Pools of Virtual Boxes
A Year Later

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Campus Grids

Applications

- Research Cluster
- Commercial Cloud
- Campus Condo
- Workstations
- Campus Cloud
- Central Cluster
- Virtual Machines
Why Use VMs on Lab Machines?

- Universities of all types have lab machines
- Lab machines are frequently idle
- No additional space or power infrastructure needed
- Decouple lab and research software requirements
- Provide a layer of safety
Overview

1. Details
2. Deployment
3. Marquette University Grid
4. Conclusion
Pools of Virtual Boxes

- A *virtual machine* campus grid brick
- Oracle VirtualBox® on Windows host
- CentOS or Fedora Core Linux configured with Condor
- Inspired by coLinux Condor distribution
  - University of Nebraska–Lincoln, University of Oklahoma
- Other possible solutions
  - VMWare (Purdue),
  - Grid Appliance (University of Florida)
Why VirtualBox®?

- Free for academia (both PUEL and GPL versions)
- Excellent command line tools and APIs
- Portable (Windows, OS X, various Linuxes)
- Both hardware and software virtualization
What’s New?

- We have a name
- http://poolsofvirtualb.sourceforge.net
- Multi-core support (VirtualBox® 3.0.x)
- NAT networking support
- Better integration of packages
- Improved robustness
Host-Guest Architecture

- Condor Central Manager
- VirtualBox® Guest
  - CentOS 5.4
  - Condor
  - Add-on packages
- Windows® Host
  - SHARED FOLDER
  - Host Monitor
  - Activity Monitor
  - Daemon
  - POVB Service
- Initialize Monitor
VirtualBox® Configuration

VirtualBox® Guest

- povb_primary_hd.vdi
- povb_condor_hd.vdi

- snapshot
- snapshot
POVB Behavior

- VirtualBox® hard drives are immutable
- Upon reboot
  - Snapshots are removed
  - VM is reconfigured based on host characteristics
  - VM is started
  - VM is monitored for failures
  - Host monitor passes information to VM
Why the POVB Behavior?

- Research support and IT support involve different people
- Common Windows IT practices
  - Install application(s) before semester starts
  - Freeze machine config, reboot to restore
  - Run Windows update nightly, might reboot host
  - Generally want/need hands off solutions
Networking

- Bridged
  - Assigned addresses via DHCP
  - Problem is that it doubles address space
- NAT
  - Made possible by Condor CCB
  - Assigned private address via VirtualBox®
  - Submit nodes must be accessible by POVB machines
Condor Configuration

- Configured to preempt jobs based on host load, user activity
- Each slot is assigned a condor account
  - Removes job files upon completion
  - Kills all processes owned by slot user
- Can be configured for any Condor security model
  - host based, SSL, GSI/X.509, Kerberos, ...
Packages

VirtualBox® Guest

povb_packages_hd  povb_primary_hd  povb_condor_hd

snapshot  snapshot  snapshot
Packages

- `/packages` directory searched in guest environment
- Available packages advertised by Condor
- Condor job hooks configure environment for packages

**Example**

```
+HookKeyword = "POVB_PACKAGES"
+POVB_PACKAGES = "Matlab,Gate"
Requirements = $(Requirements) && HasMatlab != TRUE
Requirements = $(Requirements) && HasGate != TRUE
```
Typical Deployment

Other Nodes

Condor Central Manager

POVB

POVB

POVB

POVB

POVB
Installation and Distribution

- Installation from a single installer
  - Downloads and installs VirtualBox®
  - Configures VirtualBox®
  - Installs POVB services
- Successfully installed via
  - Network mount
  - Ghost/DeepFreeze
  - Altiris
Bootstrapping

- Relatively “hands free” creation of POVB guests
- Currently CentOS and Fedora Kickstart files
- Sends keystrokes via VirtualBox® command line
- Installs VirtualBox® guest additions and POVB scripts
- Runs on Linux, Mac OS X and (soon) Windows
Marquette University Grid (MUGrid)

MSCS and COE pools contain POVB instances.
## Condor Status (POVB Only)

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<th>Total</th>
<th>Owner</th>
<th>Claimed</th>
<th>Unclaimed</th>
<th>Matched</th>
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<td>107</td>
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<td>294</td>
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</tbody>
</table>

Varies between 350–420 slots at any given time. Estimated compute capacity is around 0.6 TFLOPS (for free!).
Sample Applications

- Stochastic MRI image reconstruction
- Protein docking for drug discovery
- Genome wide association studies
- Phylogenetic analysis of environmental samples
Summary

- A virtual machine based distribution of Condor execute nodes
- Installs as a single Windows application
- Deployed via standard Windows tools
- Bootstrapping tools for custom distributions
Challenges We’ve Identified

- Distributing small updates to guest operating system
- Identifying some virtual machine failures
- Detecting incorrect BIOS settings
- Dynamically removing “bad” nodes from the pool
- Remote administration of guest machines
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- Condor Team