

# Master's thesis / internship

## Network design and equilibrium learning for collaborative logistics

Inria Grenoble (LIG) · École nationale des ponts et chaussées (LVMT)

### Context

Transport is a major challenge of the low-carbon transition, with the majority of goods being transported by road. We propose a master's thesis and PhD to investigate solutions as a part of the ACME project<sup>1</sup>, which focuses on **pooling** — several industrial actors grouping their flows — as the key ingredient for both better utilization of vehicles and a shift towards lower-carbon modes. ACME gathers researchers in computer science, applied mathematics, and economics, while working with policy makers and industrial partners that connect research to real impact.

### Scientific topic

We consider **network design for long-term planning** in logistics and supply chains. The aim is to pool transport orders coming from different firms, so that the consolidated flow unlocks means of transportation (such as a rail service) that no single firm's volume could justify. The Master's thesis or internship will bring together three streams of research:

- **Multicommodity capacitated network design.** Which services, hubs and modes to open, and at which capacity, so that pooled demand is routed at least cost and least emissions.
- **Equilibria for resource sharing.** Shared capacity must then be allocated among firms that are not a single decision-maker. We will model the interaction using tools from game theory such as Fisher markets on networks, which determine the split of shared resources.
- **Decision-focused learning.** In real transportation networks, the state of the system (e.g., congestion) is only partially observed. Decision-focused learning has emerged as a principled way to incorporate arbitrary machine learning models into sound decision-making, by predicting uncertain parameters of the optimization problem.

Design decisions are discrete and taken once, whereas the sharing of the resulting capacity is a market outcome the designer does not control but can anticipate. How should a network be designed when its capacity will be allocated by an equilibrium with uncertain input? The resulting topic, at the intersection of **integer optimization, game theory and machine learning**, has to our knowledge no counterpart in the literature. The internship is designed to **prepare a PhD thesis** on the subject, co-supervised between Inria Grenoble and ENPC.

### Profile

Master's student in applied mathematics or computer science, with a solid background in operations research and optimization: convex, linear and mixed-integer optimization, extended formulations, duality theory. Interest in mathematical modelling and scientific programming (Julia, Python or C++). No prior knowledge of machine learning, game theory or logistics is required — curiosity about these topics is. Despite the proximity of the French Alps, skiing and climbing skills remain optional.

### Supervision, location and practical information

The work is a collaboration between **Mathieu Besançon** (Inria Grenoble, LIG) and **Guillaume Dalle** (ENPC, LVMT). The candidate will be based on the campus of Université Grenoble Alpes in Saint-Martin-d'Hères, in the Inria GHOST team. **Duration:** 5–6 months **Start:** January to March 2027 **Applications:** CV, transcripts (at least last year of Bachelor's and first year of Master's) and a short motivation email to [mathieu.besancon@inria.fr](mailto:mathieu.besancon@inria.fr) and [guillaume.dalle@enpc.fr](mailto:guillaume.dalle@enpc.fr) with the subject '[network design internship]'.

References: Network Design for the Traffic Assignment Problem with Mixed-Integer Frank-Wolfe, K. Sharma, D. Hendrych, M. Besançon, S. Pokutta, 2024 [link](#), Wardropnet: Traffic flow predictions via equilibrium-augmented learning, K. Jungel, D. Paccagnan, A. Parmentier, M. Schiffer, 2025, [link](#), Infinite-dimensional Fisher markets and tractable fair division, Y. Gao and C. Kroer, 2023, [link](#), Decision-Focused Learning: Foundations, State of the Art, Benchmark and Future Opportunities, J. Mandi et al., 2024, [link](#)

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<sup>1</sup><https://acme-mobidec.github.io/>