

PhD Position on: Energy optimization in IP networks

The Operation Research team of the Data Communication Network Algorithm and Measurement Technology Laboratory, Huawei France Research Center, located in the Paris area, is looking for highly motivated candidates for a CIFRE PhD thesis on Network Optimization.

PhD thesis

Global warming has become a major concern for several decades. Information and communications technology “ICT” sector accounts for between 5% and 9% of the global electricity consumption per year [1], and telecommunication networks is taking an important part. Manufacturers have an urging need to design novel mechanisms/methods to optimize energy. In [2] authors have proposed methods for minimizing the energy consumption in the networks by rerouting traffic in an unsplitable way so that the maximum link utilization is no more than 50%. In [3], authors investigate the potential turning-off of some nodes in the network, when the traffic is low. They proposed an algorithm that aims to remove network links without causing traffic disruption during energy-saving periods. Some other recent works have been made in [4] combining energy aware routing and planning problems.

In practice, several constraints have to be satisfied before turning-off any equipment in the network. Indeed, as the traffic fluctuates during time, any decision needs to guarantee all services with respect to all SLAs (e.g., Delay, Packet loss...). This requires to consider several traffic scenarios in the planning phase. On the other hand, the energy efficiency of a device depends on several parameters that need to be evaluated over their full life cycle (LCA analysis) to evaluate the whole environmental impacts of any product. One future challenge for the telecommunication operators is the replacement of some equipment in the networks in order to improve the performance of the energy efficiency.

The PhD thesis will focus on two main aspects:

- **Network devices replacement:** The goal is to improve existing networks by suggesting the replacement of some devices in order to achieve better energy efficiency. Given a telecommunication network and a fixed budget (number of replacement, monetary budget, ... etc.), the goal is to compute the optimal strategy (in terms of energy consumption) to replace/add/remove nodes, links and devices, without exceeding the given capacity budget.
- **Robust devices shutdown:** The goal is to investigate the effects of shutdown of some network components when they are not fully-used. Given a set of scenarios (e.g., a multi-period traffic matrix), we have to decide which components to turn-off/on at every period of the time horizon such that all traffic demands are satisfied, the number of turned-off/on devices per period is bounded and the total energy saving is maximum.

Specific Requirements

Candidates should have a Master degree in Operation Research, Computer Science, or Applied Mathematics from a University or a Grande Ecole. They should have a solid background in Combinatorial Optimization. Knowledge of telecommunications will be appreciated.

English: Operational

Contacts

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Application

To apply please send a complete CV, a cover letter, grades of University/Grande Ecole studies, and references. The position is for 3 years starting as soon as possible.

Deadline: Application must be submitted as soon as possible. We will continue accepting applications until the position is filled.

Huawei

The Huawei France Research Center (PRC) located in Boulogne-Billancourt, Paris area, is responsible for advanced research in the fields of Algorithm and Software design, Aesthetics, MBB & Home devices and Parallel Computing, to create and design the innovative technologies and software platforms.

References

[1] <https://www.enerdata.net/publications/executive-briefing/between-10-and-20-electricity-consumption-ict-sector-2030.html>

[2] R. Wang, Z. Jiang, S. Gao, W. Yang, Y. Xia and M. Zhu, "Energy-aware routing algorithms in Software-Defined Networks," Proceeding of IEEE International Symposium on a World of Wireless, Mobile and Multimedia Networks 2014, 2014, pp. 1-6.

[3] Okonor, Obinna, et al. "Dynamic link sleeping reconfigurations for green traffic engineering." International Journal of Communication Systems 30.9 (2017): e3224.

[4] Zhang, Jinhong, et al. "TEAP: Traffic Engineering and ALR policy based Power-aware solutions for green routing and planning problems in backbone networks." Computer Communications 173 (2021): 27-44.