The Virtualization Cookbook

VM Workshop
Indianapolis, IN
June 21, 2013
Michael Mac Isaac - mikemac at us.ibm.com

Abstract

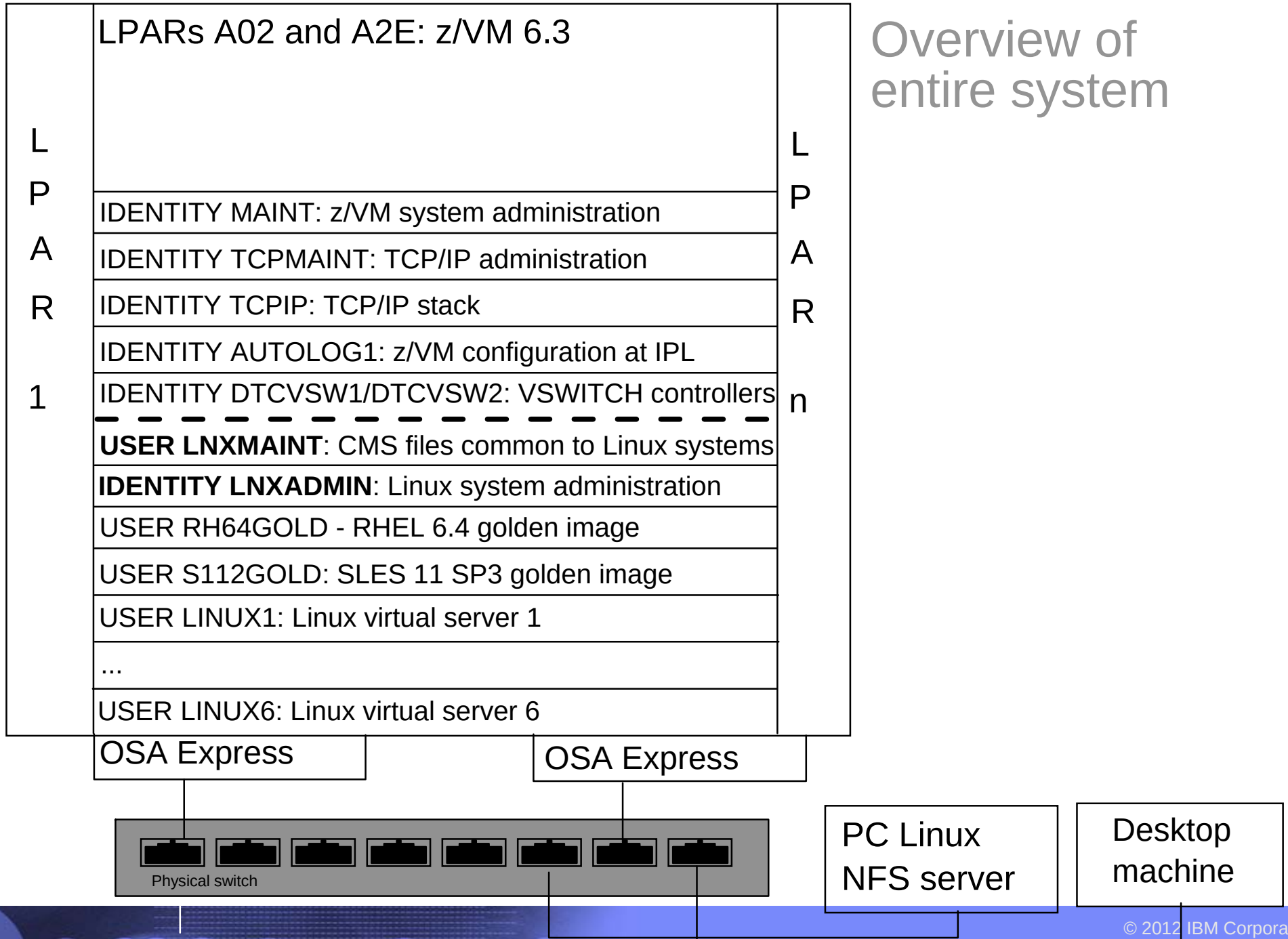
The "Virtualization Cookbook" for System z, usually in the form of a Redbook, has been a popular reference for many years. It was updated twice in 2012 and is currently being updated as an official IBM Redbook.

Overview

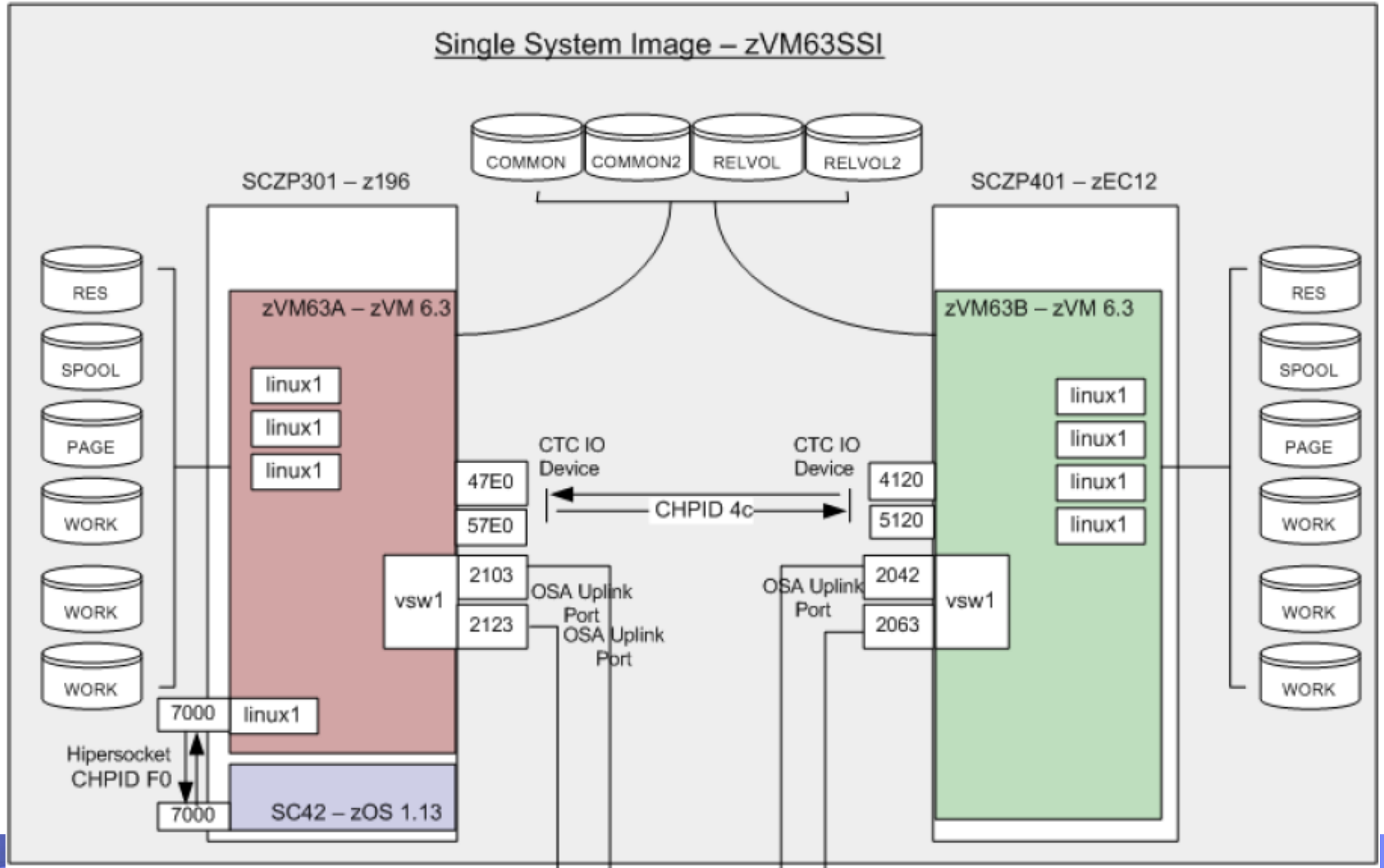
- The ***Virtualization Cookbooks*** have always had the same goal in mind: to be a single source for installing and customizing z/VM, installing and customizing Linux, and getting to the point of cloning and making appliances of Linux virtual servers.

