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# Feasibility algorithms for two pickup and delivery problems with transfers

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## 1 Introduction

This presentation follows the PhD thesis of Renaud Masson [1] on the Pickup and Delivery Problem with Transfers (PDPT). The motivating application is a dial-a-ride problem in which a passenger may be transferred from the vehicle that picked him/her up to another vehicle at some predetermined location, called *transfer point*. Both the PDPT and the Dial-A-Ride Problem with Transfers (DARPT) were investigated. An adaptive large neighborhood search has been developed to solve the PDPT [2] and also adapted to the DARPT [3]. In both algorithms, multiple insertions of requests in routes are tested. Efficiently evaluating their feasibility with respect to the temporal constraints of the problem is a key issue.

## 2 The Pickup and Delivery Problem with Transfers

Allowing transfers in a pickup and delivery problem can reduce routing costs but it also introduces an interdependency between the routes of the problem: a transferred requested has to be delivered at its transfer point before it can be pickup up by a second vehicle. When the pickup or delivery times of requests, or the opening time of transfer points are subject to time windows, this precedence constraint has to be integrated in the feasibility / routes scheduling algorithm. We show that the standard algorithms can be adapted to evaluate in constant time the feasibility of a request insertion [5].

## 3 The Dial-A-Ride Problem with Transfers

In dial-a-ride applications it is common to specify a maximum ride time for passengers in order to enforce a sufficient quality of service. This constraint is combined with time windows and precedence constraints at transfer points in the DARPT. We show that the resulting feasibility problem can be stated as a Simple Temporal Problem (STP), which is solved with a shortest path algorithm. The complexity of this new feasibility algorithm is larger than for the PDPT and the resulting solving time is significantly increased. As a result, we propose some necessary and sufficient feasibility conditions that reduce the time needed to validate or reject a request insertion [4].

## References

- [1] R. Masson. *Problèmes de collectes et livraisons avec transferts*. PhD thesis, Université de Nantes, Angers, Le Mans, 2012.
- [2] R. Masson, F. Lehuédé, and O. Péton. An adaptive large neighborhood search for the pickup and delivery problem with transfers. *Transportation Science*, articles in advance, doi:10.1287/trsc.1120.0432, 2012.
- [3] R. Masson, F. Lehuédé, and O. Péton. The dial-a-ride problem with transfers. *Computers and Operations Research*, submitted, 2012.
- [4] R. Masson, F. Lehuédé, and O. Péton. Simple temporal problems in route scheduling for the dial-a-ride problem with transfers. In N. Beldiceanu, Jussien N., and Pinson E., editors, *Proceedings of CP-AI-OR*, volume 7298 of *LNCS*, pages 275–291. 2012.
- [5] R. Masson, F. Lehuédé, and O. Péton. Efficient feasibility testing for request insertion in the Pickup and Delivery Problem with Transfers. *Operations Research Letters*, 41(3):211–215, September 2013.