ECO2Clouds

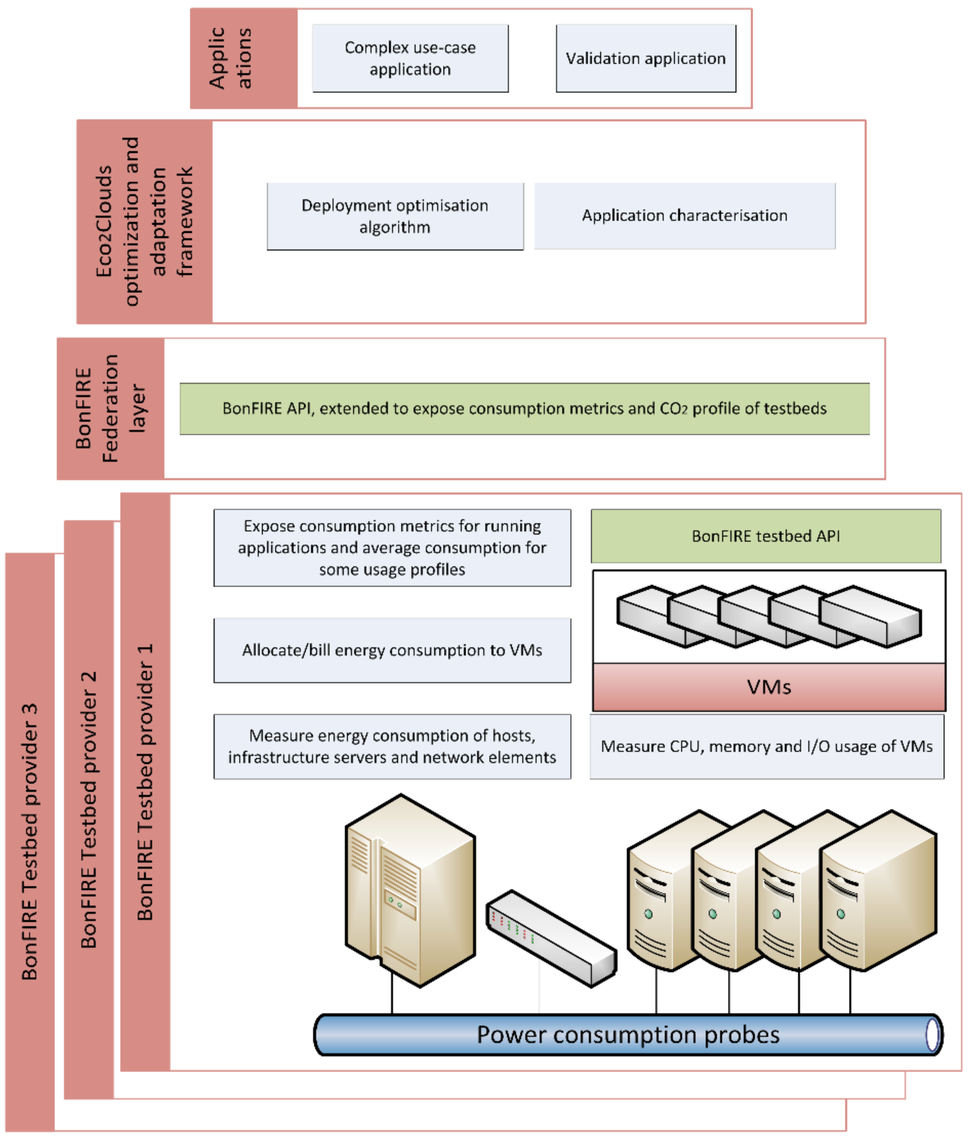
Experimental Awareness of CO_2 in Federated Cloud Sourcing

