XtreemOS

Enabling Linux
for the Grid

XtreemOS:
Evolving from a Grid to a Cloud Computing System

Christine Morin

XtreemOS scientific coordinator

INRIA Rennes-Bretagne Atlantique

Second XtreemOS Summer School – July 5, 2010

XtreemOS IP project
is funded by the European Commission under contract IST-FP6-033576

Information Society Technologies

Welcome

- **Second XtreemOS Summer School**
  - Reisensburg Castle, University of Ulm

Acknowlegments

- **Organization Committee**
  - Prof. Franz Hauck, University of Ulm, Germany
  - Dr. Alvaro Arenas, STFC, UK
  - Dr. Yvon Jégou, INRIA, France
  - Sandrine L'Hermitte, INRIA France
- **All lecturers**

Invited Speakers

- Ruben S. Montero, UCM, OpenNebula
- Bernhard Schott, Platform Computing, DGSI coordinator

Objectives of XtreemOS Summer School

- To introduce participants to emergent computing paradigms such as grid and cloud computing
- To provide lectures and practical courses on novel techniques to achieve scalability, highly availability and security in distributed systems
- To present grid applications in the domains of E-science and business.
- To provide a forum for participants to discuss your research work and share experience with experienced researchers.

Outline

- Welcome to XtreemOS summer school
- **Brief introduction to XtreemOS Grid operating system**
- **XtreemOS & Cloud computing**
- **Conclusion**

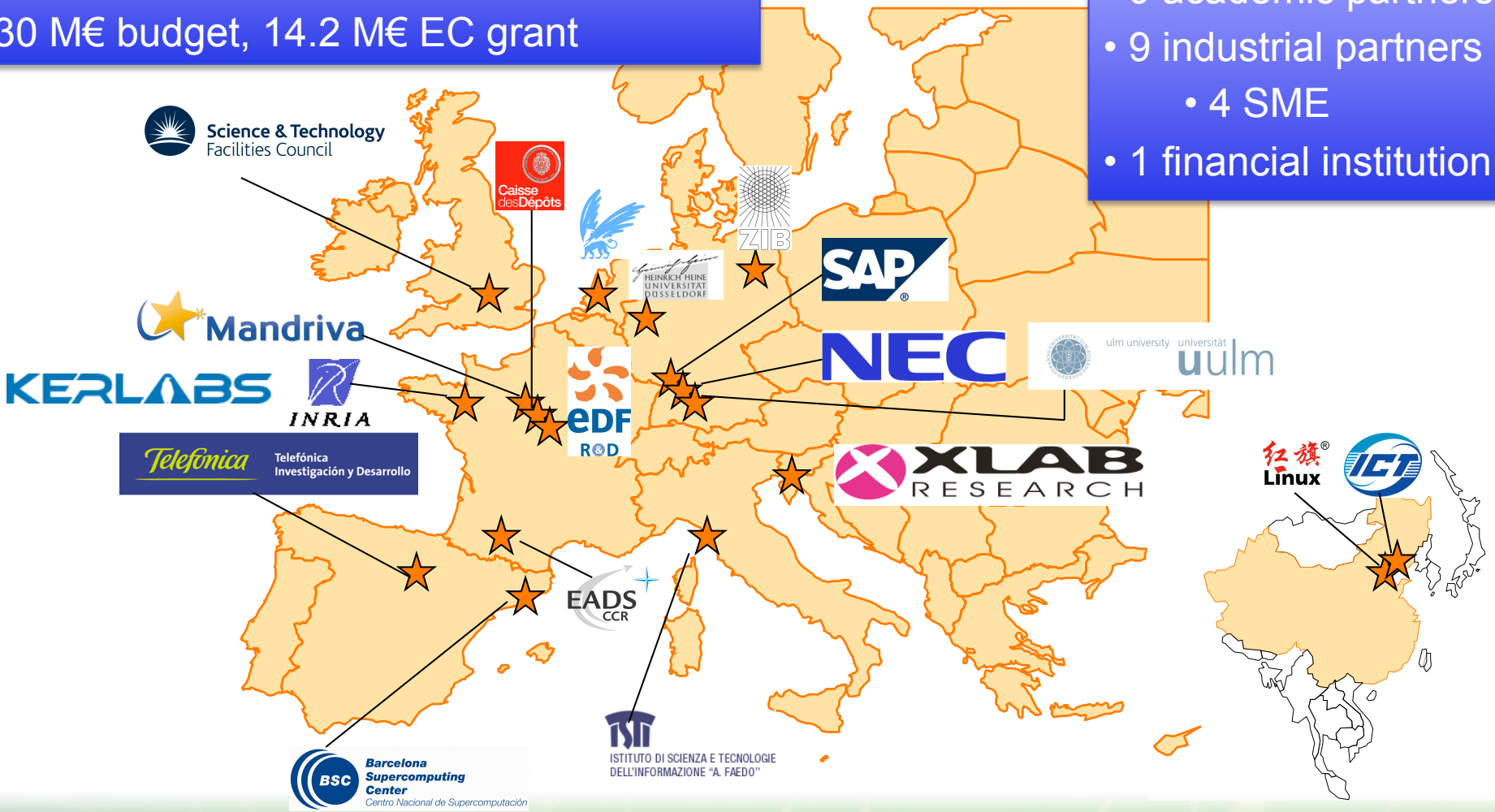
XtreemOS European Project

- **Objective**
  - Design, implement, validate, promote an open source Linux-based Grid Operating System

