

TOWARDS GREEN DATACENTERS AS AN INTERRUPTIBLE LOAD FOR GRID STABILISATION IN SINGAPORE



PROJECT SUMMARY

The aim of this research is to develop technical solutions along with an economic incentive model to enable datacenters to serve as an interruptible load (i.e. power load that can be scaled down temporarily) to stabilise Singapore's power grid as it integrates more distributed generation and renewables.

We propose a novel real-time power analytics framework called embedded software as sensors (ESaS), where software hooks are embedded into a range of datacenter subsystems, from chip to system to application level, to monitor ICT activities and power usage in a fine-grained, real-time manner. Data from these virtual sensors are then mined to construct energy consumption models and are used to develop optimal algorithms for energy-aware operation of computing, power distribution and cooling systems in the datacenter (Fig. 1). This holistic monitoring and optimisation framework reduces the overall power consumption of a datacenter and enables time-shifting of workloads in the datacenter in response to power fluctuations arising from the integration of distributed generation (DG) and renewable sources to Singapore's power grid (Fig. 2).

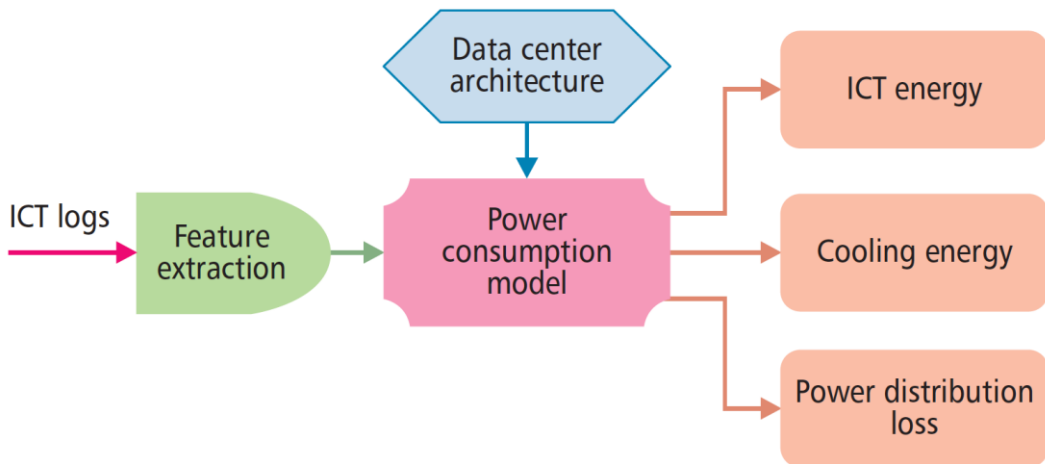


Figure 1. A multi-factor power analytic framework based on features extracted from ICT system and data center architecture.

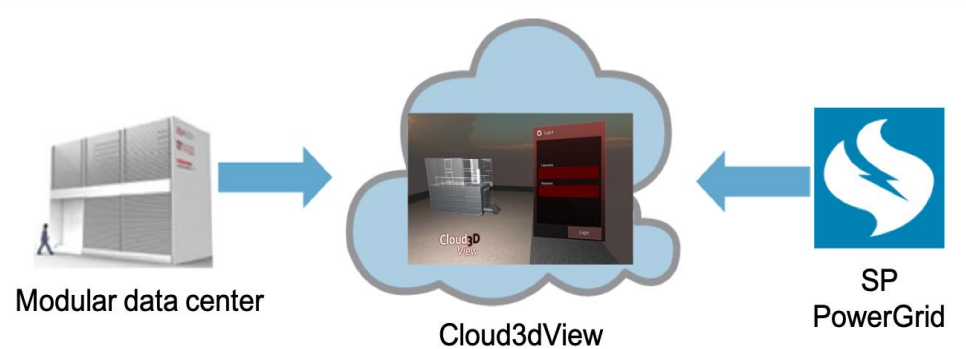


Figure 2. Simulation platform takes data input from power grid and the modular data center

PROJECT OUTCOMES



We achieved our vision in this project, which includes:

- An integrated framework for establishing energy-intensive datacenters as an interruptible load for power grid stabilisation in Singapore;
- The ESaS for real-time power analytics and management in datacenter operations, with three modules, data collection, data processing and operation adaptation; and
- Investigation of interoperability issues between datacenters and the power grid, with the goal of minimising the impact on datacenter and power grid operators (Fig. 3).