Newsletter April 2013

Meet the Project and the Team

Vision

Ecological implications of Cloud IT infrastructure are creating a critical gap in the current state of the art in research and business.
The ECO2Clouds project investigates strategies that can both ensure effective application deployment on the Cloud infrastructure and reduce energy consumption and CO2 emissions.
The need for novel deployment strategies becomes more evident when an application spans multiple Clouds, since Cloud providers operate under different regulatory frameworks and cost structures in relation to environmental policies and energy value chains.
ECO2Clouds will complement existing multi-Cloud facility provided by the FP7 BonFIRE (Building Service Testbeds on Future Internet Research and Experimentation) project, which will be extended to provide real time information about energy usage at different levels.
This will be complemented by innovative deployment optimization and runtime adaptation techniques and algorithms thus facilitating optimal energy consumption across different facilities in the Cloud infrastructure.



Consortium

ATOS, Spain

Atos is an international company focused on Services for Information Technologies (IT) and currently with headquarters located in Paris, with presence in 42 countries.

University of Manchester, UK

The University of Manchester (UNIMAN) is the largest campus based university in UK with close links to industry.

HLRS, Germany

The High Performance Computing Centre is a research and service institution affiliated to the University of Stuttgart. It has been the first national supercomputing centre in Germany offering services to academic users and industry.

EPCC, UK

EPCC is the High-Performance and Novel Computing Centre of University of Edinburgh. EPCC provides a wide variety of services to academia and industry.

Politecnico di Milano, Italy

Politecnico di Milano is a State University in Italy, established in 1863, ranked as one of the most outstanding European universities.

Inria, France

Inria is the only public research body fully dedicated to computational sciences. Inria collaborates with the main players in public and private research in France and abroad.

ECO2Clouds Advancing ecological awareness in the Cloud

Identifying good practices to improve energy efficiency of Cloud data centers

*

Developing techniques and mechanisms for CO2 aware application deployment on Cloud

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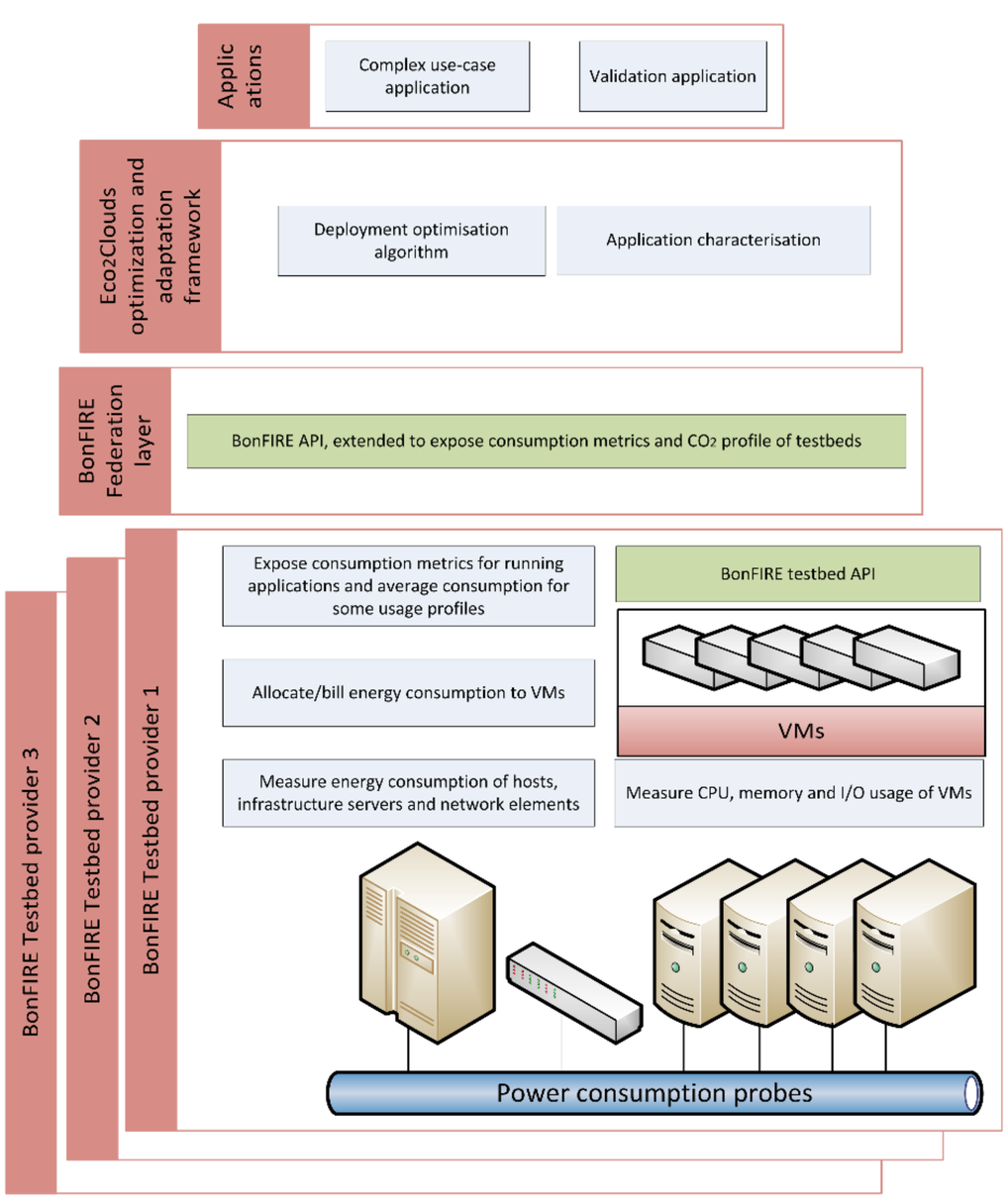

