

Extreme Cloud Administration Toolkit

xCAT on z/VM and z/Linux

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Document Abstract

The purpose of this document is to provide the user with an overview, an installation, and a quick start guide on basic z/VM and z/Linux administration on xCAT.

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Terminology

The purpose of this section is to outline the terminology used within this design document.

DirMaint	CMS application that helps manage an installation's VM directory.
Ganglia	<i>"Ganglia consists of two unique daemons (gmond and gmetad), a PHP-based web frontend and a few other small utility programs. Gmond is a multi-threaded daemon which runs on each cluster node you want to monitor. Gmetad is the daemon that monitors the other nodes by periodically polling them, parsing the collected XML, and saving all the numeric, volatile metrics to the round-robin databases."</i> - Ganglia Development Team
Image	A snapshot of an operating system running on a virtual server that is packaged and compressed into a file.
Life cycle	A collection of tasks that include: power on/off of a virtual server, and create/edit/delete of a virtual server.
OVF	<i>"The Open Virtualization Format (OVF) describes an open, secure, portable, efficient and extensible format for the packaging and distribution of virtual appliances. It enables portability and simplifies installation and deployment of virtual appliances across multiple virtualization platforms."</i> -Distributed Management Task Force
SMAPI	The Systems Management APIs simplify the task of managing many virtual images running under a single z/VM image.
Virtual server	A server composed virtualized resources. An operating system can be installed on a virtual server.
VMCP	Module that allows execution of CP commands.
CP	<i>"The Control Program (CP) is the operating system that underlies all of z/VM. It is responsible for virtualizing your z/Series machine's real hardware, and allowing many virtual machines to simultaneously share the hardware resource."</i> - IBM
xCAT	xCAT (Extreme Cloud Administration Tool) is a toolkit that provides support for the deployment and administration of large cluster environments.
zHCP	HCP (System z Hardware control point) is a Linux virtual server that interfaces with SMAPI and manages other virtual servers on z/VM.
AutoYaST	<i>"AutoYaST is a system for installing one or more SUSE Linux systems automatically and without user intervention. AutoYaST installations are performed using an autoyast profile with installation and configuration data."</i> -SUSE
Kickstart	<i>"Automated installation for Red Hat. It uses a file containing the answers to all the questions that would normally be asked during a typical Red Hat Linux installation."</i> -Red Hat

Support on z/VM and z/Linux

The purpose of this section is to provide a list of the supported functionalities of xCAT on z/VM and z/Linux.

1. Life cycle support for xCAT on z/VM, which includes:
 - a) Power on/off virtual server
 - b) Create virtual server
 - c) Edit virtual server configuration
 - d) Delete virtual server
2. Software and hardware inventory of a virtual server
3. Cloning a virtual server
4. Installation of zLinux on a virtual server using kickstart/autoyast
5. Monitoring of zLinux systems using ganglia
6. Remote shell
7. Linux OS update
8. NFS read-only root filesystem

Design Architecture

The purpose of this section is to provide information on the design architecture of xCAT on z/VM and z/Linux.

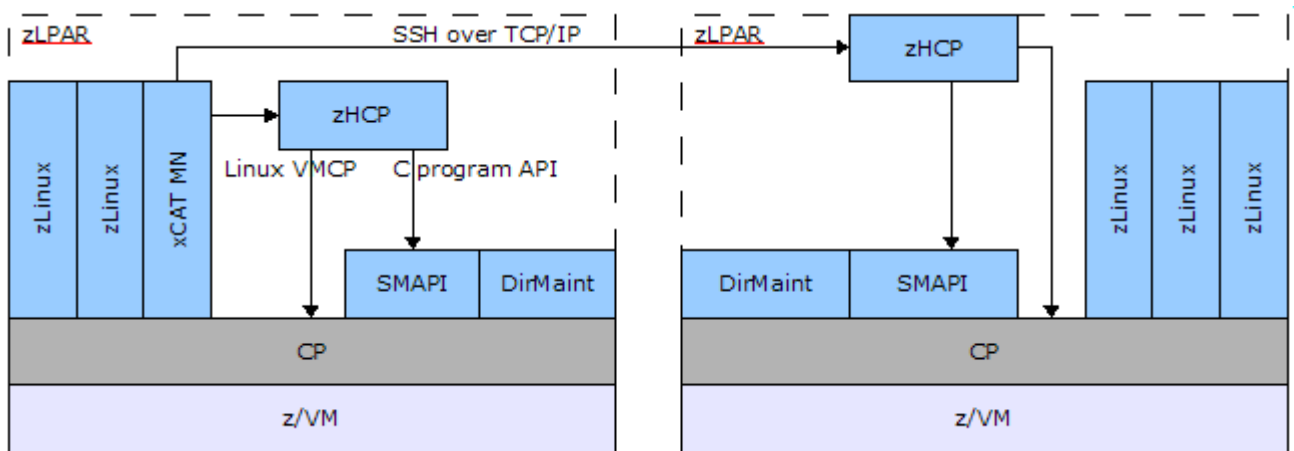


Figure 1. Shows the layout of xCAT on System z.

xCAT is used to manage virtual servers within multiple z/VM partitions. The xCAT management node (MN) can be installed on any zLinux. It communicates with a System z hardware control point (zHCP) over SSH, which is required on each z/VM partition in order to manage it. The zHCP is a zLinux, and its purpose is to interface with the SMAPI and CP layer. It utilizes a C socket interface to communicate with the SMAPI layer and VMCP Linux module to communicate with the CP layer. xCAT mainly relies on Linux VMCP module to perform its actions. However, more complicated actions, such as creating/deleting/editing virtual servers, require SMAPI.

Prerequisite

The purpose of this section is to detail what is required before you setup xCAT on z/VM and z/Linux.

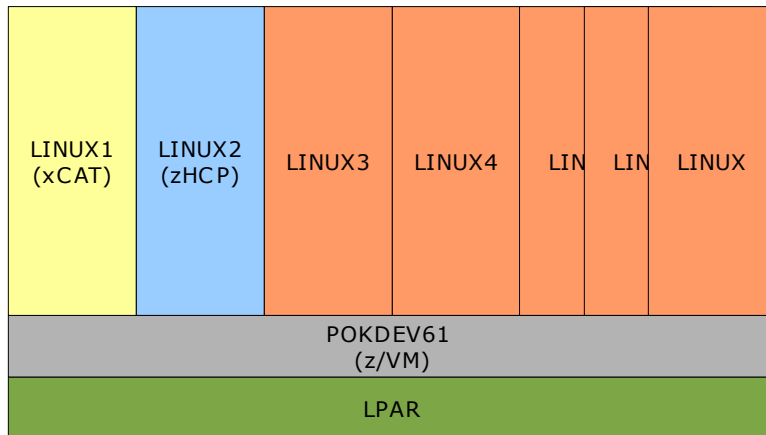


Figure 1. Sample environment

Before you can install xCAT, there are a couple of prerequisites. You need to have two virtual servers (one server for the xCAT MN and the other for the zHCP) running zLinux.