See: http://www.vm.ibm.com/devpages/mikemac/

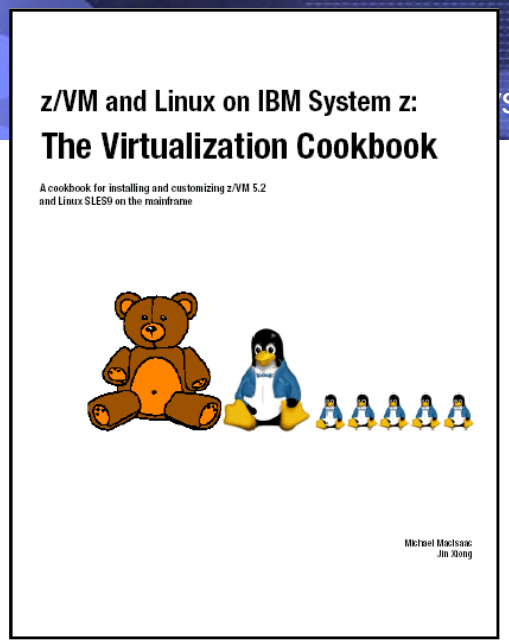
Overview of entire system



System overview



History of cookbooks



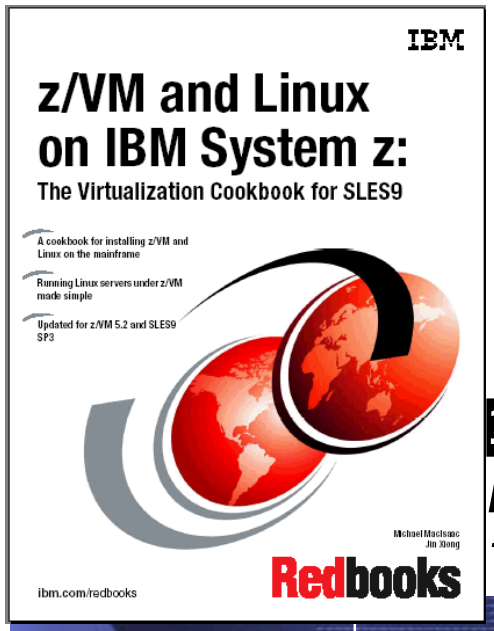
6,**7** *The Virtualization Cookbook(s) for RHEL 5 and SLES 10*, **3/07**

5 *The Virtualization Cookbook 2* [1], **8/06**

2 *The Virtualization Cookbook*, **2/06**

Project started: 11/04

2004 | 2005 | 2006 | 2007



3 Redbook: *The Virtualization Cookbook for SLES9*, SG24-6695-01, **4/06**

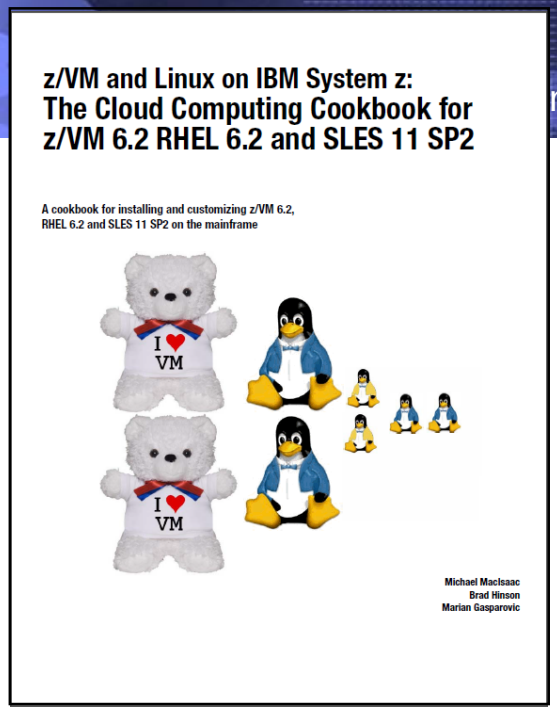
4 Redbook: *The Virtualization Cookbook for RHEL4*, SG24-7272-00, **9/06**

1 Redbook published *From LPAR to Virtual Servers in Two Days*, SG24-6695-00: 6/05

[1] includes middleware cloning

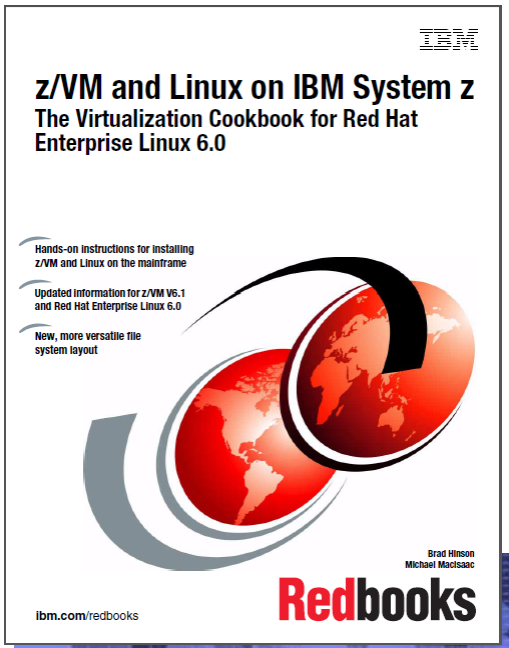
History of books (cont'd)

