yet:

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0101   active      dasdb     94:4    ECKD  4096   2347MB    600840
0.0.0300   active      dasdc     94:8    FBA   512    256MB     524288
0.0.0301   active      dasdd     94:12   FBA   512    512MB     1048576
```

2. Enable the disks with the **`chccwdev -e`** command:

```
# chccwdev -e 102 103
Setting device 0.0.0102 online
Done
```

```
Setting device 0.0.0103 online
Done
```

3. View the available disks again with the **lsdasd** command:

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0101   active      dasdb     94:4    ECKD  4096   2347MB    600840
0.0.0300   active      dasdc     94:8    FBA   512    256MB     524288
0.0.0301   active      dasdd     94:12   FBA   512    512MB     1048576
0.0.0102   active      dasde     94:16   ECKD  4096   1173MB    300420
0.0.0103   active      dasdf     94:20   ECKD  4096   1173MB    300420
```

4. Format the disks with the **dasdfmt** command and create one partition on each with the **fdasd -a** command. The disks can be formatted in parallel by using a `for loop` and putting them in the background. However, before running **fdasd**, you have to wait until they are done formatting:

```
# for i in 0.0.0102 0.0.0103
> do
>  dasdfmt -b 4096 -y -f /dev/disk/by-path/ccw-$i &
> done
[1] 1637
[2] 1638
... wait for the two jobs to finish
...
Finished formatting the device.
Finished formatting the device.
Rereading the partition table... ok
Rereading the partition table... ok

[1]-  Done                    dasdfmt -b 4096 -y -f /dev/disk/by-path/ccw-$i
[2]+  Done                    dasdfmt -b 4096 -y -f /dev/disk/by-path/ccw-$i
# fdasd -a /dev/disk/by-path/ccw-0.0.0102
reading volume label ..: VOL1
reading vtoc ..........: ok

auto-creating one partition for the whole disk...
writing volume label...
writing VTOC...
rereading partition table...
# fdasd -a /dev/disk/by-path/ccw-0.0.0103
reading volume label ..: VOL1
reading vtoc ..........: ok

auto-creating one partition for the whole disk...
writing volume label...
writing VTOC...
rereading partition table...
```

5. Make a backup of `/etc/dasd.conf` and add minidisks 102 and 103 to it:

```
# cd /etc
# cp dasd.conf dasd.conf.orig
# vi dasd.conf
0.0.0301 use_diag=0 readonly=0 erplog=0 failfast=0
0.0.0300 use_diag=0 readonly=0 erplog=0 failfast=0
```

```
0.0.0101 use_diag=0 readonly=0 erplog=0 failfast=0
0.0.0100 use_diag=0 readonly=0 erplog=0 failfast=0
0.0.0102
0.0.0103
```

6. Verify the new minidisks are activated by using the **lsdasd** command:

```
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0101   active      dasdb     94:4    ECKD  4096   2347MB    600840
0.0.0300   active      dasdc     94:8    FBA   512    256MB     524288
0.0.0301   active      dasdd     94:12   FBA   512    512MB     1048576
0.0.0102   active      dasde     94:16   ECKD  4096   1173MB    300420
0.0.0103   active      dasdf     94:20   ECKD  4096   1173MB    300420
```

If you are creating a new logical volume, go to 13.2.1, “Creating a logical volume and file system” on page 206. If you are extending an existing logical volume, go to 13.3, “Extending an existing logical volume” on page 211.

13.2 Adding a logical volume

There are times when you require more disk space than a single direct access storage device (DASD) volume provides. For example, if you want to have a shared /home/ directory, you want it to be of sufficient size. When this is the case, you can use the Logical Volume Manager (LVM) to combine multiple DASD volumes into one logical volume.

The following process describes how to create a logical volume with additional DASD on a Linux guest. The overall steps in adding a logical volume are:

- “Adding DASD” on page 204
- “Creating a logical volume and file system” on page 206
- “Updating the file system table” on page 209

13.2.1 Creating a logical volume and file system

The overall steps involved in creating a logical volume are:

- Create physical volumes from the two partitions
- Create a single volume group
- Create a single logical volume
- Make a file system from the logical volume

Figure 13-1 shows a block diagram of the logical volume manager for this example.

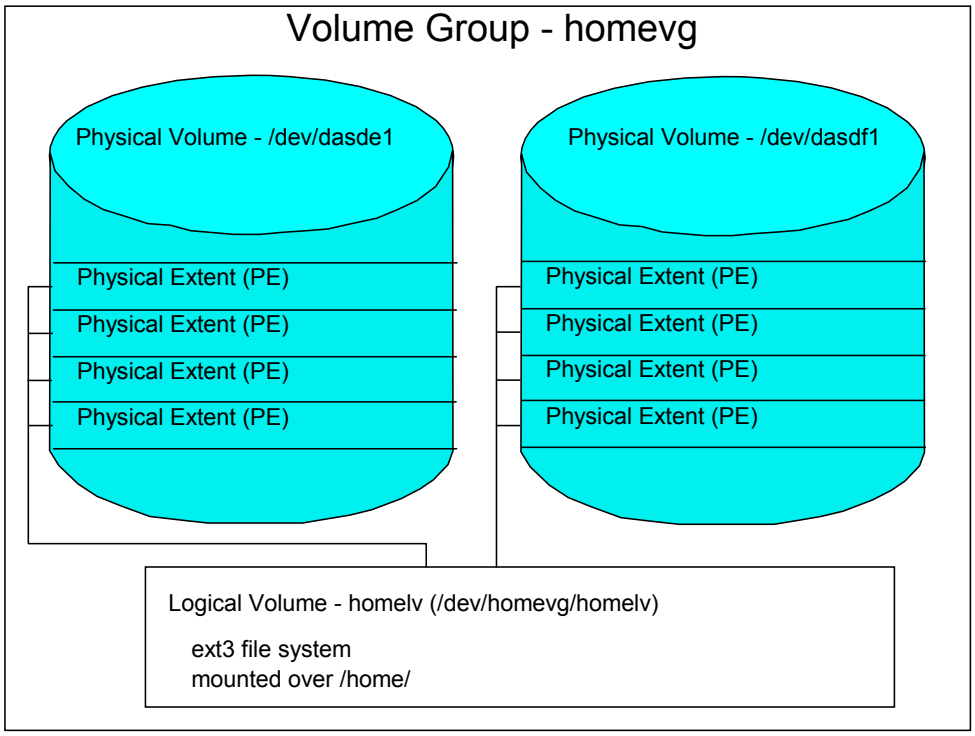


Figure 13-1 LVM block diagram

Creating physical volumes from the two DASD

To create physical volumes, perform the following steps:

1. The **pvcreate** command initializes partitions for use by LVM. Initialize the two new DASD partitions:

```
# pvcreate /dev/dasde1 /dev/dasdf1
  Physical volume "/dev/dasde1" successfully created
  Physical volume "/dev/dasdf1" successfully created
```

2. Verify that the physical volumes were created by using the **pvdisplay** command:

```
# pvdisplay /dev/dasde1 /dev/dasdf1
"/dev/dasde1" is a new physical volume of "1.15 GiB"
  --- NEW Physical volume ---
  PV Name               /dev/dasde1
  VG Name
  PV Size               1.15 GiB
  Allocatable           NO
  PE Size               0
  Total PE              0
  Free PE               0
  Allocated PE          0
  PV UUID               JY247T-Xmb6-iQT5-FlFC-KZgx-CIHO-bVKnbL

  "/dev/dasdf1" is a new physical volume of "1.15 GiB"
  --- NEW Physical volume ---
  PV Name               /dev/dasdf1
  VG Name
```

```
  PV Size               1.15 GiB
  Allocatable           NO
  PE Size               0
  Total PE              0
  Free PE               0
  Allocated PE          0
  PV UUID               3LciEw-cMM7-tiEM-QEQW-B7Fa-2aoW-thOZOr
```

Creating a single volume group

The **vgcreate** command can be used to create a volume group named homevg from the two partitions. Use the **vgdisplay homevg** command to verify that the volume group was created:

```
# vgcreate homevg /dev/dasde1 /dev/dasdf1
Volume group "homevg" successfully created
# vgdisplay homevg
  --- Volume group ---
  VG Name               homevg
  System ID
  Format                lvm2
  Metadata Areas        2
  Metadata Sequence No  1
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                0
  Open LV               0
  Max PV                0
  Cur PV                2
  Act PV                2
  VG Size               2.29 GiB
  PE Size               4.00 MiB
  Total PE              586
  Alloc PE / Size       0 / 0
  Free  PE / Size       586 / 2.29 GiB
  VG UUID               9HPTso-Amw3-7OHQ-3ofl-AszO-1aeo-dFvB7z
```

In this example, there are 586 free physical extents.

Creating a single logical volume

The **lvcreate** command is used to create a logical volume. The -l flag specifies using all the free extents, 586 in this example. The -n homelv flag specifies the name of the new logical volume. The last argument, homevg, specifies the name of the volume group from which the logical volume will be created.

```
# lvcreate -l 586 -n homelv homevg
  Logical volume "homelv" created
```

Use the **lvdisplay** command to verify the creation. The parameter is the full path of the logical volume, not just the logical volume name.

```
# lvdisplay /dev/homevg/homelv
  --- Logical volume ---
  LV Name                /dev/homevg/homelv
  VG Name                homevg
  LV UUID                BvXjOn-vA8D-yMYO-Ydex-bF2y-Gfeg-1pyr4O
  LV Write Access        read/write
```

```
  LV Status              available
  # open                 0
  LV Size                2.29 GiB
  Current LE             586
  Segments               2
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     1024
  Block device           253:4
```

Making a file system from the logical volume

Now you have a logical volume. Create an ext4 file system out of it by using the **mkfs.ext4** command:

```
# mkfs.ext4 /dev/homevg/homelv
mke2fs 1.41.12 (17-May-2010)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=1 blocks, Stripe width=0 blocks
150176 inodes, 600064 blocks
30003 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=616562688
19 block groups
32768 blocks per group, 32768 fragments per group
7904 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912

Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 25 mounts or
180 days, whichever comes first.  Use tune2fs -c or -i to override.
```

The file system created from the logical volume is now ready to be mounted.

13.2.2 Updating the file system table

You could now mount the file system manually. However, if you add the mount to the file system table file, `/etc/fstab`, you can effectively test the change by using the **mount** command with only one argument. Make a backup copy and then add the following line to the file:

```
# cd /etc
# cp fstab fstab.works
# vi fstab

#
# /etc/fstab
# Created by anaconda on Tue Oct 19 15:52:06 2010
#
```

```
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
/dev/disk/by-path/ccw-0.0.0100-part1 /                       ext4    defaults
1 1
/dev/mapper/system_vg-opt_lv /opt                     ext4    defaults        1 2
/dev/mapper/system_vg-tmp_lv /tmp                     ext4    defaults        1 2
/dev/mapper/system_vg-usr_lv /usr                     ext4    defaults        1 2
/dev/mapper/system_vg-var_lv /var                     ext4    defaults        1 2
/dev/disk/by-path/ccw-0.0.0300-part1 swap                    swap    defaults
0 0
/dev/disk/by-path/ccw-0.0.0301-part1 swap                    swap    defaults
0 0
/dev/disk/by-path/ccw-0.0.0100-part2 swap                    swap    defaults
0 0
/dev/homevg/homelv      /home                   ext4    defaults        0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
```

Before mounting over /home/, you may want to check that it is empty. If a non-root user exists and a new file system is mounted over it, the contents of the directory will be *covered*. In this example there is no data in the file system.

```
# ls -a /home
.  ..
```

Mount the /home/ file system with one argument. By using just one argument, you are testing the change to /etc/fstab. Use the **df -h** command to verify that it is mounted:

```
# mount /home
# df -h
Filesystem            Size  Used Avail Use% Mounted on
/dev/dasda1           504M  148M  331M  31% /
tmpfs                 121M     0  121M   0% /dev/shm
/dev/mapper/system_vg-opt_lv
                      372M   17M  337M   5% /opt
/dev/mapper/system_vg-tmp_lv
                      372M   17M  337M   5% /tmp
/dev/mapper/system_vg-usr_lv
                      1.5G  1.1G  366M  75% /usr
/dev/mapper/system_vg-var_lv
                      372M   93M  261M  27% /var
/dev/mapper/homevg-homelv
                      2.3G   68M  2.1G   4% /home
```

You may want to test a reboot to verify the new logical volume is successfully mounted over /home/.

```
# reboot

Broadcast message from root (pts/0) (Thu Sep  2 15:08:07 2010):

The system is going down for reboot NOW!
```

13.3 Extending an existing logical volume

This section describes the process of adding a new minidisk to an existing LVM. This is useful when your logical volume has run out of space.

First, repeat the steps described in 13.1, “Adding DASD” on page 204 to add a new minidisk. In this example, a minidisk at virtual address 104 is added with a size of 3338 cylinders. Do not forget to log off and log back on to LINUX02 so the new directory entry is read.

When your system comes back, enable the new 104 disk, run **dasdfmt** on it and create a single partition:

```
# chccwdev -e 104
Setting device 0.0.0104 online
Done
# lsdasd
Bus-ID     Status      Name      Device  Type  BlkSz  Size      Blocks
==============================================================================
0.0.0100   active      dasda     94:0    ECKD  4096   2347MB    600840
0.0.0101   active      dasdb     94:4    ECKD  4096   2347MB    600840
0.0.0300   active      dasdc     94:8    FBA   512    256MB     524288
0.0.0301   active      dasdd     94:12   FBA   512    512MB     1048576
0.0.0102   active      dasde     94:16   ECKD  4096   1173MB    300420
0.0.0103   active      dasdf     94:20   ECKD  4096   1173MB    300420
0.0.0104   active      dasdg     94:24   ECKD  4096   2347MB    600840
# dasdfmt -b 4096 -y -f /dev/dasdg
Finished formatting the device.
Rereading the partition table... ok
# fdasd -a /dev/dasdg
reading volume label ..: VOL1
reading vtoc ..........: ok

auto-creating one partition for the whole disk...
writing volume label...
writing VTOC...
rereading partition table...
```

13.3.1 Creating a physical volume

Use the **pvcreate** command to create a physical volume from the minidisk:

```
# pvcreate /dev/dasdg1
Physical volume "/dev/dasdg1" successfully created
```

13.3.2 Extending the volume group

Use the **vgextend** command to extend the volume group into the new physical volume. Then, use **vgdisplay** to verify that the volume group has free space.

```
# vgdisplay homevg
  --- Volume group ---
  VG Name               homevg
  System ID
  Format                lvm2
  Metadata Areas        2
```

```
  Metadata Sequence No  2
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                1
  Open LV               1
  Max PV                0
  Cur PV                2
  Act PV                2
  VG Size               2.29 GiB
  PE Size               4.00 MiB
  Total PE              586
  Alloc PE / Size       586 / 2.29 GiB
  Free  PE / Size       0 / 0
  VG UUID               9HPTso-Amw3-7OHQ-3ofl-AszO-1aeo-dFvB7z
# vgextend homevg /dev/dasdg1
  Volume group "homevg" successfully extended
# vgdisplay homevg
  --- Volume group ---
  VG Name               homevg
  System ID
  Format                lvm2
  Metadata Areas        3
  Metadata Sequence No  3
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                1
  Open LV               1
  Max PV                0
  Cur PV                3
  Act PV                3
  VG Size               4.58 GiB
  PE Size               4.00 MiB
  Total PE              1172
  Alloc PE / Size       586 / 2.29 GiB
  Free  PE / Size       586 / 2.29 GiB
  VG UUID               9HPTso-Amw3-7OHQ-3ofl-AszO-1aeo-dFvB7z
```

Note there are 586 new free physical extents (PEs).

