# OpenCloudware

## *Towards a PaaS Management Stack over Multiple Clouds*

**WHITE PAPER**

**October 2014**

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The information contained in this White Paper represents the current view(s) and opinions of the OpenCloudware project consortium and is being made available by OW2 in the interest of disseminating knowledge about the management and use of virtual application in multi-cloud environments. The purpose of this white paper is to provide a technical overview of the OpenCloudware multi-IaaS PaaS environment architecture with specific attention given to the identification of new concepts. This paper does not provide an exhaustive discussion of the OpenCloudware multi-IaaS PaaS and is not a competitive analysis between OpenCloudware and other cloud computing interoperability mechanisms. Neither OW2 nor the individuals who contributed to this White Paper make any representation or warranty, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this publication. OW2 assumes no responsibility for liability or damage which may result from the use of any of the information in this White Paper.

About OpenCloudware

The OpenCloudware collaborative project develops an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. The project intends to become the solution for the lifecycle management of virtual applications in multi cloud environments. Started in 2012, OpenCloudware is a three years open source project, initiated and coordinated by France Telecom. The project is supported by 18 partners, funded by the french Fonds National pour la Societe Numerique (FSN) and endorsed by competitiveness clusters Minalogic, Systematic and SCS. Visit www.opencloudware.org

About OW2

OW2 is an independent global industry community dedicated to developing open source code infrastructure (middleware and generic applications) and to fostering a vibrant community and business ecosystem. A non-profit organization, the OW2 Consortium hosts some one hundred technology projects, including ASM, Bonita, CHOReOS, CLIF, CompatibleOne, CONTRAIL, eXo Platform, JOnAS, JORAM, Petals ESB, ProActive, SpagoBI, SugarCRM, Talend Studio, WebLab and XWiki. Visit www.ow2.org

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| OpenCloudware is developed by a consortium of 18 partners, partners bringing together industry and academic leaders, innovative technology startups and open source community expertise. | **Industry Leaders and SMEs:** Bull, France Telecom, Thales Communications, Thales Services. | **Academic Partners:** Inria, IRIT – INP Toulouse, Télécom Paris Tech, Télécom Saint Etienne, Université Joseph Fourier, Université de Savoie – LISTIC. | **Associations and Open Source Community Management:** Armines, OW2. |

**Abstract**

In this white paper, we discuss OpenCloudware, the Open Source Virtual Application Management Solution for Multi-cloud Environments.
OpenCloudware aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. OpenCloudware, a three-year collaborative research project involving eighteen partners is co-funded by French Fonds National pour la Société Numérique (FSN).
The white paper presents the benefits of the platform for cloud services providers, cloud developers and devops teams. It also describes the functional architecture of the project, an overview of its main functionalities, its main software components and the roadmap for future development.

## Introduction

This white paper presents an overview of OpenCloudware, a collaborative research project aiming at providing solutions for the life-cycle management of complex applications running on the cloud, from the development of the application to its provisioning and its operation on any cloud infrastructure.

OpenCloudware aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. It will be available through a self-service portal. OpenCloudware targets virtualized multi-tier applications such as JavaEE - OSGi. The results of OpenCloudware contain a set of software components to manage the lifecycle of such applications, from modeling (Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run) for their deployment, orchestration, performance testing, self-management (elasticity, green IT optimization) and provisioning. Applications will be deployed potentially on multi IaaS (supporting either one IaaS at a time, or hybrid scenarios).

The software developed by the project are made available as open source components through the OW2 Open Source Cloudware initiative.

## OpenCloudware: New Solutions to New Issues

As of today, most of the multi-cloud deployments are hybrid, they include a private part and a public part. Whether for security or economic motivations, private clouds are more and more hybridized with public clouds. For instance, most large companies are often not yet ready to entrust third party cloud service providers with their own data.

Hybrid clouds raise specific challenges, in particular for the deployment of PaaS across different infrastructures. The key challenge here is to maintain a seamless consistency between the different components of the platform. It is more difficult to achieve this at the PaaS level than at the SaaS and IaaS levels.

One key challenge is to manage the lifecycle of applications across different cloud service providers. Questions arise such as how do we hide the technical heterogeneity between the components? Or how do we automate the deployment whatever the application technology and the execution infrastructures?