See: http://www.vm.ibm.com/devpages/mikemac/



9 *The Virtualization Cookbook for SLES 11*, **2/10**

2008 | 2009 | 2010 | 2011



8 Redbook: *The Virtualization Cookbook for SLES 10 SP2*[2] , **10/08**

10 Redbook: *The Virtualization Cookbook for SLES 11 SP1*, **1/11**

11 Redbook: *The Virtualization Cookbook for RHEL 6*, **2/11**

[2] includes "travelling /home"

History of books (cont'd)

See: http://www.vm.ibm.com/devpages/mikemac/

12 *The Cloud Computing Cookbook for z/VM 6.2, RHEL 6.2 and SLES 11 SP2*, **1/12**

13 *The Virtualization Cookbook for z/VM 6.2, RHEL 6.2 and SLES 11 SP2*, **7/12**

14 Redbook: *The Virtualization Cookbook for* z/VM 6.?, RHEL 6.4 and SLES 11 SP3, **8/13** (???)

"Parts" in current book

1. ***Introduction and z/VM***
   a. Introduces z/VM 6.?
   b. Discusses planning
   c. Installation and configuration into a two member SSI
   d. Service
2. **RHEL 6.4** Linux - install, customizing and clone RHEL
3. **SLES 11 SP3** Linux - install, customizing and clone SLES
4. ***Other topics*** - includes chapters on:
   a. Live Guest Relocation (LGR) between SSI members
   b. Configuring DirMaint, SMAPI and RACF
   c. Monitoring z/VM and Linux
   d. Miscellaneous “recipes”
5. Appendices - includes references, cheat sheets and lists the source code

Changes in the planned book

- *z/VM and Linux on IBM System z: The Virtualization Cookbook for z/VM 6.3 RHEL 6.4 and SLES 11 SP3* has many new sections:
  - z/VM sections are updated for 6.3 with a two member SSI setup
  - Linux sections are updated for both RHEL 6.4 and SLES 11 SP3
  - Layer 2 virtual switches only
  - Description of "a private interconnect" (???)
  - Installation of Non-SSI z/VM 6.? system
  - Multipathing of FCP/SCSI disks
  - Address z/VM HYPERPAV
  - AutoYast on SLES
  - Describe VIR2REAL EXEC
  - Section on Kiwi on SLES
  - Beef up "z/VM Live Guest Relocation" chapter
  - Add section on z/VM "LOGON BY" for audit trails
  - Section on the "Linux Terminal Server"
  - Add a CRON Service Virtual Machine for z/VM
  - Define command-specific z/VM privilege class
  - Red Hat Sattelite server
  - SLES "Live CD" installation (???)
  - Example of setting up hipersockets to z/OS
  - Describe smaclient

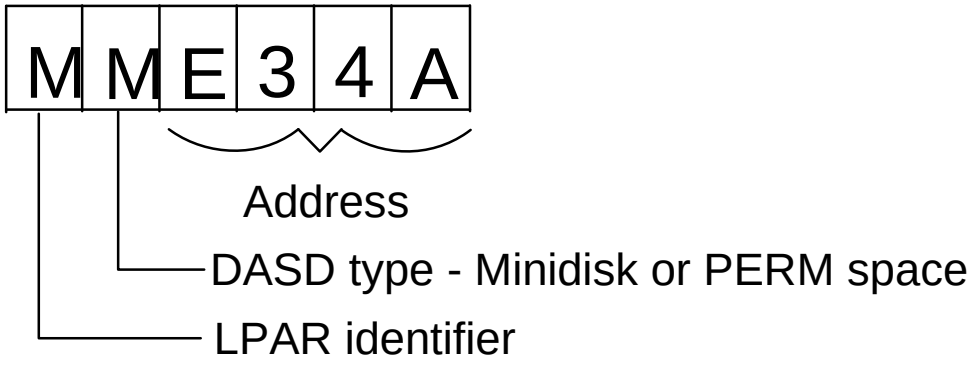
Changes in the July 17, 2012 book

- *z/VM and Linux on IBM System z: The **Virtualization** Cookbook for z/VM 6.2 RHEL 6.2 and SLES 11 SP2* has many new sections:
  - Title prefix is back.
  - Steps for installing RACF into an z/VM 6.2 SSI cluster have been added.
    - This configuration describes adding the `UseRACF=yes` setting to DirMaint.
  - z/VM development now recommends the use of layer 2 virtual switches (VSWITCH) exclusively.
  - How to attach z/VM TCP/IP stack to HA virtual switch.
  - MAINT's slightly modified PROFILE XEDIT is now copied to the MAINT 19E disk so that it need not be copied to many virtual machines 191 disk.
  - Service section updated for z/VM 6.2 (now that the first RSU is available).
  - An update to the CPFORMAT EXEC code has been made available. In the January 2012 version of the code, while in a non-SSI environment, OWNER data was still being written to CP-owned volumes. That issue has been corrected.

Introduction - Planning - bill of materials

- Hardware
  - System z LPARs (2 or 4 for SSI)
    - IFLs
    - Memory (aka *storage*)
    - DASD (aka *storage* :))
    - Two OSA cards for HA VSWITCH (One is OK)
  - Temporary Distributed server
- Software
  - z/VM 6.3
  - Linux
    - SLES-11 SP3
    - RHEL 6.4
  - Code associated with book: http://www.vm.ibm.com/devpages/mikemac/SG248147.tgz
- Networking resources
  - TCP/IP address for each z/VM SSI members
  - TCP/IP address for each Linux
  - DNS names

Introduction - Planning (cont'd)



- Conventions
  - Volume labeling convention
    - Volume labels are only 6 chars
    - Using device address in last 4 chars:
      - Guarantees unique labels
      - First character is LPAR identifier
      - Second character is function (P=page, S=spool, M=minidisk)
  - File naming convention
    - File that is shipped with VM/Linux - ORIG or .orig suffix
    - File that was last working - WRKS or .works
- Password convention - z/VM admin, Linux admin, Linux users
  - Worksheets - 2 sets of 4 worksheets
  - Populated set of worksheets for examples used in the book
  - Blank set of worksheets for
    - z/VM resources
    - Linux resources
    - z/VM DASD
    - Linux virtual machines

Introduction - Configure a desktop machine

- SSH client
  - PuTTY is described
    - Set SSH protocol to "2 only"
    - Add rows, columns, scrollback buffer
    - Save sessions
- VNC client
  - Recommended for install of Linux, some software
  - RealVNC is described
- 3270 emulator
  - Set Enter and Clear key if possible
  - Set to use 43 lines
  - Set to Reconnect after logoff
  - For Linux, x3270 is most popular