13.3.3 Extending the logical volume and the file system

Now that you have free space in the volume group, you can increase the size of the existing logical volume with the **lvextend** command. The -l option specifies the number extents to add. Finally, use the **ext2online** command to increase the size of the file system while it is still mounted.

You can use the **df** command to show the file system size before and after you extend it, as the following example shows:

```
# df -h /home
/dev/mapper/homevg-homelv
                      2.3G   68M  2.1G   4% /home
# lvextend -l +586 /dev/homevg/homelv
```

```
  Extending logical volume homelv to 4.58 GB
  Logical volume homelv successfully resized
# resize2fs /dev/homevg/homelv
resize2fs 1.41.12 (17-May-2010)
Filesystem at /dev/homevg/homelv is mounted on /home; on-line resizing required
old desc_blocks = 1, new_desc_blocks = 1
Performing an on-line resize of /dev/homevg/homelv to 1200128 (4k) blocks.
The filesystem on /dev/homevg/homelv is now 1200128 blocks long.
```

Use the **df -h** command to show that the file system is now 2.3 GB larger:

```
# df -h /home
Filesystem            Size  Used Avail Use% Mounted on
/dev/mapper/homevg-homelv
                      4.6G   69M  4.3G   2% /home
```

13.4 Adding SCSI/FCP disks

This book has only described ECKD disks, also known as DASD. In addition, z/VM and Linux support SCSI/FCP disks.

The Fibre Channel (FC) standard was developed by the National Committee of Information Technology Standards (NCITS). The System z FCP I/O architecture conforms to these standards. IBM System z FCP support enables z/VM and Linux running on System z to access industry-standard SCSI devices. For disk applications, these FCP storage devices utilize Fixed Block (512 byte) sectors rather than Extended Count Key Data (ECKD) format. A new channel-path identifier (CHPID) type has been defined called *FCP*. The FCP CHPID type is supported on the FICON and FICON Express features of all System z processors.

This is only a brief introduction to SCSI/FCP disks and multipathing. For more complete documentation, see *Fibre Channel Protocol for Linux and z/VM on IBM System z*, SG24-72666.

In addition, see *Introducing N_Port Identifier Virtualization for IBM System z9*, REDP-41255.

13.4.1 Adding a single LUN

You can determine if your LPAR has these types of disks defined by using the z/VM QUERY FCP and QUERY FCP FREE commands. Here is an example from a MAINT 3270 session:

```
==> q fcp
An active FCP was not found.
==> q fcp free
FCP  1F20 FREE    , FCP  1F21 FREE    , FCP  1F50 FREE    , FCP  1F51 FREE
FCP  3B00 FREE    , FCP  3B01 FREE    , FCP  3B02 FREE    , FCP  3B03 FREE
FCP  3B04 FREE    , FCP  3B05 FREE    , FCP  3B06 FREE    , FCP  3B07 FREE
FCP  3B08 FREE    , FCP  3B09 FREE    , FCP  3B0A FREE    , FCP  3B0B FREE
FCP  3B0C FREE    , FCP  3B0D FREE    , FCP  3B0E FREE    , FCP  3B0F FREE
FCP  3B10 FREE    , FCP  3B11 FREE    , FCP  3B12 FREE    , FCP  3B13 FREE
FCP  3B14 FREE    , FCP  3B15 FREE    , FCP  3B16 FREE    , FCP  3B17 FREE
...
```

The output shows that the LPAR has many FCP devices free, but none of them are in use. Associated with FCP devices are World Wide Port Numbers (WWPNs) and Logical Unit Numbers (LUNs). Often, this information may be available as part of the LPAR definition. However, you may not have this information handy. If you do not have this information, it can be queried on RHEL 6. In the following section, an FCP/SCSI disk is attached to LINUX02.

Perform the following steps:

1. Start an SSH session as root to LINUX02.
2. Verify that the zfcp module is loaded by using the following command:

```
# lsmod | grep zfcp
zfcp                   144433  0 [permanent]
scsi_transport_fc       68240  1 zfcp
scsi_mod               296490  3 zfcp,scsi_transport_fc,scsi_tgt
qdio                    61977  3 zfcp,qeth_l3,qeth
```

3. Change the directory to `/sys/bus/ccw/drivers/` and list the contents:

```
# cd /sys/bus/ccw/drivers
# ls -F
3215/  3270/  dasd-eckd/  dasd-fba/  qeth/  vmur/
```

   Note that there is no directory named `zfcp/`.

4. Go back to the MAINT 3270 session and attach an FCP device to LINUX02 by using the ATTACH command:

```
==> att 3b16 linux02
FCP 3B16 ATTACHED TO LINUX02 3B16
```

5. Return to the Linux SSH session and list the contents of the directory again. This time, you should see a new directory named `zfcp/`:

```
# ls -F
3215/  3270/  dasd-eckd/  dasd-fba/  qeth/  vmur/  zfcp/
```

6. Change to that directory and list the contents:

```
# cd zfcp
# ls -F
0.0.3b16@  bind  module@  uevent  unbind
```

7. Note that a symbolic link (identified by the trailing ampersand, `@`, after the file name in conjunction with the -F flag of **`ls`**) has been made to a new directory named `0.0.3b16`. Change to that directory and list the contents:

```
# ls -F
availability  cutype   driver@   online  subsystem@
cmb_enable    devtype  modalias  power/  uevent
```

8. Enter the contents of the online file:

```
# cat online
0
```

   A value of `0` shows that the device is offline.

9. Echo a `1` into the file and it will be put online (you could also use the **`chccwdev -e`** command):

```
# echo 1 > online
# cat online
1
```

10. List the contents of the directory again. You should see that many entries were added after the device was put online. The four entries in bold are the WWPNs available from this FCP device.

```
# ls -F
0x5005076306138411/  cmb_enable        host0/       peer_wwnn    subsystem@
0x500507630613c411/  cutype            in_recovery  peer_wwpn    uevent
0x500507630a10016c/  devtype           lic_version  port_remove
0x500507630a13016c/  driver@           modalias     port_rescan
availability         failed            online       power/
card_version         hardware_version  peer_d_id    status
```

11. The **lsluns** command will show all of the available LUNs from a single WWPN. In the following example, the first WWPN is used:

```
# lsluns -p 0x5005076306138411
Scanning for LUNs on adapter 0.0.3b16
        at port 0x5005076306138411:
                0x4010400000000000
                0x4010400100000000
                0x4010400200000000
                ...
```

12. Bring a LUN online. In this example, the next free LUN is `4014402600000000`. Change the directory to the first WWPN and list the contents:

```
# cd 0x5005076306138411
# ls
access_denied  in_recovery  status  unit_add
failed         power        uevent  unit_remove
```

13. The output shows that there is no active LUN under this WWPN. Bring the LUN online by echoing the value into the `unit_add` file and list the contents of the directory:

```
# echo  0x4014402600000000 > unit_add
# ls -F
0x4014402600000000/  failed       power/  uevent    unit_remove
access_denied        in_recovery  status  unit_add
```

14. Note that a new directory with the LUN value is created:

```
# lszfcp -D
0.0.010a/0x500507630503c73d/0x4020400800000000 0:0:0:1074282528

# cat /proc/scsi/scsi
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 1074282528
  Vendor: IBM      Model: 2107900          Rev: .310
  Type:   Direct-Access                    ANSI  SCSI revision: 05
```

15. Now a `/dev/sda` directory exists. Check that there are no partitions:

```
# fdisk -l /dev/sda

Disk /dev/sda: 8589 MB, 8589934592 bytes
64 heads, 32 sectors/track, 8192 cylinders
Units = cylinders of 2048 * 512 = 1048576 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x00000000

   Device Boot      Start         End      Blocks   Id  System
```

16. Create a partition with the **fdisk** command:

```
# fdisk /dev/sda

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
         switch off the mode (command 'c') and change display units to
         sectors (command 'u').

Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-8192, default 1):
Using default value 1
Last cylinder, +cylinders or +size{K,M,G} (1-8192, default 8192):
Using default value 8192

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

17. Create an ext4 file system with the **mkfs.ext4** command:

```
# mkfs.ext4 /dev/sda1
mke2fs 1.41.12 (17-May-2010)
Filesystem label=
OS type: Linux
...
```

18. You should now be able to mount it and see the size:

```
# mount /dev/sda1 /mnt
# df -h /mnt
Filesystem            Size  Used Avail Use% Mounted on
/dev/sda1             7.9G  146M  7.4G   2% /mnt
```

19. Create a test file:

```
# echo "this is the file foo" > /mnt/foo
# umount /mnt
```

13.4.2 Configuring multipathing

It is a best practice to set up multipathing for better availability. Perform the following steps:

1. Create a second WWPN:

```
# cd /sys/bus/ccw/drivers/zfcp/0.0.010a
# ls
availability  cutype   driver    online  subsystem
cmb_enable    devtype  modalias  power   uevent
# echo 1 > online
```

2. Note the second WWPN. In this example, it is 0x500507630503c73d:

```
# ls
0x500507630503c73d  devtype           in_recovery  peer_wwnn    status
```

```
availability        driver            lic_version  peer_wwpn    subsystem
card_version        failed            modalias     port_remove  uevent
cmb_enable          hardware_version  online       port_rescan
cutype              host2             peer_d_id    power
# cd 0x500507630503c73d
```

3. Echo the same LUN into the `unit_add` file. This action enables the same LUN, but from a different WWPN.

```
# cd /sys/bus/ccw/drivers/zfcp/0.0.010a
# ls
0x500507630513c73d  devtype           in_recovery  peer_wwnn    status
availability        driver            lic_version  peer_wwpn    subsystem
card_version        failed            modalias     port_remove  uevent
cmb_enable          hardware_version  online       port_rescan
cutype              host1             peer_d_id    power
# cd 0x500507630513c73d/
# ls
access_denied  in_recovery  status  unit_add
failed         power        uevent  unit_remove
# echo 0x4020400800000000 > unit_add
# cat /proc/scsi/scsi
Attached devices:
Host: scsi0 Channel: 00 Id: 00 Lun: 1074282528
  Vendor: IBM      Model: 2107900          Rev: .310
  Type:   Direct-Access                    ANSI  SCSI revision: 05
Host: scsi1 Channel: 00 Id: 00 Lun: 1074282528
  Vendor: IBM      Model: 2107900          Rev: .310
  Type:   Direct-Access                    ANSI  SCSI revision: 05
```

4. At this point, the system thinks there are two LUNs, but actually there are two paths to the same LUN.

5. Install the `device-mapper-multipath` RPM:

```
# yum -y install device-mapper-multipath
...
```

6. Create the `/etc/multipath.conf` file:

```
# cd /etc
# vi multipath.conf
defaults {
        user_friendly_names yes
}
```

7. Turn the multipath service on for this session and across reboots:

```
# service multipathd start
Starting multipathd daemon: [  OK  ]
# chkconfig multipathd on

# multipath -ll
mpatha (36005076305ffc73d0000000000002008) dm-4 IBM,2107900
size=8.0G features='1 queue_if_no_path' hwhandler='0' wp=rw
`-+- policy='round-robin 0' prio=1 status=active
  |- 0:0:0:1074282528 sda   8:0   active ready  running
  `- 1:0:0:1074282528 sdb   8:16  active ready  running
```

8. Add an entry to /etc/multipath.conf using the mpatha value (WWID):

```
defaults {
        user_friendly_names yes
}
# create a friendly name - test_lun
multipaths {
        multipath {
                wwid            36005076305ffc73d0000000000002008
                alias           test_lun
                no_path_retry   5
        }
}
```

9. Restart the multipath service and verify that the new test_lun friendly name has been added:

```
]# service multipathd restart
Stopping multipathd daemon: [  OK  ]
Starting multipathd daemon: [  OK  ]
[root@train4 etc]# ls /dev/mapper
control           system_vg-tmp_lv  system_vg-var_lv  test_lunp1
system_vg-opt_lv  system_vg-usr_lv  test_lun
```

10. Mount the multipathed LUN with the new name and see that the test file exists:

```
# mount /dev/mapper/test_lunp1 /mnt
# ls /mnt
foo  lost+found
```

13.4.3 Making the changes persistent

To make the changes persistent, two steps must be performed:

1. Put the FCP device in the virtual machines user directory entry.
2. Put the WWPN and LUN into a Linux configuration file.

Perform the following steps:

1. Add a DEDICATE statement to virtualize A000 (which is the FCP device) as virtual device 200:

```
USER LINUX02 LINUX02 256M 1G G
 INCLUDE LNXDFLT
 OPTION APPLMON
 DEDICATE 0200 A000
 MDISK 100 3390 0001 3338 MM3F06 MR LNX4VM LNX4VM LNX4VM
 MDISK 101 3390 0001 3338 MM3F07 MR LNX4VM LNX4VM LNX4VM
```

2. Run DIRECTXA to bring the change online.
3. Create the /etc/zfcp.conf file. As a shortcut, you can use the output of **lszfcp -D**:

```
# cd /etc
# lszfcp -D > zfcp.conf
# vi zfcp.conf
0.0.010a 0x500507630503c73d 0x4020400800000000
0.0.010b 0x500507630513c73d 0x4020400800000000
```

13.5 Rescuing a Linux system

This section describes how to boot your Linux server into different modes for troubleshooting purposes. It covers booting Linux into single user mode, and also entering a rescue environment when you require more advanced troubleshooting.

13.5.1 Entering single user mode

Single user mode is helpful when you need to recover the root password, or if you are having problems booting Linux into the default run level. To enter single user mode, first perform an IPL of your Linux server from the 3270 console. You will see a message similar to the following one:

```
zIPL v1.8.2-28.el6 interactive boot menu

 0. default (linux)

 1. linux

Note: VM users please use '#cp vi vmsg <input>'

Please choose (default will boot in 5 seconds):
```

You can use the **#cp vi vmsg command** to boot the desired menu option (zero in this example), followed by the number one for single user mode:

```
==> #cp vi vmsg 0 1
```

In single user mode, you are logged in as the root user. You can use the **passwd** command to set the root password. All of the file systems in `/etc/fstab` are mounted, but networking has not been started. To exit single user mode, you can type **reboot**, or enter **init 3** to continue booting normally.

13.5.2 Entering a rescue environment

If you encounter errors while mounting the root file system, or have other problems that prevent you from entering single user mode, you can enter a rescue environment. This environment loads a Linux image in memory, and does not attempt to mount the root file system.

To enter a rescue environment, initiate an interactive Linux installation. Perform the following steps to enter a rescue environment on the LINUX023 user ID:

1. Log on to LNXMAINT. Copy the `RHEL6 EXEC` file to a new file named `RESCUE EXEC`, and copy the user's `PARM-RH6` file to a new file (`LINUX02 RESCUE` in this example):

   ```
   ==> copy rhel6 exec d rescue = =
   ==> copy linux02 parm-rh6 d = rescue =
   ```

2. Edit `RESCUE EXEC` to point to the new `RESCUE` file:

   ```
   ==> x rescue exec
   /* EXEC to punch a RHEL 6 install system to reader and IPL from it */
   Address 'COMMAND'
   'CP SPOOL PUN *'
   'CP CLOSE RDR'
   'CP PURGE RDR ALL'
   ```

```
'PUNCH RHEL6 KERNEL * (NOHEADER'
'PUNCH' Userid() 'RESCUE * (NOHEADER'
'PUNCH RHEL6 INITRD * (NOHEADER'
'CP CHANGE RDR ALL KEEP'
'CP IPL 00C CLEAR'
```

3. Edit the `LINUX02 RESCUE` file, replacing any kickstart or VNC lines with the rescue command line option:

```
==> x linux02 rescue d
root=/dev/ram0 ro ip=off ramdisk_size=40000
CMSDASD=191 CMSCONFFILE=LINUX02.CONF-RH6
rescue
```

4. Log off of LNXMAINT.
5. Log on to LINUX02 and answer `n` to the IPL from 100 question.
6. Increase the memory to 1 GB:

```
==> def stor 1g
00: STORAGE = 1G
00: Storage cleared - system reset.
```

7. Run **`ipl cms`** and again answer `n` to the IPL from 100 question.