The xCAT MN should have the following user entry:

```
USER LINUX1 PWD 1G 2G G
INCLUDE LNXDFLT
COMMAND SET VSWITCH VSW1 GRANT LINUX1
COMMAND SET VSWITCH VSW2 GRANT LINUX1
MDISK 0100 3390 0001 10016 EMC21A MR
MDISK 0101 3390 0001 10016 EMC21C MR
MDISK 0102 3390 0001 10016 EMC28B MR
```

where the user profile, LNXDFLT, contains:

```
PROFILE LNXDFLT
CPU 00 BASE
CPU 01
IPL CMS
MACHINE ESA 4
CONSOLE 0009 3215 T
NICDEF 0600 TYPE QDIO LAN SYSTEM VSW1
NICDEF 0700 TYPE QDIO LAN SYSTEM VSW1
NICDEF 0800 TYPE QDIO LAN SYSTEM VSW2
SPOOL 000C 2540 READER *
SPOOL 000D 2540 PUNCH A
SPOOL 000E 1403 A
LINK MAINT 0190 0190 RR
LINK MAINT 019D 019D RR
LINK MAINT 019E 019E RR
LINK MAINT 0402 0402 RR
LINK LNXMAINT 0192 0191 RR
```

```
LINK TCPMAINT 0592 0592 RR
```

It is recommended that you use LVM for the root partition, so the disk space can grow as the number of Linux ISOs grows. NICDEF 0800 uses VSW2, a Layer 2 VSWITCH. Virtual servers on POKDEV61 must use this VSWITCH. It is through this VSWITCH that the xCAT MN communicates with each virtual server. xCAT supports Layer 2 GuestLAN and Layer 2 VSWITCH.

The xCAT MN can run on any Linux distribution, SLES or RHEL. In the sample environment above, the xCAT MN was setup on SLES 11 SP1 with Server Base, Gnome, and X Windows packages installed.

The zHCP should have the following user entry:

```
USER LINUX2 DRCT 512M 1G BCDG
COMMAND SET VSWITCH VSW2 GRANT LINUX2
CPU 00 BASE
CPU 01
IPL CMS
MACHINE ESA 4
OPTION LNKNOPAS
CONSOLE 0009 3215 T
NICDEF 0800 TYPE QDIO LAN SYSTEM VSW2
SPOOL 000C 2540 READER *
SPOOL 000D 2540 PUNCH A
SPOOL 000E 1403 A
LINK MAINT 0190 0190 RR
LINK MAINT 019D 019D RR
LINK MAINT 019E 019E RR
LINK LNXMAINT 0192 0191 RR
LINK TCPMAINT 0592 0592 RR
MDISK 0100 3390 1 10016 EMC278
```

MDISK 0100 is mounted with the root partition. NICDEF 0800 uses VSW2, a Layer 2 VSWITCH. The zHCP has B, C, D, and G privileges. The zHCP needs class B privilege so it could use the FLASHCOPY command (if permitted), class C privilege so it could use the SEND command, and class D privilege so it could use the PURGE command. In order for the zHCP to have these privileges, you must log onto MAINT after the user has been created and issue:

```
DIRM FORUSER LINUX2 CLASS BCDG
```

The zHCP can run on any Linux distribution, SLES or RHEL. In the sample environment above, the zHCP was setup on SLES 10 SP3 with Server Base package installed.

Important

- The zHCP must use the same network as the DHCP server running on the xCAT MN. For example, if the DHCP uses VSWITCH VSW2, then the zHCP must use VSWITCH VSW2. Also, the zHCP should only be on one network, in our example, VSWITCH VSW2.
- Both the xCAT MN and zHCP are linked to LNXMAINT, which contains files used by both CMS and Linux.

LNXMAINT has the following user entry.

```
USER LNXMAINT DRCT 64M 128M BEG
INCLUDE TCPCMSU
LINK TCPMAINT 0592 0592 RR
MDISK 0191 3390 1 20 EM6340 MR
MDISK 0192 3390 1 279 EM6341 MR
```

It is recommended that you have the following PROFILE EXEC on LNXMAINT 192 disk (which is linked to all virtual servers on POKDEV61).


```

/* PROFILE EXEC for Linux virtual servers */
'CP SET RUN ON'
'CP SET PF11 RETRIEVE FORWARD'
'CP SET PF12 RETRIEVE'
'ACC 592 C'
'SWAPGEN 300 1048576' /* create a 512M VDISK disk swap space */
'SWAPGEN 301 2097152' /* create a 1G 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 */

```

This statement in the PROFILE EXEC enables each virtual server to IPL 100 upon startup.

For more information on how to setup z/VM, please refer to the *z/VM and Linux on IBM System z The Virtualization Cookbook for SLES 10 SP2 (SG24-7493)*.

Installation of xCAT

The purpose of this section is to provide details on how to install the xCAT management node.

Red Hat Enterprise Linux:

1. Install the DHCP and BIND server through yum (if not already)

```
dhcp
bind
caching-nameserver
```
2. Use yum to install the following packages (accept the dependencies)

```
perl-XML-Parser
perl-IO-Socket-SSL
perl-DBI
```
3. Make an xcat directory under /root

```
mkdir /root/xcat
```
4. Download the latest xCAT tarballs, xcat-core-2.4.tar.bz2 and xcat-dep.tar.bz2, from <http://xcat.sourceforge.net/#download>
5. Transfer the xCAT tarballs to /root/xcat
6. Extract the contents of each tarball

```
tar jxf xcat-core-2.4.tar.bz2
tar jxf xcat-dep.tar.bz2
```
7. Create a yum repositories for xCAT

```
/root/xcat/xcat-dep/rh5/s390x/mklocalrepo.sh
/root/xcat/xcat-core/mklocalrepo.sh
```
8. Install additional packages (if necessary)

```
perl-IO-Tty
perl-DBD-SQLite
fping
atftp-xcat
```

These packages are available in the xcat-dep and should be installed automatically when you install xCAT through yum.
9. Use yum to install xCAT

```
yum clean metadata
yum install xCAT
```

SUSE Linux Enterprise Server:

1. Install the DHCP and DNS server through yast (if not already)

```
yast -i dhcp-server
yast -i yast2-dns-server
```
2. Use yast to install the following packages (accept the dependencies)

```
perl-IO-Socket-SSL
perl-IO-Tty
```
3. Make an xcat directory under /root

```
mkdir /root/xcat
```
4. Download the latest xCAT tarballs, xcat-core-2.4.tar.bz2 and xcat-dep.tar.bz2, from <http://xcat.sourceforge.net/#download>
5. Transfer the xCAT tarballs to /root/xcat
6. Extract the contents of each tarball

```
tar jxf xcat-core-2.4.tar.bz2
```

```
tar jxf xcat-dep.tar.bz2
```

7. Add the xCAT service to zypper

a) If you are on SLES 10:

```
zypper sa file:///root/xcat/xcat-dep/sles10/s390x xCAT-dep
```

```
zypper sa file:///root/xcat/xcat-core xcat-core
```

If you are on SLES 11:

```
zypper ar file:///root/xcat/xcat-dep/sles11/s390x xCAT-dep
```

```
zypper ar file:///root/xcat/xcat-core xcat-core
```

Ignore the warning message about the keys and accept them.

b) Install additional perl packages (if necessary)

```
perl-XML-Simple
```

```
perl-version
```

```
perl-SOAP-Lite
```