XtreemOS Consortium

- 4-year IP project started in June 2006 in the FP6 framework
- 30 M€ budget, 14.2 M€ EC grant

- 9 academic partners
- 9 industrial partners
  - 4 SME
- 1 financial institution



XtreemOS Open Source Grid System

- **Grid distributed operating system**
  - Scalability
    - Scale with the number of entities and adapt to evolving system composition
      - Target large scale highly dynamic grids spanning multiple administrative domains
      - Dependable system
  - Bring the Grid to standard users
    - Ease of use, management & programming
      - Provide Posix/Unix interface
      - Based on Linux operating system
    - Efficient, reliable and secure application execution
      - Legacy applications
      - Grid applications (SAGA)

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Enabling Linux for the Grid

XtreemOS Key Features

- **Scalable VO management**
- **XtreemFS Grid file system**
  - Transparent & efficient data access
- **Unix-like job management**
- **Support for interactive jobs**
- **Accurate & adaptable monitoring**
- **Decentralized resource discovery based on overlays**
- **Single-Sign-On**
- **Generic checkpointing service for distributed applications**
- **Tool for auto-configuration & automatic deployment**

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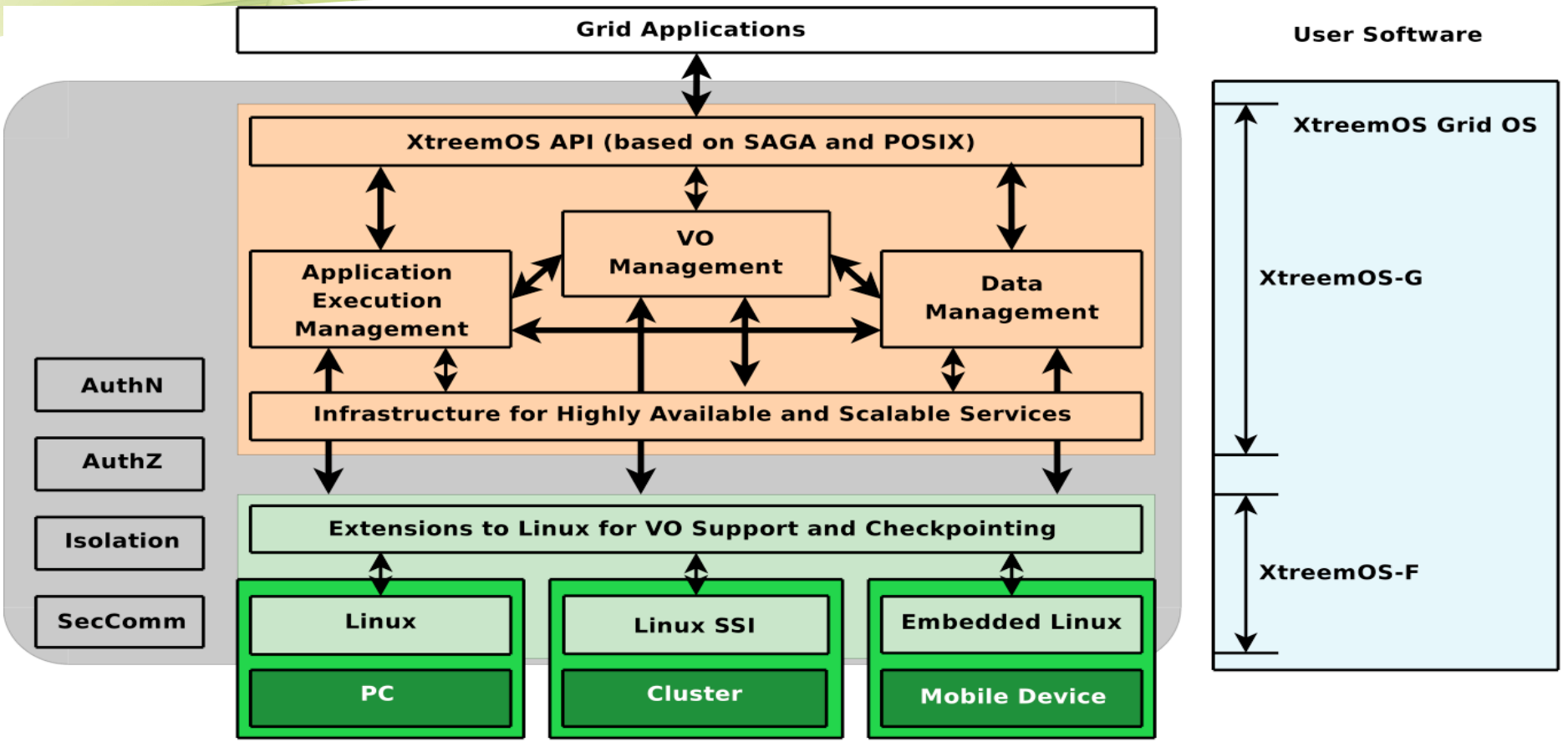
XtreemOS Architecture