Introduction - Configure a PC server

- Installing Linux on zSeries is a chicken and egg problem
- Recommendation: install Linux on an Intel box as a temporary NFS server:
  - Install Linux onto a PC
  - Copy files associated with this book to this NFS server
  - Untar to `/var/nfs/SG248147/`
  - Set up an install directory:
    - For RHEL: `/var/nfs/rhel64/`
    - For SLES: `/srv/nfs/s11s3/`
  - Configure the NFS server to export these two directories
  - If installing z/VM using FTP: copy z/VM to `/var/ftp/zvm6x/` or `/srv/ftp/zvm6x/`

Installing and configuring z/VM

- Obtain z/VM through electronic download (optional)
- Configure an FTP server for z/VM installation (optional)
- Install z/VM from DVD or FTP server
- Customize TCPIP - z/VM stack, FTP server
- Customize SYSTEM CONFIG
  - Define VSWITCHes, other configuration
- Add volumes for paging and minidisks
  - CPFORMAT EXEC is included
- Create LNXMAINT for common CMS files- kernels, RAMdisks, PARMfiles, etc.
- Customize system startup and shutdown
  - SHUTDOWN z/VM signals Linux servers to shutdown
  - IPL of z/VM autologs (boots) important Linux servers
- z/VM security issues - change default password

Obtain z/VM through Electronic Download

- Go to the z/VM service page:
  http://www.vm.ibm.com/service/
- Click on the link **IBM Shopz** in the section *IBM Support Portals*
  - Sign in by clicking on the link *Sign in for registered users* in the upper right
  - Click on the link **create new software orders**
  - On *Step 1*, click on the radio button **z/VM Products** and choose **VM SDO version 6** in the dropdown menu to the right. Click Continue.
  - On *Step 2*, select a hardware system on which you plan to run z/VM
  - On *Step 3*, first filter, select **VM - VM Base Product**, second filter, select **Show all products** then click **Show catalog**
  - Select **z/VM V6 3390 System DDR** and click **Continue**
  - On *Step 4*, verify the order and click **Continue**
  - On *Step 5*, verify the entitlements and click **Continue**
  - On *Step 6*, for the *Preferred media*, select **Internet** and click **Continue**
  - On *Step 7*, review and click **Submit**

Configure an FTP server for z/VM installation

- Prepare the z/VM product install files
- Install the FTP server
- Configure the FTP server
  - Anonymous or not?
- Test the anonymous FTP server
- Aside: interesting fact:

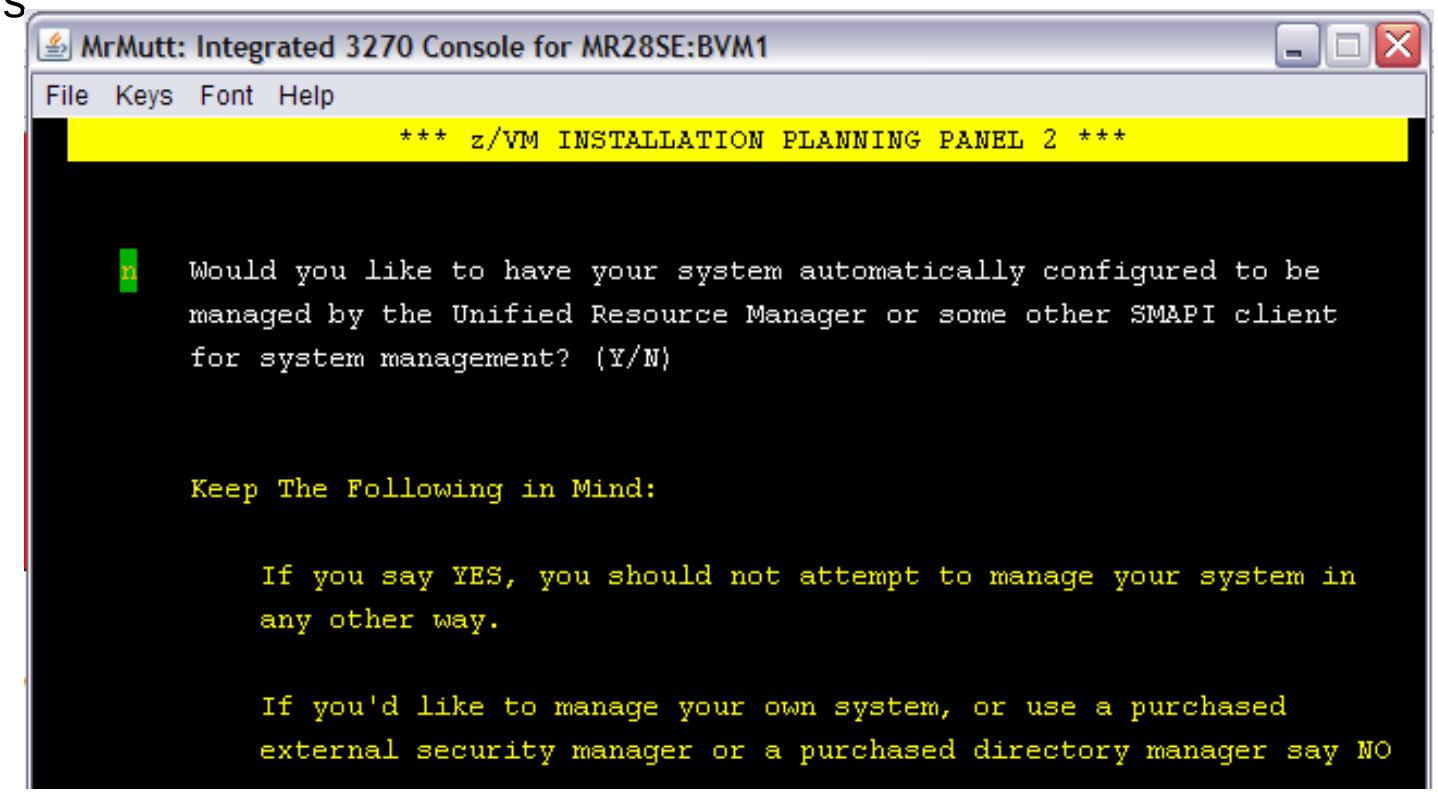
```
gpok240:/nfs # du -sh sles11sp2 rhel6.2 zvm62
13G     sles11sp2
5.3G    rhel6.2
4.1G    zvm62
```

Install z/VM from DVD or FTP server

- Start the z/VM install
  - Important screens (below and next chart)
- Copy a vanilla z/VM system to DASD
- IPL the first SSI member
  - New IPL Parms:

```
==> q iplparms

FN=SYSTEM       FT=CONFIG       PDNUM=1         PDVOL=D964
```

- IPL remaining SSI members
- Verify the installation
- Configure TCP/IP



z/VM install screens (cont'

