RED HAT
ENTERPRISE LINUX 5

RHEL 5 and Fedora Core 6

Virtualization Overview for Sys Admins

Sam Folk-Williams

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About Me

- Fedora Documentation Project
- Fedora Ambassador
- General Open Source Evangelist
- And, I work for Red Hat
  - Technical Account Manager
  - Dedicated Support Contact for Enterprise Customers

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Goals for Today

- Look at the state of open source virtualization today
- Take an initial look at the way Xen works
- Get a feel for the tools that Red Hat has developed for RHEL 5 and Fedora Core 6
- Look at some screenshots and do a demo

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Virtualization Overview

- Brief Intro
- Virtualization Hardware Notes (for those interested)
- Comparison of virtualization platforms
- State of Virtualization in Fedora 6 and RHEL 5
  - libvirt, virsh, virt-manager, gnome-applet-vm
- How to...
  - Install, clone, change virtual hardware, live migration
- Questions? Come to the booth! samfw@redhat.com

Brief Overview

- Virtualization = not a new idea
- Why virtualize?
  - Manage Cost...
  - Manage Risk...
  - It's neat
  - http://virt.kernelnewbies.org/WhyVirtualization
- Full virtualization vs. Para Virtualization
  - Performance vs. OS modification

Some Term Definitions

- Node = physical machine
- Hypervisor/VMM = Software that runs on the node, which allows for virtualization
- Domain = Operating System instance booted by the hypervisor
  - Domain 0 (Dom0) = Host OS
  - Domain U (DomU) = Guest OS

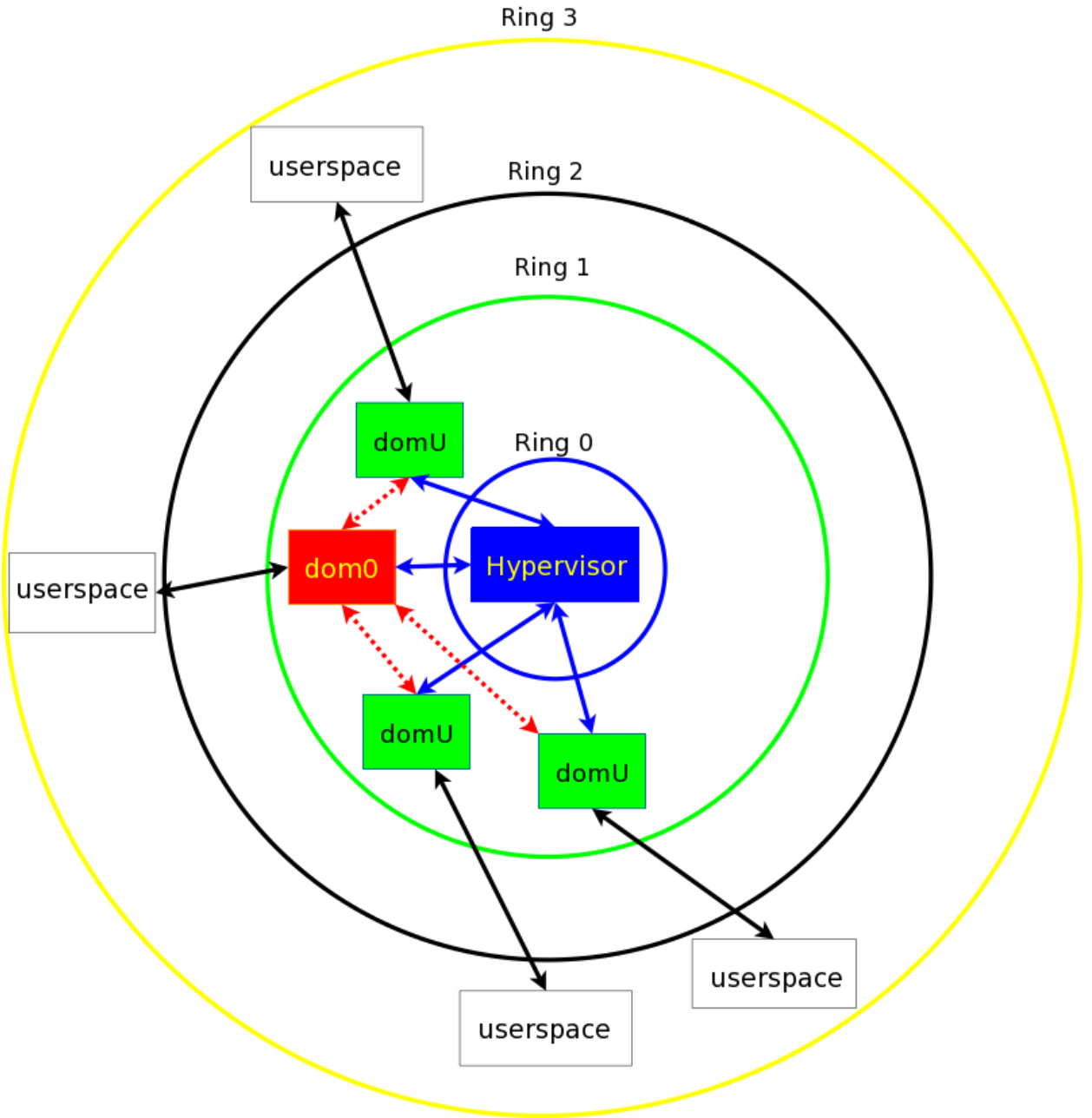
Virtualization Hardware Notes

- Intel: Virtualization Technology (VT)
  - Hardware support for virtualization
- Intel: Trusted Execution Technology (TXT)
  - Secure start up and IO security
- AMD: AMD Virtualization (AMD-V)
  - Hardware support + secure start up and IO security

Virtualization Hardware Notes

- New operating modes
  - Intel: VMX Root, VMX non-root
  - AMD: Host Mode, Guest Mode
  - Privilege levels/Rings 1-3 available to guests
  - HV runs in root/host mode at PL/Ring 0
  - HV controls access to memory and CPU
  - Dom0 controls access to other hardware drivers

X86 Privilege Levels



Virt Comparison

- Hypervisor vs. Linux Based
  - Hypervisor based (Xen)
    - Hypervisor controls basic hardware access
    - Dom0 is privileged, DomU's use Dom0 for hardware bits
  - Linux based (KVM)
    - Host OS controls hardware access
    - VMs are like processes

Virt Comparison

- Advantages of Hypervisor Based
  - The system is controlled by a small piece of software, small enough to be audited for security issues
  - The hypervisor takes up little virtual address space, which matters on 32 bit systems.
  - The same kernel can be run as host OS (dom0) and guest OS (domU)
  - The same hypervisor can be used with multiple operating systems.
    - Eg. use Linux or FreeBSD as the host OS, with the same virtualization software.

Virt Comparison

- Disadvantages of Hypervisor Based
  - Because the hypervisor relies on Dom0, any compromise to to Dom0 is effectively a compromise to the hypervisor. Thus, the software needed to be audited for security is not so small.
  - Because the hypervisor is separate, it needs to duplicate a lot of Linux functionality (such as NUMA and CPU frequency scaling)

Virt Comparison

- Which is better?
  - Right now, Xen is the only open source virtualization platform ready for the enterprise and production use
  - Ultimately, which approach is “better” depends on your view point
  - The Red Hat/Fedora tools are agnostic to the underlying virtualization platform

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Virtrualization in RHEL 5 and Fedora 6

- Xen 3.0.x
- New API developed for accessing virtualization platform
- Tools that use the new API developed to manage the virtualization platform
- Other Red Hat/Fedora applications enhanced to work with virtualization (Cluster, GFS, RHN)

Fedora 6 and RHEL 5 Features

- `libvirt`
  - Developed as a long-term, stable API for Xen *and* other virtualization platforms as they mature
  - C-toolkit to interact with the virtualization capabilities of the OS – right now just Xen, but could be any virtualization platform
  - Goal: “to provide the lowest possible generic and stable layer to manage domains on a node.”
  - Libvirt just does the basics – more advanced things can be done by applications that use libvirt

Fedora 6 and RHEL 5 Features

- `virsh`
  - Virtual Shell to allow command line access to features of a virtualization platform
  - Scriptable batch operations
  - Exposes libvirt functionality
  - Similar functionality as “xm” but not limited to Xen
  - Commands run asynchronously
  - Functionality continuously expanding
  - `virsh <subcommand> <domain-id> [OPTIONS]`