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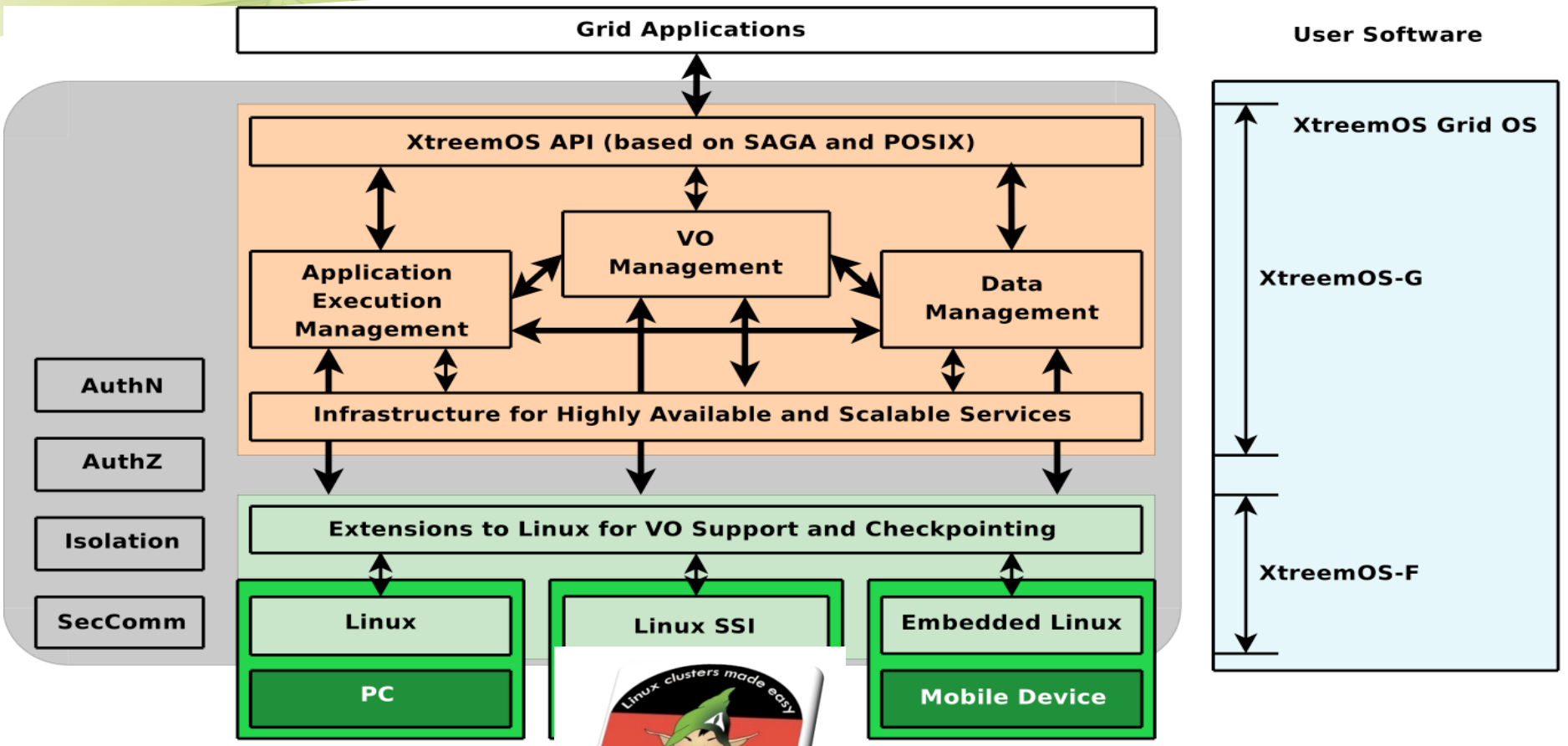
XtreemOS Architecture



XtreemOS Today

- Release 2.1.1 available for PC, cluster, mobile device
- Packaged in Mandriva & Asianux Linux distribution
- VM images available for KVM and Virtual Box
- Internal development testbed
- Open permanent testbed