The proposed technical solutions will help to ensure the long-term stability and economic viability of Singapore's electrical power system. The project was completed in March 2017, and the data analytics and machine learning engines developed as part of it were licensed to two successful start-ups:

- The first, **EverComm**, is an enterprise energy management company that has assisted its clients accumulate over US\$4.3 million in energy costs.
- The second, **Red Dot Analytics**, has signed commercial agreements to reduce energy demand with major local banks and global datacenter operators.

The project also received the "Open Data Center Project Award at the DatacenterDynamics (DCD) Asia Pacific Awards in 2015, as well as the Gold Award (R&D category) at the ASEAN ICT Awards in 2016 (Fig. 4).

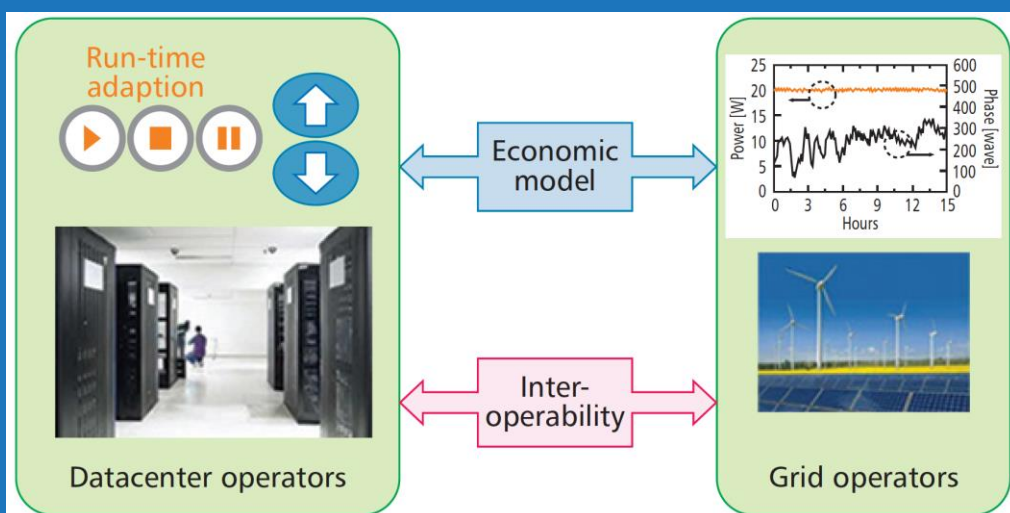


Figure 3. Conceptual paradigm: Green data center can be leveraged as an "interruptible" load for grid stabilisation in Singapore.

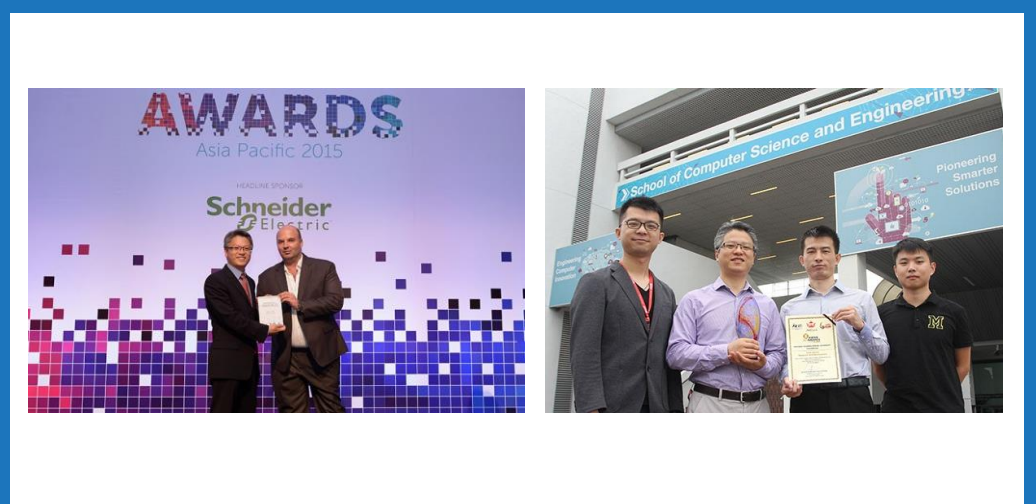


Figure 4. Winning the 2015 DCD Award ("Oscar" of Datacenter Industry) on the left and the 2016 ASEAN ICT Award (Gold Medal) on the right.

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