Creating Xen HVM Guests

0.1 Checking for hardware support

Before we create Xen HVM Guests on host we need to check for support from processor for hardware based virtualization. To check whether current processor supports HVM or not use:

- On intel based processors

  ```
  grep vmx /proc/cpuinfo
  ```

- On AMD based processors

  ```
  grep svm /proc/cpuinfo
  ```

If you see the CPU flags line in the output then the processor supports hardware based virtualization.

On some processors like Intel E7500 Core 2 Duo @2.93 GHz the vmx flags is not returned by cpuid instruction even if the processor supports virtualization. Hence a better test then one stated above is to use:

```
more /sys/hypervisor/properties/capabilities
```

command. If the processor does not supports HVM then we get output like

```
xen-3.0-x86_64 xen-3.0-x86_32p
```

with no hvm word in it. On the other hand if processor support HVM then we get output like

```
xen-3.0-x86_64 xen-3.0-x86_32p hvm-3.0-x86_32 hvm-3.0-x86_32p
hvm-3.0-x86_64
```

Note that /sys/hypervisor would exist only if one boot xen kernel. For other non-xen kernels this folder wont exist.

0.2 Pre-requisites

Apart from support from hardware support from OS and few services is required for using virtualization. Those pre-requisites are:

- The OS must be booted using xen kernel. For most CentOS distributions like Cent OS 5.5 the system by default boots into xen kernel, but for other operating systems it might be necessary to install and boot into xen kernel for virtualization to work.

You can use command '`uname -a`' to find out whether the current kernel in use is xen kernel or not. If the system is going to be used for virtualization then it makes sense in changing default kernel in grub to xen kernel.

- Following services must be running in order for xen to work:
  - libvirtd
  - xend
  - xendomains

  Again if system is going to be used for virtualization then it makes sense in enabling these services to run automatically during system boot.

0.3 Creating disc image and OS ISO

In order to create Xen based HVM guests we need file on host system which would be used as hard-disk for the guest. Also we can create ISO file of OS installation CD/DVD and use that file for installation of OS on HVM guest. This way we do not have to insert physical CD/DVD on base hosts if we want to install OS on guest.

0.3.1 Creating disk image for guest

These steps can be performed using normal (non-root) user to create disk image for guest:

1. Go to partition where you have enough free space and where you want to create file which will get used as hard-disk for guest OS.
2. Create a directory for storing disk image of harddisk of guest OS
3. Go inside directory where you want to store disk image
4. Create raw disk image using

   ```
   dd if=/dev/zero of=xenguest.img bs=1024k seek=10240
   count=0
   ```

   Note that:

(a) Value of seek supplied in the command determines the size of the image. For example in above command 10240 will cause creation of 10GB disk image. If we want only 6 GB disk image then we can use 6120 or if we want 20GB disk image then we can use 20480 and so on.

(b) The above step just creates a zero byte file with size 10 GB. What this effectively means is if we try to find size of file using say '`ls -lh`' command then the size would be reported as 10 GB. But the actual size occupied by the file data on host disk would be 0 bytes (ignoring size taken in File Allocaton Table entries).

This is quick way of creating disk images but then we should keep track of how much space we have used manually. As commands like '`df -h`' which help in seeing free disk space will not consider this file to be using 10 GB of space.

To be safe we can use the below command to actually use entire 10 GB of harddisk space when we are creating file:

```
dd if=/dev/zero of=xenguest.img bs=1024k count=10240
```

The only disadvantage of this command is that it would take long time to finish as now it would create file of 10 GB size containing all zeros.

(c) The value for parameter of ('xenguest.img' in this case) is the name of the output file we want to create. We can use any name which is allowed by underlying filesystem instead of using 'xenguest.img' as file name.

0.3.2 Creating OS ISO image

If we already have ISO image of OS on local filesystem or on some common server on network then we can simply download the ISO file from that server. In case we do not have ISO file of OS then we can make ISO image for guest installation using following steps:

1. Use '`mount`' command to see the list of currently mounted drives.

2. Insert disc containing OS installation image in CD/DVD drive.

3. On most modern distributions disk will get mounted automatically. If this is the case then use '`mount`' command again to see the list of currently mounted drives. When we compare the two mount outputs we would be able to find out the device name for CD/DVD drive.

In case the CD/DVD is not automatically mounted then we can use '`/dev/cdrom`' as device name which is generally link to CD/DVD drive on current system. In worst case one can try names like '`/dev/scd0`', '`/dev/scd1`', '`/dev/hdc`','`/dev/hdd`', etc. for CD/DVD drive device names.

4. Use command

   ```
   dd if=/dev/scd0 of=OS.iso
   ```

   to create ISO file of OS installation disk.

   Note:

   - In the above command '`/dev/scd0`' should be replaced with proper name of CD/DVD drive on your system.
   - The output file name can be changed from '`OS.iso`' to something more descriptive like '`CentOS-5.5-x86_64-DVD.iso`'.

0.4 Creating Xen HVM Guests

To configure HVM guest, Create guest domain and connect to it we can use following procedure:

0.4.1 Configuring Xen HVM Guest

We can create configuration file by following these steps as normal (non-root) user:

1. Copy example HVM guest configuration file '`/etc/xen/xmexample.hvm`' to suitable name for the new guest (like '`lab1.hvm`')

2. Edit new guest configuration file and change following options:

   - Set '`memory=600`' as GUI installation of many modern OS requires lot of RAM. After OS installation is over, we can configure guest to boot in runlevel 3 and then reduce RAM alloted to VM.
   - Increase shadow memory from 8 to 40 by setting '`shadow_memory = 40`'.
   - Give proper name to domain, like '`name = "Lab1"`'. Note that spaces or special characters are not allowed in name of domain. We manage domain by passing its name as parameter in various commands, hence it is important to give meaningful domain name to guest.