Deploying PaaS over multiple IaaS raises new issues; hence the need for new solutions.

The objective of OpenCloudware is very ambitious. OpenCloudware develops solutions for the management of the life-cycle of complex applications running on the cloud, from the development of the application to its provisioning and its operation over multiple IaaS.

Whats is OpenCloudware:

- It is a Collaborative Research project, a fairly large one involving eighteen partners, it is funded by French authorities – specifically through the Fonds National pour la Société Numérique (FSN)
- OpenCloudware's main idea is to take into account distributed enterprise applications and to be enable their deployments on any cloud; the aim of OpenCloudware is to allow IT professionals to model distributed applications which can be made of several virtual machines, to assemble them, build, deploy and operate them with the platform as a service (PaaS) layer, and on multiple IaaS, the whole process being IaaS-agnostic.
- OpenCloudware is a three year project launched in January 2012, after an initial design phase a first integrated platform is made available in 2013.

## OpenCloudware Main Benefits for Cloud Service Providers and End-Users

Four simple business cases help demonstrate the benefits of the OpenCloudware platform for the cloud service providers (CSP) and for professional end-users. Companies are now lowering their IT costs by renting industrialized and secured IaaS infrastructures. They are also expanding their internal business application resources with pay-per-use web services. Doing so, they become IT cloud services consumers (CSS). OpenCloudware allow CSPs and CSCs to keep control on application services wherever the IT resources may reside.

1- **OpenCloudware to Simplify Cloud Migrations**

Software editors becoming SaaS vendors, but also software marketplace operators and cloud services brokers may use OpenCloudware technologies to ease cloud migrations. Plugged into a multi-IaaS infrastructure, this open source PaaS (Platform as a Service) helps them select and maintain the best deployment scenario for a given application, based on operational and business criteria.

2- **OpenCloudware to Deploy New Application Services Faster**

Developers, IT administrators and DevOps teams will appreciate OpenCloudware modeling, building and deploying components. Thanks to the aggregation of new metrics and benchmarking algorithms, the platform allows for hybrid cloud deployment scenarios. This will reduce the delays between virtual applications development, tests and deployment phasis. Over time, the production resources to run the new services will be automatically optimized, through a combination of IaaS.

3- **OpenCloudware to Provide a Real Cloud Bursting Experience**

Considering the Quality of Service management at each step of the PaaS lifecycle management, OpenCloudware contributes to adapt the production infrastructure to the end-users needs, on private, public and hybrid clouds. This can be done within a range of predefined resources pool. Moreover, the platform provides a continuous monitoring of the multi-IaaS infrastructure supporting virtual applications. The compliance of the application services are evaluated through simulations, then controlled and maintained through new metrics and dynamic provisioning at the runtime.

4- **OpenCloudware to Create Robust Disaster Recovery Solutions**

Specific backup and replication software are required to save and restore virtualized applications. Those additional solutions are presently perceived as hidden costs after a cloud migration. The main problem in Disaster Recovery is not to replicate data to a distant IT room or to a remote datacenter, but rather to provide efficient recovery mechanisms to eliminate the downtime of critical business application services. Here, OpenCloudware can bring several benefits to cloud providers, starting with specific ecosystem modeling to ensure self-managed operations. The vApp management in OpenCloudware – each vApp being operated and monitored as a unit – allows fast recovery and rapid back to normal operations.

## The OpenCloudware Architecture Overview

OpenCloudware develops the complete think-build-run chain for the cloud. More concretely, OpenCloudware provides:

- a portal allowing users to create applications,
- tools for automating tests and integration,
- automated VM image generation,
- deployment over multiple IaaS,
- virtual applications management.