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Meet Our Gardens

Garden 1

USTUTT-HLRS Data Center

The ECO$_2$Clouds site USTUTT-HLRS runs OpenNebula 3.6 in a dedicated version derived for BonFIRE.

General configuration

Hypervisor used: Worker nodes operate XEN 3.1.2
Image management: Block devices managed using a modified version of the LVM manager provided by OpenNebula
Image storage: Images stored using the "raw" format

OpenNebula scheduler configuration

- t (seconds between two scheduling actions): 10
- m (max number of VMs managed in each scheduling action): 300
- d (max number of VMs dispatched in each scheduling action): 30
- h (max number of VMs dispatched to a given host in each scheduling action): 2

Permanent resources

USTUTT-HLRS provides 17 dedicated worker nodes with different hardware combinations:
8 nodes: 2x Dual Core Intel Xeon @ 2.66 GHz, 8GB RAM
1 node: Dual Core AMD Opteron @ 2 GHz, 4GB RAM
6 nodes: 2x Dual Core Intel Xeon @ 3.2 GHZ, 2GB RAM
2 nodes: 4x AMD Opteron 12 Core @ 2.6GHz, 196GB RAM
These 17 host types of various architectures offer users many various capabilities to run their case studies. Every node type can be accessed directly during the creation of a virtual computing resource. For a better overview of all available resources, USTUTT-HLRS provides a current summary of the worker nodes at http://nebulosus.rus.uni-stuttgart.de/one-status.txt. In addition, a storage server with a total amount of 12 TB disk space supplies the case studies requiring shared data storage. All these nodes are connected via Gigabit Ethernet network interconnections.

On-request resources

USTUTT-HLRS provides 36 on-request nodes distributed on two Christmann RECSs with additional fields of application:
18 nodes: Intel i7-610E Dual Core, 4 GB RAM
6 nodes: Intel Core i7 Quad Core @ 2.1 GHz, 8 GB RAM
6 nodes: AMD Atom, 2 GB RAM
6 nodes: AMD T56N Dual Core, 2 GB RAM
These nodes feature specific functionalities for green IT-related research like measuring power consumption or energy efficiency. They are not part of the permanent infrastructure; access to these nodes needs to be reserved and requires an installation process of at least one working day.