- Ensure that mentioned network interface information is correct

  ```
  vif = [ 'type=ioemu, bridge=xenbr0' ]
  ```

  Use '`ifconfig`' to see that '`xenbr0`' actually exists. If you are connected to LAN using '`eth1`' and not '`eth0`' then the bridge device could be '`xenbr1`' and not '`xenbr0`'.

- Set proper paths for raw disk image and OS installation iso image using something like

  ```
  disk = [ 'file:<complete path to raw image>,hda,w',
  'file:<complete path to OS iso file>,hdc:cdrom,r'
  ].
  ```

  In case we do not want to create OS ISO file from CD/DVD and want to install from actual physical disk kept in host CD/DVD drive then we can use

  ```
  disk = [ 'file:<complete path to raw image>,hda,w',
  'phy:<CD drive device path>,hdc:cdrom,r' ]
  ```

  In case we want to use partition on host OS as hard-disk for guest OS and not file then we can use

  ```
  disk = [ 'phy:<partition device path>,hda,w', 'phy:<CD
  drive device path>,hdc:cdrom,r' ]
  ```

- Set proper boot order to boot from CD.

  ```
  boot="dc"
  ```

  Significance of various letters in boot configuration option are:

  d $\Rightarrow$ CD Drive

  c $\Rightarrow$ Hard disk

  a $\Rightarrow$ Floppy drive

  The default boot configuration is Hard disk, CD Drive and then Floppy Drive (that is 'boot=cda').

- Disable snapshots if they are enabled using '`snapshot=0`'. If we use snapshots then changes done to Guest OS are written to temporary files and not to disk image files used to boot/create Guest.

- Ensure that SDL is disabled ('`sdl=0`') and vnc is enabled ('`vnc=1`'). Xen provides two different ways of using graphics 'sdl' and 'vnc'. If we use 'sdl' then a native graphics windows on host OS gets created and if we close that window then Guest gets destroyed.

  However, if we use 'vnc' then when we create guest only a VNC server is started. We can then connect to VNC server from same

host or remote hosts and access guest using GUI interface. Closing VNC clients has no effect on guest and they continue running without any problem.

- For modern operating systems enable ACPI and APIC.

```
apic=1
acpi=1
```

- For 32-bit guest we can leave '`pae=0`', but for 64-bit guest we must enable pae using '`pae=1`' in configuration file.

0.4.2 Starting Guest domain

For starting guest domain we need root access. We can use following command as root user to start guest domain using the configuration file we have created:

```
xm create <Guest configuration file> -c
```

Note that:

- We are using option '`-c`' to connect to Guest console as soon as it is created. This helps in debugging if guest crashes even before it boots.

0.4.3 Connecting to Guest domain

We can use '`vncviewer`' to connect to guest OS VNC server. To connect to VNC server we need to know on which port has guest OS VNC server been started. We can use command

ps -ef — grep vnc

to get list of all '`qemu-dm`' commands that have '`vnc`' as command line parameter. Also we will get value passed as argument to '`vnc`' command line parameter which is nothing but '`host:port`' on which guest VNC server should be started.

In case multiple '`qemu-dm` processes are running then we can look at '`-domain-name`' command line parameter for all domains to find command for domain we are interested in.

Once we know on which '`host:port`' pair the VNC server for guest is started, we can use command

vncviewer <host:port> &

to start VNC client and connect to VNC server of guest.

0.5 Post guest creation

After we have created guest and connected to it using above steps, we can use following steps to get proper guest installation:

1. Install guest OS after connecting to VNC server of guest for first time.

2. During installation if guest OS reboots then VNC window will get disconnected. One can follow steps mentioned in 'Connecting to guest domain' section to again connect to guest once it is rebooted.

3. When guest tries to reboot then it is possible that it again tries to boot from CD/DVD for installation even though we have already installed OS. In this case first destroy the running guest using

   xm destory <Guest domain name>

   and then change the boot order in configuration file to '`boot="cd"`' Again start guest domain using

   `xm create <Guest configuration file>`

   command and again connect to guest OS VNC server.

0.6 Tips

Following tips can be helpful while doing this lab

- We can use command '`xm list`' to see list of running guest domains. This can help in verifying whether guest domain got started properly or not.

- Pressing '`F8`' key in vncviewer gives pop-up vnc menu to send '`F8`', '`Ctrl+Alt+Del`' etc. keys to guest OS.

- When guest reboots VNC window will get disconnected and also new VNC server will listen on another port. Use '`ps`' command to find the new port and connect to guest again after it reboots.

0.7 Lab tasks

1. Install CentOS-5.5 64-bit using above procedure on Xen HVM Guest.

2. Try to install Windows XP using above mentioned steps on the same hard-disk image on which already Linux is installed If you face some problem during Windows installation mention the problem and also how you solved it. Note that it is necessary for this lab task that you use the same disk image on which Linux is already installed.

3. You might face mouse problems during and after installing Windows as guest OS. How can you solve these mouse problems? Suggest different ways.

4. Write program which gives following menu options to user:

   (a) Test if system supports HVM based guests. Also test if required services, kernel, etc. are present and running.

   (b) Create new virtual machine. Ask name for guest, RAM to be allocated, disk file to be used as hdd, disk file to be used for CD rom image, etc. details.

   (c) List running guests

   (d) Change boot order of specific guest domain to 'cda' / 'dca'.

   (e) Start new domain with guest name.

   (f) Stop guest domain with name.

   (g) Start vncviewer to connect to given guest domain.

   This program should store all configuration files in current folder and when try to start / stop new guest, it should look for configuration file for guest only in current folder.

0.8 Reference

You can refer to http://www.virtuatopia.com for more labs related to Xen and virtualization.