These packages are available in the xcat-dep and should be installed automatically when you install xCAT through yast.

c) Use zypper to install xCAT

```
zypper install xCAT
```

The following steps must be taken no matter what distribution you use:

1. Add the xCAT commands to path

```
source /etc/profile.d/xcat.sh
```

2. Check if the database is initialize

```
tabdump site
```

The output should look similar to the following:

```
gpok1:~/xcat # tabdump site
#key,value,comments,disable
"blademaxp","64",,
"domain","endicott.ibm.com",,
"fsptimeout","0",,
"installdir","/install",,
"ipmimaxp","64",,
"ipmiretries","3",,
"ipmitimeout","2",,
"consoleondemand","no",,
"master","10.1.100.1",,
"maxssh","8",,
"ppcmaxp","64",,
"ppcretry","3",,
"ppctimeout","0",,
"rsh","/usr/bin/ssh",,
"rcp","/usr/bin/scp",,
"sharedtftp","0",,
"SNsyncfiledir","/var/xcat/syncfiles",,
"tftkdir","/tftpboot",,
"xcatdport","3001",,
"xcatiport","3002",,
"xcatconfdir","/etc/xcat",,
"timezone","US/Eastern",,
```

```
"nameservers", "10.1.100.1",,
```

3. Setup an FTP server on the xCAT MN to contain Linux images

a) Download the desire Linux distribution ISO to /root

b) Go into /root directory

```
cd /root
```

c) Extract the ISO into the xCAT install tree /install

For SLES:

```
copycds SLES-10-SP3-DVD-s390x-DVD1.iso
```

For RHEL:

```
copycds -n rhel5.4 -a s390x RHEL5.4-Server-20090819.0-s390x-DVD.iso
```

d) Remove the ISO from /root since we do not need the ISO any longer

```
rm SLES-10-SP3-DVD-s390x-DVD1.iso
```

Installation of xCAT UI

The purpose of this section is to provide details on the installation of the xCAT UI.

Red Hat Enterprise Linux:

1. Use yum to install the following packages (accept the dependencies)

```
php
php-pear
httpd
```

2. Allow httpd to make network connections

```
/usr/sbin/setsebool httpd_can_network_connect=1
```

3. Install the xCAT-UI

```
yum install xCAT-UI
```

SUSE Linux Enterprise Server:

1. Use yast to install the following packages (accept the dependencies)

```
php5-openssl
apache2
apache2-mod_php5
```

2. Install the xCAT-UI

```
zypper in xCAT-UI
```

SSL Configuration

The purpose of this section is to provide details on configuring SSL on the xCAT server.

Red Hat Enterprise Linux:

TBD

SUSE Linux Enterprise Server:

The following instructions were taken from http://en.opensuse.org/Apache_Howto_SSL.

1. Make sure that apache starts with `mod_ssl` loaded.

```
a2enmod ssl
```

2. Make sure that the SSL configuration is active.

```
a2enflag SSL
```

3. The following steps will create self signed keys in a very simple way.

```
/usr/bin/gensslcert
```

4. Copy `/etc/apache2/vhosts.d/vhost-ssl.template` to `/etc/apache2/vhosts.d/vhost-ssl.conf`

5. For the enabled modules, server flags, generated keys and vhosts to take effect, start or restart the apache service

```
/etc/init.d/apache2 restart
```

Installation of zHCP

The purpose of this section is to provide details on the installation of the zHCP.

Before the zHCP can be installed on a virtual server running Linux, the following must be done (if not already).

1. Install and configure SMAPI for each z/VM partition. Refer to the [z/VM V5R4.0 Systems Management Application Programming](#).
2. Install and configure DirMaint for each z/VM partition. Refer to the [z/VM V5R2.0 Directory Maintenance Facility Tailoring and Administration Guide](#).
3. Create a disk pool on z/VM
TBD
4. Grant the zHCP access to DirMaint. Logon MAINT and issue the following commands

```
DIRM FOR ALL AUTHFOR LINUX2 CMDL 140A CMDS ADGHOPS
DIRM FOR ALL AUTHFOR LINUX2 CMDL 150A CMDS ADGHOPS
```

Change VSMWORK1 AUTHLIST

```
SET FILEPOOL VMSYS
QUERY FILEPOOL CONNECT
ACCESS VMSYS:VSMWORK1.DATA A (FORCERW
ACCESS VMSYS:VSMWORK1. B (FORCERW
X VSMWORK1 AUTHLIST B
```

Append the z/VM userID you wish to have DIRMAINT access to the end of VSMWORK1 AUTHLIST

```
LINUX2      ALL      ALL
```

5. Restart SMAPI

```
FORCE VSMWORK1
XAUTOLOG VSMWORK1
```

6. Give the virtual server where you will install the zHCP B, C, D, and G privileges. The zHCP needs class B privilege so it could use the FLASHCOPY command (if permitted), class C privilege so it could use the SEND command, and class D privilege so it could use the PURGE command. In order for the zHCP to have these privileges, you must log onto MAINT after the user has been created and issue:

```
DIRM FORUSER LINUX2 CLASS BCDG
```

Install the zHCP.

1. Install gcc and gcc-c++ (if not already)
2. Make a zhcp directory under /root

```
mkdir /root/zhcp
```
3. Download the zHCP RPM (zhcp-1-1.s390x.rpm) into /root/zhcp. You can get the zHCP RPM from xcat-dep.tar.bz2. If xcat-dep.tar.bz2 is unpackaged, then it would be located in <unpacked directory>/xcat-dep/<os>/s390x.
4. Install the RPM

```
rpm -i zhcp-1-1-s390x.rpm
```
5. Append the zHCP library path to /etc/ld.so.conf

```
echo /opt/zhcp/lib >> /etc/ld.so.conf
```
6. Configure dynamic linker run time bindings

```
ldconfig
```

Getting Started

The purpose of this section is to provide a starting guide on how to manage z/VM and z/Linux with xCAT.

1. Make sure the Linux VMCP module is loaded on the xCAT MN

```
modprobe vmcp
```

2. Set up the `passwd` table. This table will contain the default password for new nodes installed through `autoyast/kickstart` and other methods.

```
chtab key=system passwd.username=root passwd.password=rootpw
```

You can change this password on the new node once it has been installed using

```
passwd
```

3. Set up the `hosts` table (it will be used to setup `/etc/hosts`). You need to determine the regular expression that represents the nodes that xCAT will manage.

```
chtab node=all hosts.ip="|gpok(\d+)|10.1.100.(\$1+0)|" hosts.hostnames="|(.*)|(\$1).endicott.ibm.com|"
```

- Here, nodes belonging to `group=all` will have hostnames of `gpok1`, `node2`, etc. and IP addresses of `10.1.100.1`, `10.1.100.2`, etc. in `/etc/hosts`.
- Each time a new node is added to xCAT, you will need to run `makehosts`.
- You will need to setup the hosts table for each group you create.

