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A greener cloud on the horizon

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Private and public cloud computing is growing rapidly, along with the huge server farms needed to maintain such services. Demand is also rising for a more comprehensive way to measure and reduce cloud computing's carbon footprint.
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Current approaches to reducing the cloud's carbon footprint focus on increasing the energy efficiency of computing devices, on reducing the environmental impact of hardware, on virtualisation, and on dynamic mechanisms for better allocating workload. Some approaches also seek to increase the energy efficiency of non-IT components, for example cooling systems. The ECO2Clouds team took a more comprehensive approach; one that included CO2 emissions produced by data centres and their running applications – and the output of all software and hardware components.

The approach resulted in a method, guidelines and the technology for measuring this environmental impact, and for reducing energy consumption and overall CO2 footprint. This "carbon-aware" solution works by managing workloads on clouds through federated cloud infrastructures, where applications may span several cloud sites.

The technology has been integrated into the FIRE facility BonFIRE. The solution focuses on cloud computing models and metrics, for which the project proposes a federated cloud model and energy metrics.

The ECO2Clouds solution includes components for monitoring energy consumption and for adapting the infrastructure, virtualisation, and application levels to achieve energy efficiency and reduce the CO2 footprint.

The project's cloud model includes indicators on the energy consumption and CO2 footprint of cloud facilities and their applications. These quantify environmental impact. The cloud model also provides ways to more efficiently use and deploy cloud configurations which reduce energy use. The workload is distributed according to the infrastructure used and Virtual Machine (VM) levels.

Energy metrics are indicators allowing cloud services to assess energy efficiency. The proposed metrics reflect energy efficiency for each level of the cloud architecture (infrastructure, virtualisation

and application) and according to the interrelation between the different levels.

Sample metrics for infrastructure include those measuring site and storage use or Green Efficiency Coefficient (GEC), a standard measure. Metrics for virtual machines measure CPU, Storage, I/O, and memory use. For applications, the metrics measure task execution time, response time, throughput, A-PUE (application PUE), application energy productivity (AeP) and Application Green Efficiency Coefficient (A-GEC).

The different levels of energy metrics allow cloud service providers to develop deployment strategies that, along with other tasks (such as allocating cloud resources to match application requirements) consider energy consumption and the CO2 footprint of cloud applications.

More info

- ECO2Clouds – http://eco2clouds.eu/ [1]
- BonFIRE – www.bonfire-project.eu [2]

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