After decades in which companies used to host their entire IT infrastructures in-house, a major shift is occurring where these infrastructures are outsourced to external operators such as Data Centers and Computing Clouds. To allow open access to shared computing resources, the vision of the CONTRAIL project is that any organization should be able to be both a Cloud provider when its IT infrastructure is not used at its maximum capacity, and a Cloud customer in periods of peak activity.

**Goals & Objectives**

The goal of the CONTRAIL project is to design, implement, evaluate and promote an open source system in which resources that belong to different operators are integrated into a single homogeneous Federated Cloud that users can access seamlessly.

CONTRAIL will vertically integrate an open-source distributed operating system for autonomous resource management in Infrastructure-as-a-Service (IaaS) environments, and high level services and runtime environments as foundations for Platform-as-a-Service (PaaS).

To support future technology deployment and uptake, specific case studies will also be conducted within CONTRAIL. They will cover a large scope of applications ranging from the domains of e-business, telecommunication, media, e-science and information technology, and showing a clear convergence of IT, telecom and media platforms.

Case studies will include distributed provision of geo-referentiated data, a multimedia processing service marketplace, Clouds for high-performance real-time scientific data analysis, and large-scale open-source code analysis using Clouds.

---

**At a glance**

**Project title:**
Open Computing Infrastructures for Elastic Services (IP)

**Project coordinator:**
Christine Morin
INRIA (FR)

**Partners from:**
XLAB (SI), CNR (IT), VUA (NL), STFC (UK), GENIAS (NL), TISCALI (IT), ZIB (DE), HP-IIC (IT), Constellation Technologies (UK)

**Duration:**
October 2010 – September 2013

**Total cost:**
e 11.3 M

**Website:**
http://www.contrail-project.eu
Our Vision

CONTRAIL will leverage and extend the results of the XtreemOS FP6 project, which builds a Linux-based operating system to support Virtual Organizations for next-generation Grids. As illustrated in the figure below, the individual resources being contributed to the Federated Cloud will be highly heterogeneous in their hardware configuration and system-level organization.

They may take the form of physical machines running the XtreemOS operating system (see panel 1 from Figure 1), virtual instances from external Clouds (panel 2), virtual machines running XtreemOS (panel 3), or XtreemOS machines running virtualization software (panel 4).

Expected Outputs

The expected outputs of CONTRAIL are as follows:

- A collection of infrastructure services offering network, computation and storage as a service:
  - Services to federate IaaS Clouds
- A collection of PaaS services to support typical Cloud applications
- A collection of run-time environments providing elasticity, scalability and performance dependability to selected classes of applications
- A collection of applications from the domains of e-business, e-science, telecommunication and media using and demonstrating the advantages of the CONTRAIL open-source system.

CONTRAIL will build an open source technology exploiting resource virtualization to provide virtualized distributed infrastructures for supporting the Internet of Services independently from the underlying platform. The project will deliver a unified solution for building private, public and federated Cloud infrastructures. The main innovation of CONTRAIL is the development of an integrated approach to virtualization, offering IaaS services for federating IaaS Clouds, and PaaS on top of federated Clouds.

Robustness being another project priority, CONTRAIL advances will be deployed within a wide array of application use-cases in real-life implementation constraints, in order to facilitate technology uptake and exploitation of the project results. CONTRAIL case studies such as the multimedia processing service marketplace will allow the empowerment of companies offering media and computation services. CONTRAIL will allow new service / media / computation providers to join transparently the platform at any time. CONTRAIL platform will self-adjust to preserve isolation and QoS automatically, without the need for new providers to retarget their business.

Ultimately, CONTRAIL will help to fill the gap in today's business Clouds by providing reliable, transparent and secure Cloud infrastructures. CONTRAIL will also exceed the functionalities of today's solutions by allowing users to choose a trade-off between performance, scalability and isolation. All these features will give CONTRAIL a very good position in the growing Cloud computing market.

 Integrating multiple independent Clouds into a single homogeneous Federated Cloud