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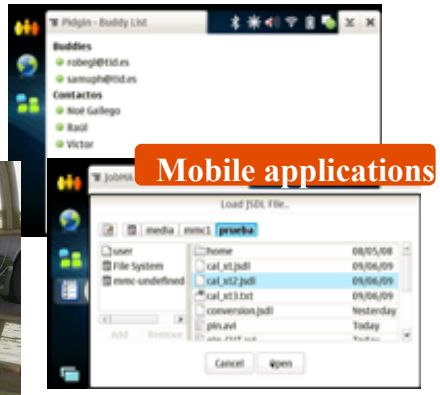
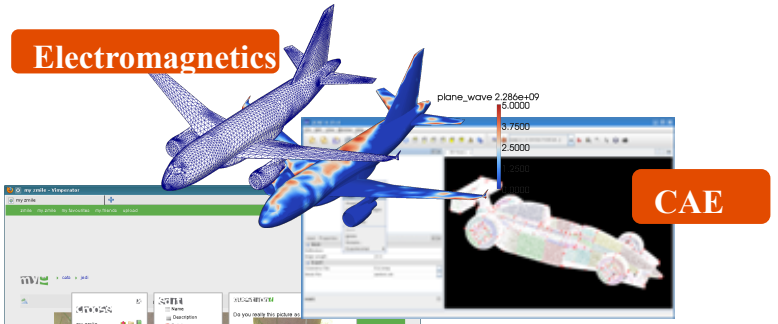
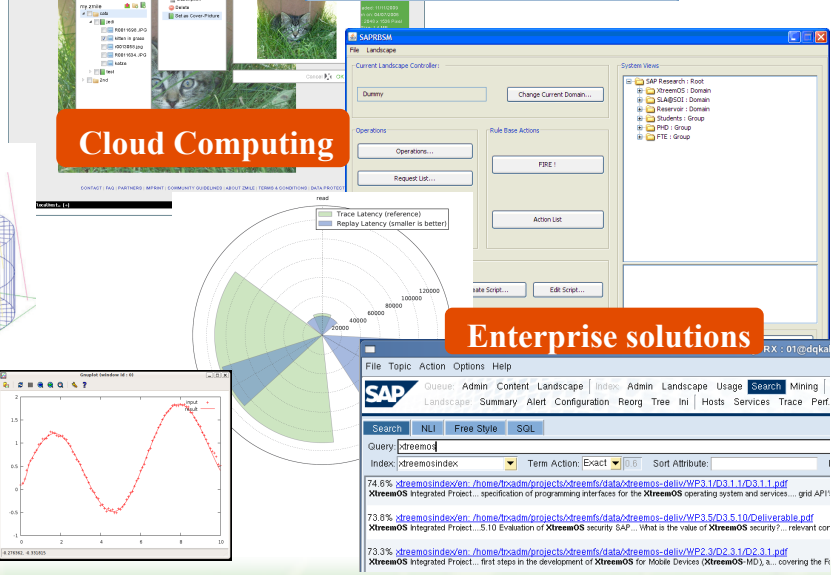
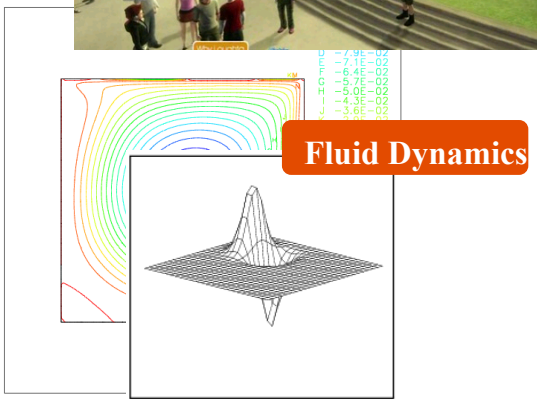
Overview of Applications

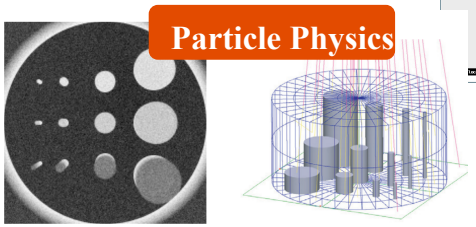
19 applications demonstrating and evaluating XtreemOS from the perspective of industrial and academic end-users