Fedora 6 and RHEL 5 Features

- Basic Functions
  - Start: “Create” a domain from a stopped state
  - Pause: Freeze a domain. When un-paused it will immediately return its previous state. Frees CPU cycles but retains memory footprint.
  - Save: Shutdown a domain, saving its memory state to a file. Completely frees guest resources for use by other domains. Easily restore to previous state.
  - Shutdown – gracefully shutdown guest
  - Destroy – hard reset of guest

Fedora 6 and RHEL 5 Features

- Basic Options
  - Full Virt or Para Virt
  - Disk: file, partition, logical volume, can add multiple
  - Memory: Can only allocate physical RAM
  - CPU: Can allocate more than physical CPUs
  - Network: Up to 3 virtual NICs per domU (can have more aliases, limitation should be lifted soon)

Fedora 6 and RHEL 5 Features

- `virt-manager`
  - GUI!
  - Does basically the same thing as virsh but in a GUI environment
  - Monitor domain statistics graphically in real time
  - Create new domains, save, pause, modify virtual hardware
  - serial console, graphical framebuffer

Fedora 6 and RHEL 5 Features

- `gnome-applet-vm`
  - Uses libvirt API
  - Gnome panel applet that lists all domains, their attributes, and their current status
  - Provides pop-up notification of changes to domain states
  - Useful for workstation deployments

How to...

- Install a domain
  - Guest OS's native installer is launched
    - Via virt-manager GUI wizard
    - Or via the virt-install command line tool (interactive or with options passed on command line)
  - Para-virt: needs install tree via NFS, FTP or HTTP
  - Full-virt: Needs ISO or install CDs
  - Kickstart fully supported

How to...

- Start a guest domain
  - `virsh` and `virt-manager` currently do not have this ability
    - `xend` 3.0.3 had no support for inactive domains, but this is added to 3.0.4
    - Currently must use `xm` (hardcoded)
    - Feature will be added soon to `virt-manager, virsh`
  - `xm create [-c] <domain name>`

How to...

- Clone a domain
  - No built-in feature
  - Copy disk and configuration file
    - LVM snapshot is easiest and most graceful
      - `lvcreate -L <size> -s -n <newname> <current LV>`
    - dd can also be used
      - `dd if=<dom1> of=<dom2> bs=1k seek=2048k count=1`
  - Change name, disk, MAC and UUID in config file
    - `/etc/xen/<domain name>`

How to...

- Change hardware settings
  - Use virsh or virt-manager
    - `virsh setvcpus --count <number> <domID>`
    - `virsh setmem --bytes <bytes> <domID>`
    - `Domain-->Details-->Hardware`
  - Memory and VCPUS can be decreased or increased to maximum set in config file at boot time
  - VCPUs can be increased beyond the number of physical CPUs (useful for multithreaded applications)

How to...

- Migrate a domain
  - `xm migrate --live <domID> <new hypervisor>`
- New hypervisor must have sufficient system resources
- Both hypervisors must be on same subnet – IP and MAC migrate with the domain
- Disk does not move with domain...
  - Shared storage required (SAN, NAS, GNBD, iSCSI).

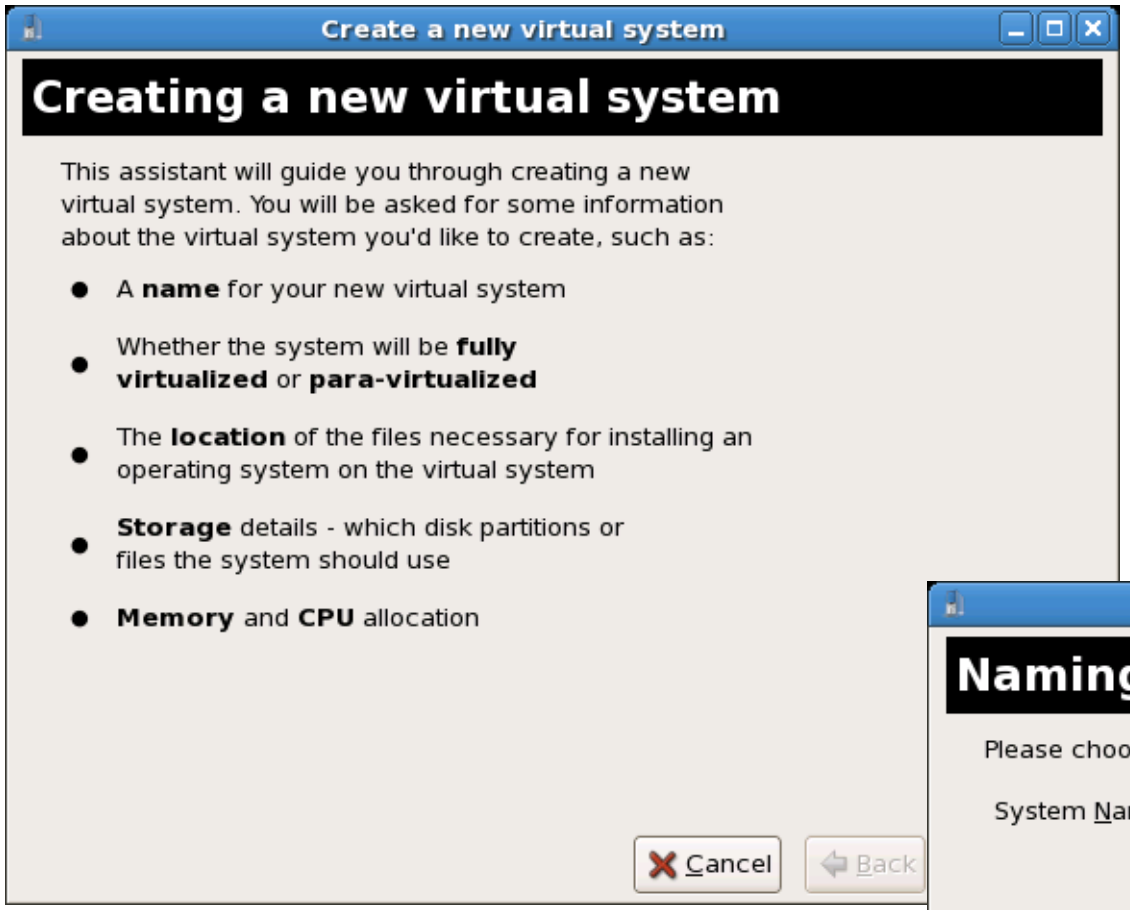
FAQ

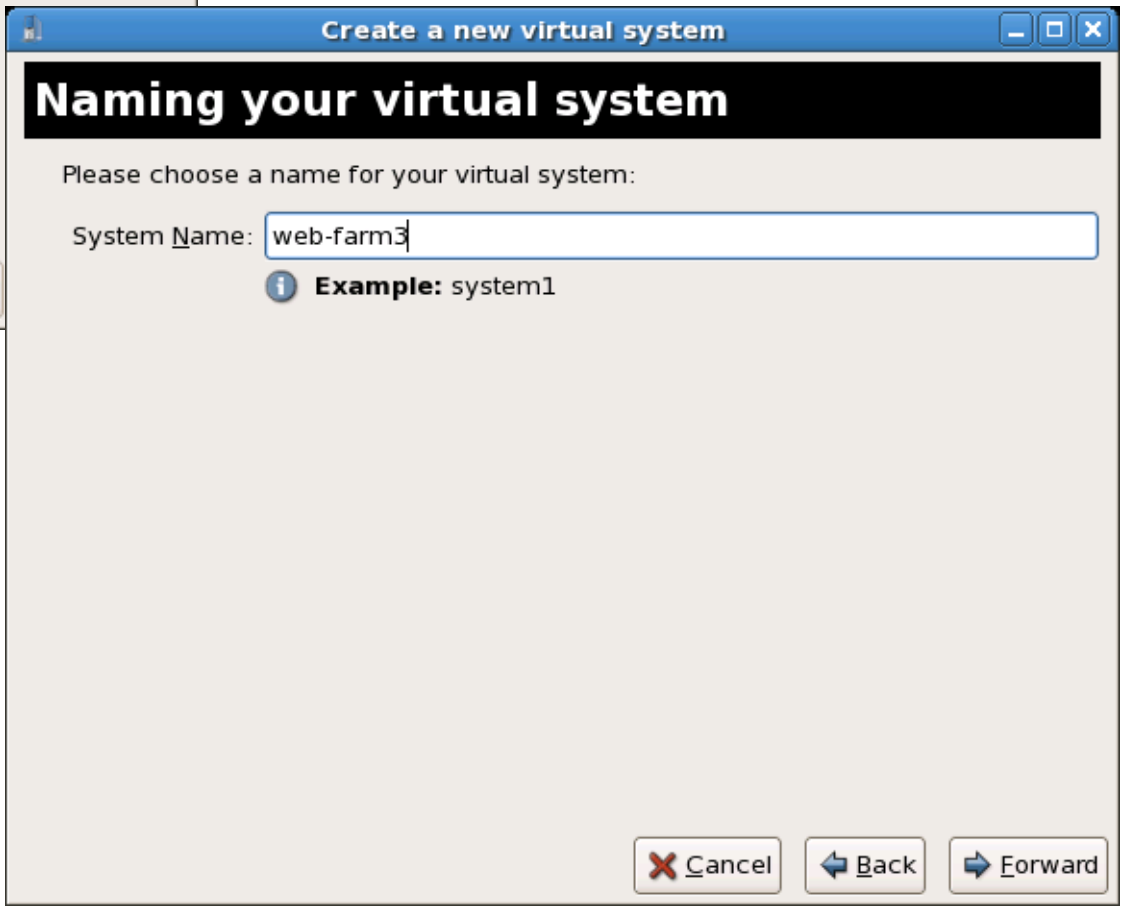
- Can I run 32 and 64 bit guests on 64 bit hardware?
  - Yes, with full virt guests. For para virt guests, the hypervisor does not [YET] have a 32-bit compatibility layer.
- Why does Xen require PAE support on i686 hardware?
  - The hypervisor can be built either for PAE or non-PAE, but not both. It makes more sense to build for PAE. In the future, it will be possible to run both PAE and non-PAE guests on a PAE hypervisor
- Can I run something other than RHEL and Fedora as DomU?
  - Yes, with full virt many other OS's can be installed and run
  - For para virt, the OS must be modified to work (Xen kernel). Many Linux distributions have paravirt support.
  - Note the difference between “works” and “supported”

