



**XtreemOS**  
Enabling Linux  
for the Grid



XtreemOS, an Open-source Grid Operating System  
targeting the Future Internet


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ConfSL 09 Bologna, 11-12 Giugno 2009

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**Summary**





ISTITUTO DI SCIENZA E TECNOLOGIE  
DELL'INFORMAZIONE "A. FAEDO"

- The XtreemOS project
- Open source philosophy
- System Architecture
- Some XtreemOS Modules
- Key Applications
- Development plan and releases
- Developers' and Users' resources

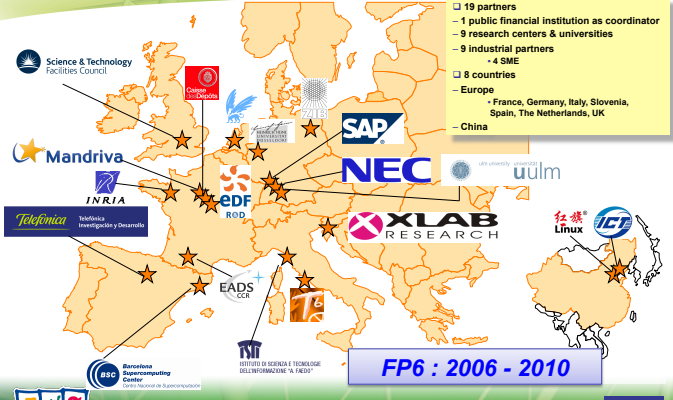
We wish to thank C. Morin, A. Arenas, Y. Jegou and other XtreemOS researchers for some of these slides



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**XtreemOS consortium**





- 19 partners
  - 1 public financial institution as coordinator
  - 9 research centers & universities
  - 9 industrial partners
- 4 SME
- 8 countries
  - Europe
    - France, Germany, Italy, Slovenia, Spain, The Netherlands, UK
  - China

FP6 : 2006 - 2010




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**Computational Grids**

- The analogous of Power Grids for Computational Capability
  - allow any user to access a variety of computers scattered around the globe, and exploit them to run his programs
  - employ a middleware to interconnect resources and adapt the interfaces
  - In principle: geographic size, heterogeneous and dynamical platforms, providing sophisticated functions



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## Computational Grids


- **In practice:**
  - resources are homogeneous clusters,
  - applications are MPI computational simulations
  - exploiting the platform can be cumbersome,
  - often the task is left to the application programmer

```
$ gftp A
> put program
> put data
$ gftp B ...
$ gftp C ...
...
```

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## XtreamOS 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)

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## Virtual Organization (VO)

- **Temporary or permanent alliances of enterprises or organizations**
  - sharing resources, skills, core competences
  - to better respond to business opportunities or large scale application processing requirements
  - whose cooperation is supported by computer networks

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## Large Scale Dynamic Grids & VO



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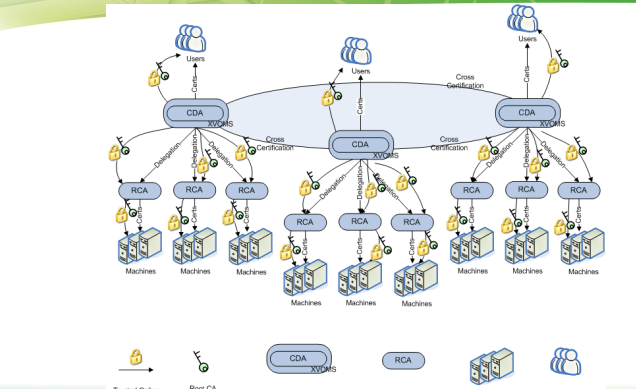
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**XtreamOS**  **VO Management**  
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- **Scalability of management of dynamic VOs**
  - Dynamic mapping between Grid VO users & Linux entities with no modification to Linux kernel
    - No centralized Grid-wide data base, no grid map file needed
- **Flexible administration of VOs**
  - Multiple VO models supported
  - Hierarchical policy management (VO, resource, user)
  - Accountability of data access and service execution
- **Single-Sign-On and Delegation**
- **Interoperability with third party security infrastructures**
  - Kerberos, LDAP, Shibboleth...