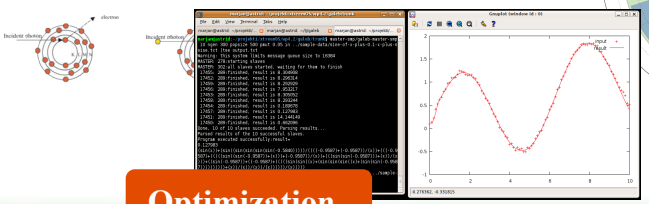












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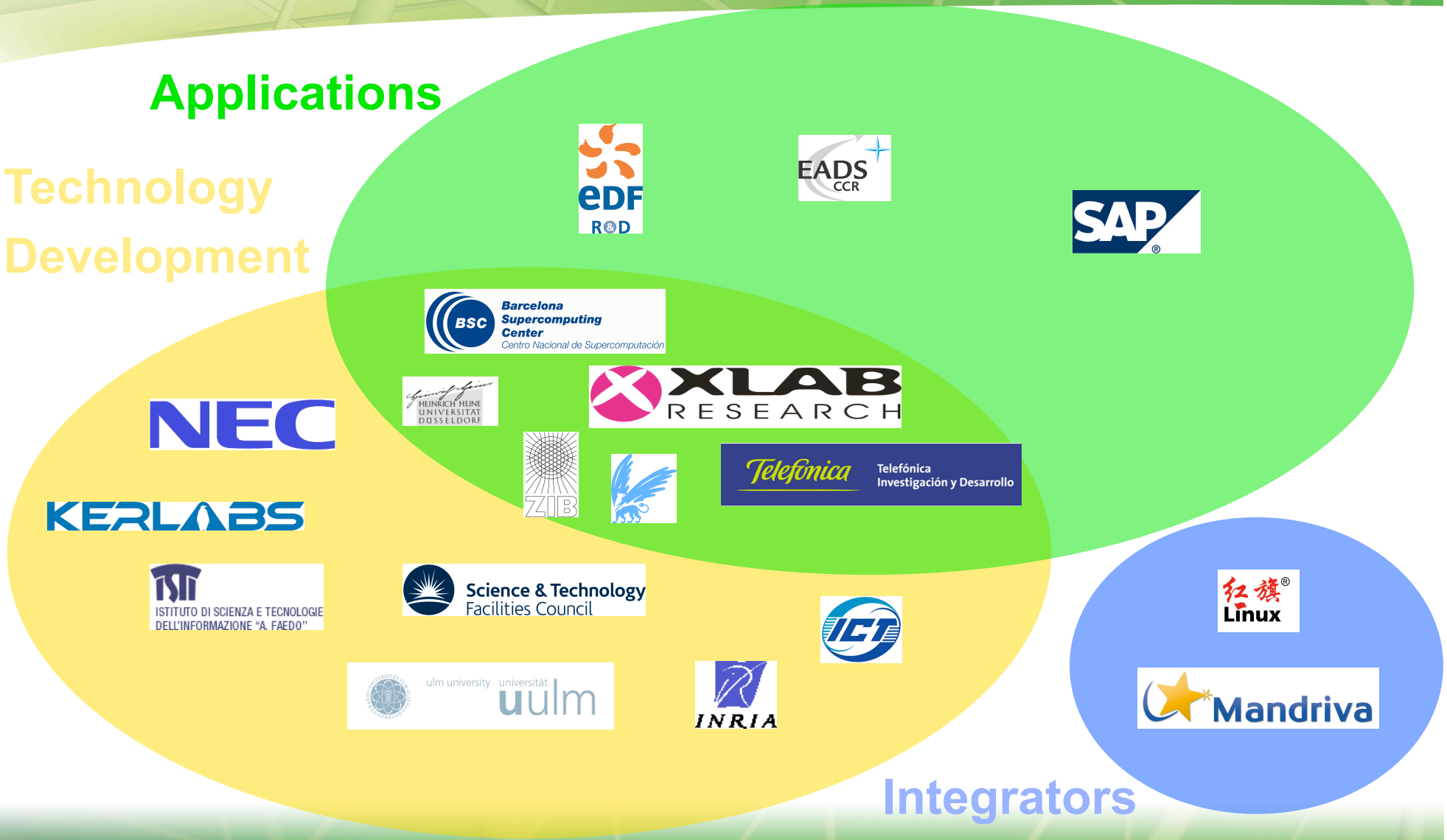
Partners Involvement



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XtreemOS Summer School

XtreemOS summer school 2010 (July 5-9)
Reisensburg Castle, the science center of Ulm University (Germany)

-Draft programme -

Time	Monday July 5	Tuesday July 6	Wednesday July 7	Thursday July 8	Friday July 9
09:00-10:30	Arrival of participants	VO Mgmt & security (A. Arenas)	Scalaris: Pub/Sub system (J. Stender)	Virtual Nodes (J.Domaschka)	Grid Checkpointing (J. Mehnert-S.)
		XtreemFS File System (J. Stender)	Application Execution Mgmt (R. Nou)	Byzantine Fault Tolerance (C. Spann)	Object Sharing Service (J. Mehnert-S)
10:30-11:00		Coffee break			
11:00-12:30		Practical session XtreemFS (J.Stender)	Practical session AEM (R.Nou/J.Giralt)	Practical session vnodes (J.Domaschka / S.Kächele/ C.Spann)	Invited talk: **Bernhard Schott** (DGSI coordinator, Platform Computing)
12:30-14:00	Lunch break				
14:00-14:30	Registration	Cluster flavour/ Kerrighed (J. Parpaillon)	Tuto:how to port an application to XOS? (M. Sterk)	XtreemOS applications	Departure of participants *(optional: guided tour in Ulm)*
14:30-14:45	Welcome				
14:45-15:30	Opening talk (C. Morin)	Testbed / deployment (Y. Jégou)	Grid Application Programming (T. Kielmann)		
15:30-16:00	Coffee break				
16:00-17:30	Invited talk: **Ruben S. Montero** (OpenNebula, UCM)	How to manage users and certificates	Practical session SAGA (T.Kielmann)	Doctoral symposium	
		XOS technical demo (M. Sterk)			
19:00-20:00	Welcome reception (incl. Poster/demo)	Dinner	Dinner	School dinner	
from 20:00		FIFA world cup semi-final 1	FIFA world cup semi-final 2		

Outline

- Welcome to XtreemOS summer school
- Brief introduction to XtreemOS Grid operating system
- **XtreemOS & Cloud computing**
- **Conclusion**

XtreemOS and Cloud Computing

- **XtreemOS: a distributed operating system designed for Grids**
  - Project started in June 2006
- **Cloud computing new era started in late 2007**
  - Lots of media attention, new products announced every day, etc.
- **Question**
  - How relevant is XtreemOS in this new context?

