

Virtualisation Intro



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What is it?

- An abstraction that allows for easy subdivision and allocation of resources
- What Computing/Network resources can be virtualized?
 - OS virtualization
 - Application virtualisation
 - Service virtualisation
 - Network virtualisation
 - Storage virtualisation
 - And **much more...**

Anything?

- In the context of this course. We're interested in virtualization along two dimensions:
 - Resource virtualisation
 - OS virtualisation

Resource/Service virtualization

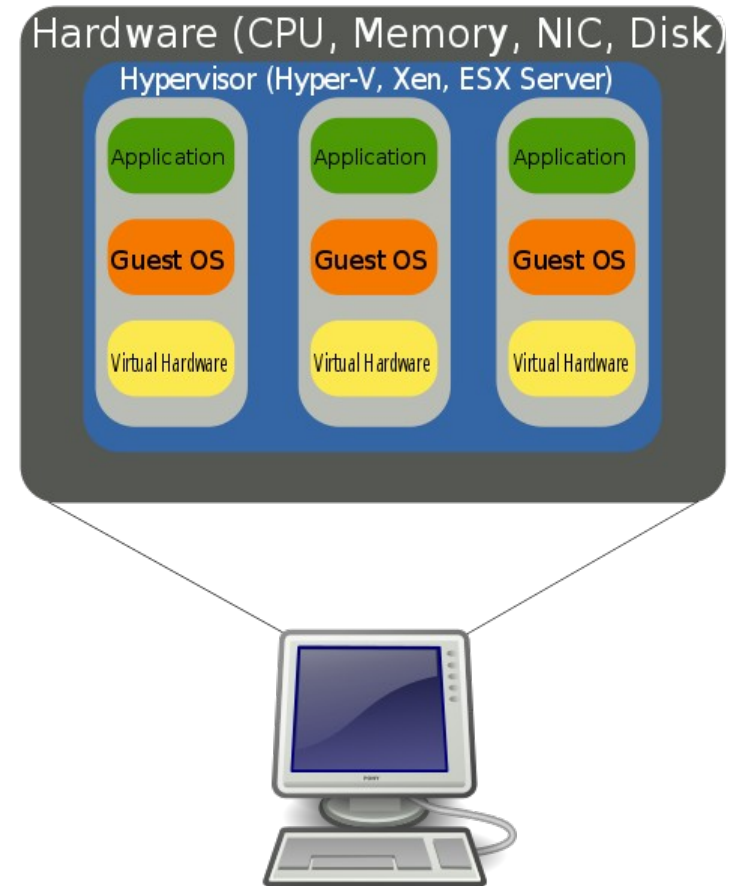
- Examples:
 - Load-balancers
 - DNS Based GLB
 - HTTP(S) Virtual Hosting
 - MX records
 - Virtual Switches
 - Virtual Routers
 - Virtual Firewalls

Resource Virtualization - Continued

- HTTP virtual hosts
 - Multiple websites on one system
- Load Balancing
 - One (or many sites or applications) across many systems
 - Can be done at Layer-3/4/7

Host Virtualization

- Examples
 - Vmware
 - Virtual-Box (used in class)
 - KVM
 - XEN
 - FreeBSD and Linux Jails
 - Windows Hyper-V



What problem are we attempting to solve with host virtualization.

- Problem 1 – Idle capacity.
 - Most of the machines in your datacenter are idle most of the time.
 - Capacity you're not using:
 - Cost money up front
 - Cost money to operate
 - Reduces your return on capital
 - Packing discrete systems into a smaller number of servers provides savings along virtually every dimension.