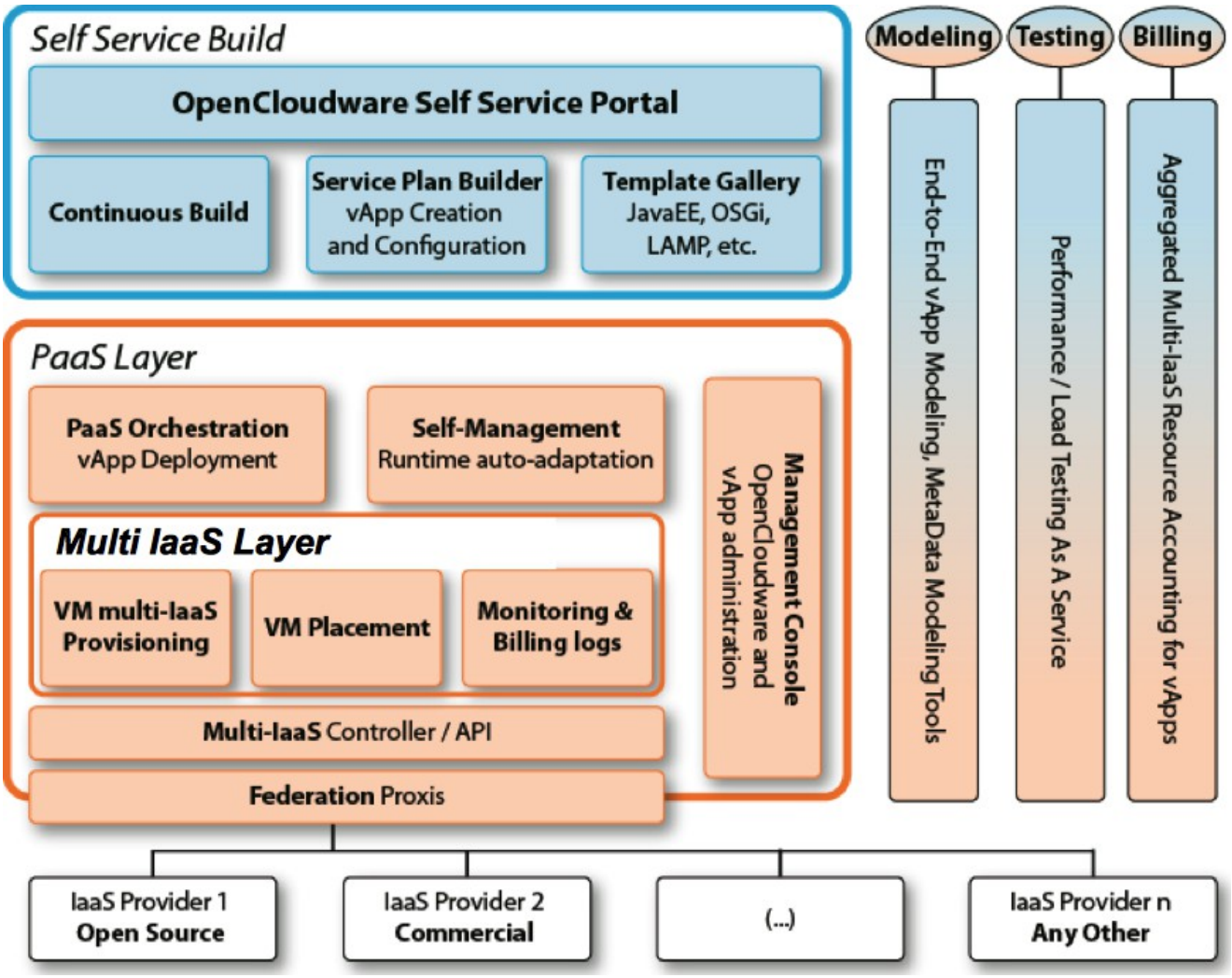


Figure 1: OpenCloudware Functional View

## The OpenCloudware Cloud Application Management Process

The best way to explain OpenCloudware is to follow a user step by step during the complete deployment of a software appliance. Or, more precisely, let's see what an automatic multi-IaaS deployment chain with integrated benchmarking service looks like. In this process, the benchmarking service is based on OW2 CLIF, the load testing framework project, featuring outstanding adaptation capabilities.

The user chooses any of his/her favorite three-tier JavaEE application, or Apache, or PHP/MySQL application. The user will want to deploy it on the Cloud. So the first step is to login into the OpenCloudware portal. As a part of the project we are working on what the portal is and also on different roles and different users may have. As a part of the different role of the users, who will be a typically developer, project manager, we are also taking into consideration the role of the company and their different accounts for various infrastructure as a service clouds or data centers, so there's work on role based access control which has be done there.

