CentOS: Virtualization

Tim Verhoeven (tim.verhoeven.be@gmail.com)
Who am I?

- System administrator at DNS.be
- CentOS contributor:
  - Support (IRC, mailing lists)
  - QA Tester
  - Wiki maintenance
  - Presenter
Agenda

- Virtualization?
- Types of OS virtualization
- Virtualization on CentOS
- Real life Xen use
- Cobbler & Koan
- Func
CentOS

- The short version:
  - Community version of a PNAELV (Prominent North American Enterprise Linux Vendor) Enterprise distribution
  - The aim is 100% binary compatibility
  - Enterprise means:
    - Long lifecycles (7 years)
    - Longer timeframe between releases 18-24 months
    - Stable ABI/API
Virtualization?

- It is a very broad term and a buzzword
- Can happen at different layers
  - Network virtualization
  - Storage virtualization
  - System virtualization
  - ... 
- Common goal is to increase manageability and flexibility
Why virtualize?

- Isolation (a.ka. security)
- Consolidation (a.k.a. save money)
- Continued use of a legacy application
- Development and testing
Common virtualization techniques

- Emulation (bochs, qemu, ...)
- Full virtualization (VMware, VirtualBox, qemu)
- Para-virtualization (Xen)
- Hardware-assisted virtualization (Xen, KVM, VMware, VirtualBox)
- OS-Level virtualization (OpenVZ, Linux-VServer)
Emulation

• Create hardware in software

• Pro's
  – Support for non-native platforms (PPC on i386)
  – Runs any OS that supports the emulated hardware
  – Useful for low-level debugging

• Con's
  – Very, very slow
Full virtualization

- Let the virtualized system use the host CPU directly
- Problem: privileged instructions are not allowed in user mode
- The hypervisor (layer between hardware and virtual system) needs to handle privileged instructions
- Scan for problematic instructions and add a trap to the hypervisor
Full virtualization

- **Pro's**
  - Decent speed
  - Run any OS that the emulated hardware supports

- **Con's**
  - x86 instruction set is hard to virtualize
  - Hardware still needs to be emulated
Para-virtualization

- Modify the guest operating system kernel to work with the hypervisor
- The guest system informs the hypervisor when privileged calls need to be made
- The hypervisor provides virtualized devices for the guest
- The guest has special drives for these virtual devices
Para-virtualization

• Pro's
  – Very fast
  – Allows for interaction between host and guest

• Con's
  – Requires modification to the guest OS kernel
Hardware assisted virtualization

- Modern Intel and AMD CPU have extra instructions to help in virtualization
- VT-X for Intel, AMD-V for AMD
- Allows the hypervisor to handle privileged instructions more easily
Hardware assisted virtualization

- **Pro's**
  - Fast
  - Simpler hypervisor (e.g. KVM)

- **Con's**
  - Hardware still needs to be emulated
  - Requires modern hardware
Virtualization in CentOS

- CentOS 5 currently supports:
  - Xen (CentOS base)
  - KVM (CentOS extras)
Xen in CentOS

- Fully integrated in CentOS 5
- CentOS 5.1 includes Xen 3.1 hypervisor
- Supports CentOS 4.5+ and CentOS 5.0+ as paravirtualized guests
- If your CPU supports VT-X or AMD-V then you can run unmodified operating systems (older CentOS versions, Windows)
How to install Xen in CentOS

- Select “Virtualization” during installation
- Or use “Add/Remove Software” to add it later
- The system will reboot by default in Xen-mode
Management tools

- GUI
  - virt-manager
  - vm-applet
- Console
  - xm
  - virsh
  - virt-install

Demo time!
KVM in CentOS

- “yum install kvm kmod-kvm”
KVM – The basics

- KVM requires VT-X or AMD-V
- Hypervisor is a kernel module
- Uses qemu for device emulation
KVM Quickstart

- “qemu-img create -f qcow2 centos5-inst.img 4G”
- “qemu-kvm -hda centos5-inst.img -cdrom boot.iso -boot d”
Real life Xen uses

- **Single machine**:
  - Testing, development, demo, ...
  - The standard tools work

- **Multiple machines**:
  - Consolidation, HA, ...
  - More tools are needed:
    - Cobbler & Koan
    - Func
Basic architecture

LAN

VM A  VM B  Host 1

VM C  Host 2

VM D  Host 3

SAN

Hosts and virtual machines connected through a local area network (LAN) and a storage area network (SAN).
Variations on the same theme

- Fibre Channel, iSCSI, AoE
- NFS, GFS, ...
- Bridging, NAT'ing, ...
- Files, LVM, Clustered LVM, EVMS, ...
- ...
- ...
Step 1: Installation - Cobbler

- Rapid installation server
- http://cobbler.et.redhat.com/
- Consists of 2 parts:
  - Cobblerd: daemon on install server + WebUI
  - Koan: tool to do reinstalls and virtualized installs
- Expandable:
  - Kickstart templating using Cheetah
  - API using Python or XML-RPC
Installation

- Available in EPEL or rebuild the SRPM
- Edit /var/lib/cobbler/settings
- Run “cobbler check” and fix all errors
- For the WebUI:
  - https://fedorahosted.org/cobbler/wiki/CobblerWebInterface
- Import a distribution “cobbler import ...”

Demo time!
Installing a VM using Cobbler

• Use Koan:
  – Install the RPM on all hosts
  – `koan --virt \ 
    --server=127.0.0.1 \ 
    --profile=CentOS-5.1-xen-i386 \ 
    --virt-name=CentOSTest`

Demo time!
Kickstart templating

- Create templates in `/etc/cobbler`
- 4 levels of flexibility:
  - `$var` to include variables from Cobbler
    - Standard variables from Cobbler
    - Self defined metadata (--ksmeta)
  - Use `SNIPPET::file` to include simple files
  - Use Cheetah for flexible templating
  - Use Python code for the crazy stuff
Step 2 : Managing - Func

- https://fedorahosted.org/func/
- Like Distributed shell, clustered SSH, ...
- But
- Using Python and XML-RPC over SSL
- Module based (commands, rpm, yum, libvirt, ...)
- Flexible output (standard, JSON, XML)
- Use API to use Func inside other applications
Installation

- Available in EPEL or rebuild the SRPM
- Start certmaster on master server
- Edit `/etc/func/minion.conf` on slaves
- Start funcd on slaves
- Sign certificates from the slaves on the master using certmaster-ca
- Use `func` to do stuff ...

Demo time!
To wrap up ...

- CentOS Virtualization SIG:
  - Mailing list: centos-virt on http://lists.centos.org/
  - Wiki: http://wiki.centos.org/SpecialInterestGroup/Virtualization

- The pieces are coming together!
Questions ?