XtreemOS
Enabling Linux for the Grid

An Open Source Grid Operating System

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Outline

- What is XtreemOS?
- Why a Grid Operating System?
- What can XtreemOS do for you?
- Why Open Source?
What is XtreemOS?
A Linux-based Operating System

with native Virtual Organization support

for Next Generation Grids
"A fully distributed, dynamically reconfigurable, scalable and autonomous infrastructure to provide location independent, pervasive, reliable, secure and efficient access to a coordinated set of services encapsulating and virtualizing resources (computing power, storage, instruments, data, etc.) in order to generate knowledge"
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Data Centers

Cloud Computing

Next Generation Grids

Service Infrastructures

Internet of the Future
Virtual Organizations

- “A Virtual Organization is a coalition of entities that pool resources to achieve common objectives.
- The coalition can be temporary or permanent.
- The entities can be individuals, groups, organizational units or entire organizations and are normally geographically dispersed.
- The resources can be physical equipment such as computing or other facilities, or other capabilities such as knowledge, information or data”
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Site 1

Site 2

Site 3

Site 4

VO A

Organization 1

Organization 3

VO Admin

Site admin

VO B

Organization 2

Organization 1

VO Admin

Site admin

WAN

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Information Society
Technologies

Enabling Linux for the Grid
Why a Grid Operating System?
Example: Globus Toolkit

![Globus Toolkit Diagram](image)

Core GT Component: public interfaces frozen between incremental releases; best effort support

Contribution/Tech Preview: public interfaces may change between incremental releases

Deprecated Component: not supported; will be dropped in a future release

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Grid Operating System

Grid OS

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- A comprehensive set of cooperating system services ...
- ... providing a stable interface ...
- ... for a wide-area dynamic distributed infrastructure ...
- ... composed of heterogeneous resources ...
- ... spanning multiple administrative domains
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What can XtreemOS do for you?
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Manage your Virtual Organizations

- **Objectives**
  - To allow secure interaction between users and resources
  - Authentication, authorization, accounting

- **Challenges**
  - Interoperability with diverse VO frameworks and security models
  - Flexible administration of VOs
  - Flexibility of policy languages
  - Embedded support for VOs in the OS
  - No compromise on efficiency, backward compatibility
Use cases

- **VO Admin**
  - Manage VO lifecycle
  - Manage users
  - Manage resources
  - Manage VO policies

- **Site admin**
  - Register resources
  - Manage Node policies
  - Manage relationships with VOs

- **VO user**
  - Register with a VO
  - Manage user policies
  - Logon to a VO

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Manage your applications

- **Objectives**
  - Start, monitor, control applications
  - Discover, select, allocate resources to applications

- **Challenges**
  - Deal with a large variety of resources with changing conditions over time
  - Cost to obtain system information and take appropriate decisions has to be orders of magnitude less than in Grid middleware-based systems
  - Take advantage of accurate information for better scheduling control
Main features

- No global job scheduler
  - Distributed management of jobs
- No assumption on local node RMS
  - AEM can be used without any batch system
- Resource discovery based on overlay networks
  - Structured and unstructured
  - Multi-criteria and range of values queries
- Checkpoint/restart mechanisms for Grid jobs
Some boxes and arrows

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Manage your data

- **Objectives**
  - Transparent access to data
  - Provide to users a global view of their files

- **Challenges**
  - Efficient location-independent access to data
  - Grid users from multiple VOs
  - Data storage in different administrative domains
  - Autonomous data management with self-organized replication and distribution
Main features

- XtreemFS, a POSIX compatible object-based file system targeting WANs
- Metadata management
- Replication of files
  - Primary/secondary with automatic failover
  - Fully synchronous to lazy data replication
- Striping (parallel read and write)
- Client-side caching and cache consistency
Some boxes and arrows

- Object-based
- Replicated
- Parallel
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Scalability

- **Scale**
  - Thousands of nodes in thousands sites in a wide area infrastructure
  - Thousands of users

- **Heterogeneity and dynamicity as a consequence of scale**
Transparency

- **Bring the Grid to standard Linux users**
  - Feeling to work with a Linux machine
  - Posix interface and semantics to access files regardless of their location
- **VO can be built to isolate or share resources**
- **Make Grid executions transparent**
  - Same system calls: wait for a job, send signals to a job
- **Standards**
  - OGF: SAGA, GLUE, JSDL
  - SSL, PKI, X509, XACML...
Security

- Secure operation within a Virtual Organization
  - Grid user and service mutual authentication
  - Confidentiality and integrity of stored and communicated data
  - Authorized access to data, services, resources
  - Isolation
  - Accountability of data access and service execution
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XtreemOS flavours

Stand-alone PCs

Clusters

Mobile devices
Cluster flavour

- **Linux based Single System Image cluster OS**
  - Illusion of a powerful SMP machine running Linux
- **Leverage Open Source project Kerrighed**
  - Posix compliant interface validated by Linux Test Suite
  - Check it at [http://www.kerrighed.org](http://www.kerrighed.org)!
Integration of XtreemOS services in mobile Linux

- Enabling Grid operation in an efficient and transparent way

Targets

- Grid-aware use cases
  - Grid users on the move
- Grid-transparent use cases
  - Services provided through a Grid infrastructure without the end users knowing it
Why Open Source?
Open Source in XtreemOS

- **Our goal**
  - Build and promote a Linux-based operating system to support Virtual Organizations for Next Generation Grids

- **We're a Grid project and our principal result will be Open Source Software**
  - The involvement in and from the OSS community will play a key role in the success of the project

- **Our OSS goal**
  - Build a community of users and developers
  - Provide value to the OSS community and obtain a payback from it later!
Open Source in research projects

- Research projects do not look like the usual OSS project
  - The community: partners distributed geographically

- People building the community is different
  - Industrial partners looking for results
  - Academic partners looking for papers
  - Not necessarily skilled in OSS project

- However, OSS offers a lot of opportunities
Strategy

- Identify groups of interest in the OSS community
  - For example those already involved in OSS Grid projects
- Make specific results of the project public and self-contained as soon as possible
- Create a XtreemOS brand for Grid Open Source Software projects
- Implement methodologies to ensure quality and trust and coordinate a distributed development

Licensing
- GPL for the Foundation layer
- BSD for the Grid layer (GPL for XtreemFS)
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To sum up

- XtreemOS is not yet another Grid middleware

- Operating system for large scale wide-area platforms distributed over multiple administrative domains
  - Comprehensive set of cooperating services
  - Native Virtual Organization Support
  - Posix compatible
To sum up

- **XtreemOS is an Open Source project**
  - Check project details at [http://www.xtreemos.eu](http://www.xtreemos.eu)
  - Project in SF.net
    - [http://sourceforge.net/projects/xtreemos/](http://sourceforge.net/projects/xtreemos/)
      - Open development from September 2008, right now cleaning the code :-/

- **First release is almost here!**
  - Mandriva-based Linux distribution
  - Email contact@xtreemos.eu to join the pioneer users group!
Thanks for your attention!

Questions and answers?

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