Clouds vs. Grids

- **Cloud and Grid computing share many characteristics**
  - *"Clouds are the user-friendly version of Grids"* (Trevor Doerksen, CEO of MoboVivo)
  - Large pools of compute resources available as utilities
  - Statistical multiplexing
  - Emphasis on scalability
- **There are also significant differences**
  - Clouds rely on a pay-as-you-go business model
  - New types of Cloud services are being created

Cloud Computing Functionality

- **Infrastructure-as-a-Service (IaaS)**
  - Delivery of computer infrastructure as a service
  - E.g., Amazon.com's EC2 and S3
  - Many (API-*in*compatible) similar offers from other vendors
- **Platform-as-a-Service (PaaS)**
  - Delivery of a computing platform and solution stack as a service
  - E.g., Google's Map/Reduce, BigTable, AppEngine
- **Software-as-a-Service (SaaS)**
  - A model of software deployment whereby a provider licenses an application to customers for use as a service on demand
  - E.g., Gmail, Google Maps

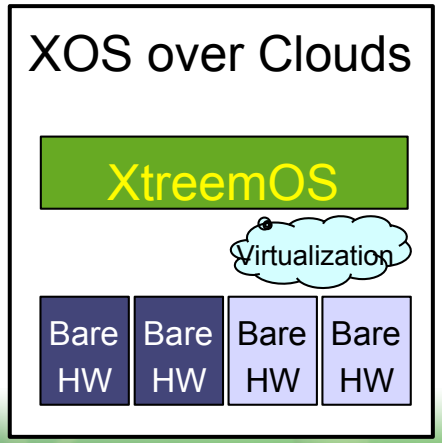
Opportunities

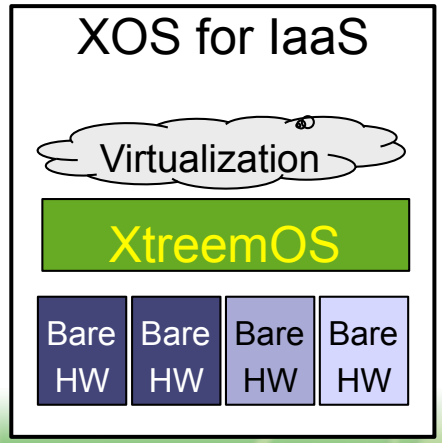
- **Cloud computing recognized as an important paradigm**
  - Flexible & efficient resource management
  - Various domains
    - Scalable service hosting platforms
    - Scientific clouds

- **XtreemOS as a reference open source cloud computing software stack for cloud federations**

XtreemOS & Clouds

- **Feasibility studies**
  - Extending a Grid with resources gathered from Clouds
  - XtreemOS as a system to manage IaaS Clouds
- **Building a Cloud Computing open source software stack based on XtreemOS**
  - CONTRAIL new European Integrated Project
    - starting 10/2010





