Abstract

In this work we consider the Commodity constrained Split Delivery Vehicle Routing Problem (C-SDVRP), a vehicle routing problem where customers request for multiple commodities, the vehicles can deliver any set of commodities, and multiple visits of a customer are allowed only if the customer requests multiple commodities. When a commodity is delivered by a vehicle to a customer, the entire amount requested by the customer is carried. If the customer is visited more than once, the different vehicles will deliver different sets of commodities.

The problem has been introduced in [2], where different models are considered to study the impact on cost from using vehicles dedicated to a single commodity compared with using flexible vehicles capable of carrying any set of commodities, and from allowing or not split deliveries of individual commodities. Allowing splitting the demand of a customer for different commodities on different vehicles can be more costly than allowing splitting the delivery of each individual commodity, but at the same time it is more natural and likely more acceptable to customers.

We modeled the C-SDVRP problem by means of a set partitioning formulation and devised a branch-and-price-and-cut algorithm. In the pricing phase, the ng-path relaxation of a constrained elementary shortest path problem is solved by means of a label setting dynamic programming algorithm (see [1]). Capacity cuts are then considered in order to strengthen the bound.

We have been able to solve to optimality instances with up to 40 customers and 3 commodities per customer.

References:

[1] - R. Baldacci, A. Mingozzi, R. Roberti (2011). New route relaxation and pricing strategies for the vehicle routing problem. Operations Research 59(5), 1269-1283.

[2] - C. Archetti, A. M. Campbell, M.G. Speranza (2014). Multi-commodity vs. Single-commodity Routing. Transportation Science, doi:10.1287/trsc.2014.0528.