Garden 2

EPCC Data Center

UK-EPCC runs OpenNebula, in a version derived from OpenNebula 3.2 for BonFIRE.
Hypervisor used: Nodes run XEN 3.0.3
Image management: Block devices managed using the same modified version of the LVM manager as used by *Inria*.
Image storage: Images are stored using the ''raw'' format

OpenNebula scheduler configuration

These values are subject to frequent changes. Their meaning can be explored at
http://opennebula.org/documentation:archives:rel3.0:schg

-t (seconds between two scheduling actions): 30
-m (max number of VMs managed in each scheduling action): 300
-d (max number of VMs dispatched in each scheduling action): 30
-h (max number of VMs dispatched to a given host in each scheduling action): 1

Permanent resources

EPCC provides 3 dedicated nodes as permanent resources. Two of these nodes offer four, 12-core AMD Opteron 6176 (2.3GHz) with 128GB of memory each (total core count is 96; total memory count is 256GB). The third dedicated node hosts the EPCC front-end and service VMs. It currently offers 6 TB of storage to BonFIRE, with another 6-10TB available, subject to RAID configuration.

On-request resources

On-request resources will be made available in the last year of the project.

Networking

The nodes are connected by Gigabit ethernet. 6 public IP addresses are available for VMs. At present the firewall allows incoming connections to these pulic IPs on tcp/udp ports 80 and 443 only (additional ports may be opened on request).
The following networking features are planned for future releases: IPv6 networking for VMs, interconnection with FEDERICA, bandwidth-on-demand service to PSNC via AutoBAHN.
HP offers 32 dedicated dual processor nodes as permanent resources. These 64 processors are Xeon X5450 (3GHz) and the nodes have 5TB shared storage. Switched Gigabit Ethernet networking interconnections are available between these nodes.
HP may provide a maximum of 96 additional nodes and a maximum of an additional 32 TB of storage in the SAN dedicated to BonFIRE. This additional infrastructure will be provided upon request and will be strictly limited to the available capacity in the HP cloud research infrastructure.

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Garden 3

Inria Data Center
FR-Inria runs OpenNebula, in a version derived from OpenNebula 3.6 for BonFIRE.
Hypervisor used Nodes run XEN 3.2
Image management Inria's setup has been described in a blog entry on OpenNebula's blog platform: http://blog.opennebula.org/?author=59
Basically, NFS is configured on the hypervisor of the service machine and mounted on the OpenNebula frontend and on workers. TM drivers are modified to use dd to copy VM images from the nfs mount to the local disk of the worker node (local LV to be precise), and cp to save MV images to NFS. This way, we :

- have a efficient copy of images to workers (no ssh tunneling)
- may have significant improve thanks to NFS cache
- don't suffer of concurrent write access to NFS because VMs are booted on a local copy

Image storage Images are stored using the ''raw'' format
OpenNebula scheduler configuration: These values are subject to frequent changes. Their meaning can be explored in http://opennebula.org/documentation:archives:rel3.0:schg

- -t (seconds between two scheduling actions): 10
- -m (max number of VMs managed in each scheduling action): 300
- -d (max number of VMs dispatched in each scheduling action): 30
- -h (max number of VMs dispatched to a given host in each scheduling action): 2

Permanent resources

Inria provides 4 dedicated worker nodes (DELL PowerEdge C6220 machines) as permanent resources.
These worker nodes have the following caracteristics:
CPU 2 Intel(R) Xeon(R) CPU E5-2620 @ 2.00GHz, Hyperthreading enabled, with 6 cores each
Memory 64GiB, in 8*8GiB, DDR3 1600 MHz memory banks
Local storage. * 2* 300GB SAS storage.
Network. 2* 1GB/s ethernet linked bonded together
One server nodes with 2+8 disks (RAID1 for system, RAID 5 on 8 SAS 10k 600G disks), 6 cores and 48GB of RAM, 2 cards of 4 Gbps ports to host the different services needed to run the local testbed. Gigabit Ethernet networking interconnections are available between these nodes, with bonds to increase performance (2GB/s on nodes, 4GB/s on the server).
This infrastructure is monitored for power consumption using eMAA12 PDUs from Eaton.