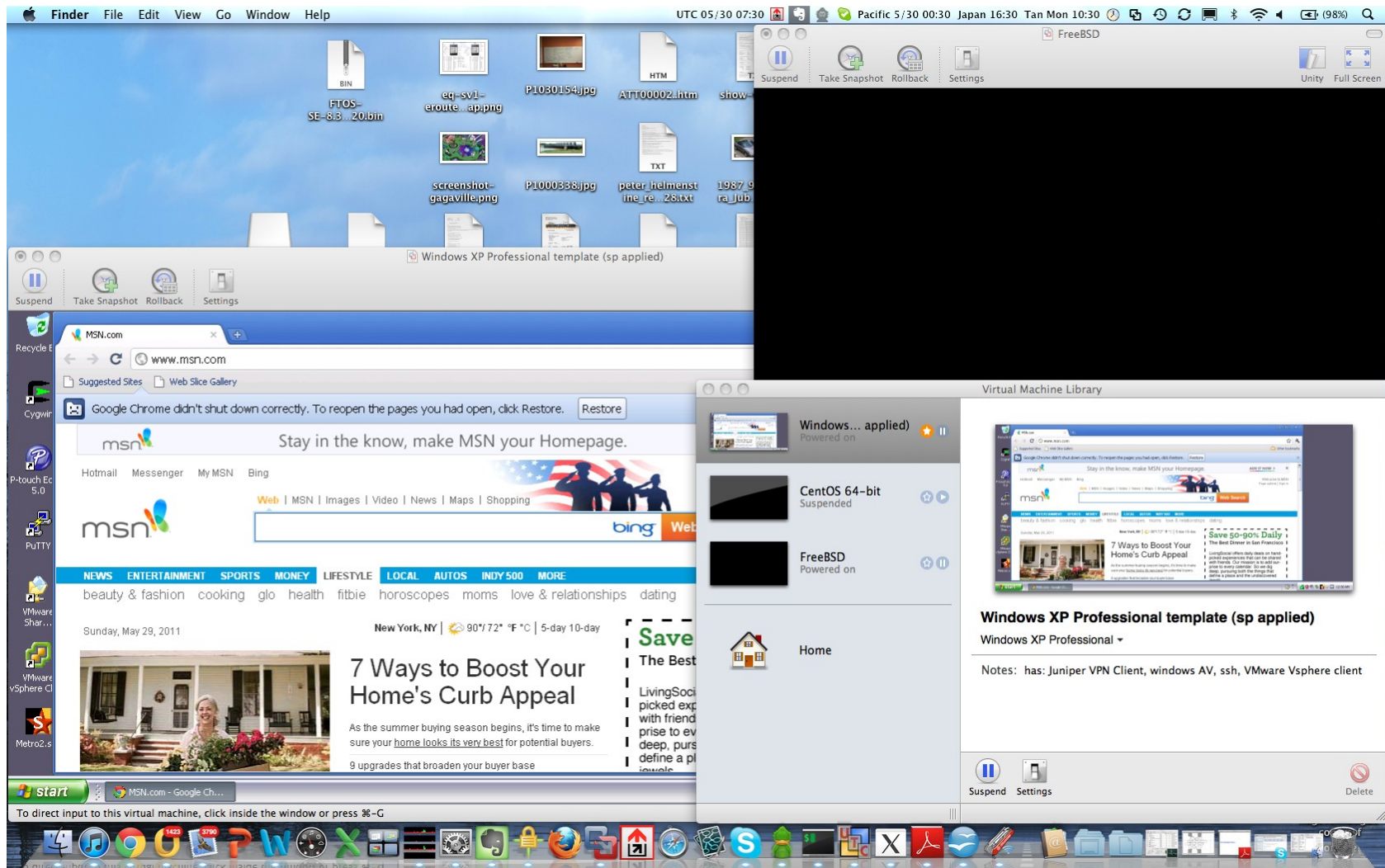
Problems - Continued

- Problem 2 – Provisioning
 - Spinning up a new service involves:
 - Acquiring the hardware
 - Building the server
 - Integration with existing services
 - With virtualization we're aiming to short-circuit that
 - Capacity is a resource
 - Machine instances may be cloned or provisioned from common basic images
 - Resources are purchased in bulk and assigned to applications as necessary.

Problems - Continued

- Problem 3 – Hardware abstraction
 - Operating systems, servers, and applications evolve at different rates.
 - Providing a common set of infrastructure resources means, virtualized systems are portable across servers
 - Hardware failure can more easily be managed.
- Abstraction may come at a performance cost however. (some workloads are more expensive than others)
 - See:
<http://blog.xen.org/index.php/2011/11/29/baremetal-vs-xen-vs-kvm-redux/>

Examples – Desktop Virtualization



Desktop Virtualization

- Uses

- Prototyping services or applications before deployment
- Utilities that don't run on your operating system
- Isolation of sandbox environments from your desktop
- Maintaining multiple versions of an environment for support purposes.
- Staying familiar with unix while running windows (consider compared to the alternative (dual-booting))

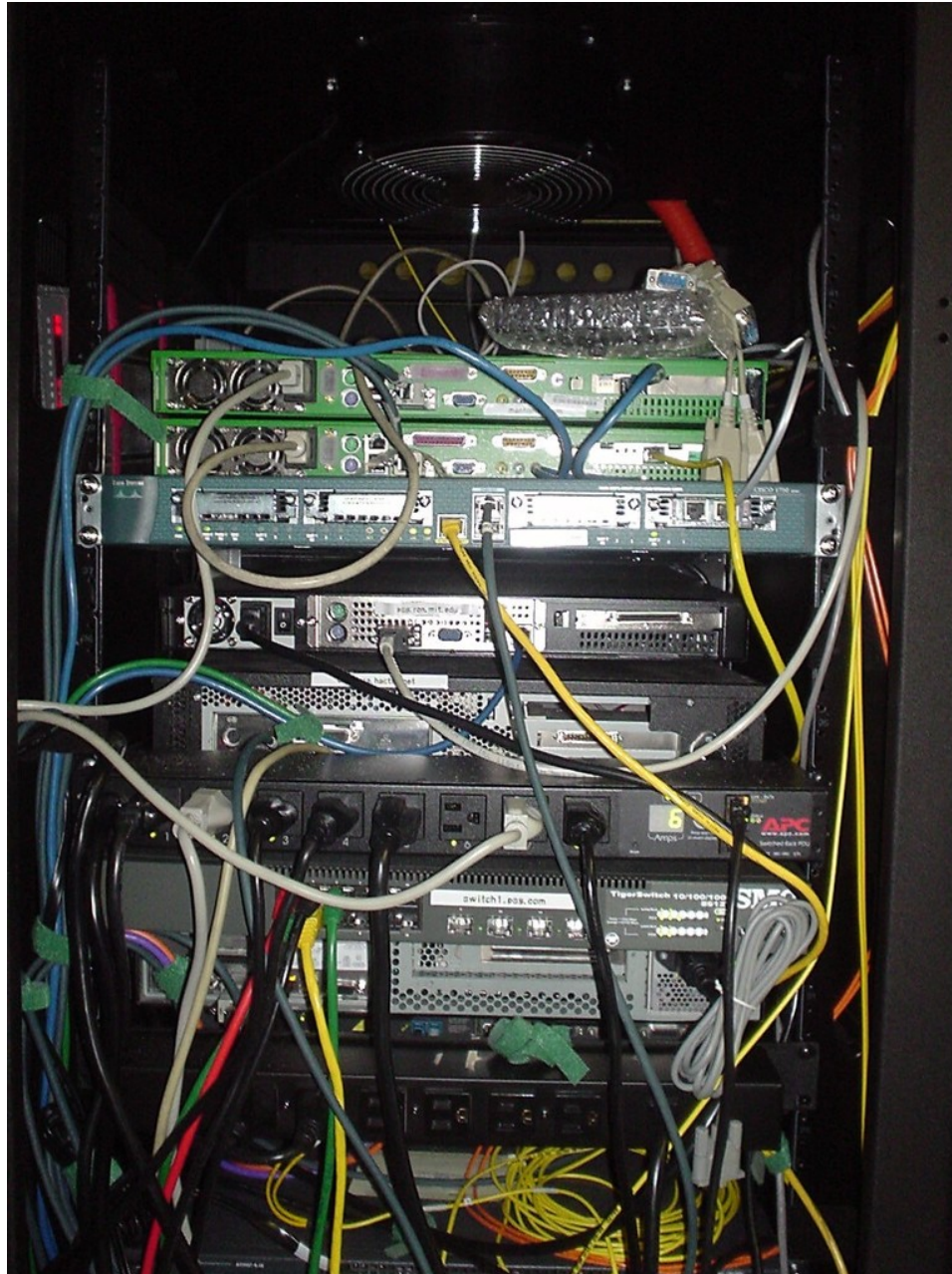
- Issues

- Emulating multiple computers on your laptop/desktop is somewhat resource intensive

- Vmware player and VirtualBox are free.

