Virtual Workspace Appliances

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Required Environments

- Diverse client environment requirements
  - Library versions
  - Application versions
  - Custom applications (with possibly complex installs)
  - OS type, version, modules

  vs.

- Provider constraints
  - Security policies
  - Administrator time

Virtual Workspaces: http://workspace.globus.org
What is a Workspace?

Not an entirely new idea. It is possible to create custom execution environments by:

• Dynamically setting up cluster nodes
  • CoD: http://www.cs.duke.edu/nicl/cod/
  • bcfg: http://trac.mcs.anl.gov/projects/bcfg2/
• Providing access to existing installation
  • Dynamic Accounts: http://workspace.globus.org/da/
• Refining site configuration
  • Pacman: http://www.archlinux.org/pacman/

Virtual Workspaces: http://workspace.globus.org
What is a Workspace?

Two aspects of workspaces:

*Environment definition*: We get exactly the (software) environment we need on demand. [[Quality of Life]]

*Resource allocation*: Provision and guarantee all the resources the workspace needs to function correctly (CPU, memory, disk, bandwidth, availability), allowing for dynamic renegotiation to reflect changing requirements and conditions. [[Quality of Service]]

Existing implementations either don't provide both, or...

*Quality of life*: Setting up a new software environment takes a long time, and still doesn't give the resource consumer full control.

*Quality of service*: Little or no enforcement.

Virtual Workspaces: http://workspace.globus.org
Virtual Machines

- VM technology is a promising way to achieve higher quality workspaces.

Virtual Workspaces: http://workspace.globus.org
Virtual Machines

• **Isolation**
  • Security enforced at hypervisor layer
  • Fine grain (alterable) resource allocations
• Flexible **control** and accounting for site
• Customization: any **software** (including legacy)
• Client can have administrator privileges
• Site software requirements reduced to VMM
• **Performance** overhead is becoming acceptable
  • Currently support Xen (studies: *within 5%*)
  • Experimented with VMware in the past

*Virtual Workspaces: http://workspace.globus.org*
Use Cases

• Science
  – Batch jobs that require a very specific software environment
  – Interactive experiments
  – Resource-hungry event-driven jobs

• Education
  – Virtual labs

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The GT4 Virtual Workspace Service (VWS) is a VM-based workspace implementation.

- GT4 WSRF frontend
- Xen-based, but other VMMs can be used (interfaces are generic).
- http://workspace.globus.org/
The workspace service has a WSRF frontend that allows users to deploy and manage virtual workspaces.

The VWS manages a set of nodes (typically a cluster). This is called the node pool.

Each pool node must have a VMM (Xen) installed, along with the workspace backend (software that manages individual nodes).

VM images can be stored on a separate node.

Virtual Workspaces: http://workspace.globus.org
Remote Interfaces

Workspace Factory Service

- Handles creation of workspaces.
- Also publishes information on what types of workspaces it can support

Workspace Service

- Handles management of each created workspace (start, stop, pause, migrate, inspecting VW state, ...)

Workspace Resource Instance

- Resource Properties publish the assigned resource allocation, how VW was bound to metadata (e.g. IP address), duration, and state

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Deployment

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- Metadata
  - Names
  - Image pointers
  - Partition map
  - Networking

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Status

- TP1.2 was released 09/14
- A lot of improvements compared over TP1.1.1
- Highlights
  - Implements the pool model
  - More functionality and deployment options
  - More reliable and manageable internal structure
  - Staging plugins
  - State machine (tracks asynchronous state changes and transitions)
  - Better installation tools
- At least one more release planned by the end of the year, to include (mainly) C client and better IP handling
- To be included in the next VDT release
- VWS is an incubator project in dev.globus

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Who's Using VWS?

- **Open Science Grid**
  - Edge Services
    - [http://osg.ivdgl.org/twiki/bin/view/EdgeServices/WebHome](http://osg.ivdgl.org/twiki/bin/view/EdgeServices/WebHome)
  - STAR application
    - Demo today

- **Intel**
  - GPE (Grid Programming Environment)
    - Includes VWS as part of a grid stack (to set up an execution environment for jobs)

- **New collaborations**
  - Rpath (rBuilder), image/appliance creation
    - Part of demo today
  - Gridway metascheduler
    - [http://www.gridway.org/](http://www.gridway.org/)
Workspaces at SC

• **Booth Talks/Demo**
  • Tuesday 3:30pm
  • Wednesday 5:00pm
  • Thursday 10:30am

• **Poster**
  • *To Bid or Not To Bid: A Hybrid Market-Based Resource Allocation Framework.* Elizeu Santos-Neto and Kate Keahey

• **Paper, VTDC06 (Friday)**
  • *Overhead Matters: A Model for Virtual Resource Management.* Borja Sotomayor and Kate Keahey

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Overhead Matters

- Two types of overhead
  - *Preparation overhead*: staging VM images to physical nodes, preparing a software environment.
  - *Runtime overhead*: resulting from the management of the VMs themselves

- Some models already deal with it by:
  - Assuming the preparation overhead away (e.g. assuming that all possible VM images are already predeployed in all physical nodes, which is a reasonable assumption in certain scenarios)
  - Having runtime overhead invade the user's allocation. The user must factor in overhead when requesting resources.

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STAR Application

www.star.bnl.gov

- Time consuming configuration, specific library needs
  - Doug Olson (LBL):
    - “tends to push the boundaries on what will actually compile”
    - “using rarely used features of the language”
    - “even just validating a new platform is a big job even when it all compiles.”
  - The STAR offline analysis software is about 1.3M lines of code, 2/3 C++, a bit under 1/3 Fortran, and a bit of C.
    - (line counts generated using David A. Wheeler's 'SLOCCount')

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rBuilder to the rescue

- rPath was founded by ex-RedHat luminaries
- Software Appliances (and not just VMs)
- http://www.rpath.com/rbuilder/

Stu Gott, Ken Vandine, and Marty Wesley worked with OSG and Doug Olson to produce a STAR appliance with rBuilder

Running on the Computation Institute's Teraport Cluster at The University of Chicago. Many thanks to Rob Gardner, Greg Cross, Borja Sotomayor, and the Computation Institute.

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Let's see appliances in action ...

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Plots from analyzing STAR data on Teraport Workspaces

Virtual Workspaces: http://workspace.globus.org
Thankyou

http://workspace.globus.org

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