4. Setup the `networks` table. You need to determine the dynamic range that the DHCP server will manage. You also need to point the DHCP, DNS, and FTP server to the IP address of your xCAT MN.

```
chtab net=10.1.100.0 networks.mask=255.255.255.0 networks.mgtifname=eth1
networks.gateway=10.1.100.1 networks.dhcpserver=10.1.100.1
networks.tftpserver=10.1.100.1 networks.nameservers=10.1.100.1
networks.dynamicrange=10.1.100.3-10.1.100.200
```

5. Define the DHCP interfaces in the `site` table to limit which network DHCP will listen on.

```
chtab key=dhcpinterfaces site.value='all|eth1'
```

In our example, `eth1` is the interface where we have the DHCP server installed on.

6. Edit the name server in the `site` table to point it to the xCAT MN.

```
chtab key=nameservers site.value='10.1.100.1'
```

7. Configure the DHCP server

- a. Add networks into the DHCP configuration

```
makedhcp -n
```

- b. Restart DHCP

```
service dhcpd restart
```

- c. Add the relevant networks to DHCP

```
makedhcp -a
```

8. Configure the DNS server

- a. Setup DNS from entries in `/etc/hosts`

```
makedns
```

- b. Setup `/etc/resolv.conf`

```
vi /etc/resolv.conf
```

```
domain endicott.ibm.com
```

```
nameserver 10.1.100.1
```

- c. Start DNS

```
service named start
```

- d. Start DNS on boot

```
chkconfig --level 345 named on
```

9. Start by adding the zHCP node (gpok2). Use the DNS hostname of that node when adding.

```
mkdef -t node -o gpok2 userid=LINUX2 hcp=gpok2.endicott.ibm.com mgt=zvm  
groups=all
```

- `userid=LINUX2` is the z/VM userID of zLinux running the zHCP
- `hcp=gpok2.endicott.ibm.com` is the zHCP that will be managing those nodes
- `mgt=zvm` is the plugin to use when actions are performed against those nodes
- `groups=all` is the group name that the nodes belong to

10. Add nodes you want to manage. Use the DNS hostname of that node when adding.

```
mkdef -t node -o gpok3 userid=LINUX3 hcp=gpok2.endicott.ibm.com  
nodetype=osi mgt=zvm groups=all
```

11. Update /etc/hosts

```
makehosts
```

12. Update DNS

```
makedns
```

13. Push the public SSH key of the xCAT management node onto a group of nodes that you want to manage

```
xdsh all -K
```

- This pushes the SSH key onto nodes within the `group=all`
- **Warning:** `xdsh` will hang if one or more nodes are powered down

You can push the public SSH key onto a single node

```
xdsh gpok3 -K
```

- This will push the public SSH key onto `gpok3`
- `xdsh` will hang if `gpok3` is powered down

The `xdsh` command will prompt you for a root password. It is the root password for the node or group of nodes you are trying to push the public SSH key to. It is recommended that you put nodes with the same root password into the same group. More importantly, the `xdsh` command will only work for nodes that are online.

14. Modify the table definitions of existing node (if desired)

```
rscan gpok2 >/tmp/stanza.txt  
cat /tmp/stanza.txt | mkdef -z
```

- This collects basic information about each on managed by the zHCP (gpok2) and outputs it to a file. The file is then used to modify the table definitions.
- The most important part of this command is that it gets the z/VM userID of each node. Actions performed by the zHCP are performed against the z/VM userID.

15. Start using supported xCAT commands

xCAT Commands

The purpose of this section is to list the current xCAT commands supported on z/VM and z/Linux.

rpower - It boots, resets powers on and off, and queries node hardware and devices. The syntax is: `rpower <node> [on|off|stat|reset]`

```
rpower gpok3 stat
```

mkvm - Creates a new virtual machine with the same profile/resources as the specified node (Clone). It can also create a new virtual machine based on a user directory entry. The syntax is: `mkvm <new node> /tmp/<directory entry text file>`.

```
mkvm gpok3 /tmp/dirEntry.txt
```

For cloning, the syntax is: `mkvm <target Linux> <source Linux> pool=<disk pool> pw=<multi password>`

```
mkvm gpok4,gpok5 gpok3 pool=POOL1
```

rmvm - Removes a virtual machine. The syntax is: `rmvm <node>`.

```
rmvm gpok3
```

lsvm - List virtual machine's configuration. Options supported are:

- List virtual machine directory entry

The syntax is: `lsvm <node>`

```
lsvm gpok3
```

- List virtual machine's defined network names

The syntax is: `lsvm <node> --getnetworknames`

```
lsvm gpok3 --getnetworknames
```

- List virtual machine's network configuration

The syntax is: `lsvm <node> --getnetwork [networkname]`

```
lsvm gpok3 --getnetwork GLAN1
```

- List virtual machine's disk pool names

The syntax is: `lsvm <node> --diskpoolnames`

```
lsvm gpok3 --diskpoolnames
```

- List virtual machine's disk pool

The syntax is: `lsvm <node> --diskpool [pool name] [space (free or used)]`

```
lsvm gpok3 --diskpool POOL1 free
```

chvm - Changes the virtual machine profile. Options supported are:

- Adds a 3390 (ECKD) disk to a virtual server's directory entry

The syntax is: `chvm <node> --add3390 [disk pool] [device address] [cylinders] [mode]`

```
[read password] [write password] [multi password]
```

```
chvm gpok3 --add3390 POOL1 0101 3338 MR
```

- Adds a 3390 (ECKD) disk that is defined in a virtual server's directory entry to that virtual server's active configuration

The syntax is: `chvm <node> --add3390active [device address] [mode]`

```
chvm gpok3 --add3390active 0101 MR
```

- Adds a 9336 (FBA) disk to a virtual server's directory entry

The syntax is: `chvm <node> --add9336 [disk pool] [virtual device] [block size] [mode]`

- [blocks] [read password] [write password] [multi password]
 chvm gpok3 --add9336 POOL3 0101 4096 3338 MR
- **Adds a network adapter to a virtual server's directory entry**
 The syntax is: chvm <node> --addnic [address] [type] [device count]
 chvm gpok3 --addnic 0600 QDIO 3
 - **Adds a virtual processor to a virtual server's directory entry**
 The syntax is: chvm <node> --addprocessor [address]
 chvm gpok3 --addprocessor 01
 - **Adds a virtual processor to a virtual server's active configuration**
 The syntax is: chvm <node> --addprocessoractive [address] [type]
 chvm gpok3 --addprocessor 01 ZAAP
 - **Adds a v-disk to a virtual server's directory entry**
 The syntax is: chvm <node> --addvdisk [userID] [device address] [size]
 chvm gpok3 --addvdisk 0300 2097120
 - **Connects a network adapter to a GuestLAN**
 The syntax is: chvm <node> --connectnic2guestlan [address] [lan] [owner]
 chvm gpok3 --connectnic2guestlan 0600 GLAN1 LN1OWNR
 - **Connects a network adapter to a VSwitch**
 The syntax is: chvm <node> --connectnic2vswitch [address] [vswitch]
 chvm gpok3 --connectnic2vswitch 0600 VSW1
 - **Copy a disk attached to a given virtual server**
 The syntax is: chvm <node> --copydisk [target address] [source node] [source address]
 chvm gpok3 --copydisk 0100 gpok2 0101
 - **Adds a dedicated device to a virtual server's directory entry**
 The syntax is: chvm <node> --dedicatedevice [virtual device] [real device] [mode]
 chvm gpok3 --dedicatedevice 0101 637F RW
 - **Deletes the IPL statement for the z/VM guest with the specified name**
 The syntax is: chvm <node> --deleteipl
 chvm gpok3 --deleteipl
 - **Formats a disk attached to a specified node (only ECKD disks supported)**
 The syntax is: chvm <node> --formatdisk [disk address] [multi password]
 chvm gpok3 --formatdisk 0100 PWD
 - **Disconnects a network adapter**
 The syntax is: chvm <node> --disconnectnic [address]
 chvm gpok3 --disconnectnic 0600
 - **Grant VSwitch access for specified node**
 The syntax is: chvm <node> --grantvswitch [VSwitch]
 chvm gpok3 --grantvswitch VSW1
 - **Removes a minidisk from a virtual server's directory entry**
 The syntax is: chvm <node> --removedisk [virtual device]
 chvm gpok3 --removedisk 0101
 - **Removes a network adapter from a virtual server's directory entry**
 The syntax is: chvm <node> --removenic [address]
 chvm gpok3 --removenic 0700
 - **Removes a processor from an active virtual server's configuration**
 The syntax is: chvm <node> --removeprocessor [address]
 chvm gpok3 --removeprocessor 01

