# Cooperative Transport Planning

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**Abstract**

To test and compare different forms of cooperative planning algorithms developed in the CABS project we use a generic simulator called MARS. Examples in the transportation sector are implemented in this simulator.

## 1 Introduction

A central problem in the transportation domain is the planning of actions, so that orders are processed efficiently according to some performance function.

Transport planning is a very complex task. Existing planners have great difficulties to construct plans. Even when these plans are created, they may become useless as a result of changes in the world (e.g. breakdown of vehicles).

As a part of the CABS (Collective Agent Based Systems) program [1] — initiated in the PDS (Parallel and Distributed Systems) group at Delft University of Technology — we deal with transport scheduling and planning algorithms. Our approach is to use those techniques in a multi-agent setting where groups of agents are able both to cooperate and to compete with each other.

In our search for a good (distributed) approximation algorithm for transport planning, we want to test and compare different forms of cooperation and planning algorithms, see e.g. [2, 6].

## 2 Tool development

For every incoming order, agents (representing companies) are *competing* by making bids on the order. Following some auction protocol one company will get the order. The plan the vehicles of this company are going to execute can be created with the following algorithm, consisting of several phases:

In the first phase (non-cooperative) an *initial*, possibly infeasible (deadlines do not necessarily meet), plan is constructed using a greedy algorithm. The second phase *improves* this plan using a slightly modified version of the *exchange* heuristic as described in [3]. In the third phase, trucks are cooperating with each other. In this phase they try to improve the global performance (that can be defined as the moment in time *all* orders are executed) by helping each other, as in the first two phases trucks try to optimize their own performance.

We can repeat the simulation with different planners under exactly the same circumstances. This allows us to empirically measure the difference in performance

between different transport planning algorithms.

A simulation tool is used to set up an environment in which we can measure the performance of different types of planning algorithms. MARS [4] (Multi-Agent Real-time Simulator), created by TNO [5] under the supervision of Z. Papp, is a generic simulator easing the construction of such an environment. The main features of MARS are:

- It is scalable in various application domains.
- The implementation relies on distributed hardware/software platforms.
- It has a model based system architecture, where the application independent kernel and the application specific parts are clearly separated.
- It is open to integration with external (e.g. legacy) systems.

# 3 Demonstration

We will show two simulation runs, first with a very simple non-cooperative planner Subsequently, a simulation run with a cooperating planner. This will clearly show the effects of *cooperation* between agents on the global performance of the transport planning. The complete demonstration will take around 20 minutes.

# References


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