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**XtreamOS**  **XtreamOS Trust Model**  
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**XtreamOS**  **OPEN SOURCE PHILOSOPHY**  
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**OPEN SOURCE PHILOSOPHY**

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**XtreamOS**  **XtreamOS and Open-source**  
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- **XtreamOS Contribution**
- **Use of open source software**
- **Interaction with the community**
- **Software developed is open-source licensed**
  - either GPL ( $\geq 2$ ) or BSD license
  - can vary to comply with constraints imposed by existing code

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**XtreamOS**  **The Open Source XtreamOS Philosophy**


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- **No need to reinvent the wheel!**
- **Current Linux-related technologies are exploited**
  - kernel modules
  - Pluggable Authentication Modules
  - kernel keyring retention system
  - Access Control Lists
- **Avoid/minimize patches to existing code**
- **Exploit available subsystem to build the distributed infrastructure**
  - add new daemons, do not change existing tools

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**XtreamOS**  **XtreamOS = eXtreme Open Source**


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- **We seek integration with the o.s. community**
  - Develop code that is useful to other  
→ it will be further developed
  - Apply and develop existing code  
→ contribute to the o.s. movement
  - Develop useful subsystems
  - Do not bloat code with tons of patches  
→ reliable complex system (e.g. kernels...) would get too many errors → developers would drop our patches
- **Do not build cathedrals in the desert!!**

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**XtreamOS**  **XTREEMOS ARCHITECTURE**


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**XTREEMOS ARCHITECTURE**

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**XtreamOS**  **XtreamOS Architecture**

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**XtreamOS Architecture**

Business Applications      Scientific Applications

XtreamOS API

VO & Security      Data Management      Application Management


Infrastructure for Highly Available and Scalable Services

Linux-XOS: Grid-enabled Linux Operating System


Linux-XOS for PC      Linux-XOS for Cluster      Linux-XOS for Mobile Devices


XtreamOS-G

XtreamOS-F

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**XtremOS**  **Single Workstations**

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- A set of packages on top of a Linux distribution
- Mandriva, Red Flag
- Additional daemons, services and modules (PAM)
- XOS use is basically transparent
  - for instance : ps → xps
- Most machines are both **clients** and **resources**
- **core** machines
  - additional infrastructure services, always online
- **clients** and **resources** are dynamically managed
  - can join/leave



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**XtremOS**  **Cluster SSI**

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- **Single-System-Image**
  - coordinated kernel instances in a cluster
  - processes migration on-the-fly
  - cluster-wide virtual memory, device availability
  - abstraction : a huge multiprocessor Linux machine
  - customized kernel
    - Kerrighed technology

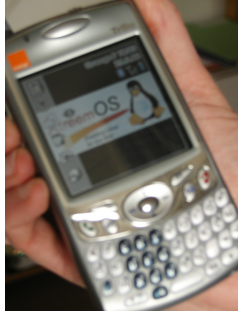




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**XtremOS**  **Mobile Devices**

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- **Client node XtremOS distribution**
  - Linux mobiles/PDA
  - Currently on top of Maemo
- **XtremOS clients**
  - log in as VO users
  - access user's data
  - use VO resources
  - steer applications





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**XtremOS** 

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## SOME KEY MODULES

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**XtreemOS SRDS**

- **Service and Resource Directory Service**
  - Common service for all XtreemOS modules
- **Scalability to Grids**
  - 1K to 100K nodes = *can't be centralized!*
- **Reliability and Self-healing**
  - Stand a degree of resource failure with no/minimal loss, readjust after local faults
  - Should recover after a crash/reboot
  - Authorization/security support
  - Ease of management
- **P2P approach!!**

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**XtreemOS SRDS architecture**

- **Provide information to several clients**
  - resource location and monitoring
  - application execution
- **One service integrates multiple P2P networks**
  - One instance of SRDS on each XtreemOS resource
- **Distributed Hash Table P2P networks**
  - OverlayWeaver
  - Scalars
- **Hierarchically Structured P2P networks**
  - Resource Selection Service
- **Adaptive configuration**
- **Easy extensibility**

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Plenary Meeting, Rennes, January 21st-25th, 2008 - WP 3.2 / SRDS status report

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**XtreemFS main facts**

- **A global FS scalable to Grid environments**
- **XtreemFS goes across multiple VO**
  - Users from different VO can see the same data
  - First time in a grid system
  - Many security issues
- **Follows the object oriented file-system paradigm**
  - A file is divided in data objects
  - Each object can be located in a different resource
  - No metadata is kept in the objects
- **POSIX layer based on FUSE for transparent use**

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**XtreemOS Architecture: global picture**

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## KEY APPLICATIONS

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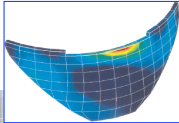

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## Key Applications

- **Distributed simulation of physical behaviour**
  - Code coupling
- **Computing resources used on demand**
  - Many applications of moderate size, many users
- **Business services**
- **New & large scale applications**
- **Legacy applications**  
Linux, POSIX

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## Upcoming applications

- **Shared computing platforms**
  - Resource federation, multi-Vo execution platforms
- **Pervasive application on Ubiquitous platforms**
  - Clusters, single users and mobile devices