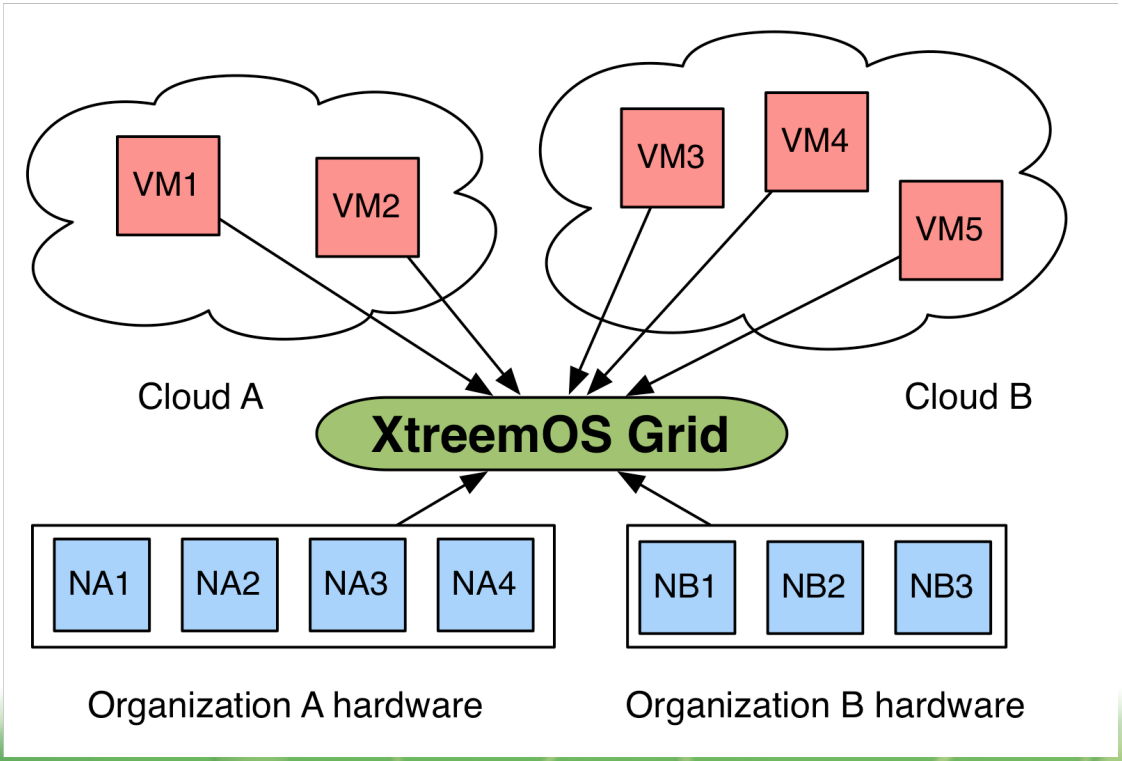
Preliminary Studies

- **XtreemOS directly comparable to IaaS clouds**
  - VM management instead of jobs
  - IaaS cloud federation spanning multiple hardware suppliers
- **Supporting cooperation between different institutions using private, commercial clouds & traditional IT infrastructure**
    - Example: extension of a Grid with virtual resources provided by a cloud
- **XtreemOS: a good starting point to build future PaaS services**
    - Example: Hbase port onto XtreemFS

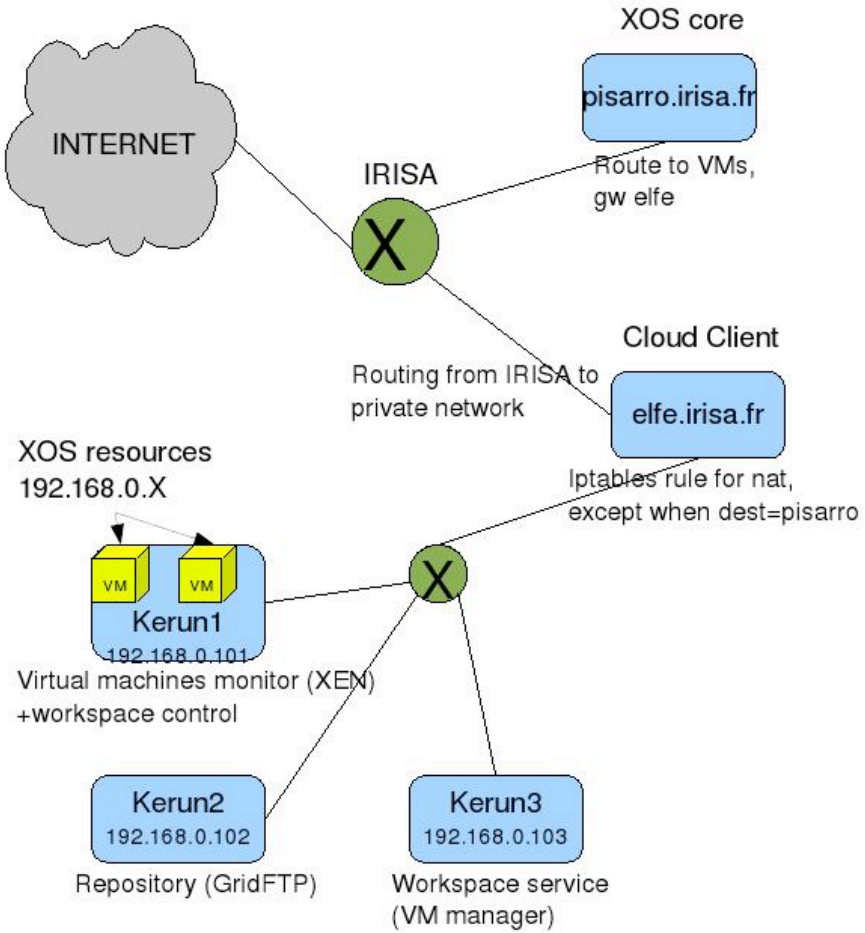
  [work done by Guillaume Pierre at Vrije University Amsterdam – See XtreemOS D3.2.15]

Supporting cooperation between different institutions using private, commercial clouds & traditional IT infrastructures

- **Extension of an XtreemOS Grid with virtual resources obtained from commercial clouds**
  - Dynamic resource provisioning



Experiment: XtreemOS & Nimbus



Automatic deployment of XtreemOS resource node software on Nimbus VMs

Contrail European Project

- **Objectives**
  - Design, implement, evaluate and promote an open source system to federate computing resources from different providers in a single cloud easy to access for users
- **Approach**
  - **Vertical integration of**
    - *Infrastructure-as-a-Service* services
    - Runtimes and high level services providing the foundations for *Platform-as-a-Service* services