MrMutt: Integrated 3270 Console for M28:BVM1

File Keys Font Help

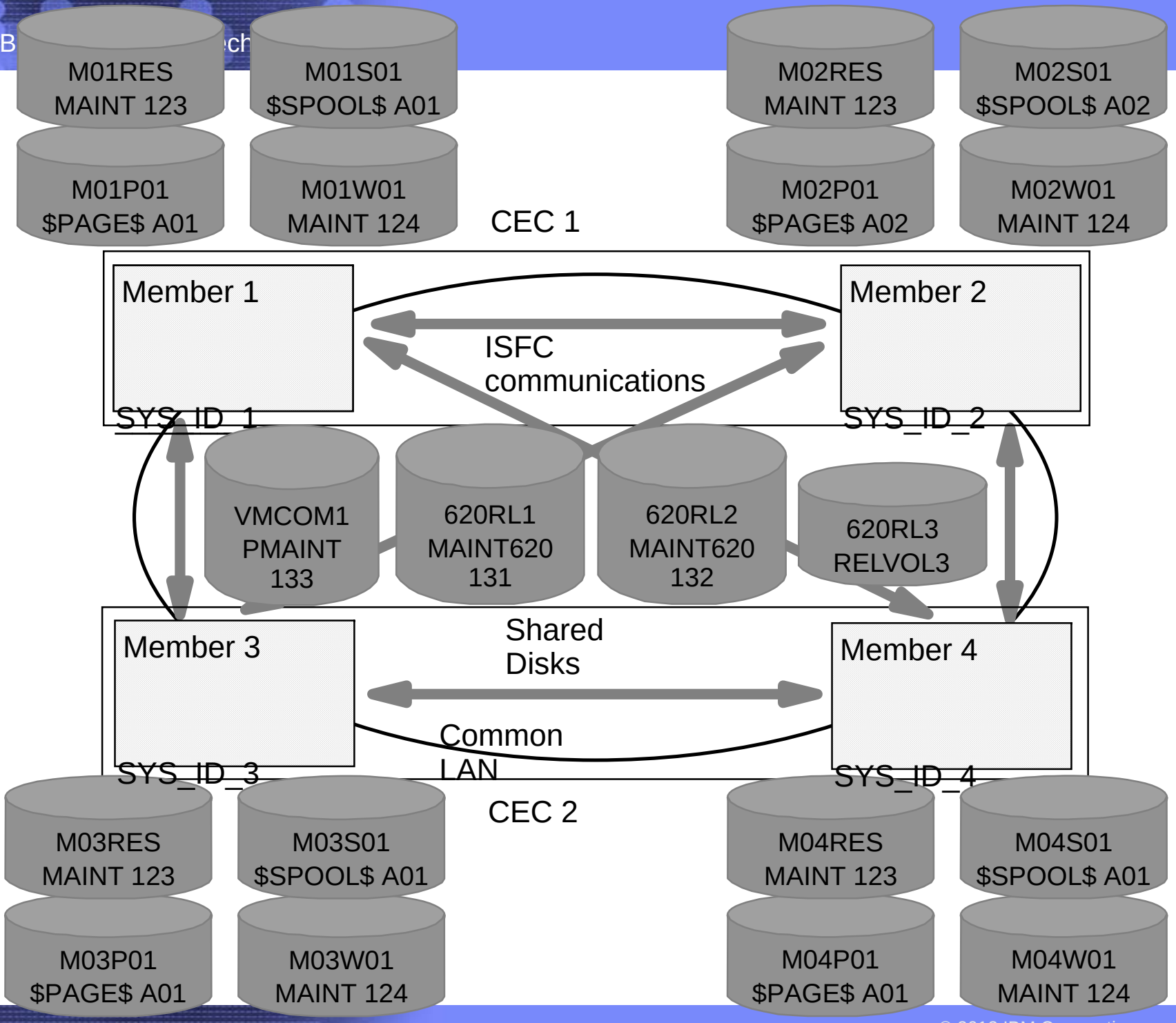
```
                *** z/VM INSTALLATION PLANNING PANEL 3 ***



SSI Cluster Name:    POKSSI


After installation is complete, the SSI cluster will be IPLed:

x     First-Level
_     Second-Level


SSI Member Name(s):

SLOT #      MEMBER NAME     IPL LPAR/USERID
======      ===========     ===============
  1          POKDEV62         BVM1
  2          POKTST62         BVM2
```

MrMutt: Integrated 3270 Console for MR28SE:BVM1

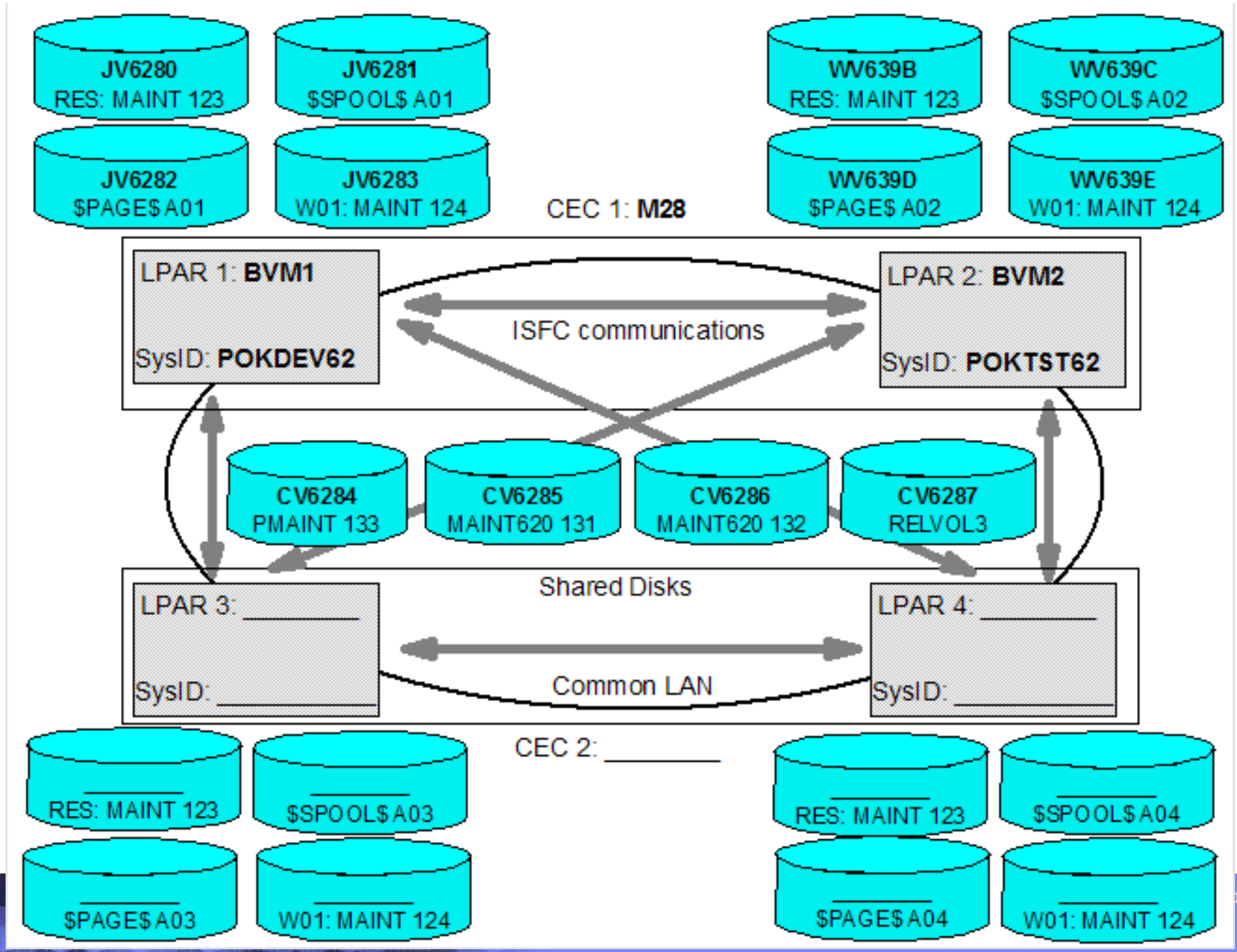
File Keys Font Help

```
            *** z/VM INSTALLATION VOLUME DEFINITION ***


        TYPE      LABEL       ADDRESS                    FORMAT (Y/N)
       =======   ========    =========                   ============
       COMMON    CV6284       6284                            Y
       RELVOL    CV6285       6285
       RELVOL2   CV6286       6286
       RELVOL3   CV6287       6287

        TYPE      LABEL       ADDRESS          TYPE      LABEL       ADDRESS
       =======   ========    =========        =======   ========    =========
POKDEV62                                 POKTST62
       RES       JV6280       6280             RES       WV639B       639B
       SPOOL     JS6281       6281             SPOOL     WS639C       639C
       PAGE      JP6282       6282             PAGE      WP639D       639D
       WORK      JV6283       6283             WORK      WV639E       639E
```