Once the user is logged-in, the user wants to build his virtual applications. To this aim OpenCloudware develops a vApp model, based on an extension of the standard OVF, the OpenCloudware extension is called OVF++. It helps describe the different nodes of the virtual application, the relationship between the nodes, also the service layer agreement that the user would like to express. The output is an XML file representing the vApp model. OpenCloudware comes with a number of templates, some prepared and predefined, typically Java EE, LAMP applications, some developed by users themselves. Templates are available in OpenCloudware template gallery.

Following the model, the next step is the deployment, a complex task involving different phases.

In the first phase covering the development of the application, from the developer's point of view, OpenCloudware connects with typical building tools. The next phase is the generation of the service plan: it is made of the different VMs composing the application, and the different VMs that need to be created.

The following phase takes place at the orchestration layer, the PaaS orchestration layer for deployment, which itself addresses the management of the various infrastructure as a service component to be able to provision the VMs required in the appropriate infrastructure as a service.

Once the application is deployed, one of the following steps is to figure out how much it will cost. OpenCloudware offers a billing component able to tell the user the costs of the application when the empty VMs have been deployed. This gives a first cost estimate but users really want to know how much an application will cost at run time with a full workload of transactions and data. Here OpenCloudware provides a function that simulates load injection into the system.

With the integration of the CLIF load testing tool into OpenClouware, users can define several workloads profiles with criteria such as: number of requests per second, percentage of read requests, percentage of write requests, etc. Running the test for one hour provides actual cost at operational workload for one hour, thus enabling users to figure out costs for the future estimated loads.

To go into production once the load testing is over, users give a public IP address. The database is then populated with real data. The vApp is now in production, and if customers are located in Brazil, the OpenCloudware platform actually migrates some of the virtual machines to a data centre closer to customers in order to reduce latency (here another SLA is taken into account at the multi-IaaS layer).

Finally OpenCloudware includes a monitoring service, based on a development in progress at Orange Labs. This service will be able to aggregate all monitoring data from the different IaaS and the OpenCloudware platform itself. This data is used for the information of users and platform-managers but also to run the self-management layer mentioned earlier in order to verify compliance with SLAs.

## The OpenCloudware Progress report

Currently, in order to provide continuous development and integration, OpenCloudware runs by combining several software components listed hereafter.

- CLIF, OW2's load testing framework project, featuring outstanding adaptation capabilities, available under LGPL license at clif.ow2.org.

- Sirocco, the multi-cloud manager with DMTF CIMI API (an OpenStack API is also available), which can be considered as the main API with the different cloud infrastructures, available under LGPL license at sirocco.ow2.org.

- VAMP (Virtual Application Management Platform) which can be considered as the application life-cycle manager, also available under LGPL license at sirocco.ow2.org.

- **The Portal** is an access control and security management portal. It is designed to manage OpenCloudware accounts with roles assigned to individual users by organisation, by project or by application.

- **The SLA/SLO Management** is being enhanced to provide automated placement and support for elasticity. It contributes to ensure automatic adjustment according to Service Level Agreements or Objectives, switching new VMs on or off while maintaining consistency of the whole platform across different infrastructures.

**- The Management Console** consolidates the parameters and the rules required by each component to interoperate within the OpenCloudware platform.

**- The Monitoring and Billing components** offer technical metrics and financial data to support alternative multi-IaaS deployment scenarios.

- **The VM placement** is presently working on CloudStack IaaS with several implementations on more infrastructures being planned in a near future.

The figure below illustrates the relative positioning of the software components.

