User Defined Runtime Environments using UNICORE

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Agenda

Introduction

Design
  Fitting the Model
  VMM Abstraction
  VM Images
  XaaS

Related Work

Summary and Future Work
Current situation

User accesses Target System

provides

Applications
Current situation

User accesses Target System

wants

provides

Applications
Current situation

User

wants

Applications

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Motivation

User

Image Repository

Resources

VMM/Cloud
Motivation

User → find image → Image Repository

Resources

VMM/Cloud
Motivation

User find image Image Repository

requires Resources

VMM/Cloud
Motivation

User

find image

Image Repository

requires

Resources

provides

VMM/Cloud

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Motivation

User

find image

Image Repository

run VM

requires

Resources

provides

create

Running instance

VMM/Cloud
Motivation

User

find image

Image Repository

resources

requires

provides

run VM

run application

Running instance

VMM/Cloud

create
Use Cases

- Specialized software setup
  - e.g. conflicting with other software configurations
- Specific runtime environments
  - Compiler suite
  - system libraries
  - Kernel
  - OS distribution
  - Applications in general
Fitting the Model
Required Changes

- **TargetSystemFactory**
  - Create TargetSystem according to requirements and given VM image

- **TargetSystem/XNJS**
  - Use a somewhat dynamic configuration taken from the image repository’s metadata
  - Dynamically connect to the TSI inside the running instance
  - Keep track of running instance’s health (Expose status)

- **Client**
  - Query image repository
  - Monitor state of VM instance
  - Provide parameters for instatiating VM images
Abstraction of the VMM

- Numerous virtualization solutions available
  - Xen, QEMU, KVM, VirtualBox, VMware, ...
- libVirt can connect to many of them
- additionally, libVirt does remote management of VMMs
- virtual networks
- storage
VM Image Repositories

- Need to store images plus metadata
  - Operating System
  - Applications provided
  - Requirements
- Will use UNICORE MMF for this purpose
  - Associate metadata with each image
  - Portions of IDB
  - Possibly TSI configuration
- The images themselves will contain the TSI
Image Metadata

- Explicitly set by image creator
- Read by user or orchestration service
- Contents
  - IDB configuration
  - TSI setup, e.g. port numbers
Resource Requirements

VM Image

VMM/TSF
Resource Requirements

VM Image

requires

CPU Architecture
Main Memory
Disk space

VMM/TSF
Resource Requirements

VM Image

requires

CPU Architecture
Main Memory
Disk space

offers

VMM/TSF
Resource Requirements

VM Image

VMM/TSF

CPU Architecture
Main Memory
Disk space

CPU Speed
CPU Count
Network Bandwidth

requires

offers
Resource Requirements

- VM Image
- CPU Architecture
  - Main Memory
  - Disk space
- OS
  - Virt. Memory
  - Applications
- CPU Speed
- CPU Count
- Network Bandwidth
- VMM/TSF
Resource Requirements

VM Image

CPU Architecture
Main Memory
Disk space

OS
Virt. Memory
Applications

CPU Speed
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VMM/TSF

requires

offers

offers

offers
IaaS - PaaS - SaaS

- Infrastructure assumed to be available
IaaS - PaaS - SaaS

- We’ll be able to cover ”Platform as a service” with our implementation
- Infrastructure assumed to be available
IaaS - PaaS - SaaS

- It doesn’t take much to add ”Software as a service” on top
- We’ll be able to cover ”Platform as a service” with our implementation
- Infrastructure assumed to be available
Software as a Service
In order to achieve full SaaS

User → find image → Image Repository

run application

run VM

requires

provides

Resources

create

Running instance

VMM/Cloud
Software as a Service

In order to achieve full SaaS

Orchestrator

Image Repository

find image

run application

run VM

requires

provides

create

Running instance

Resources

VMM/Cloud

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Related Work

- WNoDeS – Worker Nodes on Demand Service
  - LRMS integration
  - gLite Worker Nodes
  - Dynamic Provisioning of Virtual Worker Nodes
  - Use of Grid Resources through Cloud (IaaS) interfaces

- Manageable Dynamic Execution Environments on the Grid Using Virtual Machines
  - Sai Srinivas Dharanikota and Ralf Ratering, 2006
  - similar approach
  - Only OS relevant for image selection
  - Use of Software deployment service
  - abandoned prototype
Summary

- Motivation
  - flexibility in available applications
  - VO specific OS images
  - availability of virtualized hardware

- Design
  - Fitting the UNICORE model
  - Required changes
  - Abstraction of VMM
  - Image Repositories

- Metadata
  - Relation to IaaS, PaaS, and SaaS
  - Related work
Future Work

- Implementation currently ongoing
- Develop an orchestration service capable of providing full SaaS scenario
- Entire clusters of virtual nodes
  - 10,000 cores possible, would have ranked #114 in 2010 Top 500 list
  - Will need more complex setup
  - Multi-core nodes will be possible easily