

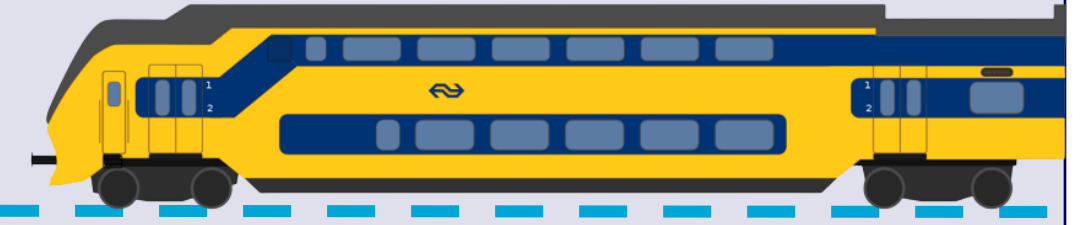
ROBUST RAIL Lab

Smart Tracks: Transforming Railway Network Planning with AI

Jan 17, 2025

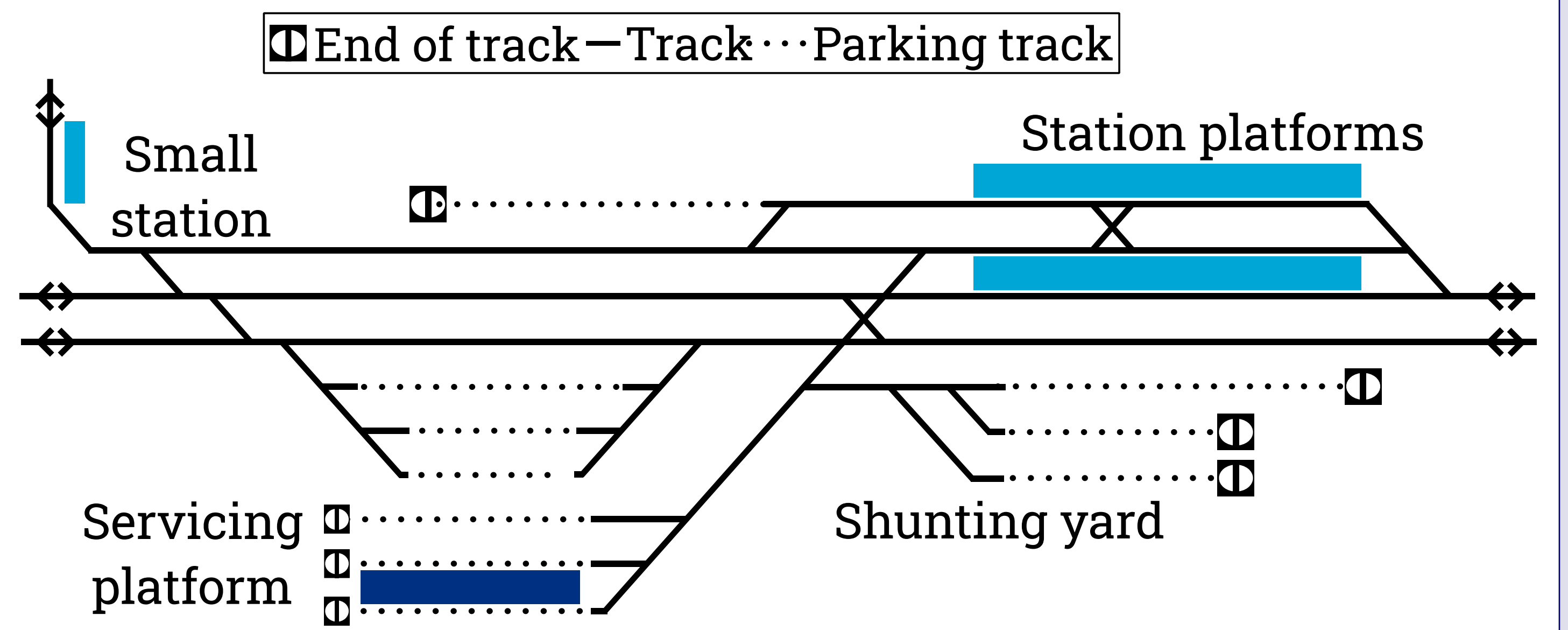
AI & Mobility Day

Issa Hanou, Rens de Heer, Jens Heuseveldt, Casper Loman, Talha Özüdoğru
Sebastijan Dumančić, Anna Lukina, Han Hoogeveen, Marjan van den Akker, Mathijs de Weerd