```
==> ipl cms
z/VM V6.1.0    2010-09-23 11:31

DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
n
```

8. Run the `RESCUE EXEC` file:

```
==> rescue
NO FILES PURGED
RDR FILE 0001 SENT FROM LINUX02  PUN WAS 0001 RECS 100K CPY  001 A NOHOLD
NOKEEP
RDR FILE 0002 SENT FROM LINUX02  PUN WAS 0002 RECS 0003 CPY  001 A NOHOLD
NOKEEP
RDR FILE 0003 SENT FROM LINUX02  PUN WAS 0003 RECS 296K CPY  001 A NOHOLD
NOKEEP
0000003 FILES CHANGED
0000003 FILES CHANGED
Initializing cgroup subsys cpuset
Initializing cgroup subsys cpu
Linux version 2.6.32-71.el6.s390x (mockbuild@s390-004.build.bos.redhat.com)
(gcc
 version 4.4.4 20100726 (Red Hat 4.4.4-13) (GCC) ) #1 SMP Wed Sep 1 01:38:33
EDT
 2010
...
Kernel command line: root=/dev/ram0 ro ip=off ramdisk_size=40000
                     CMSDASD=191 CMSCONFFILE=LINUX02.CONF-RH6
                     rescue
...
Starting sshd to allow login over the network.
```

```
Connect now to 9.60.18.225 and log in as user install to start the
installation.

E.g. using: ssh -x install@9.60.18.225
```

The installation process directs you to telnet or SSH to the IP address of your Linux server to begin the first stage of the installation.

9. Use SSH to connect to the IP address and log in as install.
10. Choose your language.
11. The rescue environment will prompt you for the location of the rescue image, which is located in the installation tree on the cloner. Choose NFS directory, then enter the IP address of the cloner and the `/nfs/rhel5` path:

```
+------------------------------¦ NFS Setup +------------------------------+
¦                                                                          ¦
¦ Please enter the server and NFSv3 path to your Red Hat Enterprise Linux  ¦
¦ installation image and optionally additional NFS mount options.         ¦
¦                                                                          ¦
¦      NFS server name:                    9.60.18.223_____________       ¦
¦      Red Hat Enterprise Linux directory: /nfs/rhel6_______________      ¦
```

12. The Rescue window appears. Choose Continue. The rescue image will search for your Linux installation. Hopefully it will prompt you to mount the partitions it finds.

```
                +--------------¦ Rescue +---------------+
                ¦                                      ¦
                ¦ Your system has been mounted under   ¦
                ¦ /mnt/sysimage.                       ¦
                ¦                                      ¦
                ¦ Press <return> to get a shell. If you ¦
                ¦ would like to make your system the   ¦
                ¦ root environment, run the command:   ¦
                ¦                                      ¦
                ¦         chroot /mnt/sysimage         ¦
                ¦                                      ¦
                ¦ The system will reboot automatically ¦
                ¦ when you exit from the shell.        ¦
```

If the rescue image cannot find your partition, you can try to mount it yourself with the **mount** command. For example:

```
# mount /dev/dasda1 /mnt/runtime/
# ls /mnt/runtime/
bin         home        media       root        sys
boot        lib         mnt         sbin        tmp
dev         lib64       opt         selinux     usr
etc         lost+found  proc        srv         var
```

13. Type **exit** to leave the shell and exit rescue mode.

13.6 Setting up Linux Memory Hotplugging

Linux Memory Hotplug allows the amount of memory in a Linux system to be increased or decreased without a reboot. You must first have standby memory defined to the virtual machine in which Linux is running. You can issue the CP DEFINE STORAGE command to configure standby memory (storage). RHEL 6 Linux can then exploit the standby memory using the Service Call (SERVC) instruction.

To set up standby storage for Linux memory hotplug, using LINUX01 as the virtual machine, perform the following steps.

1. Modify the LINUX01 directory entry by adding a COMMAND statement. This action gives the virtual machine an additional 768 MB of standby memory:

```
USER LINUX01 LNX4VM 256M 1G G
  INCLUDE LNXDFLT
  COMMAND DEFINE STORAGE 256M STANDBY 768M
  OPTION APPLMON
  MDISK 100 3390 3339 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
  MDISK 101 3390 6677 3338 UM63A9 MR LNX4VM LNX4VM LNX4VM
```

2. You could run the DISKMAP USER command to review the minidisk allocation, but because you did not change anything to do with disks, it is probably not necessary. Run the DIRECTXA command to bring the change online:

```
==> directxa user
z/VM USER DIRECTORY CREATION PROGRAM - VERSION 6 RELEASE 1.0
EOJ DIRECTORY UPDATED AND ON LINE
HCPDIR494I User directory occupies 45 disk pages
```

3. Shut down the Linux system running on LINUX01. This can be done a number of ways, but because you are logged onto MAINT, it can be accomplished with the SIGNAL SHUTDOWN command:

```
==> signal shutdown linux01
```

4. Within about 30 seconds, you should see notification that the system went down cleanly and the virtual machine was logged off:

```
HCPSIG2113I User LINUX01 has reported successful termination
USER DSC   LOGOFF AS  LINUX01  USERS = 16    AFTER SIGNAL
```

5. Log on to LINUX01. You should see the standby memory reported:

```
LOGON LINUX01
00: NIC 0600 is created; devices 0600-0602 defined
00: z/VM Version 6 Release 1.0, Service Level 0901 (64-bit),
00: built on IBM Virtualization Technology
00: There is no logmsg data
00: FILES: 0003 RDR,   NO PRT,   NO PUN
00: LOGON AT 11:47:27 EDT MONDAY 09/13/10
00: STORAGE = 256M MAX = 1G INC = 1M STANDBY = 768M RESERVED = 0
00: Storage cleared - system reset.
```

6. Answer y to boot Linux:

```
DMSACP723I A (191) R/O
DMSACP723I C (592) R/O
DIAG swap disk defined at virtual address 300 (64989 4K pages of swap space)
DIAG swap disk defined at virtual address 301 (129981 4K pages of swap space)
Do you want to IPL Linux from minidisk 100? y/n
```

```
y
...
```

7. Start an SSH session as root and view the memory in the /sys/ file system. Change the directory to /sys/devices/system/memory/ and list the files:

```
# cd /sys/devices/system/memory
# ls
block_size_bytes  memory0  memory1  memory2  memory3
```

8. Enter the block_size_bytes file by using the **cat** command:

```
# cat block_size_bytes
10000000
```

This number is the number of bytes in hexadecimal. 10000000 in hex is 256 MB in decimal. So the block size is 256 MB and there are four blocks, memory0 through memory3, which are represented as directories. Each of the memory blocks has a state, which is represented as a file.

9. Show the state of each memory block with the following command:

```
# cat memory*/state
online
offline
offline
offline
```

The output shows that the first 256 MB is online and the next three blocks are offline.

10. You can also show information about memory by using the **free -m** command:

```
# free -m
             total       used       free     shared    buffers     cached
Mem:           241        165         75          0         18         54
-/+ buffers/cache:         92        148
Swap:          761          0        761
```

This shows 241 MB

11. You can turn on memory by sending the online string to the state file. Turn on an additional 512 MB of memory by using the following commands:

```
# echo online > memory1/state
# echo online > memory2/state
```

12. Show that the memory is now online:

```
# cat memory*/state
online
online
online
offline
```

13. Again, confirm the memory by using the **free -m** command:

```
# free -m
             total       used       free     shared    buffers     cached
Mem:           753        170        582          0         18         54
-/+ buffers/cache:         98        654
Swap:          761          0        761
```

14. You can also give the memory back by echoing **offline** to the state file:

```
# echo offline  > memory1/state
# echo offline  > memory2/state
```

15. Verify that the memory has returned:

```
# cat memory*/state
online
offline
offline
offline
# free -m
             total       used       free     shared    buffers     cached
Mem:           241        165         75          0         18         54
-/+ buffers/cache:         92        148
Swap:          761          0        761
```

This section has shown how to configure virtual machines with standby memory and how to "hot-plug" the memory from Linux. Each of the four Linux virtual machines, LINUX01 through LINUX04, default to 256 MB of memory and can be moved up to 1 GB. However, LINUX02 through LINUX04 require Linux to be shut down, the CP DEFINE STORAGE command to be run, and Linux to be rebooted. LINUX01 can now have memory added while Linux is running. This function can increase your server farm's performance and availability.

13.7 Using the cpuplugd service

The cpuplugd service allows Linux to enable or disable CPUs and memory, based on a set of rules. It can improve performance by setting the correct number of processors and amount of memory for Linux systems depending on their current load. It can also prevent the Linux scheduler from queue balancing in partial load situations.

More information about cpuplugd can be found in *Linux on System z Device Drivers, Features and Commands on Red Hat Enterprise Linux 6*, which can be found on the web at the following address:

http://www.ibm.com/developerworks/linux/linux390/documentation_red_hat.html

13.7.1 Determining the virtual CPUs being used

To determine the virtual CPUs that are being used, perform the following steps:

1. Start an SSH session to a Linux system and determine how many CPUs Linux has online. Use a short bash script, lscpus, to save typing:

```
# cd /usr/local/sbin
# vi lscpus
#!/bin/bash
# script to list the number and status of virtual CPUs
for i in /sys/devices/system/cpu/cpu*
do
  echo $i
  cat $i/online
done
```

2. Save the file and the set it to be executable:

```
# chmod +x lscpus
```

3. Observe the status of the cpuplugd service:

```
# service cpuplugd status
cpuplugd (pid  1574) is running...
```

The output shows that cpuplugd starts by default in the current run level.

4. Wait a few minutes and run the lscpus script again:

```
# lscpus
/sys/devices/system/cpu/cpu0
1
/sys/devices/system/cpu/cpu1
0
/sys/devices/system/cpu/cpu2
0
/sys/devices/system/cpu/cpu3
0
/sys/devices/system/cpu/cpu4
0
/sys/devices/system/cpu/cpu5
0
/sys/devices/system/cpu/cpu6
0
/sys/devices/system/cpu/cpu7
0
/sys/devices/system/cpu/cpu8
0
/sys/devices/system/cpu/cpu9
0
```

   The output shows that now only one of the ten virtual CPUs are active. The cpuplugd service turned off the other 9.

5. The cpuplugd configuration file is `/etc/sysconfig/cpuplugd`. Some middleware products recommend a minimum of two virtual processors. If the majority of your Linux servers will be running a workload, which recommends two processors, change the default for CPU_MIN to 2. An exception would be when only a single physical processor is available. View the non-comments and lines that are not blank in the configuration file with the following command:

```
# cd /etc/sysconfig
# egrep -v '^$|^#' cpuplugd
CPU_MIN="1"
CPU_MAX="0"
UPDATE="10"
CMM_MIN="0"
CMM_MAX="8192"
CMM_INC="256"
HOTPLUG="(loadavg > onumcpus + 0.75) & (idle < 10.0)"
HOTUNPLUG="(loadavg < onumcpus - 0.25) | (idle > 50)"
MEMPLUG="0"
MEMUNPLUG="0"
```

   The default rules for the plugging and unplugging of CPUs in the configuration file is as follows:

```
HOTPLUG = "(loadavg > onumcpus +0.75) & (idle < 10.0)"
HOTUNPLUG = "(loadavg < onumcpus -0.25) | (idle > 50)"
```

Where the variables in the statements have the following meaning:

loadavg	The current average CPU load
onumcpus	The number of CPUs that are online
runable_proc	The current number of processes that can be run
idle	The current idle percentage

These CPU hot plugging and unplugging values will be used in the next section. In the default setup, cpuplugd will only make changes to the virtual processor configuration. The auto adaptive adjustment of the memory using the cmm feature (module) is deactivated by default and also not available when running in a native LPAR environment.

13.7.2 Generating a workload to see cpuplugd work

You can now generate a workload to show how cpuplugd will turn on CPUs.

Important: Running the following command will generate significant CPU use. Verify that there is not a mission-critical workload running on this z/VM LPAR, as this test may affect it. Also, be sure to kill the processes after seeing cpuplugd in action.

Perform the following steps:

1. Put ten looping jobs in the background with the following `for` loop:

```
# for i in `seq 1 10`
> do
>   bash -c "cat /dev/zero > /dev/null" &
> done
[1] 2441
[2] 2442
[3] 2443
[4] 2444
[5] 2445
[6] 2446
[7] 2447
[8] 2448
[9] 2449
[10] 2453
```

2. See that the jobs are running (you can also use the **top** command):

```
# pstree -G | grep cat
    +-sshd---sshd---bash---10*[bash---cat]
```

3. Now run **lscpus** every so often. The following example shows that, after a minute or so, cpuplugd has started five of the nine spare processors.