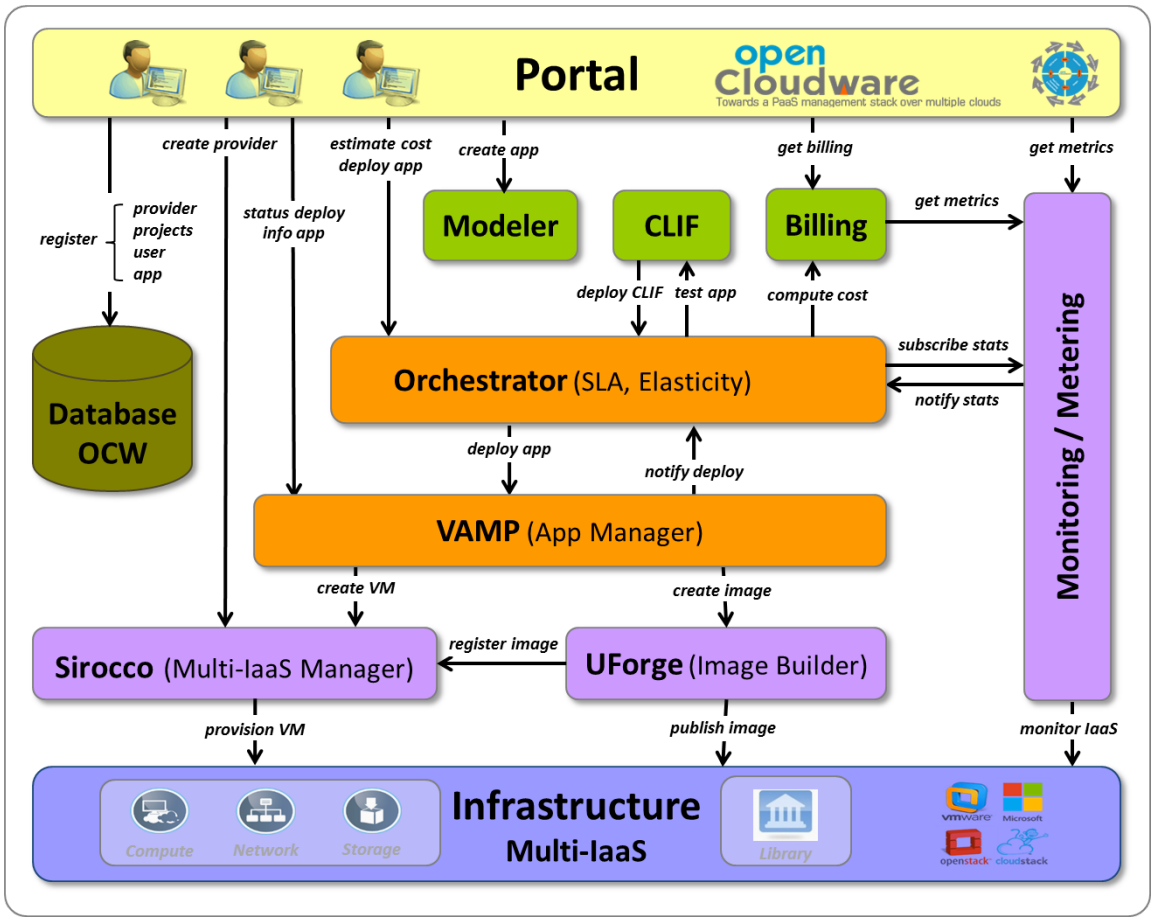


Figure 2: OpenCloudware Technical Architecture

The Multi-IaaS Provisioning allows vApp deployment on several IaaS. OpenStack deployments on Bull, OW2 and eNovance platforms have been successfully tested. OpenCloudware currently supports the following IaaS platforms :

- OpenStack via ow2stack, the OW2 community platform, and Bull
- CloudStack
- Microsoft Azure
- VMware vCloud Director