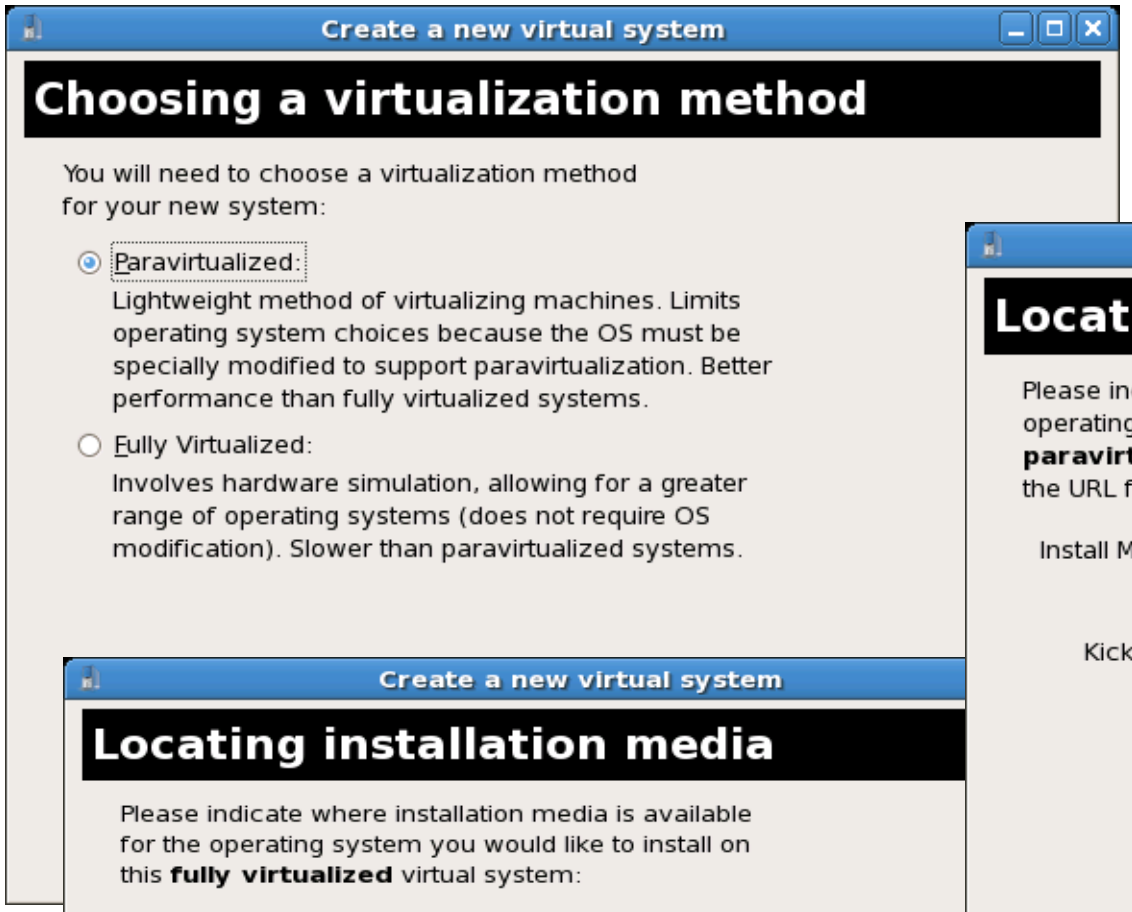
More Stuff to Learn

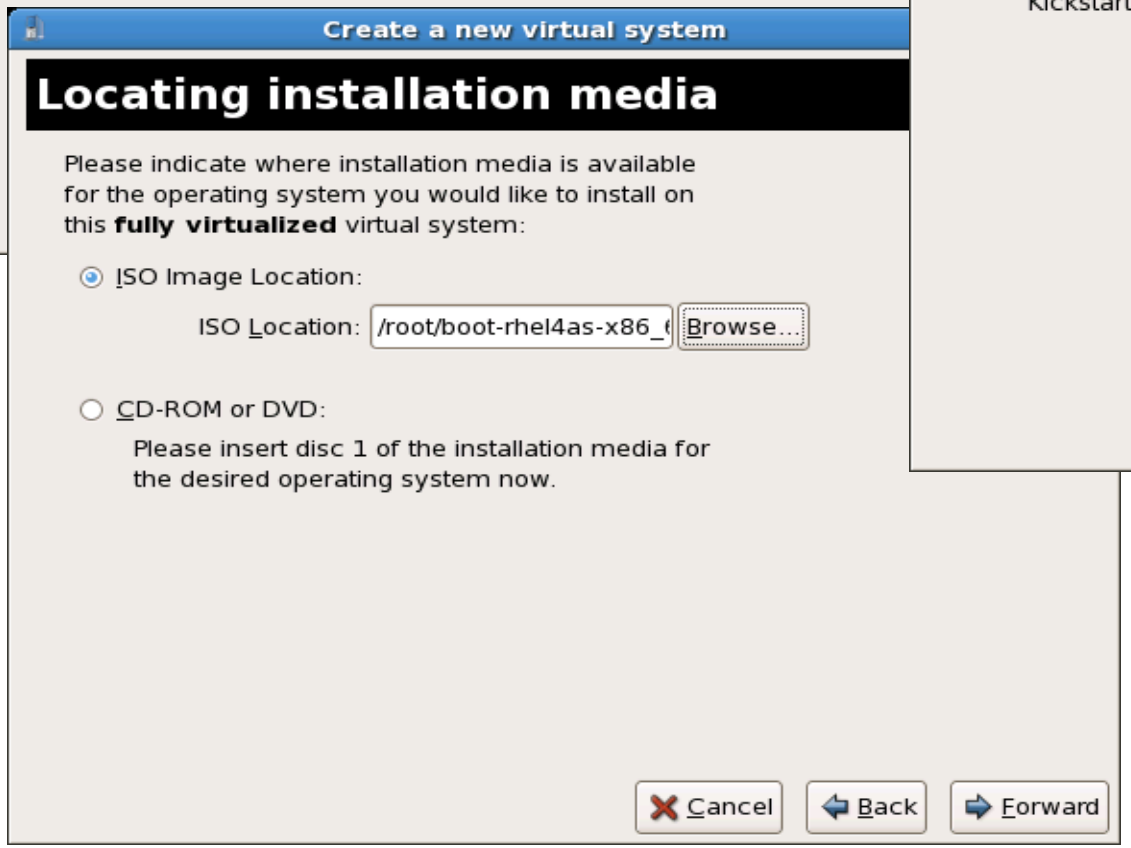
- Provision guest domains with Cobbler and Koan:
  - Set up a complete PXE provisioning tool for deploying virtual guests
  - http://cobbler.et.redhat.com/
- Set up GFS and/or Cluster Suite with guest domains:
  - Add an LV to both domains for shared storage
  - Could have 3 3-node clusters on 3 nodes