```
# lscpus
/sys/devices/system/cpu/cpu0
1
/sys/devices/system/cpu/cpu1
1
/sys/devices/system/cpu/cpu2
1
/sys/devices/system/cpu/cpu3
1
/sys/devices/system/cpu/cpu4
1
```

```
/sys/devices/system/cpu/cpu5
1
/sys/devices/system/cpu/cpu6
0
/sys/devices/system/cpu/cpu7
0
/sys/devices/system/cpu/cpu8
0
/sys/devices/system/cpu/cpu9
0
```

After a few more minutes, all of the CPUs should be activated.

4. Kill the processes with the **killall** command, then verify that the loops have stopped:

```
# killall cat
bash: line 1:  2450 Terminated              cat /dev/zero > /dev/null
bash: line 1:  2452 Terminated              cat /dev/zero > /dev/null
bash: line 1:  2451 Terminated              cat /dev/zero > /dev/null
bash: line 1:  2457 Terminated              cat /dev/zero > /dev/null
bash: line 1:  2456 Terminated              cat /dev/zero > /dev/null
[1]   Exit 143                bash -c "cat /dev/zero > /dev/null"
[2]   Exit 143                bash -c "cat /dev/zero > /dev/null"
...
# pstree -G | grep cat
```

No output shows that the processes to create a workload have been stopped.

13.7.3 Setting memory sizes with cpuplugd

Memory sizes can also be set by the cpuplugd service. However, unlike CPUs, there is no good generic default value. The following example is in the Device Drivers book:

```
MEMPLUG = "swaprate > freemem+10 & freemem+10 < apcr"
MEMUNPLUG = "swaprate > freemem + 10000"
```

However, this is just a starting point to explain the syntactical structure of a rule. Do not use this configuration in production. You should test any setting that you want to implement against a representative workload that your Linux systems will be running. The details of this topic are beyond the scope of this book.

13.8 Hardware cryptographic support for OpenSSH

This section shows how to copy a test file with OpenSSH, first without any crypto acceleration, and then crypto acceleration for OpenSSH is enabled and the same file is copied again. A much higher throughput rate should be observed. The prerequisite for using hardware cryptography is to have a firmware level of LIC 3863 installed on your System z CPC.

This section is based on the white paper *First experiences with hardware cryptographic support for OpenSSH with Linux for* System z, by Gnirss, et al. It can be found at the following address:

http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101690

This section only shows a single example of crypto acceleration. For a much more complete and detailed analysis, refer to the white paper.

To test copy a file with and without cryptographic acceleration, perform the following steps:

1. Start an SSH session to a Linux.
2. Create a 200 MB test file for copying in the `/tmp/` directory:

```
# cd /tmp
# dd if=/dev/zero of=testdata.txt bs=1048576 count=200
200+0 records in
200+0 records out
209715200 bytes (210 MB) copied, 17.87 s, 11.7 MB/s
# ls -lh testdata.txt
-rw-r--r--. 1 root root 200M Oct  9 14:51 testdata.txt
```

3. Copy the file locally with the **scp** command, two times with specific encryption algorithms and once without, prefixing them all with the **time** command:

```
# time scp -c 3des-cbc /tmp/testdata.txt localhost:/dev/null
The authenticity of host 'localhost (::1)' can't be established.
RSA key fingerprint is 41:77:58:10:50:09:ba:2a:6a:7b:8b:56:95:1a:37:79.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'localhost' (RSA) to the list of known hosts.
root@localhost's password:
testdata.txt                                  100%  200MB   4.6MB/s   00:44

real    0m51.295s
user    0m17.797s
sys     0m1.047s
# time scp -c aes128-cbc /tmp/testdata.txt localhost:/dev/null
root@localhost's password:
testdata.txt                                  100%  200MB  28.6MB/s   00:07

real    0m10.780s
user    0m1.212s
sys     0m0.698s
[root@gpok225 ssl]# time scp /tmp/testdata.txt localhost:/dev/null
root@localhost's password:
testdata.txt                                  100%  200MB  16.7MB/s   00:12

real    0m15.977s
user    0m3.072s
sys     0m0.753s
```

   The output shows throughputs of about 4.6, 28.6, and 16.7 MBps and a user times of about 17.7, 1.2, and 3.0 seconds.

4. Determine if the necessary cryptographic-related RPMs are installed:

```
# rpm -qa | grep openssl-ibmca
```

   No output shows that they are not installed.

5. Install the RPM by using the **yum install** command:

```
# yum -y install openssl-ibmca openssl-ibmca.s390
...
Installed:
  openssl-ibmca.s390 0:1.1-3.el6         openssl-ibmca.s390x 0:1.1-3.el6

Dependency Installed:
  glibc.s390 0:2.12-1.7.el6         keyutils-libs.s390 0:1.4-1.el6
  krb5-libs.s390 0:1.8.2-3.el6      libcom_err.s390 0:1.41.12-3.el6
```

```
  libselinux.s390 0:2.0.94-2.el6    nss-softokn-freebl.s390 0:3.12.7-1.1.el6
  openssl.s390 0:1.0.0-4.el6        zlib.s390 0:1.2.3-25.el6

Complete!
```

6. Verify that the RPMs are now installed:

```
# rpm -qa | egrep "libica|ibmca"
libica-2.0.3-2.el6.s390x
openssl-ibmca-1.1-3.el6.s390x
openssl-ibmca-1.1-3.el6.s390
```

7. Verify that CP Assist for Cryptographic Function (CPACF) operations are supported:

```
# icainfo
The following CP Assist for Cryptographic Function (CPACF) operations are
supported by libica on this system:
SHA-1:    yes
SHA-256:  yes
SHA-512:  yes
DES:      yes
TDES-128: yes
TDES-192: yes
AES-128:  yes
AES-192:  yes
AES-256:  yes
PRNG:     yes
```

8. Make a backup of the `/etc/ssl/openssl.cnf` SSL configuration file:

```
# cd /etc/pki/tls
# cp openssl.cnf openssl.cnf.orig
```

9. Append the sample SSL configuration file under `/usr/share/doc/openssl-ibmca-1.1/` to the actual SSL configuration file, that is, `/etc/openssl.cnf`:

```
# cat /usr/share/doc/openssl-ibmca-1.1/openssl.cnf.sample-s390x >> openssl.cnf
```

10. Edit the appended file and search for the line with the `openssl_conf` variable. Move that line from the bottom to the top and save the file, as shown in the following example:

```
# vi openssl.cnf
/openssl_conf
#
# OpenSSL example configuration file.
# This is mostly being used for generation of certificate requests.
#

# This definition stops the following lines choking if HOME isn't
# defined.
HOME                    = .
RANDFILE                = $ENV::HOME/.rnd
openssl_conf = openssl_def
...
```

11. Without a symlink, we receive the following error:

```
# time scp -c 3des-cbc /tmp/testdata.txt localhost:/dev/null
Auto configuration failed
2199031767552:error:25066067:DSO support routines:DLFCN_LOAD:could not load the
shared library:dso_dlfcn.c:185:filename(/usr/lib64/libibmca.so):
```

```
/usr/lib64/libibmca.so: cannot open shared object file: No such file or
directory
2199031767552:error:25070067:DSO support routines:DSO_load:could not load the
shared library:dso_lib.c:244:
2199031767552:error:260B6084:engine routines:DYNAMIC_LOAD:dso not
found:eng_dyn.c:450:
2199031767552:error:260BC066:engine routines:INT_ENGINE_CONFIGURE:engine
configuration error:eng_cnf.c:204:section=ibmca_section, name=dynamic_path,
value=/usr/lib64/libibmca.so
2199031767552:error:0E07606D:configuration file routines:MODULE_RUN:module
initialization error:conf_mod.c:235:module=engines, value=engine_section,
retcode=-1
lost connection
```

12. Make a symbolic link to the `/usr/lib64/openssl/engines/libibmca.so` file:

```
# cd /usr/lib64
# ln -s openssl/engines/libibmca.so
# ls -l libibmca.so
lrwxrwxrwx. 1 root root 27 Oct 20 16:47 libibmca.so ->
openssl/engines/libibmca.so
```

13. Rerun the same **scp** commands:

```
# time scp -c 3des-cbc /tmp/testdata.txt localhost:/dev/null
Password:
testdata.txt                                  100%  200MB  66.7MB/s   00:03

real    0m5.890s
user    0m1.542s
sys     0m0.558s
# time scp -c aes128-cbc /tmp/testdata.txt localhost:/dev/null
Password:
testdata.txt                                  100%  200MB  66.7MB/s   00:03

real    0m6.287s
user    0m0.993s
sys     0m0.541s
# time scp /tmp/testdata.txt localhost:/dev/null
Password:
testdata.txt                                  100%  200MB  66.7MB/s   00:03

real    0m4.839s
user    0m0.996s
sys     0m0.548s
```

14. Delete the test file:

```
# rm /tmp/testdata.txt
```

You should see an improved througput.

13.9 The X Window System

For many years, UNIX-like operating systems have been using the X Window System. This system was designed to provide a client/server, hardware-independent, and network-enabled graphical environment. The current version is X Window System 11, which is widely used on UNIX and Linux platforms.

Confusion often arises among new X Window System users regarding the concept of client and server, because client and server are defined from an application point of view, where other protocols, such as SSH, Telnet, and FTP, are defined from an user point of view. In the X Window System, the server runs on a workstation or a desktop, while the client runs on the UNIX or Linux server. Many Linux desktop users do not recognize this difference because they often run both the server and client on their desktop.

It is a common practice to connect from a PC (SSH client) to a remote Linux system (SSH server) and then run an X Window System application. It runs on a remote Linux system (X Window System client) and displays on a local PC (X Window System server).

The X Window System communication protocol, by its nature, is not secure at all. For this reason, it is often used together with the SSH protocol, which tunnels X Window System 11 traffic using encrypted (and thus secure) communications.

X Window System 11 itself provides the ability to display graphics on raster display only. If the user wants to be able to move, resize, and otherwise manage windows, a *window manager* is required. There are many window managers available; some are lightweight, while some are more robust. So using a window manager is a good idea, because it provides the functionality that one expects from a GUI.

When you have Linux installed on your workstation, a window manager is probably not enough. Here you want a full desktop environment with menus, icons, task bars, and so on, such as Gnome and KDE. Installing GNOME or KDE on System z is discouraged, as they are resource-intensive. Installing the X Window System on System z is also not recommended.

13.9.1 VNC server

As mentioned earlier, the X Window System server is run on the workstation. In a nutshell, a VNC server provides a virtual workstation with all the peripherals (virtual). The VNC server starts an embedded X Window System server. Then any X Window System-based application can send its output to this X Window System server, regardless whether the applications are local or remote to the X Window System server.

To interact with the X Window System server, one uses a VNC client on a workstation, as described in 3.2, “Setting up a VNC client” on page 24. The VNC server customization is described in 8.2.4, “Configuring the VNC server” on page 151. In our experience, this is all you need if you want to run X Window System applications from time to time.

One big advantage of VNC is that it is session oriented. If communication to VNC server is lost, a new connection is reestablished to the session as it was. Also, applications in a disconnected VNC session still continue to run.

13.9.2 X Window System Server on workstation

If for some reason VNC is not acceptable, it is possible to use a standard X Window System server on a workstation. Because Linux users usually know the X Window System, an X Window System server running on Windows is described in this section.

There are many commercial and free X Window System servers available for Windows. In the following examples, XliveCD is used, which provides a free X Window System server based on Cygwin. It can be run directly from a CD without requiring installation. You can find the installation files at the following address:

http://xlivecd.indiana.edu/

Any X Window System application will send its output to an address defined with the -display parameter or, if the address is not provided, to an address specified in the DISPLAY environment variable. If neither is provided, the local computer is used for output.

Run the following command:

```
gpok224:~ # xclock
Error: Can't open display:
```

There is no display specified for the **xclock** command and it will terminate.

A display is specified by setting DISPLAY environment variable:

```
gpok224:~ # export DISPLAY=9.145.177.158:0
gpok224:~ # xclock
No protocol specified
Error: Can't open display: 9.145.177.158:0
```

This command failed, because XliveCD requires an explicit command to allow remote hosts to connect to it. When the command **xhost +** (plus means to add authorized hosts) is run, **xclock** can finally display on Windows, as shown in Figure 13-2. Remember the program itself runs on a remote Linux.

Run the following command again. You should get a positive output this time.

