

# On the Collaboration Uncapacitated Arc Routing Problem

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**Abstract:** In this talk a new arc routing problem for the optimization of a collaboration scheme among carriers is presented. We focus on situations where collaboration is managed in a centralized way. We consider a set of carriers cooperating under the guidance of a central station that acts in a non-partisan way. Each carrier has a depot and a set of customers, whose service generates a revenue. Each carrier identifies a subset of customers that it wants or needs to serve. The remaining customers are defined as shared customers. A shared customer may be served by the carrier that decided to share it, by a different carrier or not to be served. Part of the revenue of a shared customer that is served goes to the carrier that decided to share the customer and part goes to the carrier that actually serves it. If a shared customer is not served by any carrier the revenue is not collected and a penalty is paid. We assume that each carrier has one vehicle and that vehicle capacity is not relevant, that is the vehicles are uncapacitated.

This yields to the study the Collaboration Uncapacitated Arc Routing Problem (CUARP), an uncapacitated arc routing problem with multiple depots, where carriers collaborate to improve the profit gained. We study two variants of the CUARP. In the first one the goal is the maximization of the total profit of the coalition of carriers, independently of the individual profit of each carrier. The second variant includes a lower bound on the individual profit of each carrier. This lower bound may represent the profit of the carrier in the case no collaboration is implemented.

We formulate mixed integer programming models for the two variants of the problem and study their properties and their relations with well-known arc routing problems. We solve the formulations for the two proposed variants with a branch-and-cut algorithm and quantify the impact of collaboration for a large set of benchmark instances.

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