

XtreemOS

*Enabling Linux
for the Grid*



XtreemOS and Cloud Computing

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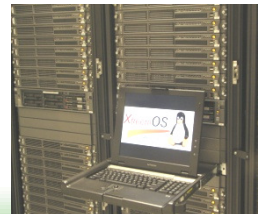
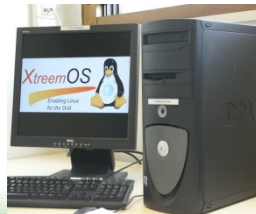
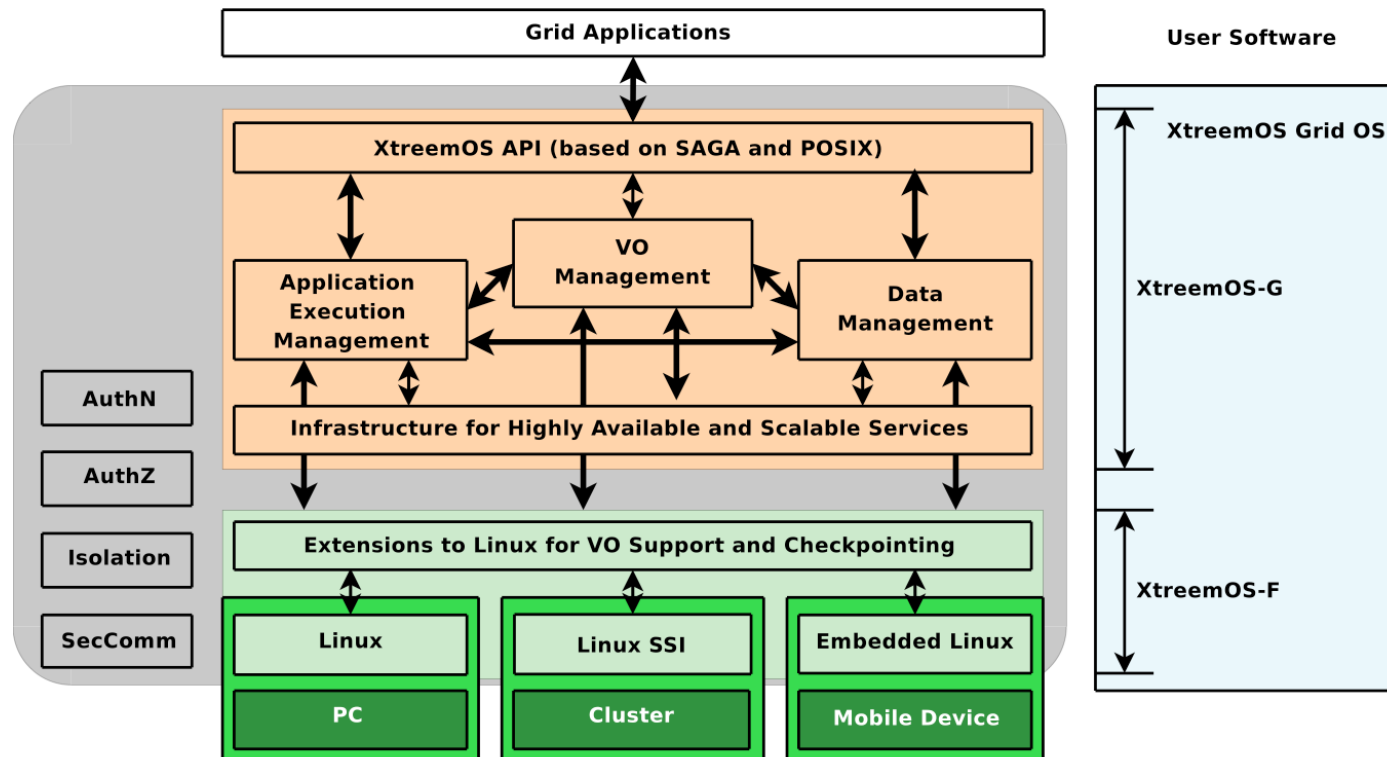
XtreemOS in a Nutshell