```
gpok224:~ # xclock &
[1] 21915
```

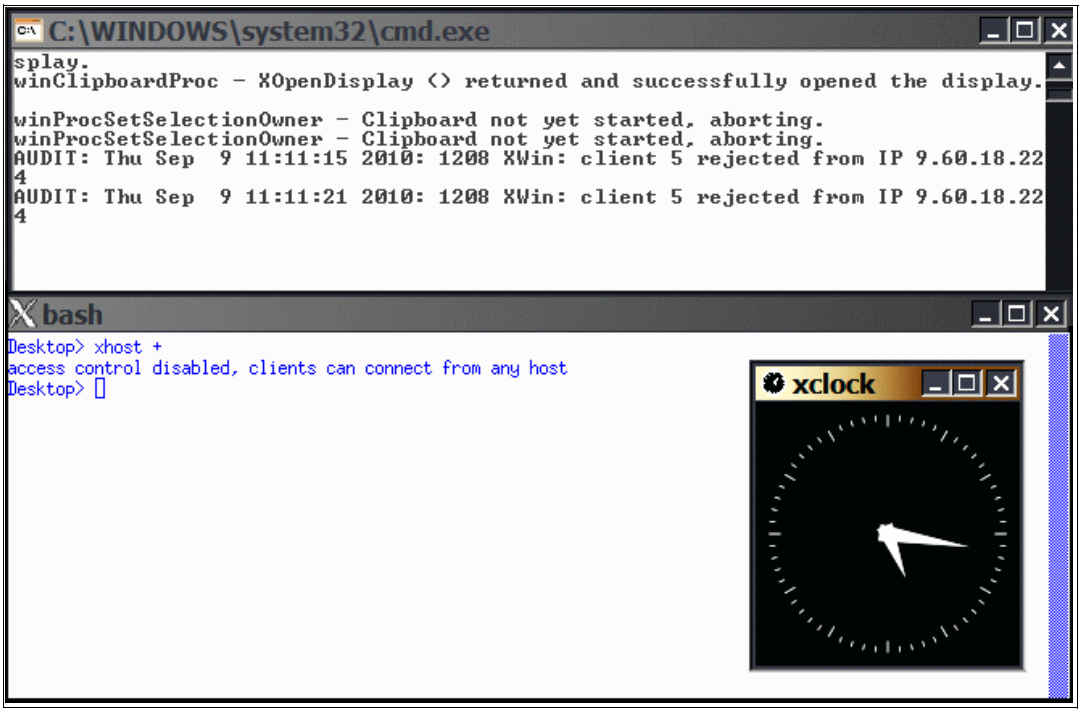


Figure 13-2 Manual setting of DISPLAY variable

The **xhost +** command allows any host to access the X Window System server. From a security point of view, this may not be a good idea. Even allowing just specific hosts is not enough, because the X Window System 11 protocol itself is not secure. Using SSH tunneling removes this security exposure. SSH tunneling also prevents firewalls and NAT from breaking X Window System 11 communications.

It is possible to use an external SSH client that allows X Window System 11 forwarding, or SSH client embedded in XliveCD itself.

Using PuTTY

To use PuTTY for X Window System 11 forwarding, check **Enable X11 forwarding**, as shown in Figure 13-3.

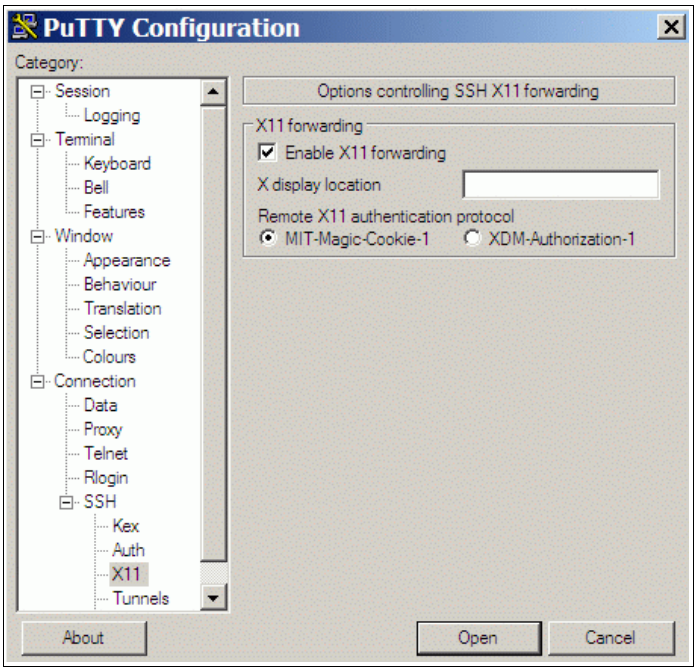


Figure 13-3 Enable X Window System 11 forwarding in PuTTY

As you can see in Figure 13-4, the DISPLAY environment variable contains the special value of `localhost:10.0`, which tells PuTTY to forward the X Window System 11 protocol over SSH to an SSH client address. In this case, there is no need to enter the **`xhost`** command, because the connection appears as a local one to the X Window System server.

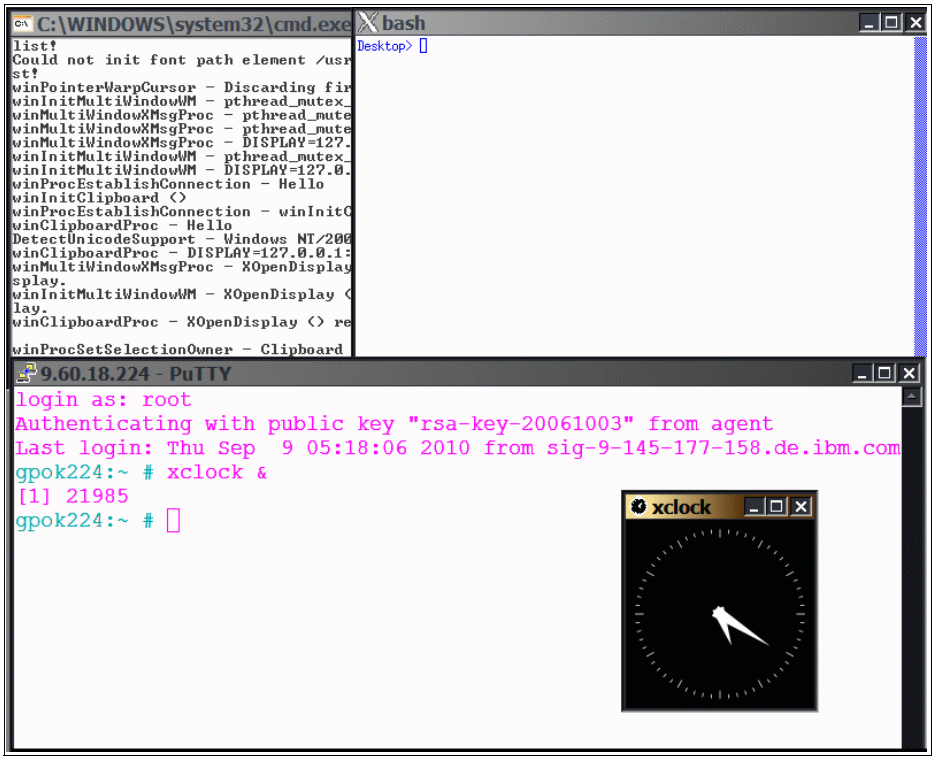


Figure 13-4 X Window System 11 forwarding with PuTTY

Using embedded SSH

It is also possible to achieve X Window System 11 forwarding with an embedded SSH client as shown in Figure 13-5. Again, no **xhost** command is needed.

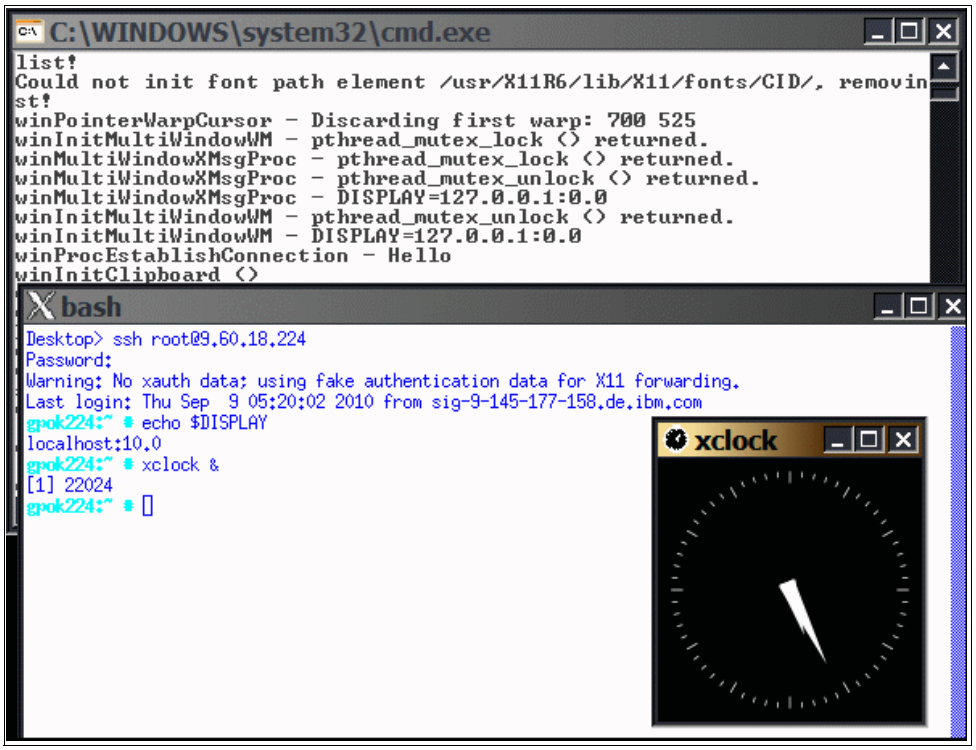


Figure 13-5 X Window System 11 forwarding with embedded SSH client

There are many ways to achieve the same results. It is up to you to choose a solution that best suits your purposes.

13.10 Centralizing home directories for LDAP users

In related books about previous versions of RHEL, there was a section about how to create a travelling `/home/` directory using LDAP, NFS, and automount. To save space, this section has been removed. The recipe for SLES 10 SP2 should be useful on SLES 11 SP1, although it might not work exactly as it did for SLES 10. See Section 13.3, “Centralizing home directories for LDAP users”, in *z/VM and Linux on IBM System z The Virtualization Cookbook for Red Hat Linux Enterprise Server 5.2*, SG24-7492.

13.10.1 Recommendations for centralizing home directories

In December of 2009, the topic of how to set up a common home directory came up on the linux-390 list server. The following post by Patrick Spinler is copied, with permission, as it may be helpful to you:

“NFSv3 is not known for it's security. Consider the use of the NFS option `root_squash`, along with limiting the list of hosts who can connect to your home share. Only export home directories to hosts which you control, remember that anyone who has root on their box (e.g. a developer workstation) can impersonate any user to NFS. Here's the relevant `/etc/exports` line we use:

```
/export/unixdata/homedirs                \
  @hgrp_autohome_admin(rw,no_root_squash,insecure,sync) \
  @hgrp_autohome_hosts(rw,root_squash,insecure,sync)
```

I look forward to going to NFSv4 with kerberos authentication, but we're not there yet.

Regarding automount maps in LDAP, this works very well for us with one exception. The problem is that there's a significant number of automount map schemas out there, and different OS's (and different revisions of OS's) use different ones. As we are a fairly heterogeneous environment, I found it near impossible to keep a master map in LDAP. Right now we're just keeping a `/etc/auto.master` or `/etc/auto_master` on each host.

In order to make the individual map entries work heterogeneously, I had to add several object classes and a few redundant attributes to each entry. Here's what my home directory automount map entry looks like:

```
# ap00375, auto_home, unix.example.com
dn: automountKey=ap00375,automountMapName=auto_home,dc=unix,dc=example,dc=com
automountInformation: linux01.example.com:/vol/vol2/unixhomes-5gb/75/ap00375
cn: ap00375
automountKey: ap00375
objectClass: automount
objectClass: nisNetId
objectClass: top
```

Regarding heterogeneous clients, we found AIX in particular to be the hardest of our clients to configure, and Linux the easiest. Insure on AIX that you have the latest available LDAP client package from IBM. Also be aware that AIX wants to use it's extended LDAP schema rather than RFC2307, and wants full write access to the LDAP servers from every AIX client. Despite that, it will work with RFC2307 and read only access. Solaris, like Linux, has an option to not use an LDAP proxy account at all via anonymous binding, but I never got Solaris anonymous binding to work.

I recommend making LDAP use TLS or SSL on the wire, in order to keep clear-text passwords from flying about. Both AIX and Solaris require the server public SSL certificates to be loaded on every client to do LDAP over TLS or SSL. Linux can be configured to ignore authenticating the LDAP servers' certificates and proceed with TLS/SSL anyway - this is convenient, but does open the possibility of man in the middle attacks. In our environment this isn't a big deal, but it might be in yours.

We've found POSIX group membership management to be one of our more challenging issues overall. Some older systems (e.g. solaris <= 8 or 9) enforce the old POSIX limit of no more than 16 secondary groups. Further, the primary group concept is annoying - conceptually, in any organization with modest member mobility, which primary group do they get? If one assumes that the primary group is meaningful, e.g. reflective of someone's function, role, or job, what about people who do two or more things (E.g. student *and* employee) or people who transfer, but will have a transitional period?

Our not so great compromise was to first use NIS-style netgroups via LDAP for anything we can. In particular, we use a mutation of netgroups to control individual's authorization to log in via the use of service search descriptors, and also for sudo privileges. Second in our environment all meaningful POSIX groups are secondary groups. For primary groups we adopt the linux convention of creating a separate POSIX group for each individual: e.g. userA gets a group userA as her primary group. This has the problem of a huge proliferation of groups, though, and several LDAP clients, in particular AIX, have issues with that."[1]

[1] Source: http://www2.marist.edu/htbin/wlvindex?linux-390

14

Monitoring and tuning z/VM and Linux

This chapter briefly describes how to monitor z/VM and Linux. For another source on z/VM performance and monitoring, see Chapter 11, “Monitoring performance and capacity,” in the manual *Getting Started With Linux*, SC24-6096, on the web at:

http://publibz.boulder.ibm.com/epubs/pdf/hcsx0b20.pdf

There are a number of z/VM monitoring tools such as CA’s VM:Monitor, the IBM z/VM Performance Toolkit, the IBM Tivoli OMEGAMON® XE for z/VM and Linux. and products from Velocity Software. The IBM z/VM Performance Toolkit is briefly described in this section.

There are also two sections on tuning z/VM and Linux using Cooperative Memory Management (CMM) and the processor plug daemon, cpuplugd.

This chapter contains the following sections:

14.1 Using INDICATE and other commands

z/VM has many commands to monitor the state of the system. CP INDICATE is the most commonly used, and there are other commands that are addressed. For more information, see the z/VM Performance Resources web page at

http://www.vm.ibm.com/perf/

14.1.1 Using the INDICATE command

z/VM has some basic commands such as INDICATE. There are many INDICATE parameters that can be included as command line options. Use the command HELP INDICATE for a basic understanding and then press F11 for help on each parameter.

INIDICATE LOAD

If no parameter is specified, INDICATE LOAD is the default option. There are two flavors of this, depending on whether the issuing user ID has privilege class G or class E. Class G users can use INDICATE to display recent contention for system resources, environment characteristics, and measurements of resources used by their virtual machine.

The output from a user ID with class E privilege (for example, MAINT and OPERATOR) is shown here. The lines are numbered for clarity of the description that follows:

```
==> ind load
1  AVGPROC-038% 03
2  XSTORE-000021/SEC MIGRATE-0001/SEC
3  MDC READS-000068/SEC WRITES-000001/SEC HIT RATIO-099%
4  PAGING-0031/SEC STEAL-000%
5  Q0-00006(00000)                              DORMANT-00357
6  Q1-00001(00000)            E1-00000(00000)
7  Q2-00001(00000) EXPAN-002 E2-00000(00000)
8  Q3-00034(00000) EXPAN-002 E3-00000(00000)
9
10 PROC 0000-038%           PROC 0001-038%
11 PROC 0002-038%
12
13 LIMITED-00000
```

The INDICATE LOAD command gives a snapshot of current system performance. Except for the counts of virtual machines in various queues and the limited list, the values you see here are a smoothed average over the past 4 minutes. Areas on which z/VM performance analysts tend to focus are the following:

- AVGPROC on line 1 gives the overall processor utilization, 38% in this example. The number following it is the number of online processors, 3 in this example. The individual processor utilization is shown on lines 10 and 11. Take a glance at these to see if they are somewhat balanced. There are cases where an imbalance is okay. This would include low utilization scenarios or cases where there are not enough users ready to run virtual processors to keep the physical processors busy. One of the processors will be a Master, all of the others Alternate, and some imbalance may result from performing these functions.

  Line 2 describes paging to expanded storage. Most z/VM systems on z9 class machines can sustain several 1000s of this type of paging operations a second without any problems. z10 class machines will perform even better. The MIGRATE rate is the number of pages per second being moved from expanded storage out to paging space on DASD. A healthy system will have a MIGRATE rate significantly lower than the XSTORE rate, probably

being measured in 100s rather than 1000s. The higher values seen tend to build up over time, and are sustained over periods of intense system activity. However, there are times when the MIGRATE value may spike for brief periods of time.

- Minidisk cache (MDC) statistics are given on the third line. The effectiveness of MDC can be judged by the combination of the READS rate and the HIT RATIO. If both are high, then a large number of physical I/Os are avoided due to the MDC feature. For a system that has an appreciably high I/O rate, composed of reads plus writes, and a high proportion of reads, and a good hit ratio for those reads (tending to 90% or greater), the real, physical I/O avoidance can be high. This author has seen the avoidance as high as 50% in some cases. Conversely, however, a high HIT RATIO with a low value for the READS rate should not be taken as good (100% hit ratio, when doing only 1 I/O per second is effectively meaningless).
- Line 4 describes more storage (memory) management. The PAGING rate is important. Higher values will often impact performance. This can be at least partially offset by increasing the number of page volumes, but a more thorough examination of this problem is advisable whenever it arises.The STEAL percentage is often misleading. This is basically the percentage of pages taken from guests that z/VM believes are non-dormant. Because some guests have periodic timers going off, they appear to be active to z/VM even when relatively idle. Pages taken from these guests are still considered to be stolen. So there are scenarios where a system only has a user set comprising active guests, in which case all pages taken would be considered stolen. Bearing this in mind, if a high STEAL value is observed, the paging rate needs to be checked. If the paging rate is relatively low, then the STEAL value is not important.
- On lines 5 through 8 you also see a series of counters that represent the users in various queues. The z/VM scheduler classifies work into 3 different classes (1 through 3) and a special additional class labelled zero. So the Column of Q_x values and E_x represent the virtual machines in the dispatch list and the eligible list. The most important value here to validate is that there are no virtual machines in the Eligible list: E1, E2, E3; this implies z/VM has stopped dispatching some virtual machines to avoid overcommitting resources. Such a system would require further investigation, possibly leading to some tuning work, or even hardware addition in extreme cases. Ignore the values in parenthesis.

INDICATE QUEUES EXP

Another useful command to understand the state of the system is the INDICATE QUEUES EXP command. Here is an example:

```
==> ind q exp
DATAMGT1      Q3 AP  00000537/00000537 .... -2.025 A02
BITNER        Q1 R00 00000785/00000796 .I.. -1.782 A00
EDLLNX4       Q3 PS  00007635/00007635 .... -1.121 A00
TCPIP         Q0 R01 00004016/00003336 .I.. -.9324 A01
APCTEST1      Q2 IO  00003556/00003512 .I.. -.7847 A01
EDLWRK20      Q3 AP  00001495/00001462 .... -.6996 A01
EDL           Q3 IO  00000918/00000902 .... -.2409 A01
EDLWRK11      Q3 AP  00002323/00002299 .... -.0183 A00
EDLWRK18      Q3 IO  00001052/00000388 .... -.0047 A00
EDLWRK4       Q3 AP  00004792/00002295 ....  .0055 A01
EDLWRK8       Q3 AP  00004804/00004797 ....  .0089 A02
EDLWRK16      Q3 AP  00002378/00002378 ....  .0170 A02
EDLWRK2       Q3 AP  00005544/00002956 ....  .0360 A00
EDLWRK12      Q3 AP  00004963/00002348 ....  .0677 A01
EDLWRK6       Q3 IO  00000750/00000302 ....  .0969 A02
EDLWRK3       Q3 AP  00005098/00005096 ....  .0999 A02
EDLWRK17      Q3 AP  00004786/00004766 ....  .1061 A01
```