z/VM 6.2 SSI block diagram



SSI block diagram - values used in book



Customize z/VM TCP/IP stack and FTP server

- Recommend IPWIZARD for TCPIP configuration
  - Run once for each SSI member
  - Configure XEDIT profile on TCPMAINT
- Recommend turning on z/VM FTP server
  - Run once for each SSI member
- New: Attach the z/VM TCP/IP stack to the HA VSWITCH
  - Comment out `:attach.` line in SYSTEM DTCPARMS
  - Modify PROFILE TCPIP: OSA rdev => 0600 vdev
  - Grant TCPIP access to VSW1 in user directory

Customize SYSTEM CONFIG file

- Recommendations
  - Increase retrieve key capacity - from 20 to 99
  - Allow VDISKs to be created for swap spaces
    - Using SWAPGEN EXEC is common to create in-memory Linux swap spaces
  - Turn off the Disconnect Timeout feature
    - So Linux virtual machines are not forced off by SYSTEM
  - Define layer 2 virtual switch (now recommended)
  - Set up "Equivalency IDs" - new for z/VM 6.2

```
/* Add EQID statements for OSA addresses and unique MAC IDs */
POKDEV62: begin
  rdev 4200-420f eqid osaset1 type osa
  rdev 4300-430f eqid osaset1 type osa
  vmlan macprefix 02000b
POKDEV62: end
POKTST62: begin
  rdev 4200-420f eqid osaset1 type osa
  rdev 4300-430f eqid osaset1 type osa
  vmlan macprefix 02000c
POKTST62: end
```

CPFORMAT EXEC

```
==> cpformat
Synopsis:

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

Syntax is:
                 <---------------<
   >>--CPFORMAT--.-vdev--------.--AS---.-PERM-.---------><
                 '-vdev1-vdev2-'       '-PAGE-'
                                       '-SPOL-'
                                       '-TEMP-'
Example:
==> att a775-a779 *
A775-A779 ATTACHED TO MAINT
==> cpformat a775-a779 as page
...
```

New: Owner information is added to CP-owned devices

Add volumes for paging and minidisks

- Copy the CPFORMAT EXEC
- Format volumes for page space
  - Use the CPFORMAT EXEC with "**for page**"
- Format DASD for minidisks
  - Use the CPFORMAT EXEC with "**for perm**"
- Update the SYSTEM CONFIG file. e.g.:

```
POKDEV62: BEGIN
  CP_Owned Slot 251 JP628A
  CP_Owned Slot 252 JP6288
  CP_Owned Slot 253 JP6233
  CP_Owned Slot 254 JP6232
  CP_Owned Slot 255 JV6282
POKDEV62: END

POKTST62: BEGIN
  CP_Owned Slot 251 WP633E
  CP_Owned Slot 252 WP633C
  CP_Owned Slot 253 WP633B
  CP_Owned Slot 254 WP628B
  CP_Owned Slot 255 WV639D
POKTST62: END
...
User_Volume_List CV6285 CV6286 CV6287
User_Volume_Include JM6*
```

Create LNXMAINT for common CMS files

- Define virtual machine
- Customize virtual machine
- Copy files
  - 191 disk: `PROFILE EXEC, PROFILE XEDIT`
  - 192 disk: Common Linux files

```
PROFILE EXEC
PROFILE XEDIT
SAMPLE CONF-RH6
SAMPLE PARM-S11
SWAPGEN EXEC
RHEL64 EXEC
SAMPLE PARM-RH6
SLES11S3 EXEC
<Linux> RAMDISK
<Linux> KERNEL
```

SSICMD EXEC

```
==> ssicmd
Synopsis:
SSICMD cmd

cmd is a command to be issued on each of the members
  in the SSI cluster using the AT command.

Example:
==> ssicmd q proc
POKDEV62:
PROCESSOR 00 MASTER CP
PROCESSOR 01 ALTERNATE CP

POKTST62:
PROCESSOR 00 MASTER CP
PROCESSOR 01 ALTERNATE CP
```

z/VM security issues

- Change passwords in USER DIRECT
- Use a z/VM Security product?
  - IBM RACF
  - CA VM:Secure
- The paper *z/VM Security and Integrity*
  - http://www.vm.ibm.com/library/zvmsecint.pdf

Servicing z/VM

- Apply a Programming Temporary Fix (PTF)
  - Get service from Internet
  - Receive, apply and build
  - Put into production
- Apply a Recommended Service Upgrade (RSU)
  - RSU6202 is now available and documented
- Determining z/VM's service level

z/VM Live Guest Relocation (LGR)