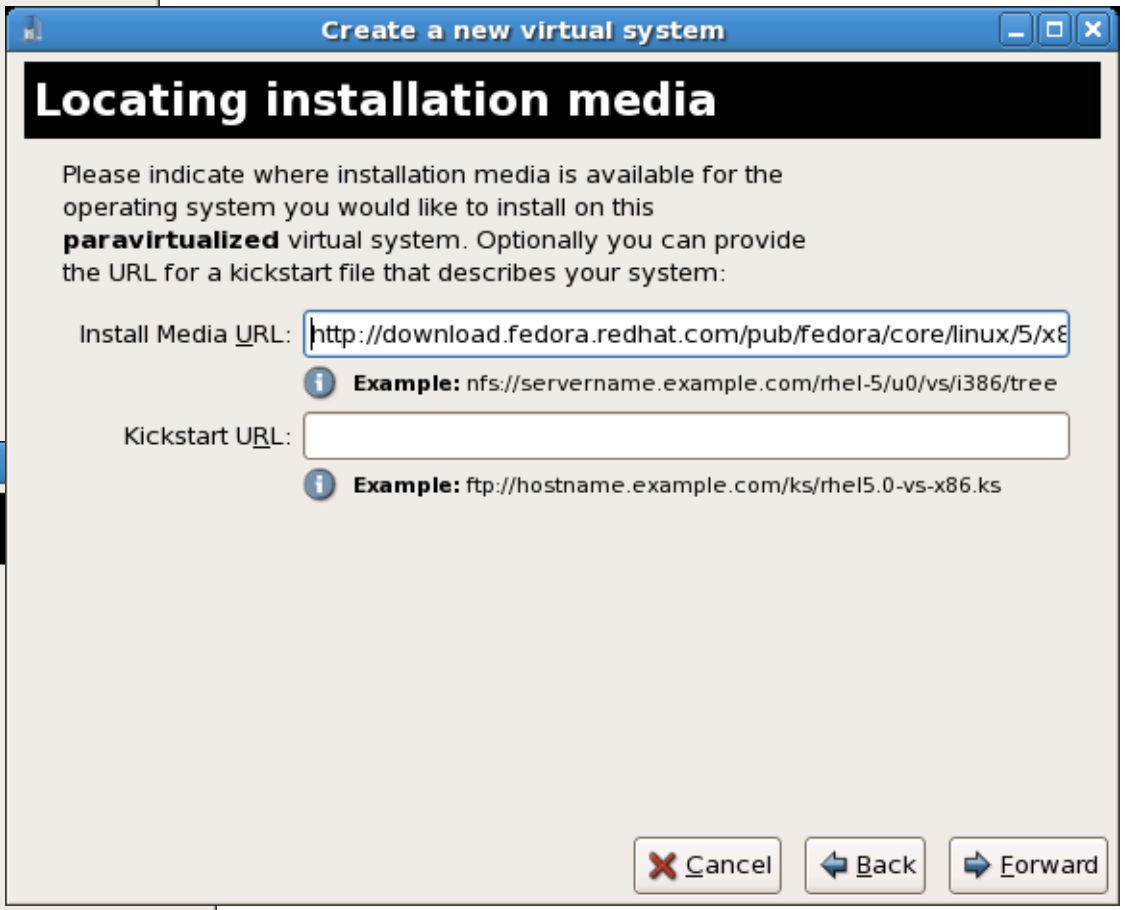
Demo: Guest Installation

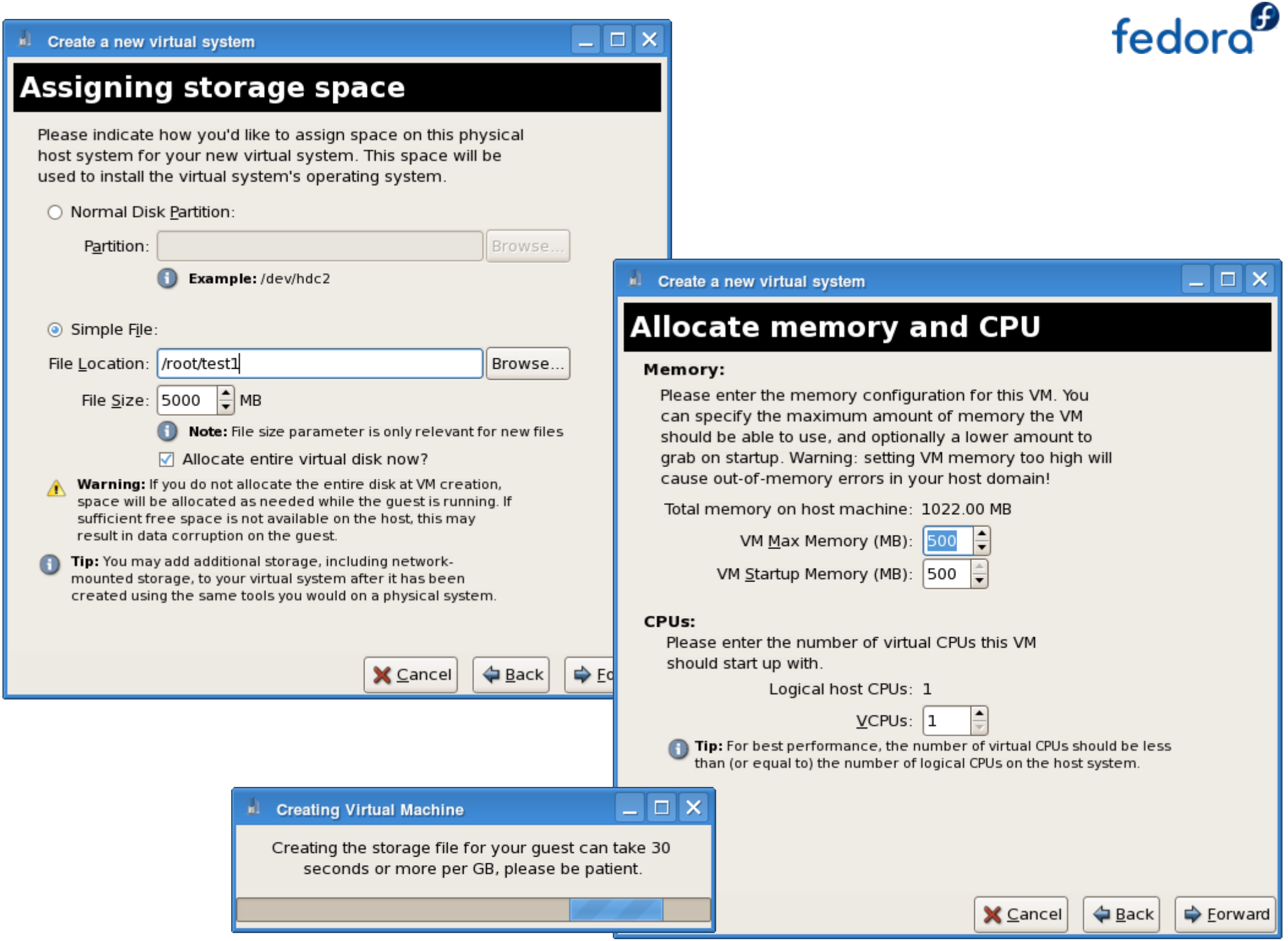

Create a new virtual system
Creating a new virtual system
This assistant will guide you through creating a new virtual system. You will be asked for some information about the virtual system you'd like to create, such as:
A name for your new virtual system
Whether the system will be fully virtualized or para-virtualized
The location of the files necessary for installing an operating system on the virtual system
Storage details - which disk partitions or files the system should use
Memory and CPU allocation
Cancel
Back