- <http://www.virtualbox.org/wiki/Downloads>
- http://downloads.vmware.com/d/info/desktop_downloads/vmware_player/3_0?ie=UTF-8

Examples – Server Virtualization



Server Virtualization - Continued

The screenshot displays the vSphere Client interface for a VMware ESXi host. The left sidebar shows a tree view of the inventory, including the host and several virtual machines. The main pane shows the 'Virtual Machines' tab for the host 'vm0.sea.rg.net'. A table lists the virtual machines with their names, states, and resource usage. Below the table is a 'Recent Tasks' section with a search bar and a table header.

Name	State	Provisioned Space	Used Space	Host CPU - MHz	Host Mem - MB	Guest Mem - %	Notes
ssh.rpki.net	Powered On	104.00 GB	104.00 GB	39	4165	3	
turing.wps.com	Powered On	102.00 GB	102.00 GB	5	2105	0	
ran.psg.com	Powered On	154.00 GB	154.00 GB	39	4187	3	
cent0.psg.com	Powered On	102.00 GB	102.00 GB	51	1453	1	
apnicrpki.rand.apnic.net	Powered On	5.29 GB	5.29 GB	57	717	9	
rip1.psg.com	Powered On	38.00 GB	38.00 GB	41	2085	4	
hiroshima.bogus.com	Powered Off	254.00 GB	250.00 GB	0	0		
nagasaki.bogus.com	Powered On	1023.00 GB	439.14 GB	124	4257	9	

Recent Tasks

Name	Target	Status	Details	Initiated by	Requested Start Ti...	Start Time	Completed Time
------	--------	--------	---------	--------------	-----------------------	------------	----------------

Server Virtualization

The screenshot displays the vSphere Client interface for a VMware ESXi host. The window title is "vm0.sea.rg.net - vSphere Client". The main content area is titled "vm0.sea.rg.net VMware ESXi, 4.1.0, 260247" and is divided into several sections:

- General:** Manufacturer: Supermicro, Model: X7DWU, CPU Cores: 8 CPUs x 2 GHz, Processor Type: Intel(R) Xeon(R) CPU E5405 @ 2.00GHz, License: vSphere 4 Essentials Licensed for 2 physical CPU..., Processor Sockets: 2, Cores per Socket: 4, Logical Processors: 8, Hyperthreading: Inactive, Number of NICs: 2, State: Connected, Virtual Machines and Templates: 8, vMotion Enabled: N/A, VMware EVC Mode: N/A, Host Configured for FT: N/A, Active Tasks: N/A, Host Profile: N/A, Profile Compliance: N/A.
- Resources:** CPU usage: 750 MHz (Capacity: 8 x 2 GHz), Memory usage: 20163.00 MB (Capacity: 32766.17 MB).
- Datastore:** A table showing the capacity and free space of the datastore1.
- Network:** A table showing the network configuration for the VM Network.
- Fault Tolerance:** Fault Tolerance Version: 2.0.1-2.0.0-2.0.0, Total Primary VMs: 0, Powered On Primary VMs: 0, Total Secondary VMs: 0, Powered On Secondary VMs: 0.

The interface also includes a "Recent Tasks" section at the bottom, which is currently empty. The bottom right corner shows the user "root".

Datastore	Capacity	Free	Last Update
datastore1	3.63 TB	2.45 TB	4/29/2011

Network	Type
VM Network	Standard switch network

Property	Value
Fault Tolerance Version	2.0.1-2.0.0-2.0.0
Total Primary VMs	0
Powered On Primary VMs	0
Total Secondary VMs	0
Powered On Secondary VMs	0

Virtualized Servers as a Service (Amazon Web Services)

- Much as collocated servers, are available from a hosting provider, virtual servers are also available.
- Model is:
 - You pay for what you use.
 - Flexibility, need fewer servers today than you used, yesterday.
 - Leverage other amazon tools (storage/map-reduce/load-balancing/payments etc)

AWS

The screenshot shows the AWS Management Console interface for the 'My Instances' page. The browser address bar shows the URL: <https://console.aws.amazon.com/ec2/home?region=us-west-1#s=Instances>. The navigation pane on the left includes sections for EC2 Dashboard, INSTANCES, IMAGES, ELASTIC BLOCK STORE, and NETWORKING & SECURITY. The main content area displays a table of instances with the following data:

Name	Instance	AMI ID	Root Device	Type	Status	Security Groups	Key Pair Name	Monitoring	Virtualization
<input checked="" type="checkbox"/>	i-7a255b3e	ami-c7643482	ebs	t1.micro	terminated	default	joelja_amazon_key	basic	paravirtual
<input type="checkbox"/>	empty	i-ac1213e8	ebs	t1.micro	running	bare	amazon	basic	paravirtual

Below the table, a message states: "You have selected an instance that is not running. Amazon CloudWatch Detailed Monitoring can only be enabled for running instances." Below this message are four monitoring charts:

- Avg CPU Utilization (Percent)**: Shows a flat line at 0% from 5/30 08:30 to 5/30 09:00.
- Avg Disk Reads (Bytes)**: Shows a flat line at 0.0 from 5/30 08:30 to 5/30 09:00.
- Avg Disk Writes (Bytes)**: Shows a flat line at 0.0 from 5/30 08:30 to 5/30 09:00.
- Max Network In (Bytes)**: Shows a flat line at 0 until 5/30 08:30, then a sharp spike to approximately 5,000 bytes by 5/30 09:00.

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AWS Steps

- Select availability zone
- Launch new instance
- Select appropriate ami
- Associate with ssh key
- Launch instance
- Add ip
- SSH into new machine instance.
- t1-micro-instances run \$54 a year + bandwidth

Try it for free...

- Free tier for the first Calendar year is (per month):
 - 750 hours of EC2 running Linux/Unix Micro instance usage
 - 750 hours of Elastic Load Balancing plus 15 GB data processing
 - 10 GB of Amazon Elastic Block Storage (EBS) plus 1 million IOs, 1 GB snapshot storage, 10,000 snapshot Get Requests and 1,000 snapshot Put Requests
 - 15 GB of bandwidth in and 15 GB of bandwidth out aggregated across all AWS services
- Which is not to say that, at scale EC2 is particularly cheap, (It isn't)
 - Limited capital at risk is in the context of prototyping or experimentation however.

