

How to design an experiment to measure and compare the electricity consumption of a server machine across network topologies?

Supervision team:

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Context

Research efforts have been engaged for a long time in optimising the electricity consumption in datacenters [1-8]. While today's datacenters are capable of achieving highly effective power usage through better infrastructure design and operations, it is anticipated that their energy costs will further be reduced through the implementation of resource management strategies that take application elasticity into account when deciding on which server machine(s) to execute computational tasks. To make decisions, these strategies need information about the electricity consumption of the machines, which assumes the availability of a measurement mechanism. While various tools have been proposed in the literature to collect consumption data from devices [9-11], to design a protocol for experiments that enables the comparison of consumption profiles as a function of the environment in which the applications and the server machine run, as well as the current computational workload, is a challenging process.

Objectives

The proposed placement is a follow-up to a previous exploratory study that investigates how to use consumption data of a server machine as a guiding principle for the design of a renewable datacenter. The objective is to develop and implement a protocol for the setup of experiments that aim to collect electricity consumption of a server machine in different types of environment, including for varying computational workloads, different types of datacenter topologies, and machine characteristics.

The project will involve three main tasks. The student will first be responsible for identifying and specifying different types of datacenter environments where consumption data can be collected. S/he will then do a review of the main challenges associated with the measurement of a machine's electricity consumption based on the analysis of the literature and hands-on experiments carried out on servers. S/he will finally develop a protocol for experiments and conduct a measurement study to assess the consumption profiles of server machines.

The results of the project will contribute to the developments of specifications for the design of a green datacenter as part of the Energy4Climate demonstrators.

About the placement

- 6 months – starting March-April 2025
- Located at Telecom SudParis, Institut Polytechnique de Paris
- Joint supervision between Telecom SudParis and Ecole des nationale des ponts et chaussees
- Part of the Energy4Climate (<https://www.e4c.ip-paris.fr/#/fr/>) multidisciplinary research center of Institut Polytechnique de Paris

Skills and competence

- Final year engineering school / master (MEng / MSc) student
- Good knowledge and demonstrated experience of a programming language
- Good knowledge of computer system architectures and infrastructures
- Good knowledge of optimisation techniques
- Knowledge of tools to measure the energy consumption of a server is an asset but not required.

Contact

To apply, contact

- Michel Marot, Telecom SudParis, michel.marot AT telecom-sudparis.eu
- Daphne Tuncer, Ecole des nationale des ponts et chaussees, daphne.tuncer AT enpc.fr

by providing the following documents:

1. CV
2. Motivation letter
3. Transcripts of the last 3 years
4. A course report or article written in English (if any)

Incomplete applications and / or applications sent to only one of the supervisors will be automatically rejected.

References

1. <https://arxiv.org/pdf/2209.02198.pdf>
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4. <https://arxiv.org/abs/2204.06654>
5. <https://arxiv.org/abs/2106.11750>
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7. [Zhabelova, Gulnara & Vesterlund, Mattias & Eschmann, Sascha & Berezovskaya, Yulia & Vyatkin, Valeriy & Flieller, Damien. \(2018\). A Comprehensive Model of Data Center: from CPU to Cooling Tower. IEEE Access. PP. 1-1. 10.1109/ACCESS.2018.2875623.](#)
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9. <https://www.yoctopuce.com/EN/products/usb-electrical-sensors/yocto-watt>
10. <https://github.com/hubblo-org/scaphandre>
11. <https://github.com/humbertoAv/ecofloc>