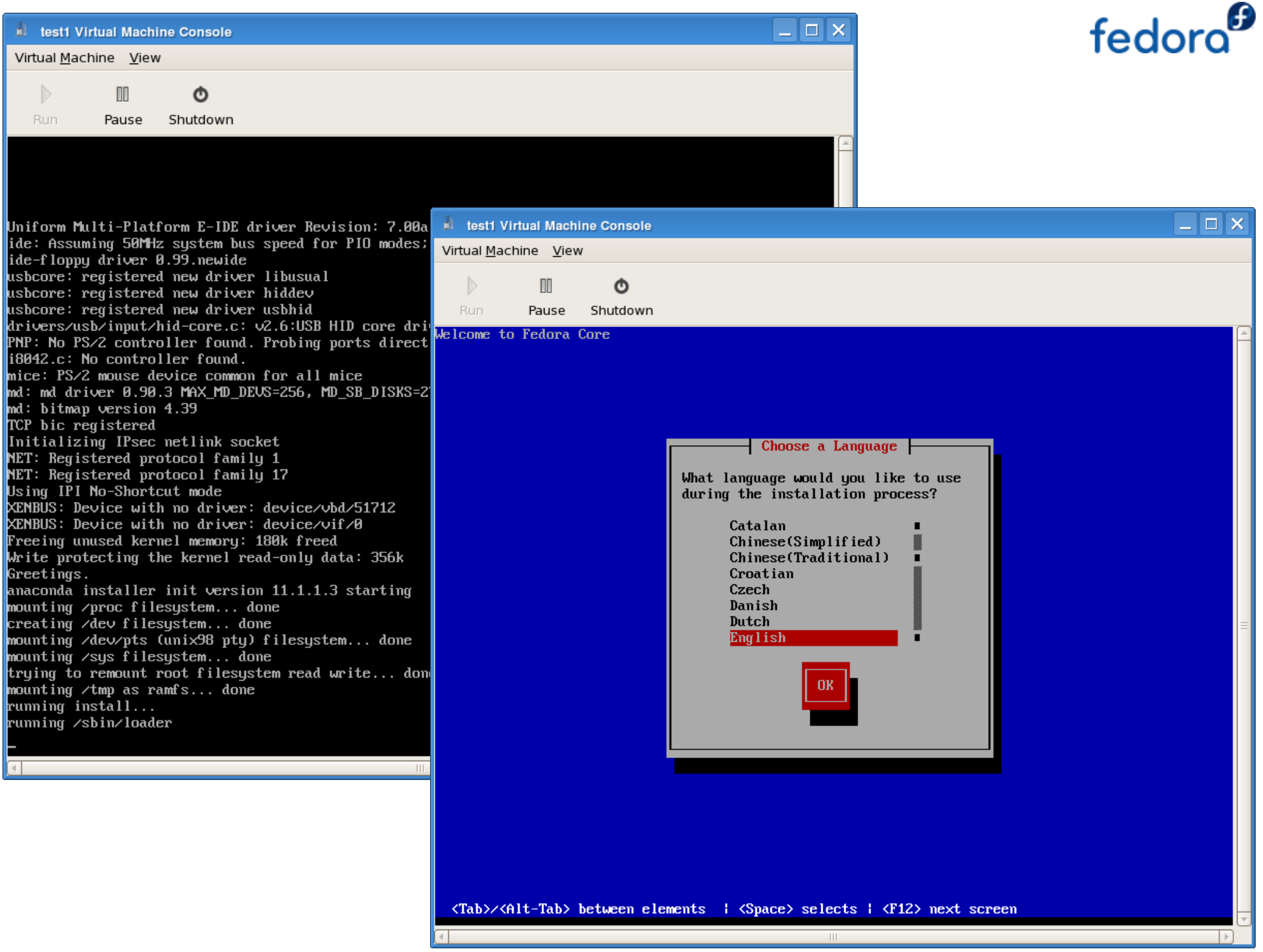

Create a new virtual system
Naming your virtual system
Please choose a name for your virtual system:
System Name: web-farm3
Example: system1
Cancel
Back
Forward


Create a new virtual system
Choosing a virtualization method
You will need to choose a virtualization method for your new system:
Paravirtualized:
Lightweight method of virtualizing machines. Limits operating system choices because the OS must be specially modified to support paravirtualization. Better performance than fully virtualized systems.
Fully Virtualized:
Involves hardware simulation, allowing for a greater range of operating systems (does not require OS modification). Slower than paravirtualized systems.


Create a new virtual system
Locating installation media
Please indicate where installation media is available for the operating system you would like to install on this **fully virtualized** virtual system:
ISO Image Location:
ISO Location: /root/boot-rhel4as-x86_
Browse...
CD-ROM or DVD:
Please insert disc 1 of the installation media for the desired operating system now.
Cancel
Back
Forward


Create a new virtual system
Locating installation media
Please indicate where installation media is available for the operating system you would like to install on this **paravirtualized** virtual system. Optionally you can provide the URL for a kickstart file that describes your system:
Install Media URL: http://download.fedora.redhat.com/pub/fedora/core/linux/5/x8
Example: nfs://servername.example.com/rhel-5/u0/vs/i386/tree
Kickstart URL:
Example: ftp://hostname.example.com/ks/rhel5.0-vs-x86.ks
Cancel
Back
Forward


Create a new virtual system
Assigning storage space
Please indicate how you'd like to assign space on this physical host system for your new virtual system. This space will be used to install the virtual system's operating system.
Normal Disk Partition:
Partition:
Browse...
Example: /dev/hdc2
Simple File:
File Location: /root/test1
Browse...
File Size: 5000 MB
Note: File size parameter is only relevant for new files
Allocate entire virtual disk now?
Warning: If you do not allocate the entire disk at VM creation, space will be allocated as needed while the guest is running. If sufficient free space is not available on the host, this may result in data corruption on the guest.
Tip: You may add additional storage, including network-mounted storage, to your virtual system after it has been created using the same tools you would on a physical system.
Cancel
Back
Fo
Create a new virtual system
Allocate memory and CPU
Memory:
Please enter the memory configuration for this VM. You can specify the maximum amount of memory the VM should be able to use, and optionally a lower amount to grab on startup. Warning: setting VM memory too high will cause out-of-memory errors in your host domain!
Total memory on host machine: 1022.00 MB
VM Max Memory (MB): 500
VM Startup Memory (MB): 500
CPUs:
Please enter the number of virtual CPUs this VM should start up with.
Logical host CPUs: 1
VCPUs: 1
Tip: For best performance, the number of virtual CPUs should be less than (or equal to) the number of logical CPUs on the host system.
Cancel
Back
Forward
Creating Virtual Machine
Creating the storage file for your guest can take 30 seconds or more per GB, please be patient.


test1 Virtual Machine Console
Virtual Machine View
Run
Pause
Shutdown
Uniform Multi-Platform E-IDE driver Revision: 7.00a
ide: Assuming 50MHz system bus speed for PIO modes;
ide-floppy driver 0.99.newide
usbcore: registered new driver libusual
usbcore: registered new driver hiddev
usbcore: registered new driver usbhid
drivers/usb/input/hid-core.c: v2.6:USB HID core dri
PNP: No PS/2 controller found. Probing ports direct
i8042.c: No controller found.
mice: PS/2 mouse device common for all mice
md: md driver 0.90.3 MAX_MD_DEVS=256, MD_SB_DISKS=2
md: bitmap version 4.39
TCP bic registered
Initializing IPsec netlink socket
NET: Registered protocol family 1
NET: Registered protocol family 17
Using IPI No-Shortcut mode
XENBUS: Device with no driver: device/vbd/51712
XENBUS: Device with no driver: device/vif/0
Freeing unused kernel memory: 180k freed
Write protecting the kernel read-only data: 356k
Greetings.
anaconda installer init version 11.1.1.3 starting
mounting /proc filesystem... done
creating /dev filesystem... done
mounting /dev/pts (unix98 pty) filesystem... done
mounting /sys filesystem... done
trying to remount root filesystem read write... don
mounting /tmp as ramfs... done
running install...
running /sbin/loader
test1 Virtual Machine Console
Virtual Machine View
Run
Pause
Shutdown
Welcome to Fedora Core
Choose a Language
What language would you like to use
during the installation process?
Catalan
Chinese(Simplified)
Chinese(Traditional)
Croatian
Czech
Danish
Dutch
English
OK
<Tab>/<Alt-Tab> between elements | <Space> selects | <F12> next screen