On-request resources

FR-INRIA can expand over the 160 nodes of Grid'5000 located in Rennes. When using on-request resources of Grid'5000, BonFIRE users have a dedicated pool of machines that can be reserved in advance for better control of experiment conditions, but nevertheless accessible using the standard BonFIRE API. The interface of the reservation system is documented in *the dedicated page*
When requesting resources, a description of the nodes made available is shown on the web interface so the user can choose between the 4 available types of nodes. Parapluie nodes are instrumented for power consumption with the same pdus as the permanent infrastructure

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Objectives

The practical aims of ECO2Clouds are:

Develop key metrics to express energy consumption and CO2 footprint of Cloud facilities and applications for quantification of their environmental impact.

Create optimization and deployment models to generate configurations reducing the environmental impact when the workload is mapped to infrastructure at Cloud site, host and VM level.

Propose and design innovative application deployment strategies for sustainable federated Cloud sourcing while supporting adaptation mechanisms that can perform changes to running applications based on energy consumption.

Validate the effectiveness of the proposed optimization and adaptation process through challenging application case studies.

ECO2Clouds social life

Past Events

1. Oct. 16, 2012 ECO2Clouds presentation at the IoS Collaboration Days 2012, Brussels.

2. Nov.7, 2012 ECO2Clouds presentation at FIRE Engineering. Ghent.

3. Nov. 2012 ECO2Clouds participates in the Datacenter Dynamics Event. London.

4. April 2013 Participation in COST 804 School on Energy efficiency in large scale distributed systems.

Forthcoming Events

ECO2Clouds organizes the Energy Efficient Systems Special Session at IEEE International Conference on Systems, Man and Cybernetics (SMC), October 13–16, 2013, Manchester, UK

This special session will be an opportunity for researchers and industrial participants to discuss the state of the art and exchange ideas about energy efficiency and reducing CO2 footprint of ICT applications, systems as well as underlying infrastructure.
Deadline for submission: May 15, 2013.
Webpage: http://eco2clouds.eu/ees/

ECO2Clouds is one of the EU projects co-organizing the EuroEcoDC (E2DC) Workshop co-located with the 3rd International Conference on Cloud and Green Computing (CGC), Sept. 30–Oct. 2, 2013,Karlsruhe,Germany.
Deadline for submission June 16, 2013.

The workshop will serve as a platform to discuss European initiatives concerning energy-efficiency in data centers, including both infrastructure- and software-oriented solutions. The workshop will feature two prestigious keynote speakers, as well as several academic and industry papers related to the three organizing projects (All4Green, CoolEmAll and Eco2Clouds).
Webpage:http://www.all4green-project.eu/EuroEcoDC

ECO2Clouds related workshop, eChallenges 2013 (Organized by HRLS)

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Topics and achievements

1° semester

Analysis of existing approaches for energy efficiency in the Cloud- State of the Art.

Requirements for achieving energy efficiency and CO2 awareness in federated Clouds –Requirements and Case Studies.

Architecture of the proposed energy efficient and CO2 aware ECO2Clouds solution – Functional Architecture.

Eco metrics to quantify energy consumption and CO2 footprint at application, Cloud infrastructure, and VM levels - Identification of green indicators.

Investigation of optimization and run-time adaptation techniques that can contribute towards achieving the project goals – basis for scheduling and monitoring models.

Our current work

Detailed eco-metrics, to expose energy consumption and CO2 footprint of applications and Cloud infrastructure at site, host and VM level.