- LGR considerations
  - USERs are relocatable, not IDENTITYs
  - Memory size (central, expanded)
  - Link and resource contention
  - Add `OPTION CHPIDV ONE` to the Linux PROFILE in user directory
  - FCP/SCSI disk devices
  - Linux must not have CMS disks at relocate time
    - Disks can be detached at Linux boot time
    - Added to /etc/rc.d/rc.local:

```
...
chshut halt vmcmd logoff
chshut poff vmcmd logoff
modprobe vmcp
vmcp det 190
vmcp det 191
vmcp det 19d
vmcp det 19e
rmmod vmcp
```

- Relocate a Linux system

```
==> vmrelocate test <user ID> <target system ID>
==> vmrelocate move <user ID> <target system ID>
```

DirMaint, SMAPI and RACF

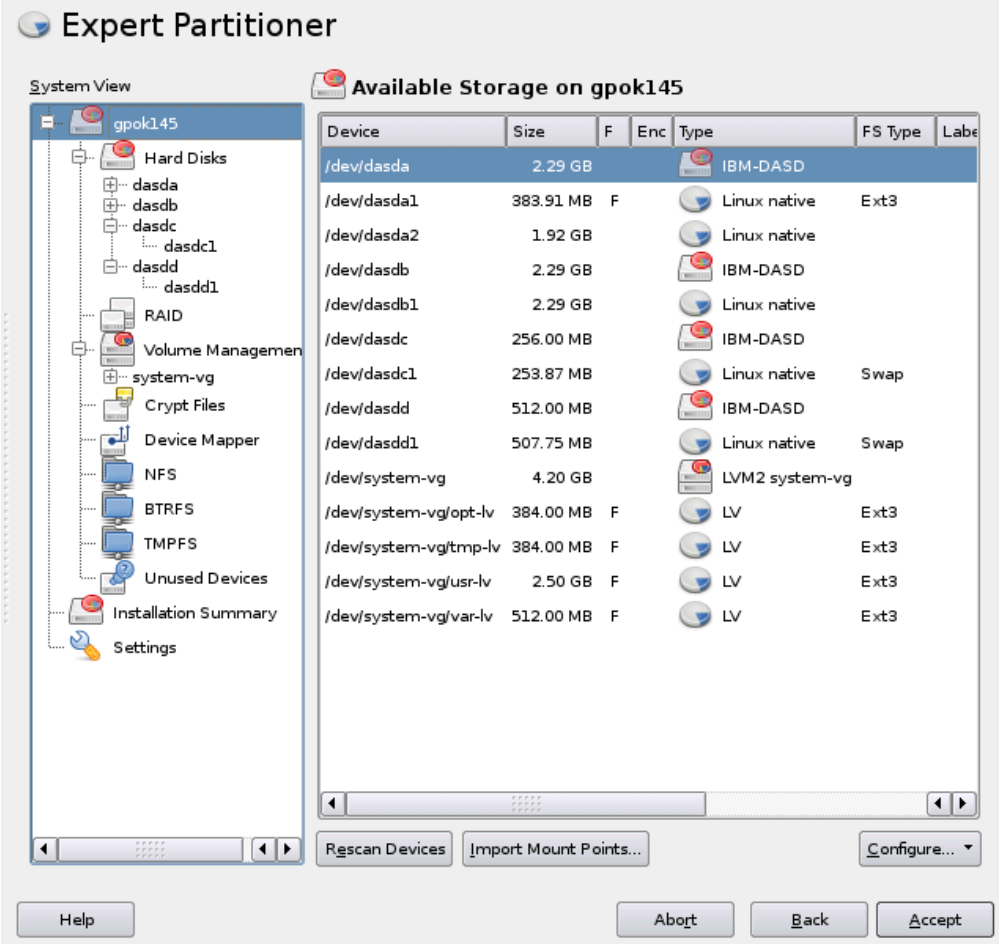
- Configure DirMaint
  - Enable DirMaint
  - Tailor DirMaint
  - Customize the EXTENT CONTROL file
  - Start DirMaint
  - Test DirMaint
- Configure SMAPI
  - Set up basic SMAPI configuration
  - Turn off ensembles
  - Start SMAPI at IPL time
  - Test SMAPI
- Some common DirMaint tasks
- RACF with shared database

Install and configure RHEL 6.4 on LNXADMIN

- Install the golden image
  - Create the IDENTITY LNXADMIN
  - Set LNXADMIN to start at IPL time
  - Prepare the RHEL 6.4 bootstrap files
  - Install RHEL 6.4 Linux
  - Boot the new system from disk
- Configure the Linux administration system
  - Copy RHEL 6.4 install tree/other files from PC to LNXADMIN
  - Configure yum
  - Turn off unneeded services
  - Configure the VNC server
  - Set system to halt on SIGNAL SHUTDOWN
  - Turn on NFS server
  - Configure SSH keys
  - Change order of swap disks
  - Insert vmcp module
  - Reboot/verify changes

Install and configure the RHEL 6.4 golden image

- Install the golden image
  - Create the RH64GOLD virtual machine
  - Prepare the RH64GOLD parameter files
  - Install RHEL 6.4 on the golden image
    - File system layout with LVMs
  - Verify the installation
- Configure the golden image
  - Configure automount of the install tree
  - Configure yum for online updates
  - Turn off unneeded services
  - Configure the VNC server
  - System to halt on SIGNAL SHUTDOWN
  - Configure SSH keys and boot time settings
  - Change the order of the swap disks
  - Reboot system and verify changes