test1 Virtual Machine Console
Virtual Machine View
Run
Pause
Shutdown
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fedora
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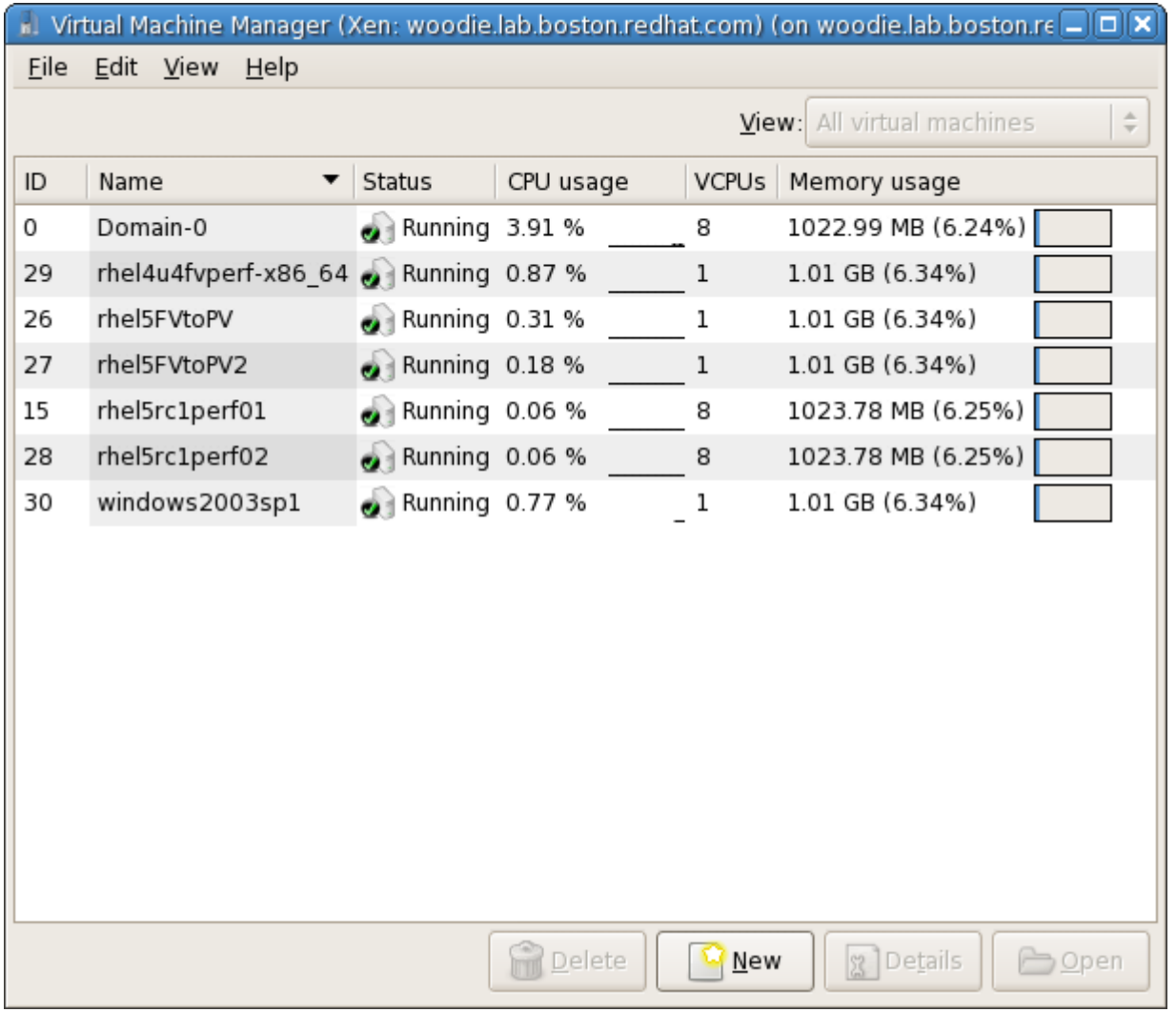
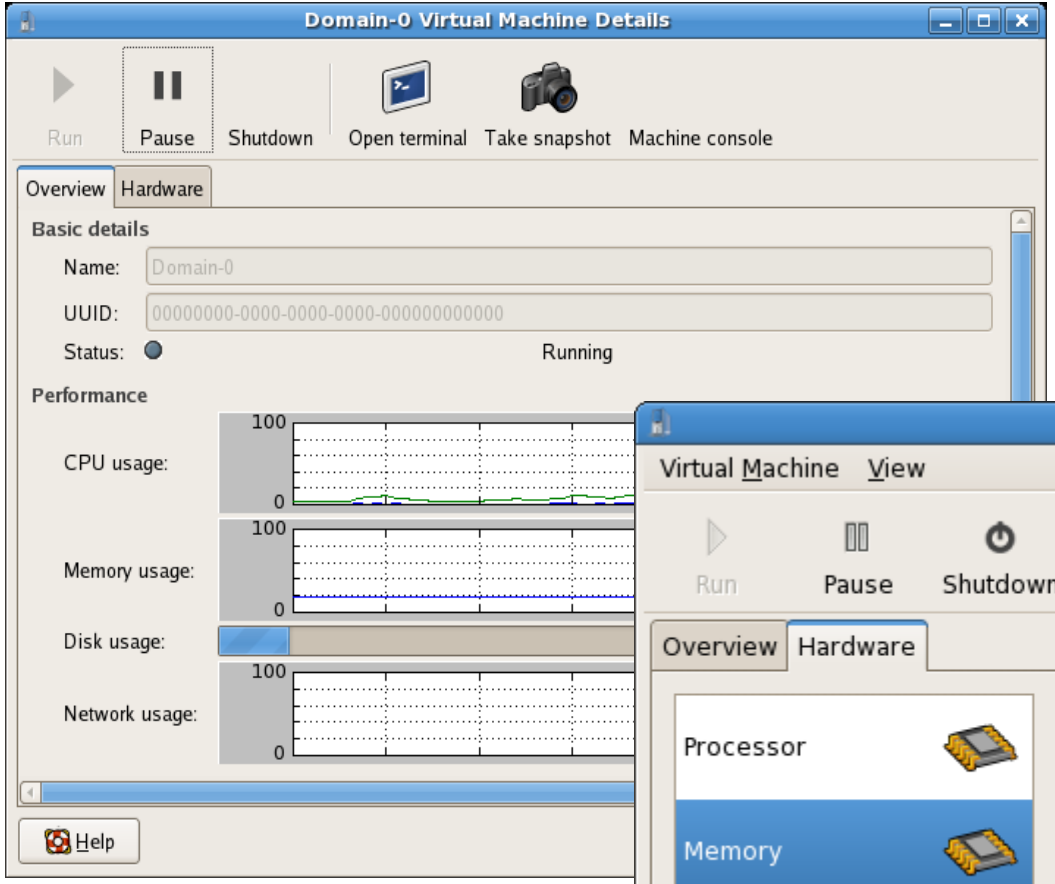
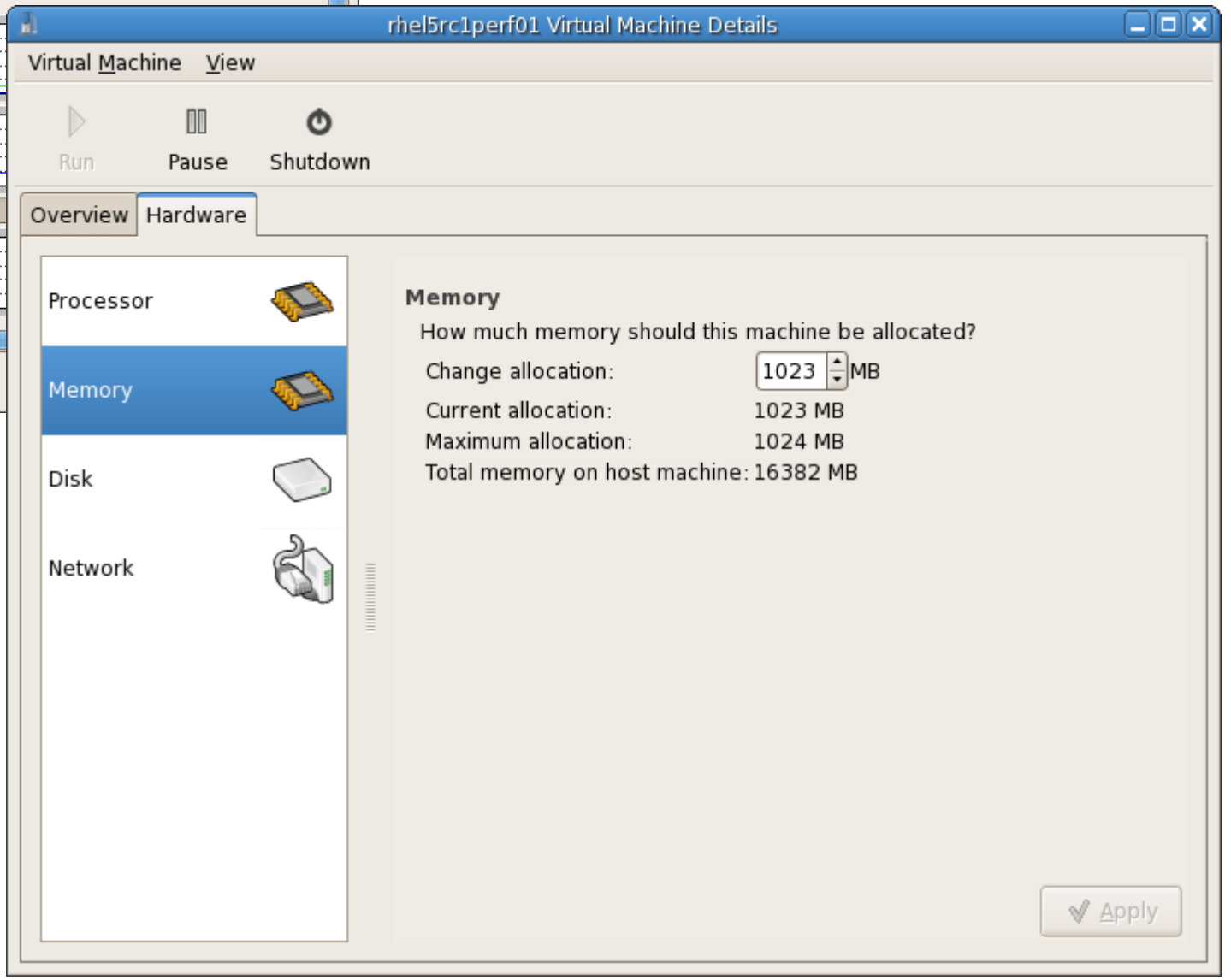
Release Notes
Back
Next