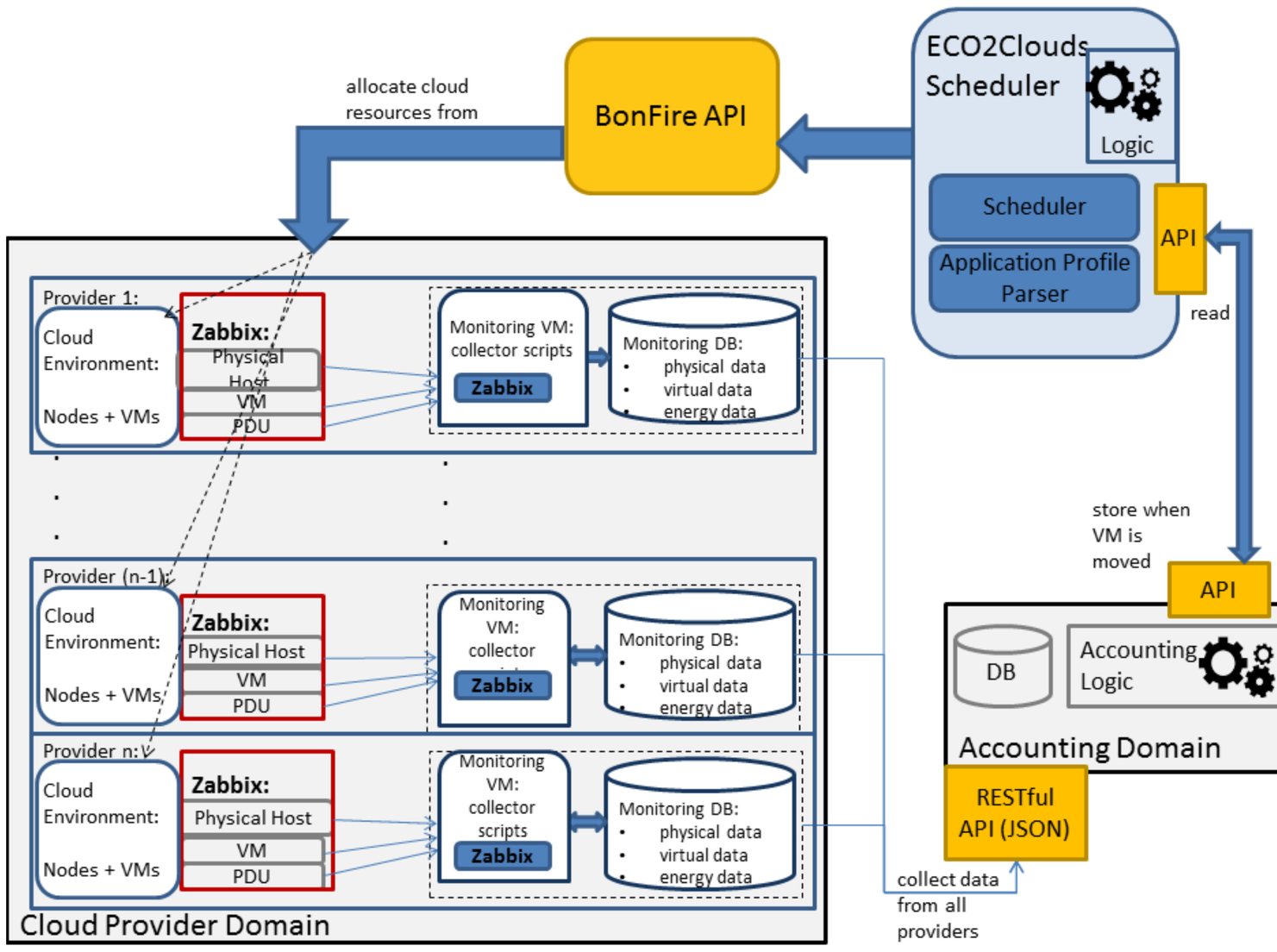
Quantification of energy consumption at application and different levels of Cloud infrastructure.

Intelligent Scheduling techniques for CO2 aware application deployment in a multi-site Cloud environment.

Optimization techniques for energy efficient resource utilization in a multi-site Cloud environment.

Runtime adaptation techniques to ensure efficient resource utilization and minimum CO2 footprint of applications throughout their deployment on the Cloud.

Energy-aware deployment strategies at design and at run time



Scheduler / ECO2Clouds Architecture

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