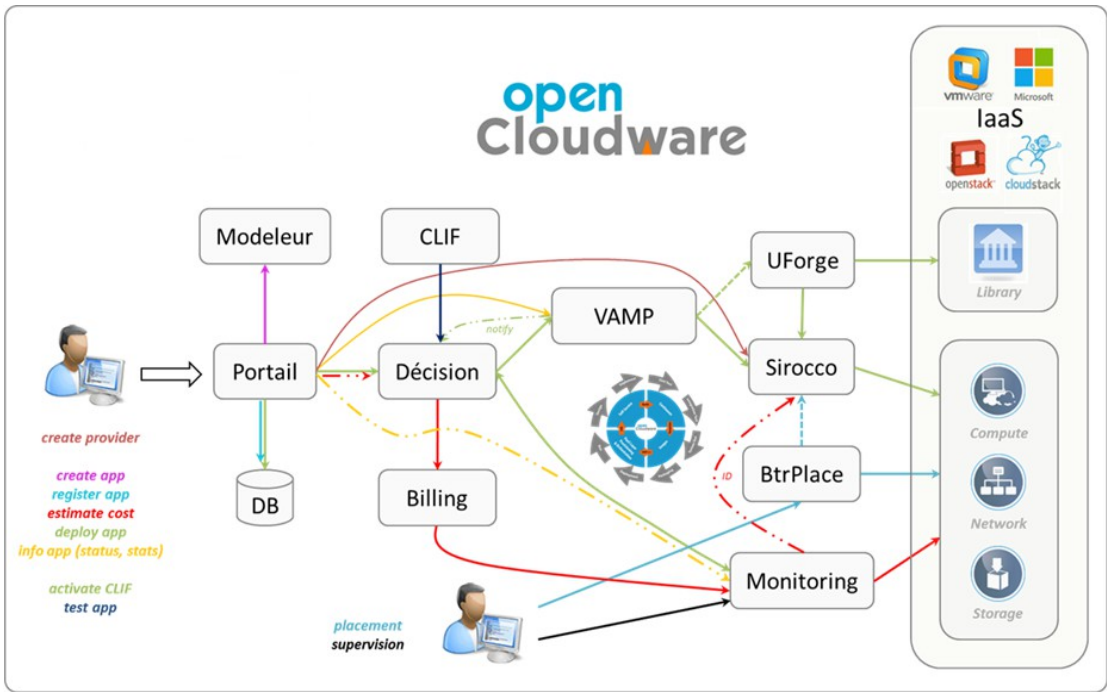


Figure 3: Example of OpenCloudware scenario

All the interactions and controls are realized through the Portal.
A typical usage scenario comprises the following steps:

- automatic deployment of an appliance over an IaaS, after its description through a high level language based on OVF;
- launch of up to three services:
  - cost estimation,
  - supervision,
  - performance testing.

Recent developments are extending the project with the integration of new functions such as SLA management, metering and accounting, continuous integration, dynamic VM image generation and the support for a greater number of IaaS technologies.

New Meta-models have been proposed, as WS-Agreement language extensions, to describe cloud-related SLAs. To provide a more intuitive view of SLAs, a combination of XSLT/XML files now allows the generation of graphical Web pages. Listic Savoie, UJF, Mines Nantes, Orange, See an example here:
http://www.polytech.univ-savoie.fr/opencloudware/v2/models/springoo_styled.xml

## The OpenCloudware Ecosystem

OpenCloudware is a direct output of the OW2 Open Source Cloudware initiative.

OpenCloudware is developing complementarities with CompatibleOne, the Open Source Cloud Broker, through several partners common to both OW2 projects. OpenCloudware and CompatibleOne cooperate on how to take Service Level Agreement (SLA) into account in the platform. CompatibleOne is based on OGF OCCI while OpenCloudware prefered DMTF CIMI. Another common development area is JPaaS, CompatibleOne's initial Platform as a Service component. JPaaS is being extended within OpenCloudware by the same people who created it.

OpenCloudware leverages a number of IaaS technologies, either proprietary or open source. For instance, it has been tested with VMWare vCloud and also worked with OpenStack. Of course, OpenCloudware being open source, anybody can contribute to support their favorite IaaS.

In terms of software, OpenCloudware relies on and extends a number of OW2 software including Fractal reused by CLIF and VAMP; JORAM, Jasmine & Petals ESB for the JavaEE environment; CLIF and Sirocco for deployment and multi-IaaS management; ProActive and Entropy for VM placement and optimization of energy consumption and eXo Platform for the portal. The component dealing with role-based access control is called AuthzForce and its mainly edited by Thales. For building images, OpenCloudware relies on Uforge from UShareSoft.

# Conclusion

No single company could ever develop the technologies required by the need to manage applications over multi-cloud environments. Only a broad-scale collaborative project such as OpenCloudware could face the challenge. As open source development continues the project invite third party developers to join in the effort. OpenCloudware is a world-class project, it will shape the way users, cloud service providers and network operators will manage multi-cloud environments that are becoming increasingly complex.

**For more information**

To learn more about OpenCloudware, The Open Source Virtual Application Management Solution for Multi-cloud Environments please visit: http://www.opencloudware.org