Future Internet Engine
CONTRAIL
Seamless Cloud federation through open virtualisation infrastructure

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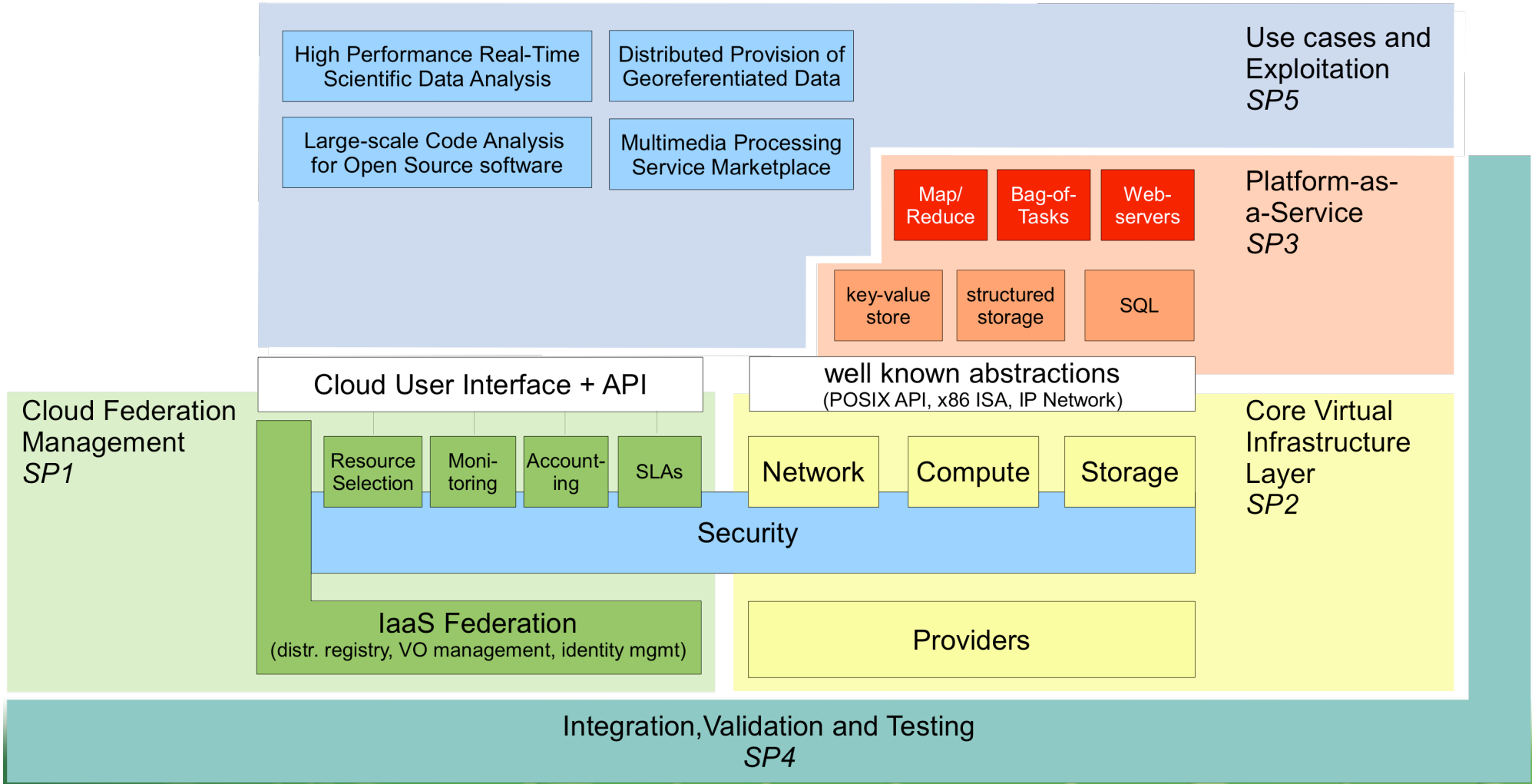
Contrail Overview



Conclusion

- **XtreemOS software available for the community**
  - Open source development
  - XtreemOS 2.1.1 release available
    - Packaged for Mandriva & Asianux Linux distributions
    - Ready to use VM images (KVM, Virtual Box)
  - XtreemOS open testbed
- **XtreemOS & Clouds**
  - XtreemOS Grids extensible with cloud resources
  - XtreemOS is directly comparable to an IaaS platform
  - XtreemOS: a sound platform for providing PaaS

Perspectives

Next goals:

- Sustainability of XtreemOS open source community
  - XtreemOS Grid technology
  - Open permanent testbed
- Making XtreemOS a major platform for utility computing in the coming years
  - CONTRAIL European Project opportunity

More Information

- **Web site: http://www.xtreemos.eu**
- **Software: http://gforge.inria.fr/projects/xtreemos/**
  - GPL/BSD licence
- **Email: contact@xtreemos.eu**