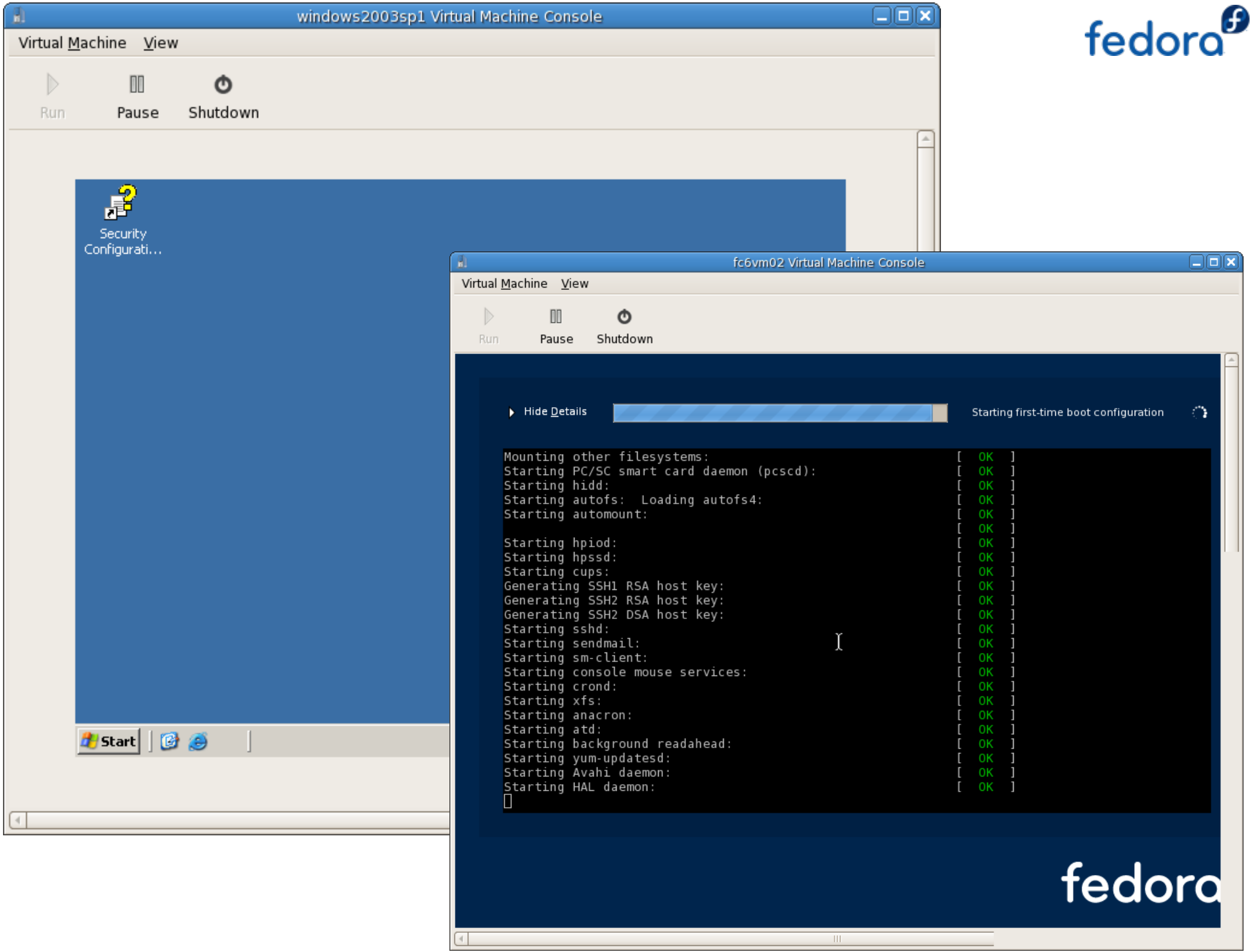
Demo: virt-manager

Open connection
Local Xen host
Remote Xen host
Host:
Port:
Secure connection
Other hypervisor
URI:
Read only connection
Cancel
Connect


Virtual Machine Manager (Xen: woodie.lab.boston.redhat.com) (on woodie.lab.boston.re
File Edit View Help
View: All virtual machines
ID Name Status CPU usage VCPUs Memory usage
0 Domain-0 Running 3.91 % 8 1022.99 MB (6.24%)
29 rhel4u4fvperf-x86_64 Running 0.87 % 1 1.01 GB (6.34%)
26 rhel5FVtoPV Running 0.31 % 1 1.01 GB (6.34%)
27 rhel5FVtoPV2 Running 0.18 % 1 1.01 GB (6.34%)
15 rhel5rc1perf01 Running 0.06 % 8 1023.78 MB (6.25%)
28 rhel5rc1perf02 Running 0.06 % 8 1023.78 MB (6.25%)
30 windows2003sp1 Running 0.77 % 1 1.01 GB (6.34%)
Delete
New
Details
Open


Domain-0 Virtual Machine Details
Run
Pause
Shutdown
Open terminal
Take snapshot
Machine console
Overview
Hardware
Basic details
Name:
Domain-0
UUID:
00000000-0000-0000-0000-000000000000
Status:
Running
Performance
CPU usage:
Memory usage:
Disk usage:
Network usage:
100
0
Help


rhel5rc1perf01 Virtual Machine Details
Virtual Machine
View
Run
Pause
Shutdown
Overview
Hardware
Processor
Memory
Disk
Network
Memory
How much memory should this machine be allocated?
Change allocation:
1023
MB
Current allocation:
1023 MB
Maximum allocation:
1024 MB
Total memory on host machine:
16382 MB
Apply