- Replaces a user directory entry
The syntax is: `chvm <node> --replacevs [user directory entry]`
`chvm gpok3 --replacevs /tmp/dirEntry.txt`
- Sets the IPL statement for the specified z/VM userID
The syntax is: `chvm <node> --setipl [ipl target] [load parms] [parms]`
`chvm gpok3 --setipl CMS`
- Sets the password for the specified z/VM userID
The syntax is: `chvm <node> --setpassword [password]`
`chvm gpok3 --setpassword PW4U`

`rscan` - Collects node information from one or more hardware control points. The syntax is

`rscan <hcp>`.
`rscan gpok2`

`rinv` - Remote hardware inventory. The syntax is: `rinv <node>`.

`rinv gpok3 all`

Installing Linux Using AutoYast or Kickstart

The purpose of this section is to detail the installation of Linux using AutoYast or Kickstart.

Before you begin, make sure the following is done.

- The FTP server must be setup during the xCAT MN installation. The FTP root directory (/install) must contain the desired Linux distribution
- Nodes should be on the same network as the zHCP

There are two ways to install Linux onto a z/VM virtual machine, depending on which Linux distribution you want. One is through [AutoYast](#), which is used to install SUSE Linux Enterprise Server (SLES) releases. The other is through [Kickstart](#), which is used to install Red Hat Enterprise Linux (RHEL) releases.

1. Create the node definition

```
mkdef -t node -o gpok3 userid=LINUX3 hcp=gpok2.endicott.ibm.com mgt=zvm groups=all
```

2. Update /etc/hosts

```
makehosts
```

3. Update DNS

```
makedns
```

4. Create the new virtual machine using the desired user entry. For example,

```
USER LINUX3 PWD 512M 1G G
INCLUDE LNXDFLT
COMMAND SET VSWITCH VSW1 GRANT LINUX3
```

This is accomplished by copying the user entry above into a text file (userEntry.txt), and issuing

```
mkvm gpok3 /tmp/userEntry.txt
```

The user entry text file should not contain any extra new lines (/n). A MAC address will be assigned to the userID upon creation.

5. Add disks to the new node (the default autoyast/kickstart template available in xCAT requires 1 3390-MOD9 disks, you can edit this template under /opt/xcat/share/xcat/install/<distribution>). For more information on how to customize the template, see Appendix B.

```
chvm gpok3 --add3390 POOL1 0100 10016 MR
```

6. Set up the noderes and nodetype tables. You need to determine the OS and profile (autoyast/kickstart template) for the node. When xCAT was setup, the Linux distribution was unpackaged using copycdfs. You can find available OS and profiles by issuing

```
tabdump osimage
```

For SUSE:

```
chtab node=gpok3 noderes.netboot=zvm nodetype.os=sles10.3 nodetype.arch=s390x
nodetype.profile=compute
```

For Red Hat:

```
chtab node=gpok3 noderes.netboot=zvm nodetype.os=rhel5.4 nodetype.arch=s390x
nodetype.profile=compute
```

7. Verify the definition

```
lsdef gpok3
```

```
Object name: gpok3
  arch=s390x
  groups=all
  hcp=gpok2.endicott.ibm.com
  hostnames=gpok3.endicott.ibm.com
```

```
ip=10.1.100.3
mac=02:00:01:FF:FF:FF
mgt=zvm
netboot=zvm
nodetype=osi
os=sles10.3
postbootscripts=otherpkgs
postscripts=syslog,remoteshell,syncfiles
profile=compute
userid=LINUX3
```

8. Add the new node to DHCP

```
makedhcp -a
```

9. Prepare the new node for installation

```
nodeset gpok3 install
```

10. Boot the new node from reader

```
rnetboot gpok3 ipl=000C
```

11. In Gnome or KDE, open the VNC viewer to see the installation progress. It might take a couple of minutes before you can connect.

```
vncviewer gpok3.endicott.ibm.com:1
```

The default VNC password is 12345678.

12. (Only for SLES 10 SP2 or older) Once the first phase of installation is complete, restart the virtual server to complete the final phase of installation

```
rpower gpok3 reset
```

13. The default password for the node can be found in the passwd table. See *Getting Started* section step 2.

Cloning Virtual Servers

The purpose of this section is to show how to clone a virtual server running Linux.

1. The source node must be online. If it is not online, bring it online.

```
rpower gpok3 on
```

2. Exchange SSH keys between the xCAT server and the source node to be cloned (if not already).

```
xdsh gpok3 -K
```

3. Create the table definitions for new nodes (gpok4 and gpok5)

```
mkdef -t node -o gpok4 userid=LINUX4 hcp=gpok2.endicott.ibm.com mgt=zvm groups=all
```

```
mkdef -t node -o gpok5 userid=LINUX5 hcp=gpok2.endicott.ibm.com mgt=zvm groups=all
```

4. Update /etc/hosts

```
makehosts
```

5. Update DNS

```
makedns
```

6. Add the new node to DHCP

```
makedhcp -a
```

7. In order to clone a virtual server running Linux, the partition must be mounted by path.

In SUSE, the root directory under /etc/fstab, which contains information on the system partitions and disks, should be similar to this:

```
/dev/disk/by-path/ccw-0.0.0100-part1 / ext3 acl,user_xattr 1 1
```

The parameters under /etc/zipl.conf, which specifies which disks to bring online when the system is IPLed, should be similar to this:

```
parameters = "root=/dev/disk/by-path/ccw-0.0.0100-part1 TERM=dumb"
```

If you happen to edit zipl.conf, you must run zipl after you made the changes so that changes are written to the boot record.

Moreover, to clone a virtual server, the source virtual server running Linux must be online at the time of cloning. This allows xCAT to gather information about the source virtual server.

8. Clone virtual server(s) running Linux:

```
mkvm gpok4,gpok5 gpok3 pool=POOL1
```

This will create two virtual servers (gpok4 and gpok5) identical to gpok3. It will use disks in disk pool POOL1.