```
EDLWRK9       Q3 AP  00002372/00002334 ....  .1107 A02
EDLWRK5       Q3 IO  00002376/00002376 ....  .1205 A01
EDLWRK14      Q3 AP  00002426/00002323 ....  .1238 A02
EDLLIB19      Q3 IO  00001226/00001100 ....  .1309 A02
EDLWRK19      Q3 AP  00002322/00002298 ....  .1705 A00
EDLWRK15      Q3 AP  00002839/00002781 ....  .2205 A02
EDLWRK1       Q3 AP  00002969/00002935 ....  .2491 A02
```

This is another class E command and displays the virtual processors associated with a given user ID (a single virtual machine may have multiple virtual processors), what queue (dispatch list, eligible list, or limit list) they are in, and what state they are in. This is a snapshot in time. Again you want to check this output to make sure there are no virtual machines in the eligible list. Normal virtual processors in the dispatch list will be Q_x (x=1,2,3). The eligible list would be marked as E_x.

The third column in the example also gives the state of the virtual processor. This can be helpful to get an idea of how the virtual processors might be constrained. Virtual processors that are actually running in the snapshot period are marked with `RNN` where `NN` is the processor number they are on. An `R` without a number means the virtual processor is ready to run but there is no available processor. (Note: the virtual machine that issues the INDICATE command will always be one of the running machines).

Other states are documented in the help for IND Q EXP. One does not have to be concerned about the other columns unless detailed analysis is required or when IBM support requests it. Also, always remember that it is just a snapshot in time, so repeating this command often over time can give a more accurate picture of your z/VM system. A single snapshot cannot be regarded as indicative.

14.1.2 Using other basic commands

Some other useful basic commands are briefly mentioned. All examples are shown from the MAINT user ID. The results will be different for users with fewer privileges.

Getting help

To get help on the system use the HELP command. Sometimes it is hard to find help for exactly the command you are looking for. Some useful HELP commands are as follow

```
==> help             // for basic help
==> help menus       // for menu of all z/VM help menus
==> help cp menu     // for a menu of all CP commands
==> help cpquery     // for a menu of all CP QUERY command
==> help cpset       // for a menu of all CP SET commands
```

Determining who is logged on

To see who is logged on to the system, use the QUERY NAMES command. For example:

```
==> q n
FTPSERVE - DSC , LINUX04  - DSC , LINUX03  - DSC , LINUX02  - DSC
LINUX01  - DSC , S11S1CLN - DSC , DTCVSW2  - DSC , DTCVSW1  - DSC
VMSERVR  - DSC , VMSERVU  - DSC , VMSERVS  - DSC , TCPIP    - DSC
OPERSYMP - DSC , DISKACNT - DSC , EREP     - DSC , OPERATOR - DSC
MAINT    -L0003
VSM     - TCPIP
```

Determining storage or memory

To see how much central and expanded storage (memory) is installed and allocated to a system, use the QUERY STORAGE and QUERY XSTOR commands. For example:

```
==> q stor
STORAGE = 16G CONFIGURED = 16G INC = 256M STANDBY = 0  RESERVED = 0
==> q xstor
XSTORE= 2048M online= 2048M
XSTORE= 2048M userid= SYSTEM usage= 0% retained= 0M pending= 0M
XSTORE MDC min=0M, max=0M, usage=0%
XSTORE= 2048M userid=  (none)  max. attach= 2048M
```

Determining processors

To see how many processors (CPs, IFLs, and CPUs) you have allocated at the system level, use the QUERY PROCESSORS command. For example:

```
==> q proc
PROCESSOR 00 MASTER CP
PROCESSOR 01 ALTERNATE CP
PROCESSOR 02 ALTERNATE CP
PROCESSOR 03 ALTERNATE CP
PROCESSOR 04 ALTERNATE CP
PROCESSOR 05 ALTERNATE CP
PROCESSOR 06 ALTERNATE CP
PROCESSOR 07 ALTERNATE CP
PROCESSOR 08 ALTERNATE CP
PROCESSOR 09 ALTERNATE CP
```

Determining the software level

To determine what level of CP your system is at, use the QUERY CPLEVEL command. For example:

```
==> q cplevel
z/VM Version 6 Release 1.0, service level 0901 (64-bit)
Generated at 09/11/09 16:51:48 EDT
IPL at 08/31/10 08:44:19 EDT
```

Determining system cylinder allocation

The QUERY ALLOC MAP command shows you the system allocation of spool, paging, and directory space. For example:

```
==> q alloc map
EXTENT     EXTENT                          % ALLOCATION
VOLID  RDEV      START        END  TOTAL IN USE   HIGH USED TYPE
------ ---- ---------- ---------- ------ ------ ------ ---- -------------
610RES 6280          1         20     20      1      1   5% DRCT ACTIVE
UV6281 6281          1       3338 600840  75482  75533  12% SPOOL
UV6282 6282          1       3338 600840      0      0   0% PAGE
UP6285 6285          0       3338 601020      0      0   0% PAGE
UP6286 6286          0       3338 601020     16     59   1% PAGE
UP6287 6287          0       3338 601020      0      0   0% PAGE
```

Determining DASD, OSA, and virtual resources

The QUERY DASD and QUERY DASD FREE commands show you what DASD is assigned to the system and what DASD is free to be assigned. Similarly, the QUERY OSA and QUERY OSA FREE commands report on the OSA resources. Finally, the QUERY VIRTUAL ALL command can be useful. The following list gives the short form of these commands without any of the associated output shown:

```
==> q da
==> q da free
==> q osa
==> q osa free
==> q v all
```

14.2 The z/VM Performance Toolkit

To use the z/VM Performance Toolkit, the product must be ordered. You should only configure the product if you have ordered it.

Much more detail can be found in the following books:

- *z/VM Performance Toolkit Guide*, SC24-6156
- *z/VM Performance Toolkit Reference*, SC24-6157
- *The Program Directory for Performance Toolkit for VM*, GI10-0785
- *Linux on IBM zSeries® and S/390®: Performance Toolkit for VM*, SG24-6059

The sections that follow describe how to set up and use the IBM Performance Toolkit briefly:

- “Configuring the z/VM Performance Toolkit”
- “Using the z/VM Performance Toolkit”

14.2.1 Configuring the z/VM Performance Toolkit

The Performance Toolkit is installed with z/VM. Configuration is described in the Program Directory. Here is a summary of how to turn it on. Again, you should configure the product only if you have ordered it.

Perform the following steps:

1. Query which priced products are enabled with the QUERY PRODUCT command:

   ```
   ==> q product
   Product  State    Description
   6VMDIR10 Disabled 00/00/00.00:00:00.$BASEDDR DIRECTORY MAINTENANCE FL 610
   6VMPTK10 Disabled 00/00/00.00:00:00.$BASEDDR PERFORMANCE TOOLKIT FOR VM
   6VMRAC10 Disabled 00/00/00.00:00:00.$BASEDDR RACF for VM
   6VMRSC10 Disabled 00/00/00.00:00:00.$BASEDDR RSCS Networking Version 6 Release
   1
    Modification 0
   ```

2. To enable the z/VM Performance Toolkit, log on to MAINT and enter the following command:

   ```
   ==> service perftk enable
   VMFSRV2760I SERVICE processing started
   ...
   VMFSUT2760I VMFSUFTB processing started
   ```

```
VMFSUT2760I VMFSUFTB processing completed successfully
VMFSRV2760I SERVICE processing completed successfully
```

You should see a few screens of messages scroll by and finally the success messages shown above. This will enable the Performance Toolkit for the current z/VM session.

- At IPL time, the `SYSTEM CONFIG` file is modified by having a line appended to the end. Verify that this has been added by the SERVICE command with the following commands:

```
==> link * cf1 cf1 rr
==> acc cf1 f
DMSACP723I F (CF1) R/O
==> x system config f
====> bot
====> -2
====> pre off
...
PRODUCT PRODID 6VMPTK10 STATE ENABLED DESCRIPTION '12/17/09.15:35:41.MAINT
PE

RFKIT Minidisk Install and Service'
```

The Performance Toolkit is now enabled. You can also verify this with the QUERY PRODUCT command again.

14.2.2 Configuring web browser support

After the product is enabled, the TCPIP profile must be modified to enable web access to the Performance Toolkit. The following example sets the port to 80, the default for a web browser:

1. Log on to TCPMAINT. Edit the TCPIP configuration file. In this example, it is the POKSND61 TCPIP D file (assuming you modified this file name earlier; the default name is PROFILE TCPIP) and search for the string reserve ports. This is where z/VM TCP/IP ports are reserved.

   ```
   ==> x poksnd61 tcpip d
   ====> /port
   ```

2. Add the following line under the PORT entries:

   ```
   ...
   PORT
     20   TCP FTPSERVE  NOAUTOLOG ; FTP Server
     21   TCP FTPSERVE            ; FTP Server
     23   TCP INTCLIEN            ; TELNET Server
   ; 25   TCP SMTP                ; SMTP Server
   ; 53   TCP NAMESRV             ; Domain Name Server
   ; 53   UDP NAMESRV             ; Domain Name Server
   ; 67   UDP DHCPD               ; DHCP Server
   ; 69   UDP TFTPD               ; TFTPD (Trivial FTP) Server
   ; 69   UDP TFTPD               ; TFTPD (Trivial FTP) Server
     80   TCP PERFSVM             ; Performance Toolkit
   ; 111  TCP PORTMAP             ; Portmap Server
   ...
   ```

   Save your changes. The TCPIP user ID needs to be recycled in order for our changes to take effect. You can FORCE and XAUTOLOG TCPIP from a console. Alternatively, if you are in a position to perform an IPL of the system, you can do that (run **`shutdown reipl iplparms cons=sysc`**).

3. When the system comes back, log on to TCPMAINT and check whether everything was successful with the NETSTAT CLIENTS command. You want to see that the service PERFSVM is a client (listening). This should be shown after a few windows of output:

```
==> netstat clients
...
Client: PERFSVM                 Authorization: {none}
Notes Handled: none
Last Touched:   0:01:22
Vmcf error count: 0
```

The entry for PERFSVM should be at the end of the output.

14.2.3 Configuring PERFSVM

The PERFSVM user ID is the Performance Toolkit service machine. To configure it, perform the following steps:

1. Log on to PERFSVM. If you successfully enabled the product, you should be put in a Performance Toolkit session and see the following text at the top of the panel:

```
FCX001                Performance Toolkit for VM               Autoscroll 12
  FCXBAS500I Performance Toolkit for VM FL610
  Monitor event started -- recording is activated
  Monitor sample started -- recording is activated
  FCXPMN446E Incomplete monitor data: SAMPLE CONFIG size too small
```

2. Press F12 twice to get to a CMS prompt.
3. Copy the `PROFILE XEDIT` file from the MAINT 191 disk so that editor sessions will have a common interface among user IDs.
   a. Use the VMLINK command to both link the disk read-only and access it as the highest available file mode. The default read password is read. However, if you changed your passwords as described in 4.9.5, “Changing passwords in USER DIRECT” on page 65, it will be lnx4vm (or whatever you set it to).

```
==> vmlink maint 191
ENTER READ PASSWORD:
lnx4vm
DMSVML2060I MAINT 191 linked as 0120 file mode Z
```

   b. Copy the `PROFILE XEDIT file` to the A disk:

```
==> copy profile xedit z = = a
```

4. Copy the default configuration files, which are on PERFSVM's D disk, to your A disk:

```
==> copy * * d = = a
```

5. The main configuration file is `FCONX $PROFILE`. Edit this file and search for the string `VMCF`.

```
==> x fconx $profile
====> /vmcf
```

   This should take you to line 175 where the next four lines are comments starting with an *****. Perform the following changes:

   – Uncomment the second and fourth lines by changing *C to FC.
   – Change port 81 to 80 on the fourth line. This will enable you to use a browser interface without having to specify port 81 on the URL (with a :81 suffix).

The modified lines should be as follows. Save your changes with the FILE subcommand:

```
*    Following command activates VMCF data retrieval interface
FC MONCOLL VMCF ON
*    Following command activates Internet interface
FC MONCOLL WEBSERV ON TCPIP TCPIP 80
*    Following command activates Internet interface with SSL
*C MONCOLL WEBSERV ON SSL TCPIP TCPIP 81 IDTEST RACF
...
====> file
```

6. Create a remote data retrieval authorization file with your z/VM system identifier (replace ***POKSND61*** with your system identifier):

```
==> x fconrmt authoriz
====> a 2
POKSND61 PERFSVM  S&FSERV
POKSND61 MAINT    DATA CMD EXCPMSG
```

7. Create a system identification file that links your z/VM system and PERFSVM to the special resource name FCXRES00 (replace ***POKSND61*** with your system identifier):

```
==> x fconrmt systems
====> a
POKSND61 PERFSVM  ESA   N   FCXRES00
```

8. Edit the PROFILE EXEC file, search for the word once and uncomment the five MONITOR SAMPLE and the two MONITOR EVENT statements:

```
==> x profile exec a
====> /once
```

Before:

```
...
/*** Once you have PERFKIT enabled and running uncomment the      ***/
/*** following comments                                           ***/
/* 'CP MONITOR SAMPLE ENABLE PROCESSOR'    */
/* 'CP MONITOR SAMPLE ENABLE STORAGE'      */
/* 'CP MONITOR SAMPLE ENABLE USER ALL'     */
/* 'CP MONITOR SAMPLE ENABLE I/O ALL'      */
/* 'CP MONITOR SAMPLE ENABLE APPLDATA ALL' */
/* 'CP MONITOR EVENT  ENABLE STORAGE'      */
/* 'CP MONITOR EVENT  ENABLE I/O ALL'      */

'PERFKIT'                   /* Invoke the PERFKIT module   @FC012BD*/

Exit
```

After:

```
...
/*** Once you have PERFKIT enabled and running uncomment the      ***/
/*** following comments                                           ***/
'CP MONITOR SAMPLE ENABLE PROCESSOR'
'CP MONITOR SAMPLE ENABLE STORAGE'
'CP MONITOR SAMPLE ENABLE USER ALL'
'CP MONITOR SAMPLE ENABLE I/O ALL'
'CP MONITOR SAMPLE ENABLE NETWORK'
'CP MONITOR SAMPLE ENABLE APPLDATA ALL'
'CP MONITOR EVENT  ENABLE STORAGE'
'CP MONITOR EVENT  ENABLE I/O ALL'
```

```
'PERFKIT'                    /* Invoke the PERFKIT module   @FC012BD*/

Exit
====> file
```

9. Set the PERFSVM virtual machine to be started at z/VM IPL time. Edit the `PROFILE EXEC` file on AUTOLOG1 so that PERFSVM is automatically started at IPL time. First, log on to AUTOLOG1.
10. Before pressing Enter at the `VM READ` prompt, type **`acc (noprof`** so that the `PROFILE EXEC` file is not run:

```
LOGON AUTOLOG1
z/VM Version 6 Release 1.0, Service Level 1002 (64-bit),
built on IBM Virtualization Technology
There is no logmsg data
FILES:   NO RDR,   NO PRT,   NO PUN
LOGON AT 14:51:02 EDT THURSDAY 10/07/10
DMSIND2015W Unable to access the Y-disk. Filemode Y (19E) not accessed
z/VM V6.1.0    2010-09-23 11:31
==> acc (noprof
```

11. Add a line so the virtual machine PERFSVM is started at z/VM IPL time:

```
==> x profile exec
/***************************/
/* Autolog1 Profile Exec   */
/***************************/
'cp xautolog tcpip'          /* start up TCPIP */
'CP XAUTOLOG VMSERVS'
'CP XAUTOLOG VMSERVU'
'CP XAUTOLOG VMSERVR'
'CP XAUTOLOG DTCVSW1'
'CP XAUTOLOG DTCVSW2'
'cp xautolog perfsvm'        /* start Performance Toolkit */
'cp set pf12 ret'            /* set the retrieve key */
...
```

12. Save the file and log off from AUTOLOG1.

14.2.4 Increasing the size of the MONDCSS DCSS

The Discontiguous Shared Segments (DCSS) named MONDCSS shipped with z/VM V6.1 is often not large enough, especially when your LPAR has access to many devices. To increase the size of the DCSS, first determine where the current MONDCSS is located by entering the following command:

```
==> q nss name mondcss map
FILE FILENAME FILETYPE MINSIZE  BEGPAG ENDPAG TYPE CL #USERS PARMREGS VMGROUP
0011 MONDCSS  CPDCSS     N/A    09000  09FFF   SC  R  00001   N/A       N/A
```

In this example, the DCSS starts at `x9000` and ends at `x9FFF`. This is x1000 or 4096 pages. Because a page is 4096 bytes or 4 KB, the size of this DCSS is 16 MB (4 KB * 4 KB).

Before starting the Performance Toolkit, you may want to increase the size of the DCSS named MONDCSS. The following steps quadruples the size of MONDCSS to 64 MB:

1. Delete the old MONDCSS with the PURGE NSS command:

```
==> purge nss name mondcss
NO FILES PURGED
0001 FILE  PENDING PURGE
```

2. Verify that the device addresses 4000-7FFF are free with the QUERY NSS MAP command:

```
==> q nss map
FILE FILENAME FILETYPE MINSIZE  BEGPAG ENDPAG TYPE CL #USERS PARMREGS VMGROUP
0033 CMS      NSS      0000256K 00000  0000D   EW  A  00007   00-15     NO
                                00020  00023   EW
                                00F00  013FF   SR
0032 NLSKANJI DCSS       N/A    02000  020FF   SR  A  00000   N/A       N/A
0031 NLSUCENG DCSS       N/A    02000  020FF   SR  A  00000   N/A       N/A
0030 NLSAMENG DCSS       N/A    02000  020FF   SR  A  00004   N/A       N/A
0029 HELPSEG  DCSS       N/A    00C00  00CFF   SR  A  00000   N/A       N/A
0016 SCEEX    DCSS       N/A    02100  028FF   SR  A  00000   N/A       N/A
0023 ZCMS     NSS      0000256K 00000  0000D   EW  A  00000   00-15     NO
                                00020  00023   EW
                                00F00  013FF   SR
0002 GCS      NSS      0000256K 00000  0000C   EW  R  00000   OMITTED   YES
                                00400  0044E   SR
                                0044F  0044F   SW
                                00450  005FF   SN
                                01000  0101A   SR
                                0101B  011FF   SN
0018 PERFOUT  DCSS       N/A    08A00  08FFF   SN  A  00000   N/A       N/A
0017 SCEE     DCSS       N/A    00900  009FF   SR  A  00000   N/A       N/A
0014 CMSDOS   DCSS-M     N/A    00B00  00B0C   SR  A  00000   N/A       N/A
0013 CMSBAM   DCSS-M     N/A    00B0D  00B37   SR  A  00000   N/A       N/A
0012 DOSBAM   DCSS-S     N/A    00B00  00B37   --  A  00000   N/A       N/A
0010 GUICSLIB DCSS       N/A    01F00  01FFF   SR  A  00000   N/A       N/A
0009 CMSFILES DCSS       N/A    01900  01BFF   SR  A  00003   N/A       N/A
0008 SVM      DCSS       N/A    01900  019FF   SR  A  00000   N/A       N/A
0007 CMSPIPES DCSS       N/A    01800  018FF   SR  A  00011   N/A       N/A
0006 CMSVMLIB DCSS       N/A    01700  017FF   SR  A  00011   N/A       N/A
0005 INSTSEG  DCSS       N/A    01400  016FF   SR  A  00011   N/A       N/A
0003 DOSINST  DCSS       N/A    00900  0090F   SR  A  00000   N/A       N/A
```

3. Redefine the DCSS to a larger size with the following DEFSEG and SAVESEG commands:

```
==> defseg mondcss 4000-7fff sc rstd
HCPNSD440I Saved segment MONDCSS was successfully defined in fileid 0034.
==> saveseg mondcss
HCPNSS440I Saved segment MONDCSS was successfully saved in fileid 0034.
```

4. Verify that the new DCSS was created:

```
==> q nss name mondcss map
FILE FILENAME FILETYPE MINSIZE  BEGPAG ENDPAG TYPE CL #USERS PARMREGS VMGROUP
0034 MONDCSS  CPDCSS     N/A    04000  07FFF   SC  R  00000   N/A       N/A
```

You should now be ready to run the Performance Toolkit.

14.2.5 Starting the z/VM Performance Toolkit

To start the Performance Toolkit, perform the following steps:

1. Log on to the PERFSVM user ID.
2. Press Enter and the performance toolkit should start through the `PROFILE EXEC` file:

```
FCX001                Performance Toolkit for VM               Autoscroll 12
 FCXBAS500I Performance Toolkit for VM FL610
 FCXAPP530I Connected to *IDENT for resource FCXRES00
 FCXAPF530I Connected to *IDENT for resource FCXSYSTM
 FCXTCP571I Connected to TCP/IP server TCPIP on path 0003
 FCXAPP527I User PERFSVM connected on path 0006
 FCXAPC535I Connected to resource FCXRES00 on path 0005, for S&F-Coll
 FCXTCP575I WebServer host IP address is 9.60.18.249:00080
 FCXTCP590I WebServer interface activated
 Monitor event started -- recording is activated
 Monitor sample started -- recording is activated
```

3. Disconnect from PERFSVM now:

```
Command ===> disc
```

The Performance Toolkit should now be configured and running.

14.2.6 Using the z/VM Performance Toolkit

The Performance Toolkit can be used with a web browser or 3270 interface.

Using a web browser interface

To use the web-enabled Performance Toolkit, perform the following steps:

1. Point a browser to your z/VM system. For example:

```
http://9.60.18.249
```

You should see a splash window, then the Web Server Logon window, as shown in Figure 14-1.

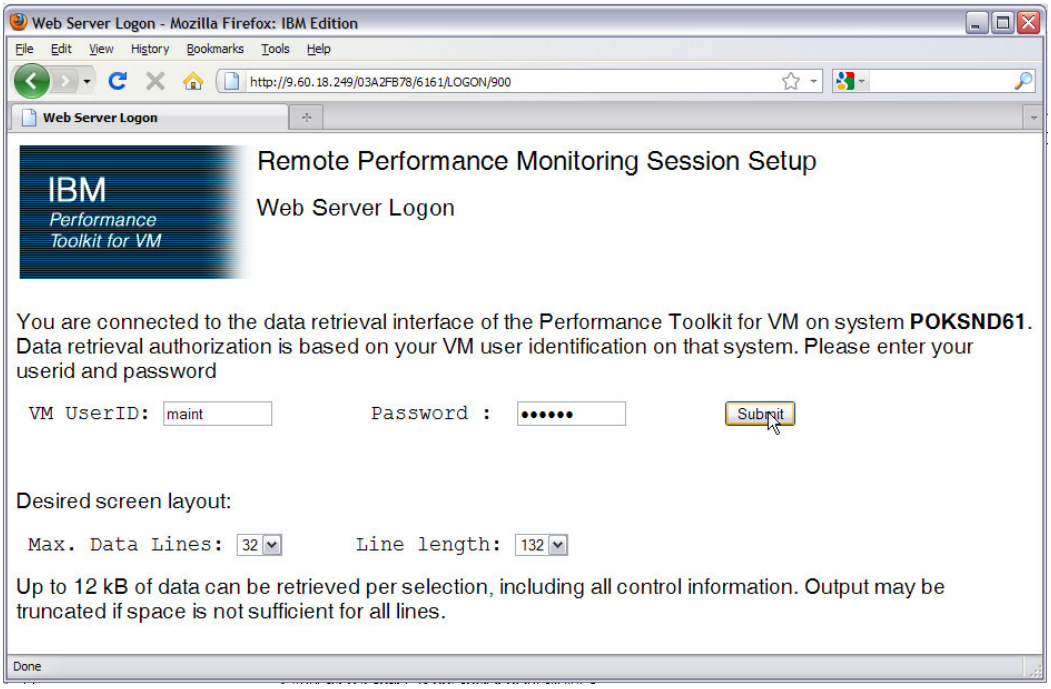


Figure 14-1 Performance Toolkit logon window

2. Enter any valid user ID and password and click **Submit**. In this example, MAINT is used.
3. The Central Monitoring System Load Overview appears with your system identifier (Node-ID) on the left side.

4. Click your system identifier and the Initial Performance Data Selection Menu window appears, as shown in Figure 14-2. From this window, you can drill down into many different types of reports.

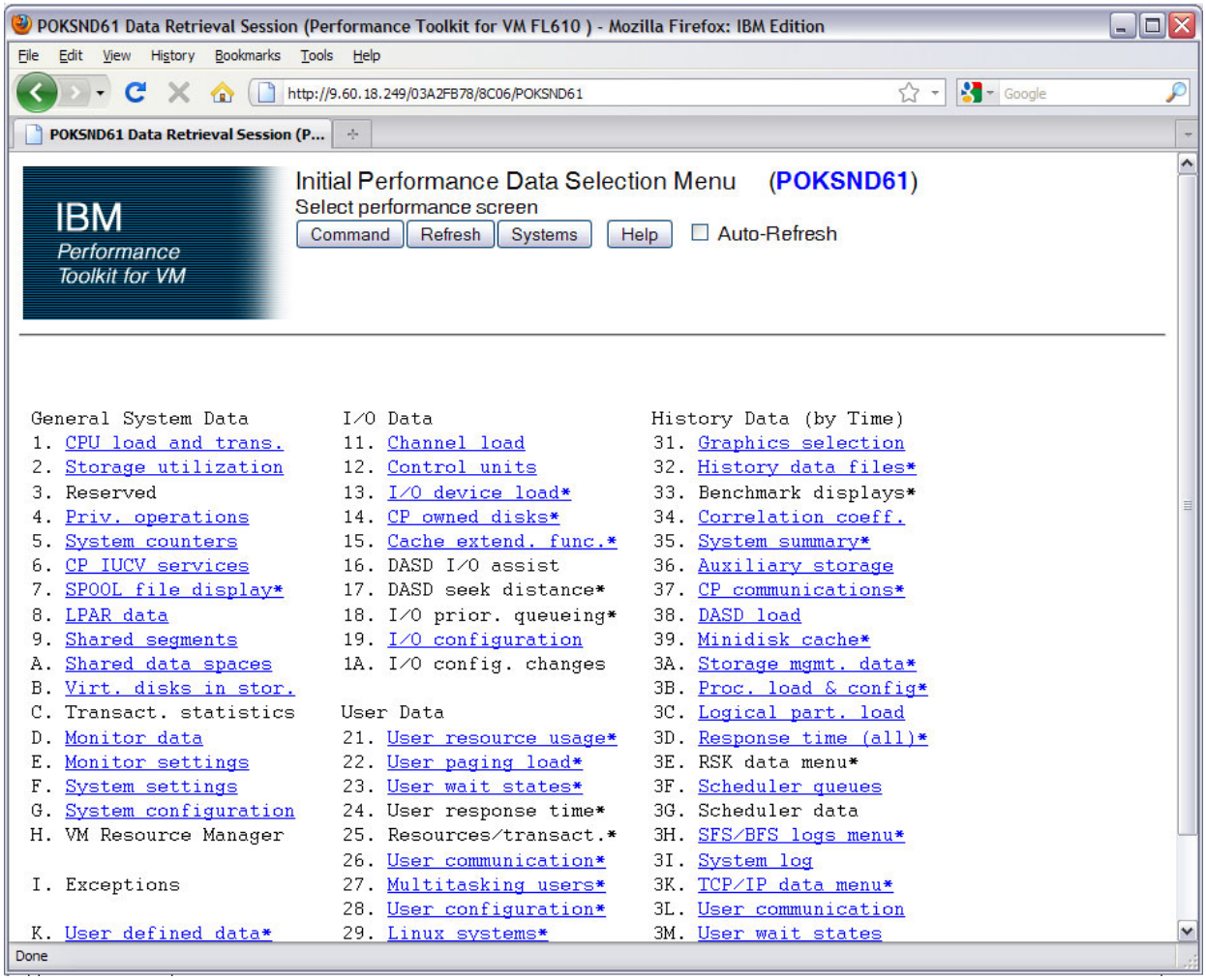


Figure 14-2 Browser interface to the Performance Toolkit

Using a 3270 interface

You can also use a 3270 interface or a browser interface. To do so, perform the following steps:

1. Log on to PERFSVM.

2. If you had disconnected, pressing Enter should get you back to the Performance Toolkit command line. If the virtual machine was logged off, the `PROFILE EXEC` should run and get you to the command line; see Figure 14-3. Enter the command MONITOR:

```
Command ==> monitor
```

```
 FCX124          Performance Screen Selection  (FL610       )    Perf.
Monitor

 General System Data        I/O Data                  History Data (by
Time)
 1. CPU load and trans.     11. Channel load          31. Graphics
selection
 2. Storage utilization     12. Control units         32. History data
files*
 3. Reserved                13. I/O device load*      33. Benchmark
displays*
 4. Priv. operations        14. CP owned disks*       34. Correlation
coeff.
 5. System counters         15. Cache extend. func.*  35. System summary*
 6. CP IUCV services        16. DASD I/O assist       36. Auxiliary
storage
 7. SPOOL file display*     17. DASD seek distance*   37. CP
communications*
 8. LPAR data               18. I/O prior. queueing*  38. DASD load
 9. Shared segments         19. I/O configuration     39. Minidisk cache*
 A. Shared data spaces      1A. I/O config. changes   3A. Storage mgmt.
```

Figure 14-3 Performance Toolkit 3270 Interface Main Menu window

Drilling down into report panels

You should now be able to use the active report panels. To drill down into these, move the cursor to any of the titles that are active (active titles display the number or letter in white, inactive titles in green). Some of the more useful report panels to drill down into are:

```
21. User resource usage
22. User paging load
23. User wait states
28. User configuration
29. Linux systems
33. Benchmark displays
```

For example, to drill down into the Benchmark submenu panel, enter the following command:

```
Command ===> 33
```

Then type `S` over the period on the left side of the submenu panel in the row corresponding to the report you want to see.

14.3 Monitoring Linux

Measurements can show resource consumption of the Linux guest as measured and dispatched by the VM host. It is also possible to measure performance data from within the Linux guest itself. To monitor Linux performance data at this level, a data gatherer process must be running within each Linux guest you want to monitor. There are different ways of gathering this data. The data should be gathered in the kernel. All modern Linux distributions have been enabled for the kernel to gather performance data.

14.3.1 Monitoring Linux performance data from the kernel

To monitor Linux performance data directly from the kernel, the following items must be true:

1. The APPLMON option must be set in the user directory.
2. Applmon data monitoring must be built into the kernel.

The first requirement should be true, as the OPTION APPLMON was set for the cloner, the golden image, and for Linux user IDs in earlier sections.

For the second requirement, refer to Chapter 13, “Writing kernel APPLDATA records”, in *Linux on System z Device Drivers, Features and Commands on Red Hat Enterprise Linux 6*, found at the following address:

`http://www.ibm.com/developerworks/linux/linux390/documentation_red_hat.html`

A quick description about how to use this built-in monitoring function follows.

Perform the following steps:

1. Start an SSH session to a Linux system. In this example, LINUX01 is used.
2. There are three modules that are built into the kernel but are not loaded by default. They are named appldata_mem, appldata_os, and appldata_net_sum. You can verify that they are not loaded by using the **lsmod** and **grep** commands:

   ```
   # lsmod | grep appldata
   ```

3. There is no output, so no modules with the `appldata` string are loaded. Load those modules by using the **modprobe** command and verify that they have been loaded:

   ```
   # modprobe appldata_mem
   # modprobe appldata_os
   # modprobe appldata_net_sum
   ```

   Now if you repeat the **lsmod** command, you should see the following output:

   ```
   # lsmod | grep appldata
   appldata_net_sum        1844  0
   appldata_os             2987  0
   appldata_mem            1966  0
   ```

4. The directory in the virtual `/proc/` file system where the monitoring variables exist is `/proc/sys/appldata/`. In this directory, there are five files:

timer	Controls whether any data gathering is in effect.
interval	Sets the interval, in milliseconds, that samples will be taken.
mem	Controls the memory data gathering module.
os	Controls the CPU data gathering module.
net_sum	Controls the net data gathering module.

To turn on the built in kernel monitoring, use the **echo** command to send a non-zero value into four of the five monitoring variables in the /proc/ virtual file system:

```
# echo 1 > /proc/sys/appldata/timer
# echo 1 > /proc/sys/appldata/mem
# echo 1 > /proc/sys/appldata/os
# echo 1 > /proc/sys/appldata/net_sum
```

Built-in kernel monitoring should now be turned on.You may only want to leave the monitoring on for specific periods of time. As Linux monitoring data is captured, the Performance Toolkit's minidisk space can fill up relatively quickly.

14.4 Viewing Linux data in the Performance Toolkit

After the system has had some time to collect data, you should be able to use the Performance Toolkit to view Linux performance data. To view that data, drill down into menu 29, Linux systems. This can be done either from the browser interface or the 3270 interface, as shown in Figure 14-4.

```
FCX242       CPU 2094  SER 2991E            Linux Displays


  Linux screens selection
S Display     Description
. LINUX       RMF PM system selection menu
S LXCPU       Summary CPU activity display
. LXMEM       Summary memory util. & activity display
. LXNETWRK    Summary network activity display









Select performance screen with cursor and hit ENTER
Command ===>
```

Figure 14-4 Linux Guest Systems submenu

Then type S over the period on the left side of the submenu panel in the row corresponding to the report you want to see. You should see a new report panel with the Linux guest systems CPU overview.

You can also use a web interface to view the same data. You would drill down into menu 29 Linux systems and should see that the drill down links for LXCPU (Linux CPU), LXMEM (Linux memory), and LXNET (Linux Network) are hot.

A

References

z/VM differs from Linux in regards to the location and number of configuration files. In Linux, there are many configuration files and most of them are in or under the `/etc/` directory. On z/VM, there are relatively few configuration files. However, they are on many different minidisks. Table 14-1provides a summary and the location of important z/VM configuration files.

Table 14-1 Important z/VM configuration files

File	Location	Description
`SYSTEM CONFIG`	MAINT CF1	This is the operating system's main configuration file. It defines the system name, the CP volumes, user volumes, and other settings.
`USER DIRECT`	MAINT 2CC	This file defines the user directory. All user IDs or virtual machines known to the system are defined here (assuming a directory maintenance product is not being used).
`<System_ID> TCPIP`	TCPMAINT 198	This file defines the resources for the primary z/VM TCP/IP stack, including TCP/IP address, OSA resources, subnet mask, and gateway. It is initially created by the IPWIZARD tool as `PROFILE TCPIP`.
`SYSTEM DTCPARMS`	TCPMAINT 198	This file is created to define the TCP/IP stacks on the system. It is initially created by the IPWIZARD tool.
`TCPIP DATA`	TCPMAINT 592	This file defines the DNS server, the domain name, and some other settings. It is initially created by the IPWIZARD tool.
`PROFILE EXEC`	AUTOLOG1 191	This file is a REXX EXEC that is run when the system starts. It is analogous to the `/etc/inittab` file in Linux.

Cheat sheets

This section contains quick references or “cheat sheets” for the XEDIT and vi editors.

XEDIT cheat sheet

XEDIT has line commands that are entered on the command line (===>) and prefix commands that are typed over the line numbers on the left side of the panel.

Line commands

a	Adds a line.
a<n>	Adds ‘n’ lines.
c/<old>/<new>/ <n> <m>	Searches for the ‘old’ string and replaces it with ‘new’ for ‘n’ lines below the current line and ‘m’ times on each line. ‘*’ can be used for ‘n’ and ‘m’
/<string>	Searches for ‘string’ from the current line.
-/<string>	Searches backwards for ‘string’.
all /<string>/	Shows all occurrences of ‘string’ and hide the other lines.
bottom	Moves to the bottom of the file.
top	Moves to the top of the file.
down <n>	Moves down ‘n’ lines.
up <n>	Moves up ‘n’ lines.
file	Saves the current file and exit XEDIT.
ffile	Saves the current file and exit but do not warn of overwrite.
save	Saves the current file but do not exit.
quit	Exits XEDIT if no changes have been made.
qquit	Exits XEIDT even if changes have not been saved.
left <n>	Shifts ‘n’ characters to the left.
right <n>	Shifts ‘n’ characters to the right.
get <file>	Copies the file and insert past the current line.
:<n>	Moves to line ‘n’.
?	Displays the last command.
=	Executes the last command.
x <file>	Edits ‘file’ and put it into the XEDIT “ring”.
x	Moves to the next file in the ring.

Prefix commands

a	Adds one line.
a<n>	Adds 'n' lines.
c	Copies one line.
cc	Copies a block of lines.
d	Deletes one line.
dd	Deletes a block of lines.
f	The line after which a copy (c) or a move (m) is to be inserted.

p	The line before which a copy (c) or a move (m) is to be inserted.
i	Inserts a line.
i<n>	Inserts 'n' lines.
m	Moves one line.
mm	Moves a block of lines.
"	Replicates a line.
"<n>	Replicates a line 'n' times.
""	Replicates a block of lines.

A vi cheat sheet

Here is a small subset of vi commands (the ones most commonly used). The vi editor has three modes:

1. Input mode: The Insert key, i, o (add a line below), O (add a line above) and other commands put you in this mode. When you are in this mode, you will see the text `--INSERT--` in the last line.
2. Command mode: Pressing Esc takes you out of input mode and into command mode. The relevant commands are:

i	Brings you back to input mode.
dd	Deletes a line and puts it into the buffer.
<n>dd	Deletes <n> lines.
x	Deletes a character.
dw	Deletes a word.
p	Adds the buffer past the current location.
P	Adds the buffer before the current location.
o	Adds a line and goes into insert mode.
/string	Searches for a string.
n	Performs the last command again.
jkl;	Performs a cursor movement.
A	Adds text at the end of the line.
<nn>G	Goes to line <nn>.
G	Goes to the last line in the file.
yy	Yanks a line (copies into buffer).
<n>yy	Yanks n lines.

3. Command line mode: Pressing the colon key puts you into this mode:

:wq	Saves (writes and quits).
:q!	Quits and discards changes.
:<nn>	Goes to line number <nn>.
:r <file>	Leads <file> into the current file.
:1,$s/old/new/g	Globally replaces <old> with <new>.
:help	Gives help.

B

Additional material

This book refers to additional material that can be downloaded from the Internet as described in the following sections.

Locating the web material

The web material associated with this book is available in softcopy on the Internet from the IBM Redbooks web server. Point your web browser at:

`http://www.vm.ibm.com/devpages/mikemac/SG247932.tgz`

Using the web material

The additional web material that accompanies this book includes the following files:

File name	*Description*
README.txt	The main README file
clone.sh	The script to clone the golden image to a target user ID
vm/	A directory containing files used on z/VM
vm/cpformat.exec	EXEC to format multiple DASD volumes
vm/chpw610.xedit	XEDIT macro to change passwords
vm/profile.exec	Sample PROFILE EXEC for Linux IDs
vm/swapgen.exec	EXEC to define VDISK swap spaces
vm/sample.parm-rh6	Sample RHEL 6 parameter file
vm/sample.conf-rh6	Sample RHEL 6 configuration file
vm/rhel6.exec	XEC to start RHEL 6 install

clone-1.0-10.s390x.rpm	RPM with Linux cloning script and man page
README.txt	Tar file description file

System requirements for downloading the web material

The web material requires the following system configuration:

Hard disk space: 25 KB minimum
Operating System: Linux

Downloading and extracting the web material

Download the tar file to your NFS server and use it as described in 7.2.1, “Copying files to the cloner” on page 127. After extracting the file, you have a directory named `virt-cookbook-RH6`, which contains the files listed in “Using the web material” on page 261.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks

The following IBM Redbooks publications provide additional information about the topic in this document. Note that some publications referenced in this list might be available in softcopy only.

- *Fibre Channel Protocol for Linux and z/VM on IBM System z*, SG24-7266
- *IBM Lotus Domino 6.5 for Linux on zSeries Implementation*, SG24-7021
- *Introducing N_Port Identifier Virtualization for IBM System z9*, REDP-4125
- *Linux on IBM eServer zSeries and S/390: Application Development*, SG24-6807
- *Linux on IBM eServer zSeries and S/390: Performance Toolkit for VM*, SG24-6059
- *Linux on IBM System z: Performance Measurement and Tuning*, SG24-6926
- *Lotus Workplace Messaging Administration Guide*, REDP-3860
- *Printing with Linux on zSeries Using CUPS and Samba*, REDP-3864
- *Running Linux Guest in less than CP Privilege Class G*, REDP-3870
- *z/VM and Linux on IBM System z*, SG24-7492

You can search for, view, or download IBM Redbooks, IBM Redpapers, Technotes, draft publications and Additional materials, as well as order hardcopy IBM Redbooks publications, at this website:

ibm.com/redbooks

Other publications

These publications are also relevant as further information sources:

- *Documentation for System z Linux Development stream*, found at:

  http://www.ibm.com/developerworks/linux/linux390/documentation_red_hat.html
- *First experiences with hardware cryptographic support for OpenSSH with Linux for* System z, by Gnirss, et al., found at:

  http://www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101690
- *Getting Started With Linux*, SC24-6096
- *Installation Instructions for Electronically Delivered IBM z/VM Operating System Deliverable*, GI11-2900
- *Linux on System z Device Drivers, Features and Commands on Red Hat Enterprise Linux 6*, found at:

  http://www.ibm.com/developerworks/linux/linux390/documentation_red_hat.html

- *The Program Directory for Performance Toolkit for VM*, GI10-0785
- *Red Hat Installation Guide for the IBM S/390 and IBM System z Architectures*, found at:

  http://www.redhat.com/docs/manuals/enterprise/
- *RHEL 6: IBM System z Architecture - Installation and Booting*, found at:

  http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Installation_Guide/pt-install-info-s390.html
- *XEDIT User's Guide and Command Reference*, found at:

  http://ukcc.uky.edu/ukccinfo/391/xeditref.html
- z/VM documentation, found at:

  http://www.vm.ibm.com/library/

  Consult the following publications:
  - *The Program Directory for Performance Toolkit for VM*, which can be found at the following address:

    http://publib.boulder.ibm.com/infocenter/zvm/v5r3/index.jsp?topic=/com.ibm.zvm.v53.hcpl0/fconxcfg.htm
  - *z/VM CP Commands and Utilities Reference*, SC24-6175
  - *z/VM CP Messages and Codes*, GC24-6177
  - *z/VM CP Planning and Administration*, SC24-6178
  - *z/VM Getting Started with Linux on System z*, SC24-6194
  - *The z/VM Guide for Automated Installation and Service*, GC204-6099
  - *z/VM Guide for Automated Installation and Service, Version 6 Release 1.0*, GC24-6097
  - *z/VM and Linux on IBM System z: The Virtualization Cookbook for RHEL 5* and *z/VM and Linux on IBM System z: The Virtualization Cookbook for SLES 10*, found at:

    http://linuxvm.org/present
  - *z/VM Performance Toolkit Guide*, SC24-6156
  - *z/VM Performance Toolkit Reference*, SC24-6157
  - *z/VM Security and Integrity*, found at:

    http://www.vm.ibm.com/library/zvmsecint.pdf
  - *z/VM Service Guide, Version 6, Release 1*, found at:

    http://publib.boulder.ibm.com/epubs/pdf/hcsf1c00.pdf
  - *z/VM TCP/IP Messages and Codes*, GC24-6237
  - *z/VM TCP/IP Planning and Customization*, SC24-6238

Online resources

These websites are also relevant as further information sources:

- The linux-390 list server:

  http://www2.marist.edu/htbin/wlvindex?linux-390

- The Linux for IBM eServer zSeries and S/390 portal:

  http://linuxvm.org/
- Linux on IBM System z and S/390 developerWorks:

  http://awlinux1.alphaworks.ibm.com/developerworks/linux390/index.shtml
- SUSE LINUX Enterprise Server 9 evaluation:

  http://www.novell.com/products/linuxenterpriseserver/eval.html
- z/VM performance tips:

  http://www.vm.ibm.com/perf/tips/
- z/VM publications:

  http://www.vm.ibm.com/pubs/

Help from IBM

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ibm.com/services

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z/VM and Linux on IBM System z: The Virtualization Cookbook for Red Hat Enterprise Linux 6.0

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z/VM and Linux on IBM System z

The Virtualization Cookbook for Red Hat Enterprise Linux 6.0

Hands-on instructions for installing z/VM and Linux on the mainframe

Updated information for z/VM V6.1 and Red Hat Enterprise Linux 6.0

New, more versatile file system layout

This IBM Redbooks publication describes how to create Linux virtual servers in z/VM on IBM System z hardware. This book adopts a cookbook format that provides a concise, repeatable set of procedures for installing and configuring z/VM in a logical partition (LPAR) and then installing and customizing Linux. You need an IBM System z LPAR with the associated resources, z/VM V6.1 media, and a Linux distribution.

This book assumes that you have a general familiarity with System z technology and terminology. It does not assume an in-depth understanding of z/VM and Linux. It is written for those clients who want to get a quick start with z/VM and Linux on the mainframe.

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