windows2003sp1 Virtual Machine Console
Virtual Machine View
Run
Pause
Shutdown
Security Configurati...
Start
fc6vm02 Virtual Machine Console
Virtual Machine View
Run
Pause
Shutdown
Hide Details
Starting first-time boot configuration
Mounting other filesystems: [OK]
Starting PC/SC smart card daemon (pcscd): [OK]
Starting hidd: [OK]
Starting autofs: Loading autofs4: [OK]
Starting automount: [OK]
[OK]
Starting hpiod: [OK]
Starting hpssd: [OK]
Starting cups: [OK]
Generating SSH1 RSA host key: [OK]
Generating SSH2 RSA host key: [OK]
Generating SSH2 DSA host key: [OK]
Starting sshd: [OK]
Starting sendmail: [OK]
Starting sm-client: [OK]
Starting console mouse services: [OK]
Starting crond: [OK]
Starting xfs: [OK]
Starting anacron: [OK]
Starting atd: [OK]
Starting background readahead: [OK]
Starting yum-updatesd: [OK]
Starting Avahi daemon: [OK]
Starting HAL daemon: [OK]
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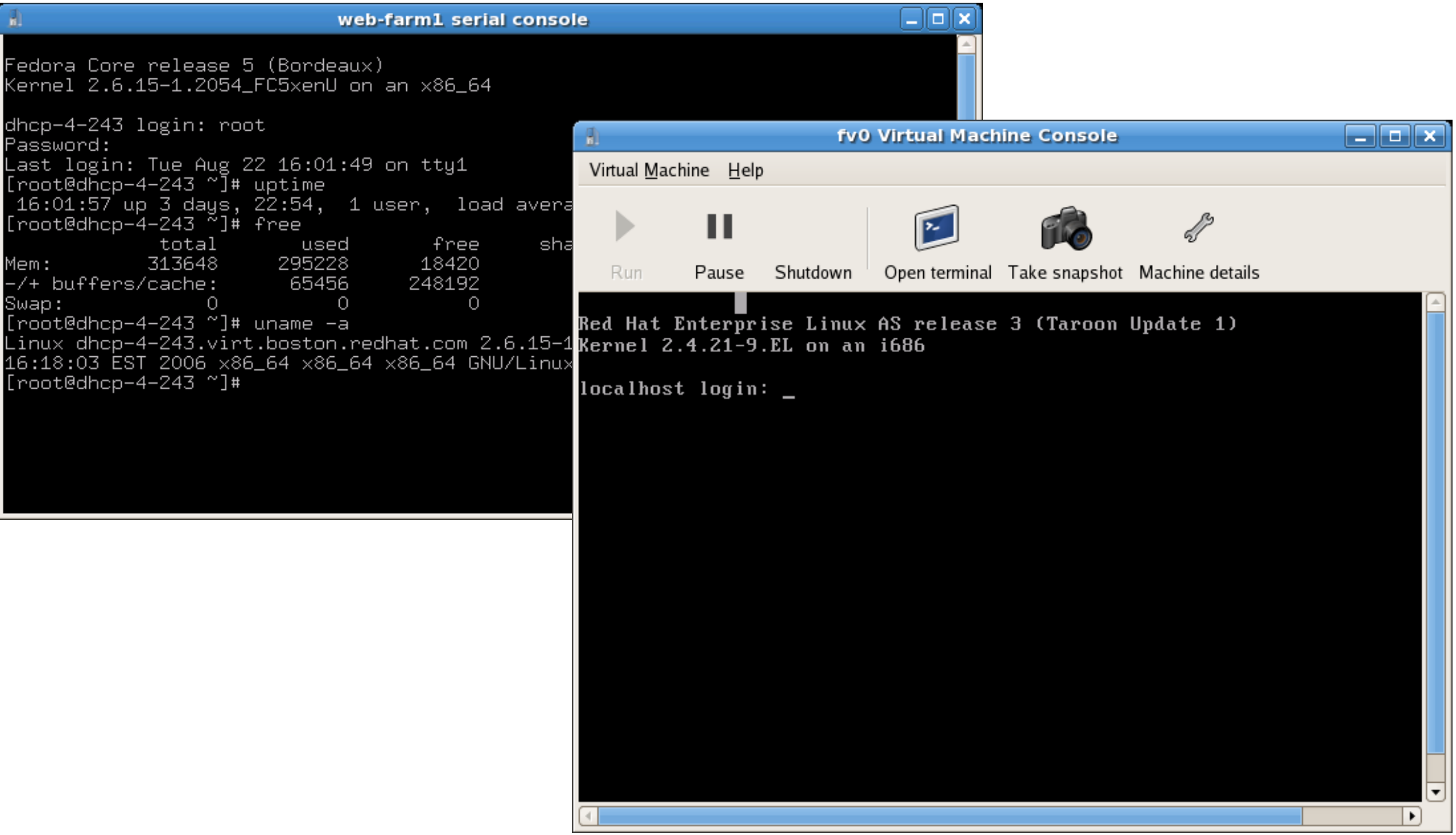
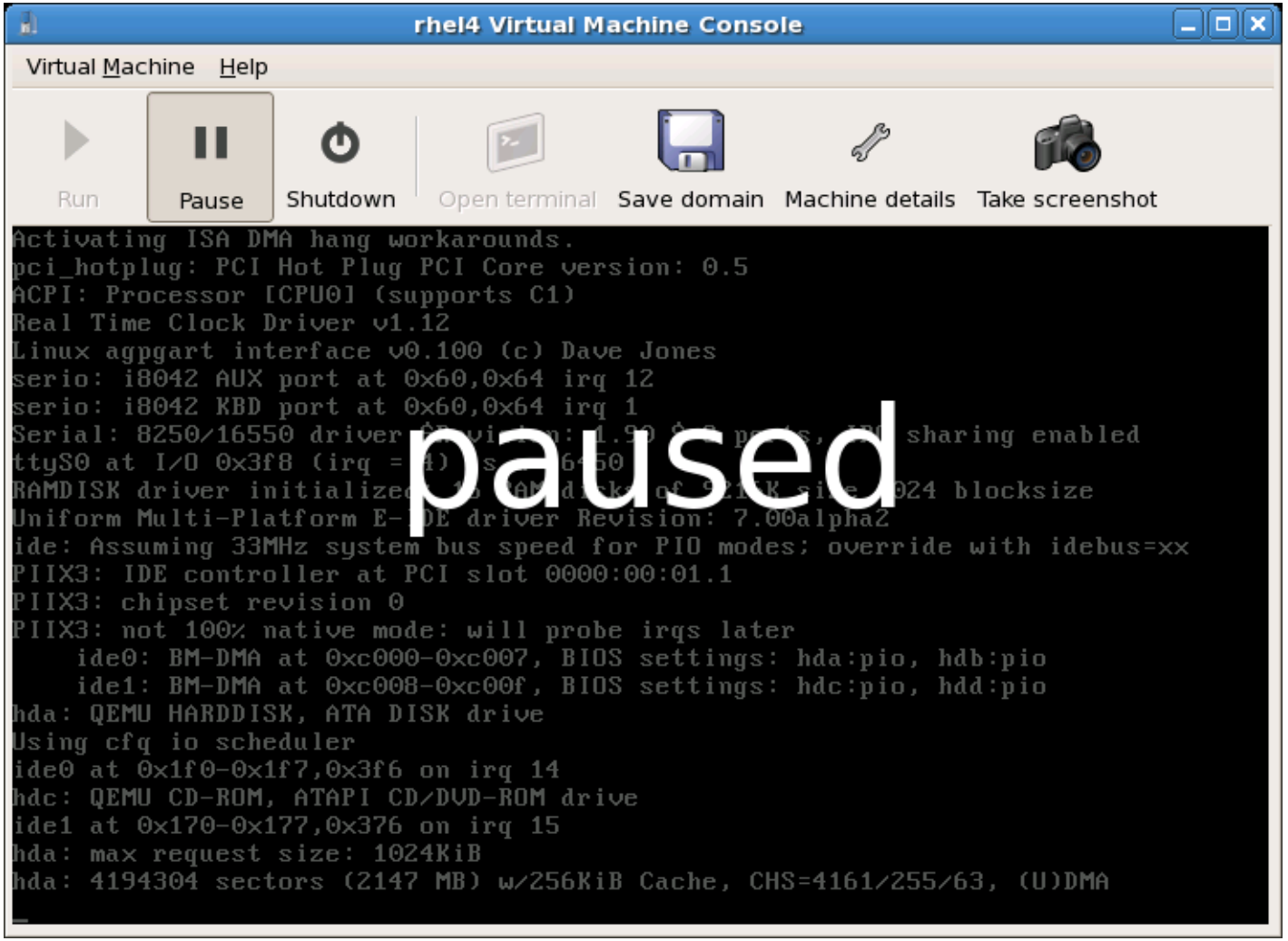
Demo: virt-manager console



Demo: pausing



Sources and Further Reading

- Virtualization Wiki:
  - http://virt.kernelnewbies.org
- Fedora Documentation:
  - http://fedoraproject.org/wiki/CategoryVirtualization
- Xen Manual
  - http://tx.downloads.xensource.com/downloads/docs/user/
- Mailing List:
  - http://www.redhat.com/mailman/listinfo/fedora-xen

Questions?

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