Setting Up Ganglia on xCAT

The purpose of this section is to provide details on the set up of Ganglia on xCAT.

1. Download the Ganglia RPMs

```
libconfuse-2.6-1.s390x.rpm
libganglia-3.1.1-1.s390x.rpm
ganglia-gmetad-3.1.1-1.s390x.rpm
ganglia-gmond-3.1.1-1.s390x.rpm
ganglia-web-3.1.1-1.s390x.rpm
```

2. Set up ganglia on the xCAT MN (gpok1)

a) Install PHP and apache packages

SUSE Linux Enterprise Server:

Use yast to install the following packages (if necessary)

```
libapr1
pkgconfig
php5-pear
php5-gd
apache2
apache2-mod_php5
```

Red Hat Enterprise Linux:

Use yum to install the following packages (if necessary)

TBD

b) Install the Ganglia library RPMs

```
rpm -i libconfuse-2.6-1.s390x.rpm
rpm -i libganglia-3.1.1-1.s390x.rpm
```

c) Install gmetad (This monitors other nodes by periodically polling them)

```
yast -i rrdtool
rpm -i ganglia-gmetad-3.1.1-1.s390x.rpm
```

d) Install gmond

```
rpm -i ganglia-gmond-3.1.1-1.s390x.rpm
```

e) Install the ganglia web RPM

```
rpm -i ganglia-web-3.1.1-1.s390x.rpm
```

f) Configure the apache server

- Specify the NameVirtualHost in /etc/apache2/listen.conf

```
NameVirtualHost 9.60.18.253:80
```
- Copy /etc/apache2/vhosts.d/vhost.template

```
cd /etc/apache2/vhosts.d
cp vhost.template ganglia.conf
```
- Edit ganglia.conf

```
<VirtualHost 9.60.18.253:80>
    ServerName gpok253.endicott.ibm.com
    DocumentRoot /srv/www/htdocs/ganglia
    <Directory "/srv/www/htdocs/ganglia">
        Order allow,deny
        Allow from all
```

```
</Directory>  
</VirtualHost>
```

g) Restart the apache server

```
/etc/init.d/apache2 restart
```

h) Restart gmond and gmetad

```
service gmond restart
```

```
service gmetad restart
```

3. Create the directory /opt/xcat/install on the xCAT MN

```
mkdir /opt/xcat/install
```

4. Download the following packages and place them in /opt/xcat/install

- libganglia-3.1.1-1.s390x.rpm
- libconfuse-devel-2.6-1.s390x.rpm
- ganglia-gmond-3.1.1-1.s390x.rpm

Ganglia Monitoring on xCAT

The purpose of this section is to provide details on using Ganglia on xCAT.

1. Transfer ganglia RPMs required to run gmond over to nodes you want to monitor

```
xdcp <node> /opt/xcat/install/ganglia-gmond-3.1.1-1.s390x.rpm
xdcp <node> /opt/xcat/install/libconfuse-2.6-1.s390x.rpm
xdcp <node> /opt/xcat/install/libganglia-3.1.1-1.s390x.rpm
```

 - This command transfers the files into /root directory on the target node
2. Install the RPMs

```
xdsh <node> rpm -i libconfuse-2.6-1.s390x.rpm
xdsh <node> rpm -i libganglia-3.1.1-1.s390x.rpm
xdsh <node> rpm -i ganglia-gmond-3.1.1-1.s390x.rpm
```

 - Make sure the target node has [libapr1](#) package
3. Ensure the nodetype of all nodes you wish to monitor have the type of 'osi'. This can be done by editing the nodetype table.

```
tabedit nodetype
```
4. Add gangliamon to the monitoring table

```
monadd gangliamon
```
5. Configure the node

```
moncfg gangliamon -r
```

 - This runs the ganglia configuration script on all the nodes
6. Start gangliamon:

```
monstart gangliamon -r
```

 - This will start the gmond daemon on all the nodes
 - The -r flag is required to ensure the gmond daemon is started on each node

You may also specify a particular node to start:

```
monstart gangliamon gpok246 -r
```

7. Stopping gangliamon:

```
monstop gangliamon -r
```

Stalite

The purpose of this section is to detail how to configure an NFS read-only root filesystem. For more details, refer to the xCAT Stalite Cookbook located in <http://xcat.svn.sourceforge.net/viewvc/xcat/xcat-core/trunk/xCAT-client/share/doc/index.html>.

1. Export the /install directory as read-only under /etc/exports

```
/install *(ro,no_root_squash,sync,no_subtree_check)
```

2. Restart the NFS server

```
service nfs restart
```

3. Edit the litefile table. This table specifies which files should be kept persistent across reboots. By default, all files are kept under tmpfs, unless a *persistent*, *ro*, or *bind* option is specified. Refer to the litefile table description for more details.

```
tabedit litefile
```

Copy the following defaults into the litefile table.

```
#image, file, options, comments, disable
"ALL", "/etc/inittab",,,
"ALL", "/etc/lvm/.cache",,,
"ALL", "/etc/mtab",,,
"ALL", "/etc/ntp.conf",,,
"ALL", "/etc/resolv.conf",,,
"ALL", "/etc/ssh/", "persistent",,
"ALL", "/etc/sysconfig",,,
"ALL", "/etc/syslog-ng",,,
"ALL", "/tmp",,,
"ALL", "/var/tmp",,,
"ALL", "/var/run",,,
"ALL", "/etc/yp.conf",,,
"ALL", "/var/lib",,,
"ALL", "/var/empty",,,
"ALL", "/var/spool",,,
"ALL", "/var/lock",,,
"ALL", "/var/log",,,
"ALL", "/var/cache",,,
"ALL", "/etc/fstab",,,
"ALL", "/var/adm",,,
"ALL", "/root/.viminfo",,,
"ALL", "/root/.bash_history",,,
"ALL", "/opt/xcat",,,
"ALL", "/xcatpost",,,
```

4. Edit the litetree table. This table controls where the files specified in the litefile table come from.

```
tabedit litetree
```

Copy the following into the litetree table.

```
#priority, image, directory, comments, disable
"1.0",, "10.1.100.1:/install/netboot/sles11.1/s390x/compute",,
```

You will need to determine the Linux distribution you want. In our example, SLES11 SP1 is used.

5. Edit the stalite table. This table controls where the permanent files are kept.

```
tabedit stalite
```

Copy the following into the stalite table.

```
#node, image, statemnt, comments, disable
"statelite",, "10.1.100.1:/lite/state",,
```

6. Ensure policies are set up correctly. When a node boots up, it queries the xCAT database to get the lite-files and the lite-tree. In order for this to work, the command must be set in the policy table to allow nodes to request it. (This should already be done automatically when xCAT was installed)

```
chtab priority=4.7 policy.commands=litefile policy.rule=allow
chtab priority=4.8 policy.commands=litetree policy.rule=allow
```

7. Copy the packages from the Linux distro media into /install (if not already)

For SLES:

```
copycds SLES-10-SP3-DVD-s390x-DVD1.iso
```

For RHEL:

```
copycds -n rhel5.4 -a s390x RHEL5.4-Server-20090819.0-s390x-DVD.iso
```

8. Create a list of packages that should be installed onto the statelite image. You should start with the base packages in the compute template.

```
mkdir -p /install/custom/netboot/sles
cp /opt/xcat/share/xcat/netboot/sles/compute.sles11.s390x.pkglist
/install/custom/netboot/sles
```

You can add more packages by editing the .pkglist

9. Create the statelite image

```
genimage -i eth1 -n qeth -o sles11.1 -p compute -m statelite
```

This command creates a SLES11 SP1 image with an eth1 interface and qeth network driver. The interface used must match the xCAT MN interface that is managed by DHCP. The genimage command creates an image under /install/netboot/sles11.1/s390x/compute/rootimg. It also creates a ramdisk and kernel that can be used to boot the statelite node.

