Internship : On-line scheduling forcomputer tasks and power source commitment in datacenters only operated with renewable energy

This internship is placed in the context of the ANR-Datazero2 (2020-2023). The DATAZERO2 project (a project of the French National Research Agency) in partnership with IRIT (Toulouse), LAPLACE (Toulouse), FEMTO St (Belfort-Besancon) and the industrial partner EATON (Grenoble), aims at improving the operation and design of datacenters operated with local renewable energy sources.

The internship will be co-supervised by IRIT's SEPIA team and LAPLACE's CODIASE team. The SEPIA team has been working for several years on the optimization of the energy consumption of datacenters. The CODIASE team has also been working for several years for an efficient use of an energy-mix based on renewable energy production and storage to supply different consumers.

The internship may continue with a PhD thesis.

In the context of the project, the aim is to study an online scheduling of computer tasks and consequently a commitment of production and storage sources over a short time window (few hours). The scheduler will be aware of a long term planning (few days) of a mass of compute (the workload) and production prediction (according to weather prediction).

Research contribution:

During the internship, the student will propose an online scheduler to dynamically take into account the uncertainties. Depending on the competences of the student, either the IT part of the problem, or the electrical part will be developed first.

In the IT part, the online scheduler will manage unforeseen IT workload variation, or urgent customer requests, tasks longer/shorter than expected, node failures…. respecting available power envelop.

In the electrical part, the online scheduler will handle the intermittence of the energy sources used (variable production linked to the weather, source failures...) also providing expected power for the computer side.

The internship will have to optimize the placement of tasks or the commitment of sources in order to manage these uncertainties as well as possible.
In order to react at runtime, different IT and electrical leverages could be considered: DVFS (voltage/frequency of processors), on/off of machines, on/off on sections of solar panels and/or on/off of Fuel Cell ...
Different objectives may be studied: the quality of service (QoS) provided to each user requesting computing tasks, the overall quality of service of the datacenter (profit, carbon footprint), the respect of the planned energy envelope (at each instant, turning back to setpoints linked to supervisor), the stability of the voltage of the electrical distribution network, the workload mass executed ... Different resolution methods can be considered and compared.

Implementation and validation:

The contributions will be integrated into the project's middleware.
The proposed placement algorithms will be validated by simulations and/or real experiments. Thanks to

the presence of the EATON partner in the consortium, an OpenStack platform and hardware (inverters, e-PDU (controllable power distribution unit) ...) will be available as experimental support.
The multidisciplinary team of the project, with the expertise acquired with the previous project, will provide a high quality of technical and theoretical support on the notions that the candidate may lack either on the electrical level (accurate models of batteries, solar panels, hydrogen sources and other electrical circuits...), or on the IT level (consumption model, scheduling by virtual machines and IT leverages that can be used to save energy,...).

Knowledge requirements:
- Optimization and performance evaluation
- Programming skills in Java, Python
- Fluent English (bonus for French)
- curiosity for research
- bonus for electrical engineering skills and/or cloud computing

Application:
A detailed CV with academic results and ranking.

Contacts:
Patricia STOLF (IRIT, MdC HDR, patricia.stolf@irit.fr)
Stéphane Caux (LAPLACE, Pr INPT, caux@laplace.univ-tlse.fr)