XTREEMOS

Scope

Due to the increasingly changing business environments, one of the key success factors for many companies will be the ability to quickly react to this varying scenario by allocating and accessing the resources (computing power, storage, etc.) required for each situation. Companies in the future will have to adopt more flexible service-oriented business processes under a distributed but collaborative paradigm, involving not only geographically scattered departments and employees but also exploiting collaborative relationships with other organizations. To cope with the need for adaptability at the higher level, the infrastructure at the lower level must support dynamic, on-demand allocation and assembly of resources. FP6 funded Xtreemos project is facing this challenge from a fairly unexplored view: embedding grid features at operating system level. Being now at its halfway, Xtreemos project has just released the first version of Xtreemos open source operating system, targeting both PCs and HPC clusters, while another version for mobile devices is foreseen by the beginning of 2009.

Advances

Unlike most of the work carried out to build grid implementations up to now, namely, building a grid middleware layer on top of existing operating systems (Globus Toolkit, gLite, etc.), Xtreemos project focuses on embedding basic grid services and functionalities directly into the operating system, but also providing appropriate standard interfaces to allow easier development of grid applications. In brief, the main Xtreemos project result is and will be an open source operating system for grid platforms based on general purpose Linux OS, not only targeting PCs but also HPC clusters and mobile devices. Xtreemos will hide the complexity of the underlying grid infrastructure in the same way that a traditional operating system does with local resources, reducing the administrative burden and time-consuming efforts that current middleware solutions imply. Despite the number of technological advances Xtreemos project has achieved so far – support for secure Virtual Organization management, grid file system implementation for distributed data management or job-oriented scheduling for distributed application execution among others –, the main achievement has been the integration of these innovations in a Linux-based operating system. Thanks to Xtreemos transparency, heterogeneity and scalability, a wide range of users are foreseen, ranging from companies offering cloud computing solutions to scientific groups which need high computing power without investing either a large amount of money in specific hardware or a lot of time in administrative tasks.

Positioning in global context

Xtreemos is an appealing alternative to grid middleware like Globus since it overcomes the lack of consistent interfaces that make grid middleware difficult to install, manage and use for large systems. Even though simplifying the middleware layer by integrating it in the infrastructure layer is not an entirely new idea – there have been several initiatives which can be considered inside "grid operating systems" trend – Xtreemos is the first one to target the exploitation of wide area resources for the execution of applications taking into account the heterogeneity of users' devices, from standard PCs to mobile devices, also including HPC clusters.

Contribution to standardization and interoperability issues

An API name space, XOSAGA, has been defined as an Xtreemos specific extension to SAGA (Simple API for Grid Applications). XOSAGA only contains those packages and interfaces that are required by Xtreemos and forms the Xtreemos API jointly with SAGA. This way, Xtreemos is contributing to the development of OGF standard SAGA API name space.

Target users / sectors in business and society

Xtreemos is mainly targeting three kinds of users: (i) systems administrators, in charge of wide grid deployments and/or local resources; (ii) **end users**, including the service administrators that deploy distributed services across the grid infrastructure as well as end users launching applications or using the grid services and resources; and (iii) **application developers** that will implement their applications on top of its standard API.

Inside the Grid value network model, Xtreemos is well positioned to be used by Grid Equipment Providers (technology providers), in charge of providing the technological environment for grid services, Grid Resource Providers (resource providers), which can share the resources by means of Xtreemos VO model, and Grid Operators (system integrators), that buy resources from the Grid Resource Providers and sell a transparent grid solution.

In summary, Xtreemos will become a valuable tool for companies offering grid and, as a consequence, cloud computing solutions (e.g. Amazon S3 and EC2) as well as companies offering resources or companies willing to deploy a large scale geographically distributeded solution across several remote facilities. But Xtreemos is also appropriate for scientific communities due to its open source approach, platform independence and ease of use.

Overall benefits for business and society

Through the introduction of the Unigrids Atomic Services Being an open source Linux-based operating system targeting heterogeneous computing devices, Xtreemos will have a great impact in the new service-oriented marketplace as a consequence of the raising need for on-demand adaptation of the companies' assets to market

requirements. In brief, Xtreemos will allow grid operators to make the grid transparent for their users.
Finally, despite it will not be available until the beginning of next year, Xtreemos MD will allow for accessing the grid on the go, which nowadays is commonly achieved through gateways or grid portals. Overcoming this bottleneck, extended enterprise business model will finally come true.

Examples of use

A financial firm cooperating with research institutions on financial data analysis, a telecommunication service provider performing joint market research with a cell phone manufacturer, or a business solution provider working with a client company all need to share and aggregate data that is stored in a distributed fashion on different computers, while ensuring that their partners can only access selected parts of information and that all information is secured from third party access. Regardless of whether the data is distributed for performance, security or legal reasons, the concept of virtual organizations that is built into the core of Xtreemos allows them to express their needs in the form of VO membership, roles and policies, which are then enforced by the underlying Xtreemos authentication, authorization and auditing based on industry-standard X.509 certificate infrastructure.

Many business applications also require high-performance, high-reliability storage and computing resources, such as distributed databases, large-scale web servers, and aerodynamics calculations in automotive industry. Xtreemos allows them to aggregate multiple resources owned by a single enterprise, their partners on a project and/or external providers. Xtreemos can also transparently improve the dependability of such a system using replication of data and processes.

Achievements

Xtreemos system architecture

- Type: Reference architecture
- Maturity: First version (ongoing activity).

Xtreemos standard flavour

- Type: SW – Operating system modules
- Maturity: Beta version.

Xtreemos cluster flavour

- Type: SW – Operating system modules
- Maturity: Alpha version.

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Building and promoting a Linux-based operating system to support virtual organizations for next generation grids

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