AWS - Continued

- For provisioning purposes cli interaction is possible:
 - <http://aws.amazon.com/developertools/351>
- Along with tools to support the provisioning and destruction of virtual machines.

Provisioning and management

- Is the glue that makes virtualization usable
- In commercial virtualization environments the provisioning/management toolkits represent the bulk of the licensing cost (VMware) and the secret sauce (VMotion, disaster recovery, backup, etc)
- Examples:
 - XEN tools – a collection of perl scripts for spinning VMs
<http://www.xen-tools.org/software/xen-tools/>
 - KVM tools - http://www.linux-kvm.org/page/Management_Tools
 - Cloud.com/cloud-stack (orchestration) - <http://www.cloudstack.org/>
 - Rightscale – (orchestration multiple public/private clouds)
<http://www.rightscale.com>
 - Puppet (host / configuration management) -
<http://puppetlabs.com/puppet/>
 - PDSH – (Parallel Shell execution) <http://code.google.com/p/pdsh/>
 - Salt/chef/ansible/parallel-ssh/libvirt.....


Virtualbox Exercise

- Download [virtualbox](#) and install it.
- Download the [openbsd install iso](#).
- Create an openbsd 32bit virtual machine.
- Adjust the virtual machine settings to boot off the iso.
- Install and accept the defaults at the prompts to install OpenBSD.
- After installation, type reboot and then intercept the reboot by shutting down the vm at the bios stage
- Change boot order in the VM settings (CD last)
- Boot into VM

Name and operating system

Please choose a descriptive name for the new virtual machine and select the type of operating system you intend to install on it. The name you choose will be used throughout VirtualBox to identify this machine.

Name:

Type: 

Version:

Hide Description Go Back Continue



New



Settings



Start



Discard

Details

Snapshots

Memory size

Select the amount of memory (RAM) in megabytes to be allocated to the virtual machine.

The recommended memory size is 64 MB.



Go Back

Continue

is empty




openbsd - Storage

- General
- System
- Display
- Storage
- Network
- Ports
- Shared Folders

Storage Tree

- Controller: IDE
 - openbsd.vdi
 - Empty

Attributes

CD/DVD Drive: IDE Secondary M 

Live CD/DVD

Information

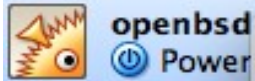
Type: --
Size: --
Location: --
Attached to: --

Choose a virtual C
Host Drive 'MATSH
Remove disk from

Cancel OK

Network
Adapter 1: Intel PRO/1000 MT Desktop (NAT)

USB



openbsd - Storage

General System Display Storage Audio Network Ports Shared Folders

Downloads

Name	Date Modified
install55.iso	2:09 PM
sse-LB-overview.pdf	11:40 AM
sse-virtualizati...rview-2012.odp	11:07 AM
prineville-servers-1000.jpg	Yesterday
alcoholic-vagra...-a-doorway.jpg	Yesterday
sse-LB-overview.odp	Yesterday
ok	Yesterday
loadbalancing.png	5/25/14
93k22.jpg	5/25/14
Solarized Light.itemcolors	5/25/14
Apache_OpenO...stall_en-GB.dmg	5/25/14
Solarized Dark.itemcolors	5/25/14

Files of type: All virtual optical disk files (*.d...)

New Folder Cancel Open



Adapter 1: Intel PRO/1000 MT Desktop (NAT)

USB



openbsd - Storage



Storage Tree

- Controller: IDE
 - openbsd.vdi
 - install55.iso

Attributes

CD/DVD Drive: IDE Secondary M 

Live CD/DVD

Information

Type: Image
Size: 221.53 MB
/Users/lmwangi/Dow...
--

Contains all storage controllers for this machine and the virtual images and host drives attached to them.



Adapter 1: Intel PRO/1000 MT Desktop (NAT)

USB



Details Snapshots

openbsd Running

General Name: openbsd Operating System: OpenBSD (32 bit)

System Base Memory: 256 MB Boot Order: Flop Acceleration: VT-

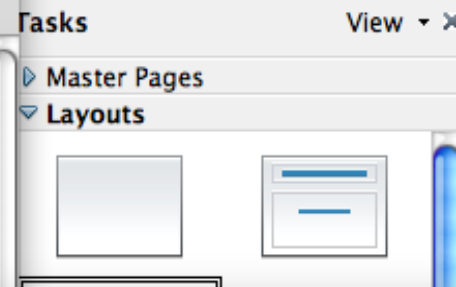
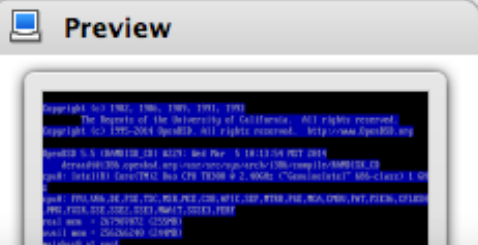
Display Video Memory: Remote Desktop Se Video Capture:

Storage Controller: IDE IDE Primary Maste IDE Secondary Mas

Audio Host Driver: CoreA Controller: ICH A

Network Adapter 1: Intel PR

USB



```

openbsd [Running]
OpenBSD 5.5 (RAMDISK_CD) #229: Wed Mar  5 10:13:54 MST 2014
You have the Auto capture keyboard option turned on. This will cause the Virtual Machine to automatically capture the
cpu0: Intel(R) Core(TM)2 Duo CPU T8300 @ 2.40GHz ("GenuineIntel" 686-class)
cpu0: FPU, U86, DE, PSE, TSC, MSR, MCE, CX8, APIC, SEP, MTRR, PGE, MCA, CMOV, PAT, PSE36, CF
, MMX, FXSR, SSE, SSE2, SSE3, MWAIT, SSSE3, PERF
real mem = 267907072 (255MB)
avail mem = 256266240 (244MB)
mainbus0 at root
bios0 at mainbus0: AT/286+ BIOS, date 06/23/99, BIOS32 rev. 0 @ 0xfda00, SMB
rev. 2.5 @ 0xe1000 (10 entries)
bios0: vendor innotek GmbH version "VirtualBox" date 12/01/2006
bios0: innotek GmbH VirtualBox
acpi0 at bios0: rev 2
acpi0: sleep states S0 S5
acpi0: tables DSDT FACP SSDT
acpiprt0 at acpi0: bus 0 (PCI0)
bios0: ROM list: 0xc0000/0x8000 0xe2000/0xcc00
cpu0 at mainbus0: (uniprocessor)
pci0 at mainbus0 bus 0: configuration mode 1 (bios)
pchb0 at pci0 dev 0 function 0 "Intel 82441FX" rev 0x02
pci0 at pci0 dev 1 function 0 "Intel 82371SB ISA" rev 0x00
pciide0 at pci0 dev 1 function 1 "Intel 82371AB IDE" rev 0x01: DMA, channel
nfigured to compatibility, channel 1 configured to compatibility

```

- Choose interactive install (I)
- Choose defaults by pressing <enter> on the prompts below
- Note that we configured the default interface to acquire an address via DHCP

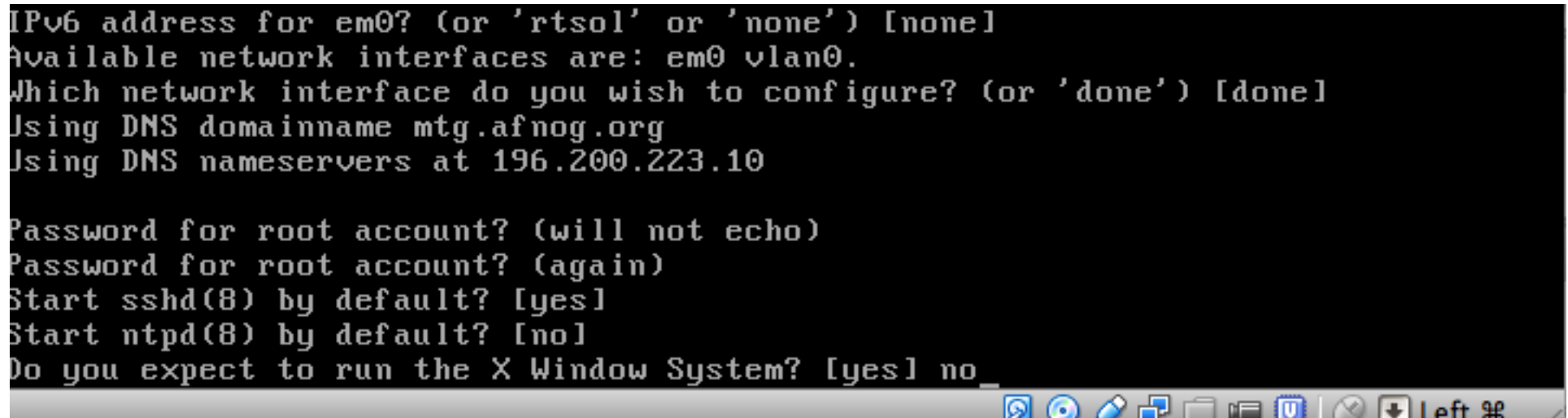
```
No response file found; non-interactive mode aborted.
(I)nstall, (U)pgrade, (A)utoinstall or (S)hell? I
At any prompt except password prompts you can escape to a shell by
typing '!'. Default answers are shown in []'s and are selected by
pressing RETURN. You can exit this program at any time by pressing
Control-C, but this can leave your system in an inconsistent state.
Choose your keyboard layout ('?' or 'L' for list) [default]
System hostname? (short form, e.g. 'foo') mine

Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [em0]
IPv4 address for em0? (or 'dhcp' or 'none') [dhcp]
Issuing hostname-associated DHCP request for em0.
DHCPREQUEST on em0 to 255.255.255.255 port 67
DHCPACK from 10.0.2.2 (52:54:00:12:35:02)
bound to 10.0.2.15 -- renewal in 43200 seconds.
IPv6 address for em0? (or 'rtol' or 'none') [none]
Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [done]
```

- Elect not to run X windows
- Elect to enable ssh
- Type in a root password (afnog). You will need this password to log in once the installation is complete.

```
IPv6 address for em0? (or 'rtsol' or 'none') [none]
Available network interfaces are: em0 vlan0.
Which network interface do you wish to configure? (or 'done') [done]
Using DNS domainname mtg.afnog.org
Using DNS nameservers at 196.200.223.10

Password for root account? (will not echo)
Password for root account? (again)
Start sshd(8) by default? [yes]
Start ntpd(8) by default? [no]
Do you expect to run the X Window System? [yes] no_
```



- Auto layout and auto partition...
- Note the resource consumption for OpenBSD is extremely low!