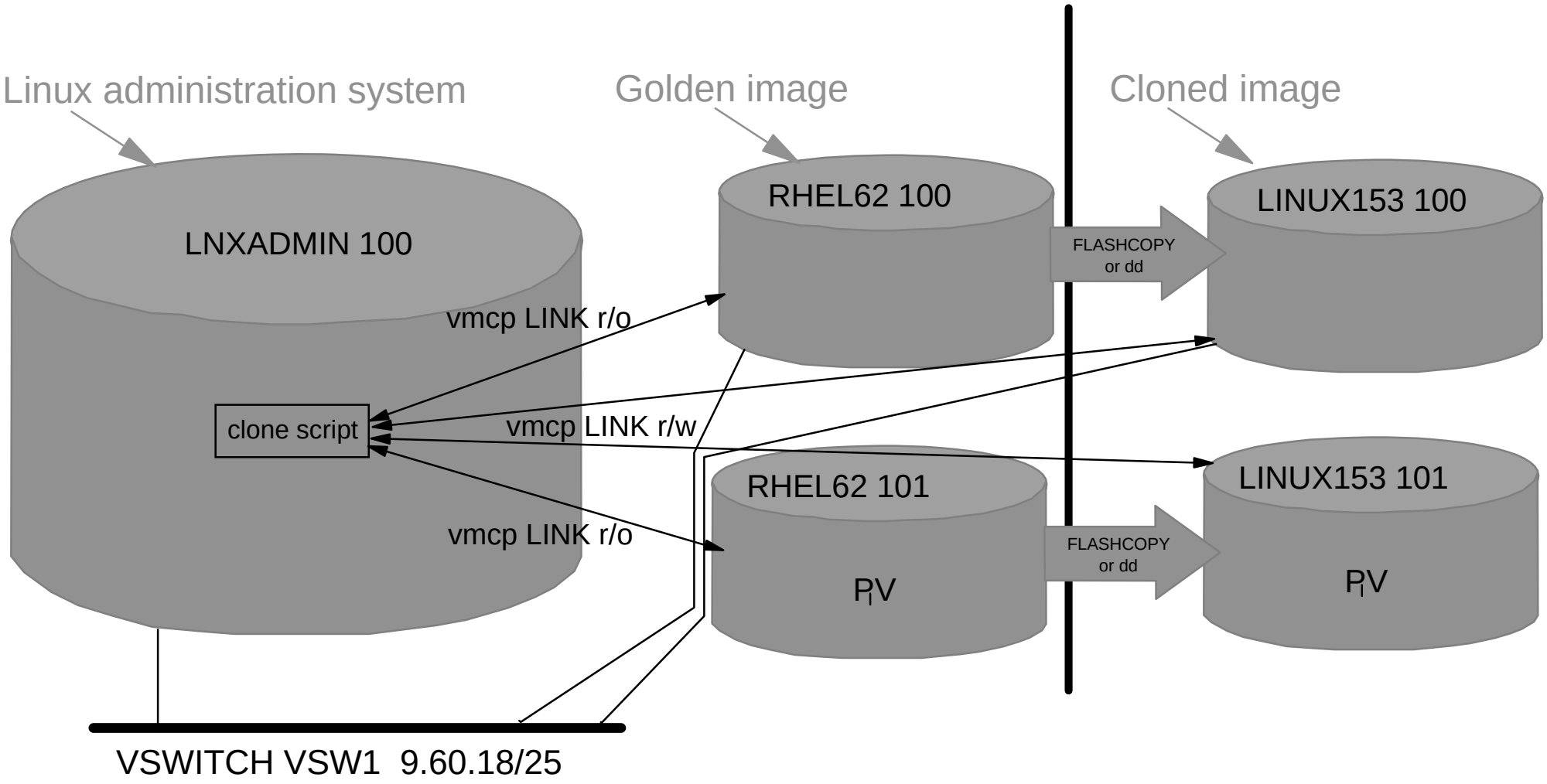
Mount point	Logical Volume Name	Size (MB)
/tmp/	tmp_lv	512
/opt/	opt_lv	512
/var/	var_lv	512
/usr/	usr_lv	2048

Configure RHEL 6.4 for cloning

- Define three new virtual machines
- Clone a virtual server manually
- Clone a virtual server automatically
- Review system status

Cloning Linux

- Cloning block diagram:



Create RHEL 6.4 appliances

- A Web Server appliance
- An application development appliance
- An LDAP server appliance
- A file and print server appliance
  - Section on setting up subversion

Install SLES 11 SP3 on LNXADMIN

- Review the identity LNXADMIN
- Prepare the SLES 11 SP3 bootstrap files
- Install SLES 11 SP3 on to LNXADMIN
- Configure the Linux administration system
  - Reset install location
  - Turn off unneeded services
  - Apply service
  - Install the cmsfs package
  - Enable vmcp
  - Set system to halt on SIGNAL SHUTDOWN
  - Modify zipl.conf
  - Reboot and verify changes

Install the SLES 11 SP3 golden image

- Create the S113GOLD virtual machine
- Create the S113GOLD parameter file
- Install the SLES 11 SP3 golden image
  - Logical volumes for flexibility:

Mount point	Logical volume name	Size
/usr/	**usr-lv**	2.5 GB
/var/	**var-lv**	512 MB
/opt/	**opt-lv**	384 MB
/tmp/	**tmp-lv**	384 MB

- Configure SLES 11 SP3 golden image
  - Configure the VNC server
  - Prepare for YaST Online Update
  - Turn off unneeded services
  - Apply service with Online Update
  - Configure /etc/inittab
  - Configure SSH keys
  - Modify zipl.conf
  - Cleanup temporary files
  - Reboot and verify changes

Clone SLES 11 SP3

- Clone a virtual server manually
- Clone a virtual server automatically
- Use AutoYAST
- Use Kiwi

Create SLES 11 SP3 appliances

- A Web Server appliance
- An LDAP appliance
- A file and print server appliance
- An application development appliance
  - Including subversion

Monitor and tune z/VM and Linux

- Use basic z/VM commands
  - Especially: INDICATE
- The z/VM Performance Toolkit
  - Configure the z/VM Performance Toolkit
  - Configure Web Browser support
  - Configure PERFSVM
  - Start the z/VM Performance Toolkit
  - Use the z/VM Performance Toolkit
- Section on the VIR2REAL EXEC
- Collect and use raw CP Monitor data
- Monitor Linux performance data from the kernel
- Monitor Linux with sysstat

New chapter: Working with disks

- Add disk space to virtual machines
- Add a logical volume
- Extend an existing logical volume
- Add SCSI/FCP disks
  - As emuldated devices (aka "EDEVs")
  - As real devices
  - Configure multipathing
- HyperPAV for Linux Use

Miscellaneous Recipes

- Rescue a Linux system
- Set up memory hot plugging
- Utilize the cpuplugd service
- Hardware cryptographic support for OpenSSH (remove???)
- The X window system
- Centralizing home directories for LDAP users (no specific steps)
- Automatically logging root onto the 3270 console
- Adding CTCs to an SSI cluster
- Setting up Linux Terminal Server
- Setting up a private interconnect
- Creating a hipersocket connection between Linux and z/OS
- CRON like service virtual machine
- Configuring Port Groups with LACP

Resources

- All *Virtualization Cookbooks* and other papers:
  - http://www.vm.ibm.com/devpages/mikemac/
- *The* Linux for zSeries and S/390 portal
  - http://linuxvm.org/
- The linux-390 list server
  - http://www2.marist.edu/htbin/wlvindex?linux-390
- The IBMVM list server
  - http://www.lsoft.com/scripts/wl.exe?SL1=IBMVM&H=LISTSERV.UARK.EDU
- Linux for zSeries and S/390 developerWorks®
  - http://awlinux1.alphaworks.ibm.com/developerworks/linux390/index.shtml
- Red Hat Enterprise Linux evaluation
  - http://www.redhat.com/rhel/server/mainframe/
- SUSE LINUX Enterprise Server evaluation
  - http://www.novell.com/products/linuxenterpriseserver/eval.html
- z/VM publications
  - http://www.vm.ibm.com/pubs/
- z/VM performance tips
  - http://www.vm.ibm.com/perf/tips/

Questions

- Are there any questions?