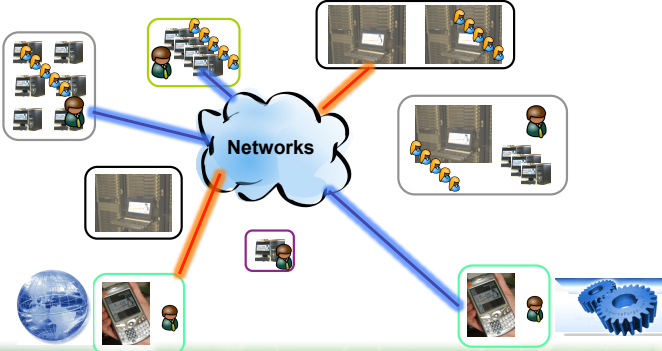
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## Pervasive Mobile Applications




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# DEVELOPMENT PLAN

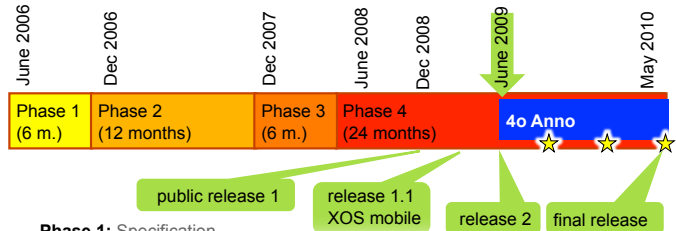


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# XtreamOS Work Plan





**Phase 1:** Specification  
**Phase 2:** Design and implementation of basic version of XtreamOS components  
**Phase 3:** Integration of XtreamOS components  
**Phase 4:** Design and implementation of XtreamOS advanced versions

Main releases once a year + intermediate releases



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# Where to get XtreamOS


**Official WWW and Blog**  
<http://www.xtreemos.eu>  
<http://www.xtreemos.org/blog>

**Mirror for CD Images**  
<ftp://ftp.free.fr/mirrors/ftp.mandriva.com/MandrivaLinux/devel/iso/xtreemos/XtreamOS>

**Mobile distribution**  
<ftp://ftp.free.fr/mirrors/ftp.mandriva.com/MandrivaLinux/devel/xtreemos/2008.0/mobile/>



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# Community tools

**TikiWiki site**  
<http://xtreemos.wiki.irisa.fr/>

**Developer mailing list**  
<http://lists.gforge.inria.fr/cgi-bin/mailman/listinfo/xtreemos-developers>

**IRC user support channel to be activated on**  
[irc.freenode.net](http://irc.freenode.net)

**XtreamOS Development site**  
<https://gforge.inria.fr/projects/xtreemos/>

**Public SVN**  
<http://gforge.inria.fr/plugins/scmsvn/viewcvs.php/?root=xtreemos>


**Architecture documents**  
<http://www.xtreemos.eu/publications/project-deliverables/>



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## Academic Events

- **Upcoming XtreemOS Demos**
  - June 23-26, 2009: **ISC '09**, Hamburg, Germany
  - November 14-20, 2009: **SC '09**, Portland, Oregon, USA
- **XtreemOS Summer School, Oxford, UK**
  - Wadham College, September 7-11, 2009




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## XtreemOS Future

- **Contributions are needed**
  - O.S. Community contribution is essential
  - Beta-users
  - Early adopters
  - Experimentation with various applications
  - Interested Developers
- **Separate adoption of modules and flavours**
  - XtreemFS
  - Workstation / Mobile / SSI




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is funded by the [ConfSL 09 - Bologna 13 Giugno 2009](#) ST-PP-6-033576

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## Conclusions

- **XtreemOS makes Grids**
  - Easier to use
  - Easier to build
  - Safer to use
- **But Grids are not the end!**
  - Pervasive, ubiquitous open source platform
  - Infrastructure suited to deploy Virtualisation Technologies
  - Open toward Cloud and Service Computing
- **Open source is the key**
  - No such platform can exist without community support



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## Thanks for your attention

**Questions are welcome!**

<http://www.xtreemos.eu>  
<http://www.xtreemos.org/blog>


**Mirror for CD Images**  
<ftp://ftp.free.fr/mirrors/ftp.mandriva.com/MandrivaLinux/devel/iso/xtreemos/XtreemOS>

**Mobile distribution**  
<ftp://ftp.free.fr/mirrors/ftp.mandriva.com/MandrivaLinux/devel/xtreemos/2008.0/mobile/>




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**Some numbers**

- **105 Developers**
- **Packages**
- **Activity Percentile: 99.47%**



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