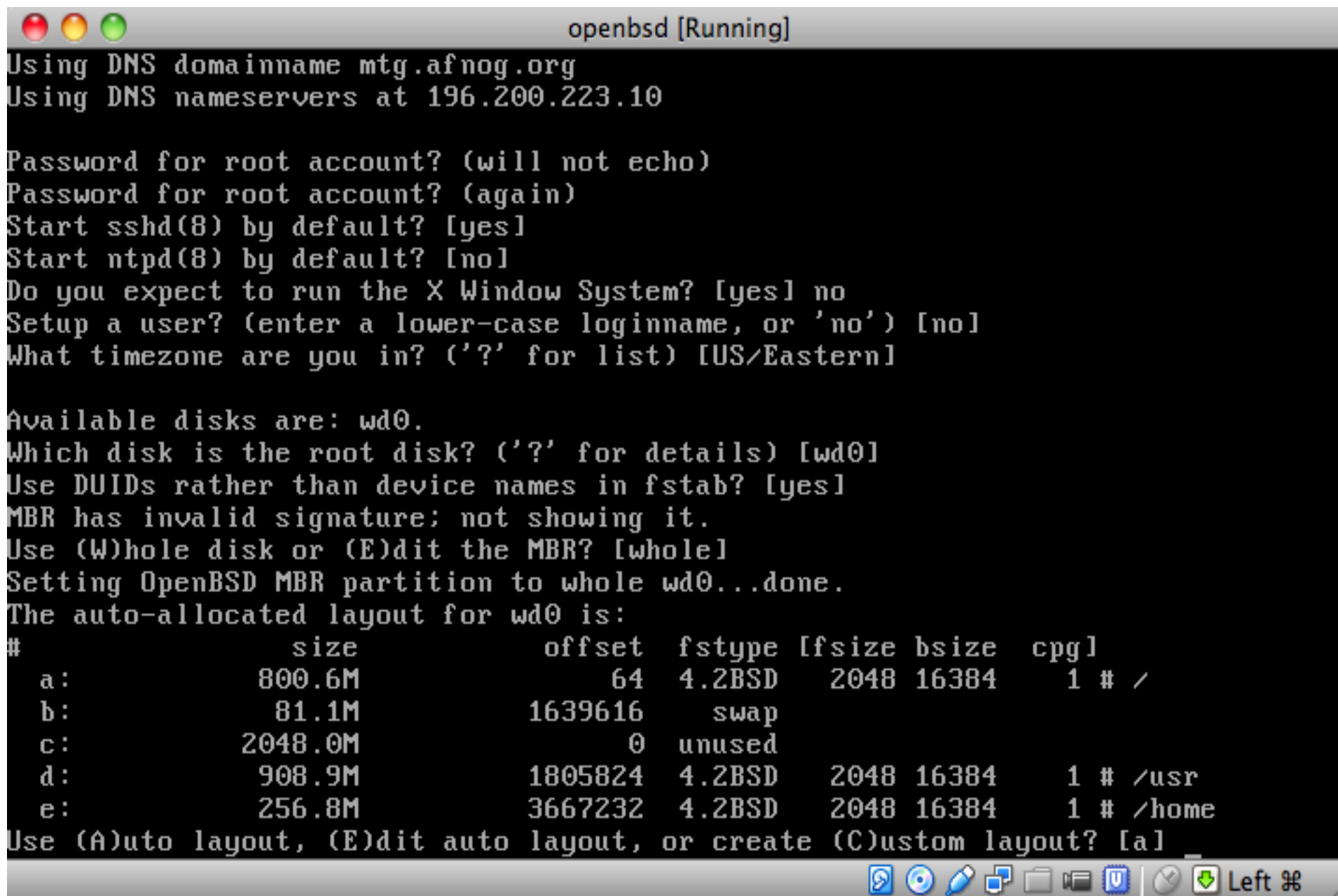
```

openbsd [Running]
Using DNS domainname mtg.afnog.org
Using DNS nameservers at 196.200.223.10

Password for root account? (will not echo)
Password for root account? (again)
Start sshd(8) by default? [yes]
Start ntpd(8) by default? [no]
Do you expect to run the X Window System? [yes] no
Setup a user? (enter a lower-case loginname, or 'no') [no]
What timezone are you in? ('?' for list) [US/Eastern]

Available disks are: wd0.
Which disk is the root disk? ('?' for details) [wd0]
Use DUIDs rather than device names in fstab? [yes]
MBR has invalid signature; not showing it.
Use (W)hole disk or (E)dit the MBR? [whole]
Setting OpenBSD MBR partition to whole wd0...done.
The auto-allocated layout for wd0 is:
#          size          offset  fstype  [fsize  bsize  cpgh]
a:         800.6M          64    4.2BSD   2048 16384    1 # /
b:          81.1M       1639616    swap
c:        2048.0M           0   unused
d:          908.9M     1805824    4.2BSD   2048 16384    1 # /usr
e:          256.8M     3667232    4.2BSD   2048 16384    1 # /home
Use (A)uto layout, (E)dit auto layout, or create (C)ustom layout? [a]

```



#	size	offset	fstype	[fsize	bsize	cpgh]
a:	800.6M	64	4.2BSD	2048	16384	1 # /
b:	81.1M	1639616	swap			
c:	2048.0M	0	unused			
d:	908.9M	1805824	4.2BSD	2048	16384	1 # /usr
e:	256.8M	3667232	4.2BSD	2048	16384	1 # /home

- Ignore the SHA256 signature verification prompt!
- Image below should give you an idea...

```
Let's install the sets!  
Location of sets? (cd disk ftp http or 'done') [cd]  
Available CD-ROMs are: cd0.  
Which CD-ROM contains the install media? (or 'done') [cd0]  
Pathname to the sets? (or 'done') [5.5/i386]  
  
Select sets by entering a set name, a file name pattern or 'all'. De-select  
sets by prepending a '-' to the set name, file name pattern or 'all'. Selected  
sets are labelled '[X]'.  
[X] bsd                [X] etc55.tgz          [X] xbase55.tgz      [X] xserv55.tgz  
[X] bsd.rd            [X] comp55.tgz         [X] xetc55.tgz  
[ ] bsd.mp           [X] man55.tgz          [X] xshare55.tgz  
[X] base55.tgz        [X] game55.tgz         [X] xfont55.tgz  
Set name(s)? (or 'abort' or 'done') [done]  
Directory does not contain SHA256.sig. Continue without verification? [no] yes
```



- Wait for the installation to complete.

```

openbsd [Running]
Which CD-ROM contains the install media? (or 'done') [cd0]
athname to the sets? (or 'done') [5.5/i386]

Select sets by entering a set name, a file name pattern or 'all'. De-select
sets by prepending a '-' to the set name, file name pattern or 'all'. Selected
sets are labelled '[X]'.
  [X] bsd          [X] etc55.tgz      [X] xbase55.tgz   [X] xserv55.tgz
  [X] bsd.rd      [X] comp55.tgz    [X] xetc55.tgz
  [ ] bsd.mp      [X] man55.tgz     [X] xshare55.tgz
  [X] base55.tgz  [X] game55.tgz    [X] xfont55.tgz
Set name(s)? (or 'abort' or 'done') [done]
Directory does not contain SHA256.sig. Continue without verification? [no] yes
Installing bsd          100% |*****| 10263 KB  00:09
Installing bsd.rd      100% |*****| 6349 KB   00:05
Installing base55.tgz  100% |*****| 58796 KB  01:16
Installing etc55.tgz   100% |*****| 513 KB    00:00
Installing comp55.tgz  100% |*****| 48489 KB  01:35
Installing man55.tgz   100% |*****| 9836 KB   00:28
Installing game55.tgz  100% |*****| 2643 KB   00:03
Installing xbase55.tgz 100% |*****| 12565 KB  00:22
Installing xetc55.tgz  100% |*****| 64910     00:00
Installing xshare55.tgz 100% |*****| 4300 KB   00:07
Installing xfont55.tgz 100% |*****| 38994 KB  00:44
Installing xserv55.tgz 100% |*****| 23534 KB  00:36
Location of sets? (cd disk ftp http or 'done') [done]