10. Modify the statelite image by creating symbolic links will all the files listed under the litetree table

```
liteimg -o sles11.1 -a s390x -p compute
```

11. Create the statelite node definition

```
mkdef -t node -o gpok6 userid=LINUX6 nodetype=osi hcp=gpok3.endicott.ibm.com
mgt=zvm groups=all
```

12. Update /etc/hosts

```
makehosts
```

13. Update DNS

```
makedns
```

14. Create the new virtual machine using the desired user entry. For example,

```
USER LINUX6 PWD 512M 1G G
COMMAND SET VSWITCH VSW2 GRANT LINUX6
CPU 00 BASE
CPU 01
IPL CMS
MACHINE ESA 4
CONSOLE 0009 3215 T
NICDEF 0800 TYPE QDIO LAN SYSTEM VSW2
SPOOL 000C 2540 READER *
SPOOL 000D 2540 PUNCH A
SPOOL 000E 1403 A
LINK MAINT 0190 0190 RR
LINK MAINT 019D 019D RR
LINK MAINT 019E 019E RR
```

This is accomplished by copying the user entry above into a text file (userEntry.txt), and issuing

```
mkvm gpok6 /tmp/userEntry.txt
```

15. Clone this node as many times as you want to achieve the number of statelite nodes you desire.
Refer to *Cloning Virtual Servers* section above.

16. Add the new node to DHCP

```
makedhcp -a
```

17. Prepare the node(s) to boot from the statelite image

```
nodeset gpok6 statelite
```

18. Boot the statelite node(s). During this process, the symbolic links are made to files listed under the litefile table.

```
rnetboot gpok6 ipl=00c
```

Limitations

The purpose of this section is to highlight the limitations of xCAT on z/VM and z/Linux.

1. The zHCP only support RHEL 5.3/SLES 10 SP2 or greater.
2. Nodes that the zHCP manages must have the VMCP Linux module.
3. SCSI/FCP disks are not yet supported in cloning. Only ECKD disks are supported.
4. The zHCP should be attached to only one network, and it must be a Layer 2 network, either Guest LAN or VSwitch. Each node can have more than one NIC, but the nodes that are managed by this zHCP must also be on the same network.
5. The zHCP was tested on SLES 10.2/10.3 and RHEL 5.4. Other releases of SLES and RHEL should also be supported.
6. The default autoyast and kickstart templates available on xCAT was tested on SLES 10.2/10.3 and RHEL 5.3/5.4. Other releases of SLES and RHEL should also be supported.

Appendix A: Setting Up a Private Network

The purpose of this section is to detail how to setup a private network based on a Layer 2 VSWITCH.

Red Hat Enterprise Linux:

SSH to the desire Linux where you want to setup the private network. A network script must be added under `/etc/sysconfig/network-scripts/` to let the system know about the new interface and a qeth group must be created under `/sys/bus/ccwgroup/drivers/qeth/group`.

Copy the hardware settings from the existing network `/etc/sysconfig/network-scripts/ifcfg-eth0`.

```
cp /etc/sysconfig/network-scripts/ifcfg-eth0 /etc/sysconfig/network-scripts/ifcfg-eth1
```

Edit the network settings.

```
vi /etc/sysconfig/network-scripts/ifcfg-eth1
```

```
# IBM QETH
DEVICE=eth1
ARP=no
BOOTPROTO=static
BROADCAST=10.1.100.255
IPADDR=10.1.100.1
IPV6INIT=yes
IPV6_AUTOCONF=yes
MTU=1500
NETMASK=255.255.255.128
NETTYPE=qeth
NETWORK=10.1.100.0
ONBOOT=yes
PORTNAME=PORT800
OPTIONS="layer2=1"
SUBCHANNELS=0.0.0800,0.0.0801,0.0.0802
MTU=1500
```

Load the qeth driver

```
modprobe qeth
```

Create a qeth group device

```
echo 0.0.0800,0.0.0801,0.0.0802 > /sys/bus/ccwgroup/drivers/qeth/group
```

Declare the qeth group device as Layer 2

```
echo 1 > /sys/bus/ccwgroup/drivers/qeth/0.0.0800/layer2
```

Bring the device back online

```
echo 1 > /sys/bus/ccwgroup/drivers/qeth/0.0.0800/online
```

Verify the state of the device (1 = online)

```
cat /sys/bus/ccwgroup/drivers/qeth/0.0.0800/online
```

Check to see what interface name was assigned to the device

```
cat /sys/bus/ccwgroup/drivers/qeth/0.0.0800/if_name
```

A qeth device requires an alias definition in /etc/modprobe.conf. Edit this file and add an alias for your interface

```
vi /etc/modprobe.conf

alias eth0 qeth
alias eth1 qeth
options dasd_mod dasd=0.0.0100,0.0.0103,0.0.0300,0.0.0301
```

Start the new interface

```
ifup eth1
```

SUSE Linux Enterprise Server 10:

SSH to the desired Linux where you want to setup the private network. Two configuration files must be added under /etc/sysconfig/ to let the system know about the new interface, one for hardware and one for network settings.

Copy the hardware settings from the existing network /etc/sysconfig/hardware/hwcfg-qeth-bus-ccw-0.0.0600. Both interfaces will use the qdio/qeth drivers, therefore, the configuration files can be identical except for the virtual addresses. The existing file is copied to specify the new NIC. The only difference needed is to change the 060X values to 080X.

```
cd /etc/sysconfig/hardware/
sed *600 -e 's/060/080/g' > hwcfg-qeth-bus-ccw-0.0.0800
```

It should look like the following.

```
cat hwcfg-qeth-bus-ccw-0.0.0800
```

```
STARTMODE="auto"
MODULE="qeth"
MODULE_OPTIONS=""
MODULE_UNLOAD="yes"
SCRIPTUP="hwup-ccw"
SCRIPTUP_ccw="hwup-ccw"
SCRIPTUP_ccwgroup="hwup-qeth"
SCRIPTDOWN="hwdown-ccw"
CCW_CHAN_IDS="0.0.0800 0.0.0801 0.0.0802"
CCW_CHAN_NUM="3"
CCW_CHAN_MODE="OSAPORT"
QETH_LAYER2_SUPPORT="1"
```

Copy the network settings from the existing network /etc/sysconfig/network/ifcfg-qeth-bus-ccw-0.0.0600.

```
cd /etc/sysconfig/network
cp ifcfg-qeth-bus-ccw-0.0.0600 ifcfg-qeth-bus-ccw-0.0.0800
```

