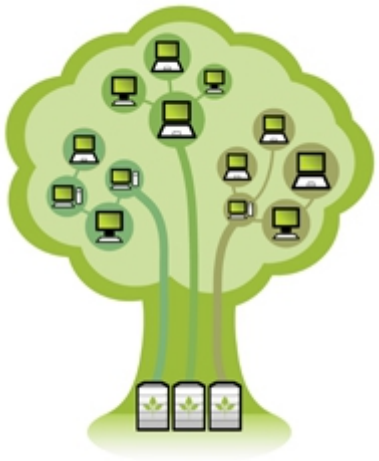
Digital Single Market

Projects news and results14/03/2013

Making 'the cloud' greener

As the world becomes increasingly digital, demand for data centres is booming — and so too is their energy consumption. Data centres worldwide produce around half the volume of emissions of the global aviation industry and more than the total emissions of the Netherlands. EU-funded researchers are developing ways to reduce data centres' environmental impact.



[1]

With tens of thousands of processors and storage units that need to be kept cool, about the same amount of energy is used for cooling data-centre equipment as powering it. This makes the infrastructure behind cloud services ripe for improving energy efficiency.

'For every kilowatt of energy consumed by the data centre, almost another kilowatt is dissipated as heat,' explains Dr Massimo Bertoncini at Engineering Ingegneria Informatica in Italy. 'With ever-larger data centres being built around the world to meet rising demand for digital services, powering and cooling them is an increasingly significant environmental issue.'

Dr Bertoncini coordinated a team of researchers who spent 30 months tackling the challenge. Their work on energy efficiency, conducted in the 'Green active management of energy in IT service centres' (GAMES [2]) project and supported by EUR 3 million in funding from the European Commission, is about to be applied commercially. It has helped cut energy consumption at the data centres where it has been implemented so far by more than 20 %.

The GAMES consortium investigated effective methodologies and enabling technologies aimed at

reducing the energy consumption of the IT infrastructure, taking the view that any improvement in energy efficiency at IT infrastructure level will automatically reduce energy consumption at the cooling/facility subsystem level by the same amount.

'For data centres to become more efficient, it is essential to know how energy is being consumed. Our focus was therefore to develop effective monitoring solutions that allow data centre performance and processes to be adapted in real time,' the GAMES coordinator explains.

The team developed methodologies, software tools and services, and innovative metrics with a focus on next-generation smart data centres. The key to their approach was to investigate and deploy technologies and methodologies to measure the energy consumption of IT infrastructure, in a more detailed way than previously possible, all the way down to server level. Their solution is based on a mixed approach, combining real-time sensing and measurement with intelligent processing for inferring predictive energy consumption models.

The approach takes into account the trade-off between energy-efficiency optimisation and the needs of business - such as Service Level Agreements (SLAs) and Quality of Service (QoS) guarantees.

Though modern data centres are more energy efficient than their predecessors, only around 60 % of the overall energy they use is for the servers, processors and software - the rest is mostly for the cooling system and the uninterruptible power system.

Toward a perfect PUE

Data-centre energy use is measured in units of 'Power-usage effectiveness,' or PUE, which is the ratio of the total power used by the facility, divided by the power delivered to its IT equipment. An ideal PUE would be 1, while the average is about 1.83 to 1.92.

The GAMES team deployed and tested their energy monitoring and real-time adaptation technology at two large and already relatively energy-efficient data centres, located at Pont Saint Martin in Italy and Stuttgart in Germany, representing two very different types of data centre.

At Engineering's Pont Saint Martin site, used mostly for legacy application hosting services, the technology was able to improve PUE from 1.35 to 1.25 - a considerable energy saving. At the Stuttgart site, a high performance computing centre operated by the University of Stuttgart, the GAMES system resulted in similar improvements despite the different technology and applications of the centre.

'We showed that this approach works across technologies and at different data centres designed for performing different tasks,' Dr Bertoncini says. 'It enables data centre operators to determine the best practices at each site to reduce power consumption without impacting performance.'

For example, at one site it may make sense to lower the frequency of the running processors, while at another the optimal approach might be to transfer computation load from one server to another one and run all servers at 80 % of their capacity, rather than running fewer at 100 % capacity. Similarly, with adaptive technology, underused servers can be dynamically powered down when necessary.

'There is always a trade-off between energy efficiency and performance: essentially, the more performance required, the more energy will be used. The key is finding the right balance to provide the best service at the lowest energy cost,' Dr Bertoncini notes.

Another key outcome of the project was the study and categorising of families of applications exhibiting common energy-consumption behaviour patterns. This categorisation enabled the team to associate a set of best practices and optimised hardware and software adaptation actions in order to achieve the best possible trade-off among SLAs, performance and energy consumption. The project made available a living repository of these best practices.

Improving data-centre energy efficiency will not only help the environment, but it also makes financial sense for data-centre operators. Running a large data centre can cost more than EUR 10 million a year just for the electricity. It is not surprising therefore that data-centre operators are keenly interested in the work of the GAMES team.

'We've received a lot of interest from industry,' Dr Bertoncini says. 'First we are implementing this solution at our data centres and then will start to offer it to clients.'

The team are also looking into launching a follow-up project to advance the technology and achieve further improvements in efficiency.

With industries from banking to healthcare - as well as government - moving more processes online and into the cloud, global cloud IP traffic is projected to increase six-fold over the next five years, while the number of data centres is increasing at close to 20 % per year. Designing and managing them with energy efficiency in mind will be essential to avoiding a similar increase in environmental and energy costs.

GAMES received research funding under the European Union's Seventh Framework Programme (FP7).

Link to project on CORDIS:

- FP7 on CORDIS [3]
- GAMES project factsheet on CORDIS [4]

Link to project's website:

- 'Green active management of energy in IT service centres' project website [2]

Project coordinator
European Commission
Share this page

Links
[1] https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/newsroom/greencloud-light_4098.jpg
[2] http://www.green-datacenters.eu/
[3] http://cordis.europa.eu/fp7/home_en.html
[4] http://cordis.europa.eu/projects/rcn/93738_en.html