```

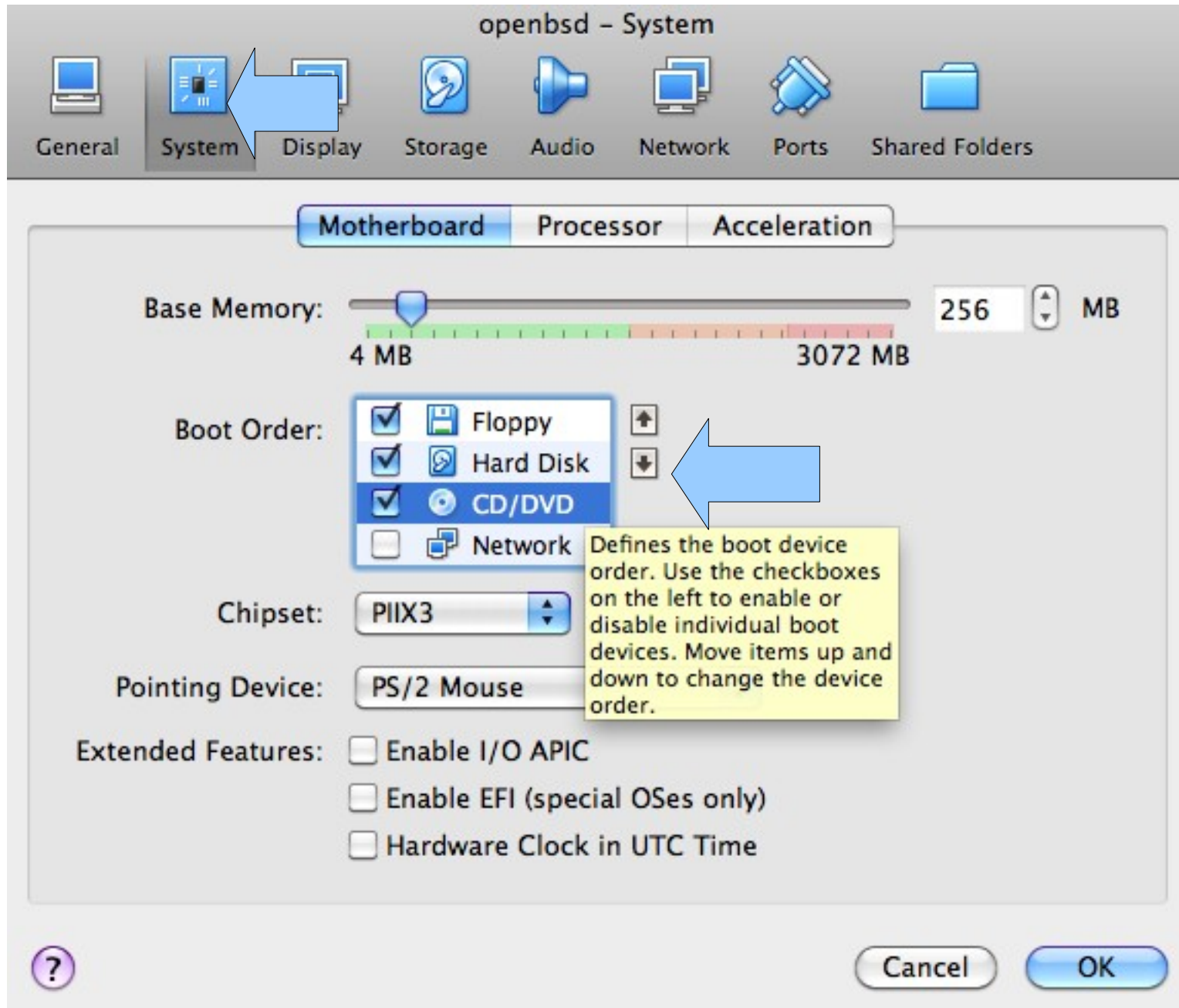

- Reboot the instance
- Intercept the reboot at the bios stage and shutdown the instance.

```
openbsd [Running]
[X] base55.tgz      [X] game55.tgz      [X] xfont55.tgz
Set name(s)? (or 'abort' or 'done') [done]
Directory does not contain SHA256.sig. Continue without verification? [no] yes
Installing bsd      100% |*****| 10263 KB  00:09
Installing bsd.rd  100% |*****|  6349 KB  00:05
Installing base55.tgz 100% |*****| 58796 KB  01:16
Installing etc55.tgz  100% |*****|   513 KB  00:00
Installing comp55.tgz 100% |*****| 48489 KB  01:35
Installing man55.tgz  100% |*****|  9836 KB  00:28
Installing game55.tgz 100% |*****|  2643 KB  00:03
Installing xbase55.tgz 100% |*****| 12565 KB  00:22
Installing xetc55.tgz  100% |*****|  64910   00:00
Installing xshare55.tgz 100% |*****|  4300 KB  00:07
Installing xfont55.tgz 100% |*****| 38994 KB  00:44
Installing xserv55.tgz 100% |*****| 23534 KB  00:36
Location of sets? (cd disk ftp http or 'done') [done]
Time appears wrong. Set to 'Tue May 27 07:43:40 EDT 2014'? [yes]
Saving configuration files...Making all device nodes...done.

CONGRATULATIONS! Your OpenBSD install has been successfully completed!
To boot the new system, enter 'reboot' at the command prompt.
When you login to your new system the first time, please read your mail
using the 'mail' command.

# reboot_
```