Edit the network settings.

```
vi ifcfg-qeth-bus-ccw-0.0.0800
```

```
BOOTPROTO="static"
UNIQUE=""
STARTMODE="onboot"
IPADDR="10.0.0.1"
NETMASK="255.255.255.0"
NETWORK="10.0.0.0"
BROADCAST="10.0.0.255"
```

```
_nm_name='qeth-bus-ccw-0.0.0800'
```

Add the IP address of the virtual server you want to access into the /etc/hosts file.

```
vi /etc/hosts
```

```
#
# hosts          This file describes a number of hostname-to-address
#                mappings for the TCP/IP subsystem.  It is mostly
#                used at boot time, when no name servers are running.
#                On small systems, this file can be used instead of a
#                "named" name server.
# Syntax:
#
# IP-Address    Full-Qualified-Hostname  Short-Hostname
#
127.0.0.1       localhost

# special IPv6 addresses
::1            localhost ipv6-localhost ipv6-loopback

fe00::0        ipv6-localnet

ff00::0        ipv6-mcastprefix
ff02::1        ipv6-allnodes
ff02::2        ipv6-allrouters
ff02::3        ipv6-allhosts
9.60.18.253    gpok253.endicott.ibm.com gpok253
10.0.0.1       gpok1.endicott.ibm.com gpok1
```

Reboot the virtual server to have the changes take effect.

```
reboot
```


Appendix B: Customizing Autoyast and Kickstart

The purpose of this section is to detail how to customize the autoyast and kickstart templates.

Autoyast and kickstart allows you to customize a Linux system based on a template. While you would typically go through various panels to manually customize your Linux system during boot, you no longer have to with autoyast and kickstart. This allows you to configure a vanilla Linux system faster and more effectively.

The following applies to SUSE Linux Enterprise Server (SLES):

1. Base your customization on the default template in `/opt/xcat/share/xcat/install/sles`. This template is pre-configured to setup the network for you using DHCP.
2. Determine the number of disks your vanilla system will have and the mount points for each disk.
3. Copy the default template: `/opt/xcat/share/xcat/install/sles/compute.sles10.s390x.tmpl`
4. Put the new template in the same directory: `/opt/xcat/share/xcat/install/sles`

Remember to add this template to the osimage table (if you want to use it):

```
chtab imagename=sles10.2 osimage.profile=compute.sles10.s390x.tmpl
osimage.imagetype=linux osimage.provmethod=install osimage.osname=linux
osimage.osvers=sles10.2
```

5. Add the disk to the template using the following format:

```
<!-- Dasd attached at 0101 -->
<listentry>
  <bus>None</bus>
  <bus_hwcfg>none</bus_hwcfg>
  <channel>0.0.0101</channel>
  <format config:type="boolean">>true</format>
  <dev_name>/dev/dasdb</dev_name>
  <dev_names config:type="list">
    <listentry>/dev/dasdb</listentry>
    <listentry>/dev/disk/by-path/ccw-0.0.0101</listentry>
  </dev_names>
  <device>DASD</device>
  <driver>io_subchannel</driver>
  <drivers config:type="list">
    <listentry>
      <active config:type="boolean">>true</active>
      <modprobe config:type="boolean">>true</modprobe>
      <modules config:type="list">
        <module_entry config:type="list">
          <listentry>dasd_eckd_mod</listentry>
          <listentry></listentry>
        </module_entry>
      </modules>
    </listentry>
  </drivers>
  <formatted config:type="boolean">>true</formatted>
  <partition_info>/dev/dasdb1 (Linux native)</partition_info>
  <resource>
    <disk_log_geo config:type="list">
      <listentry>
```

```

        <heads config:type="integer">15</heads>
        <sectors config:type="integer">12</sectors>
    </listentry>
</disk_log_geo>
<io config:type="list">
    <listentry>
        <active config:type="boolean">true</active>
        <length config:type="integer">1</length>
        <mode>rw</mode>
    </listentry>
</io>
</resource>
<sysfs_bus_id>0.0.0101</sysfs_bus_id>
</listentry>

```

The variables highlighted in **red** need to be modified based on how you customize your Linux. In the example above, a disk attached at 0101 is added. The device name for this disk is dasdb. The drive name is determined by how many devices are attached to the Linux system. For example, the first device gets a name of dasda, the second device gets a name of dasdb, and so on. You need to place the new dasd before the swap space and rename the device names for each swap space following the rule above.

Once complete, add it to the `<dasd>` section of the template.

6. Add a module entry for the new disk

```

<module_entry>
    <device>dasd-bus-ccw-0.0.0101</device>
    <module>dasd_eckd_mod</module>
    <options></options>
</module_entry>

```

The variables highlighted in **red** need to be modified based on how you customize your Linux. In the example above, a disk attached at 0101 is added.

Once complete, add it to the `<modules>` section of the template.

7. Add the mount point for the new disk

```

<!-- /usr partition -->
<drive>
    <device>/dev/dasdb</device>
    <partitions config:type="list">
        <partition>
            <create config:type="boolean">true</create>
            <filesystem config:type="symbol">ext3</filesystem>
            <format config:type="boolean">true</format>
            <mount>/usr</mount>
            <mountby config:type="symbol">path</mountby>
            <partition_id config:type="integer">131</partition_id>
            <partition_nr config:type="integer">1</partition_nr>
            <partition_type>primary</partition_type>
            <size>max</size>
        </partition>
    </partitions>

```

```
</partitions>
<use>all</use>
</drive>
```

The variables highlighted in **red** need to be modified based on how you customize your Linux. In the example above, a disk attached at 0101 is added. The device name given to disk is `dasdb`. For the example, this disk will be mounted at `/usr` and will have a `ext3` file system.

Once complete, add it to the `<partitioning>` section of the template.

8. Add the software you need to the `<software>` section of the template. You need to determine the package name and add it to the patterns list, e.g. `<pattern>gnome</pattern>`.

The following applies to Red Hat Enterprise Server (RHEL):

1. Base your customization on the default template in `/opt/xcat/share/xcat/install/rh`. This template is preconfigured to setup the network for you using DHCP.
2. Determine the number of disks your vanilla system will have and the mount points for each disk.
3. Copy the default template: `/opt/xcat/share/xcat/install/rh/compute.rhel5.s390x.tmpl`
4. Put the new template in the same directory: `/opt/xcat/share/xcat/install/rh`

Remember to add this template to the `osimage` table (if you want to use it):

```
chtab imagename=rhel5.3 osimage.profile=custom.rhel5.s390x.tmpl
osimage.imagetype=rhel5.3 osimage.osname=linux
```

5. Add the disk and mount point to the template using the following format:

```
clearpart --initlabel -drives=dasda,dasdb,dasdc
part / --fstype ext3 --size=100 --grow -ondisk=dasda
part /usr --fstype ext3 --size=100 --grow -ondisk=dasdb
part /home --fstype ext3 --size=100 --grow -ondisk=dasdc
```

The variables highlighted in **red** need to be modified based on how you customize your Linux. In the example above, a disk is added with a device name of `dasdc`. The disk will be mounted at `/home` and will have a `ext3` file system.

6. Add the software you need to the `%packages` section.