- 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





XtreemOS and Virtualization

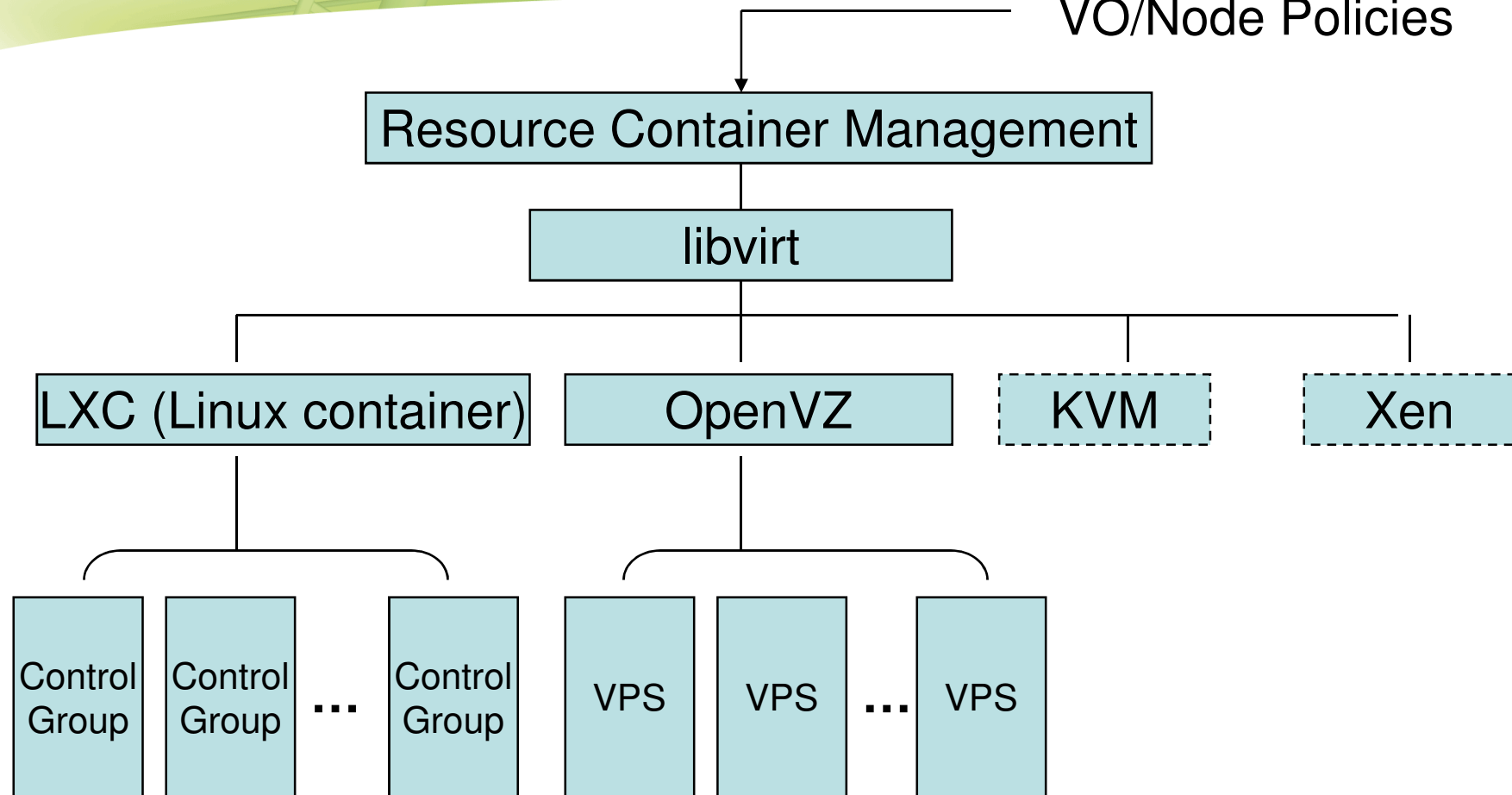
- **Objective: job isolation and fine-grained control of resource usage**
- **Idea: Put each job (PAM session) into a resource container**
 - A resource container could be seen as either lightweight or heavy-weight virtual machines in a local OS instance
 - A resource container allows **fine-grained**,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





- **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

XtreemOS

Bare HW Bare HW Bare HW Bare HW

2. IaaS Cloud

Virtualization

Bare HW Bare HW Bare HW Bare HW

Extensions to XtreemOS in CONTRAIL

XOS over Clouds

XtreemOS

Virtualization Virtualization

Bare HW Bare HW Bare HW Bare HW

XOS for IaaS

Virtualization

XtreemOS

Bare HW Bare HW Bare HW Bare HW

XtreemOS services federate resources (VM) dynamically provisioned from clouds

- standard interface to be interoperable with any cloud (e.g. OCCl, 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)





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)