- Stop the instance and adjust the settings of the VM
- Make sure that CD/DVD comes after Hard disk as shown below
- Restart the instance



```
openbsd [Running]
dev/wd0a (e508ca3ad951b0d5.a): file system is clean; not checking
dev/wd0e (e508ca3ad951b0d5.e): file system is clean; not checking
dev/wd0d (e508ca3ad951b0d5.d): file system is clean; not checking
etting tty flags
f enabled
tarting network
HCPREQUEST on em0 to 255.255.255.255 port 67
HCPACK from 10.0.2.2 (52:54:00:12:35:02)
ound to 10.0.2.15 -- renewal in 43199 seconds.
tarting early daemons: syslogd pflogd.
tarting RPC daemons:.
avecore: no core dump
hecking quotas: done.
learing /tmp
tarting pre-securelevel daemons:.
etting kernel security level: kern.securelevel: 0 -> 1
reating runtime link editor directory cache.
reserving editor files.
tarting network daemons: sshd sendmail sndiod.
tarting local daemons: cron.
ue May 27 10:49:11 EDT 2014

penBSD/i386 (mine.mtg.afnog.org) (ttyC0)

ogin: _
```

Class Exercise

- Good engineers are **lazy, lazy, lazy, lazy!**
- **vagrant** profiter de la vie!!



Vagrant

- Install vagrant from the [local server](#) on your laptop
- Make a vagrant file by issuing `vagrant init`
- Edit the vagrantfile
- Change the line:
 - From: `config.vm.box = "base"`
 - To: `config.vm.box = "http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box"`

- Create a new dir and change to it
- Run `vagrant init`
- Run `ee Vagrantfile` to edit the generated file

```
lmwangi ~ > work > virts > vagrant init
/Applications/Vagrant/bin/./embedded/gems/gems/vagrant-1.6.2/lib/vagrant/pre-rubygems.rb:31: warning: Insecure world writable dir /usr/local in PATH, mode 040777
/Applications/Vagrant/embedded/gems/gems/bundler-1.6.2/lib/bundler/runtime.rb:222: warning: Insecure world writable dir /usr/local in PATH, mode 040777
A 'Vagrantfile' has been placed in this directory. You are now
ready to 'vagrant up' your first virtual environment! Please read
the comments in the Vagrantfile as well as documentation on
'vagrantup.com' for more information on using Vagrant.
lmwangi ~ > work > virts > ls
/vagrantfile
lmwangi ~ > work > virts > ee Vagrantfile
```

- Change the line `config.vm.box` to the one below
 - http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box

```
# Every Vagrant virtual environment requires a box to build off of.
config.vm.box = "http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box"
# Disable automatic box update checking. If you disable this, then
# boxes will only be checked for updates when the user runs
```

- Run vagrant up to start the instance

```
lmwangi ~ > work > virts > vagrant up
/Applications/Vagrant/bin/./embedded/gems/gems/vagrant-1.6.2/lib/vagrant/pre-rubygems.rb:31: warning: Insecure world writable dir /usr/local in PATH, mode 040777
/Applications/Vagrant/embedded/gems/gems/bundler-1.6.2/lib/bundler/runtime.rb:222: warning: Insecure world writable dir /usr/local in PATH, mode 040777
Bringing machine 'default' up with 'virtualbox' provider...
=> default: Box 'http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box' could not be found. Attempting to find a
default: Box Provider: virtualbox
default: Box Version: >= 0
=> default: Adding box 'http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box' (v0) for provider: virtualbox
default: Downloading: http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box
=> default: Successfully added box 'http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box' (v0) for 'virtualbox'
=> default: Importing base box 'http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/hashicorp/precise32/version/1/provider/virtualbox.box'...
=> default: Matching MAC address for NAT networking...
=> default: Setting the name of the VM: virts_default_1401192233099_60272
=> default: Clearing any previously set network interfaces...
=> default: Preparing network interfaces based on configuration...
default: Adapter 1: nat
=> default: Forwarding ports...
default: 22 => 2222 (adapter 1)
=> default: Booting VM...
=> default: Waiting for machine to boot. This may take a few minutes...
default: SSH address: 127.0.0.1:2222
default: SSH username: vagrant
default: SSH auth method: private key
default: Warning: Connection timeout. Retrying...
=> default: Machine booted and ready!
=> default: Checking for guest additions in VM...
default: The guest additions on this VM do not match the installed version of
default: VirtualBox! In most cases this is fine, but in rare cases it can
default: prevent things such as shared folders from working properly. If you see
default: shared folder errors, please make sure the guest additions within the
default: virtual machine match the version of VirtualBox you have installed on
default: your host and reload your VM.
default:
default: Guest Additions Version: 4.2.0
default: VirtualBox Version: 4.3
=> default: Mounting shared folders...
default: /vagrant => /Users/lmwangi/work/virts
```

- Run `vagrant ssh` to connect to the instance

```
lmwangi ~ > work > virts > vagrant ssh
/Applications/Vagrant/bin/./embedded/gems/gems/vagrant-1.6.2/lib/vagrant/pre-ruby
/Applications/Vagrant/embedded/gems/gems/bundler-1.6.2/lib/bundler/runtime.rb:222:
Welcome to Ubuntu 12.04 LTS (GNU/Linux 3.2.0-23-generic-pae i686)

* Documentation:  https://help.ubuntu.com/
Welcome to your Vagrant-built virtual machine.
Last login: Fri Sep 14 06:22:31 2012 from 10.0.2.2
vagrant@precise32:~$ uname
linux
vagrant@precise32:~$ uptime
12:06:58 up 2 min,  1 user,  load average: 0.72, 0.79, 0.34
vagrant@precise32:~$
```

- You just provisioned an instance in minutes
- You can now configure this instance for a service
- You can change to another directory and repeat the process to get another instance
 - Run: **vagrant init**
 - Edit the file: **Vagrantfile**
 - Run: **vagrant up**
- Exercise: Create a new FreeBSD vm using this box:
 - http://mini1.sse.ws.afnog.org/~inst/vagrant_boxes/chef/freebsd-9.2/version/1/provider/virtualbox.box

Other vagrant commands

- List instances: **vagrant global-status**
- Stop an instance: **vagrant halt**
- Suspend an instance: **vagrant suspend**
- Resume an instance: **vagrant resume**
- Terminate an instance: **vagrant destroy**
- Snapshot and store/share an instance: **vagrant package**