XtreemOS and Cloud Computing

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XtreemOS in a Nutshell

- An open source Linux-based Grid Operating System with native VO support

- Grid Operating System
  A comprehensive set of cooperating system services providing a stable interface for a large-scale wide-area dynamic distributed infrastructure

- Novel features
  - Scalability and dependability
  - Dynamic and flexible Virtual Organisation management
  - No global scheduler
  - Resource discovery on P2P overlay
  - POSIX/UNIX interfaces for developers and users
  - Support Grid standards (e.g. SAGA)
XtreemOS Software Architecture
Objective: job isolation and fine-grained control of resource usage

Idea: Put each job (PAM session) into a resource container
- A resource container could be seen as either lightweight or heavy-weight virtual machines in a local OS instance
- A resource container allows fine-grained, isolated and strong control of resource usage of a job

Features: Full-fledged control of resource usage by VOs
- CPU: Assignment of cores, bandwidth/percentage/priority/walltime allocation
- Memory: virtual/physical/swap memory limitation
- Disk I/O: disk i/o bandwidth limitation
- Network: network bandwidth/traffic limitation
XtreemOS and Virtualization

VO/Node Policies

Resource Container Management

libvirt

LXC (Linux container)  OpenVZ  KVM  Xen

Control Group  Control Group  ...  Control Group  VPS  VPS  ...  VPS

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- XtreemOS used to build Cloud infrastructures
  - EU FP7 CONTRAIL project, starting in October 2010

- XtreemOS will be extended to globally manage VMs on top of physical resources provided by different sites
  - Instead of running jobs, XtreemOS in CONTRAIL will run VMs
  - CONTRAIL will orchestrate VMs

- Vertical integration of IaaS and PaaS
  - Virtualized resources: computing + network + storage
  - PaaS: map/reduce on GAFS; key/value store; hosting SOA applications; autonomic workflows
XtreemOS and Clouds

Existing approaches

1. XtreemOS Grid

[Diagram showing XtreemOS and Bare HW]

2. IaaS Cloud

[Diagram showing Virtualization and Bare HW]

Extensions to XtreemOS in CONTRAIL

XtreemOS services federate resources (VM) dynamically provisioned from clouds
- standard interface to be interoperable with any cloud (e.g. OCCI, EC2)

XtreemOS “the OS” provides an IaaS cloud spanning multiple sites
- XtreemOS manages VMs running any guest OS requested by customers
- GAFS used to store VM images and as storage for customers data (GAFS driver for the various guest OS, standard Posix interface to the storage)

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Concluding Remarks

- Using a Grid-based OS to build Cloud infrastructures

- XtreemOS provides lightweight virtualization via Linux containers
  - Isolation and fine-grained control of resources

- CONTRAIL will extend XtreemOS to build Clouds infrastructures
  - IaaS: computing + networking + storage
  - IaaS + PaaS in an integrated system

- CONTRAIL e-Science case studies
  - Real-Time Scientific Data Analysis (STFC ISIS)
  - High-throughput Electronic Drug Discovery (Constellation)
  - Distributed Provision of Geo-referentiated Data (Tiscali)