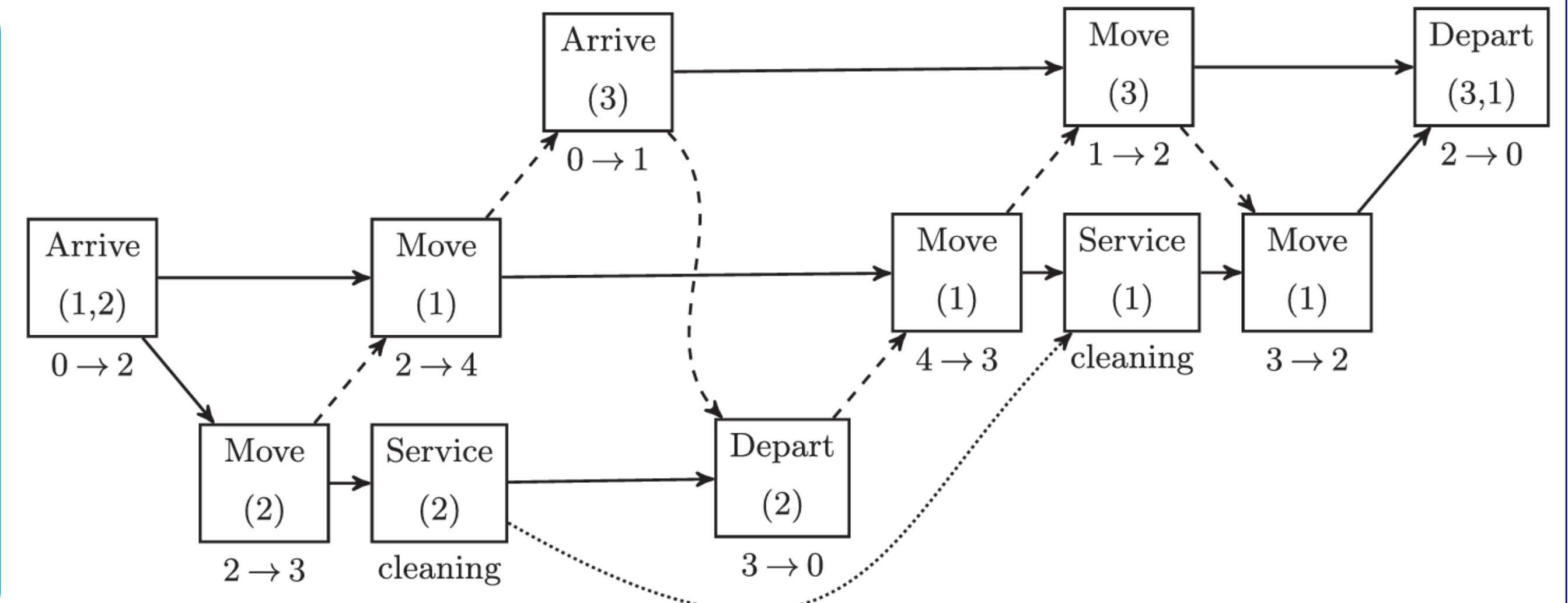
RAILWAY HUB

- Station area including several shunting yards
- Complex problem with many details
- Includes passenger traffic (from different operators) as well as freight traffic
- **PROBLEM STATEMENT:** Trains need to be routed (conflict-free) and undergo service tasks



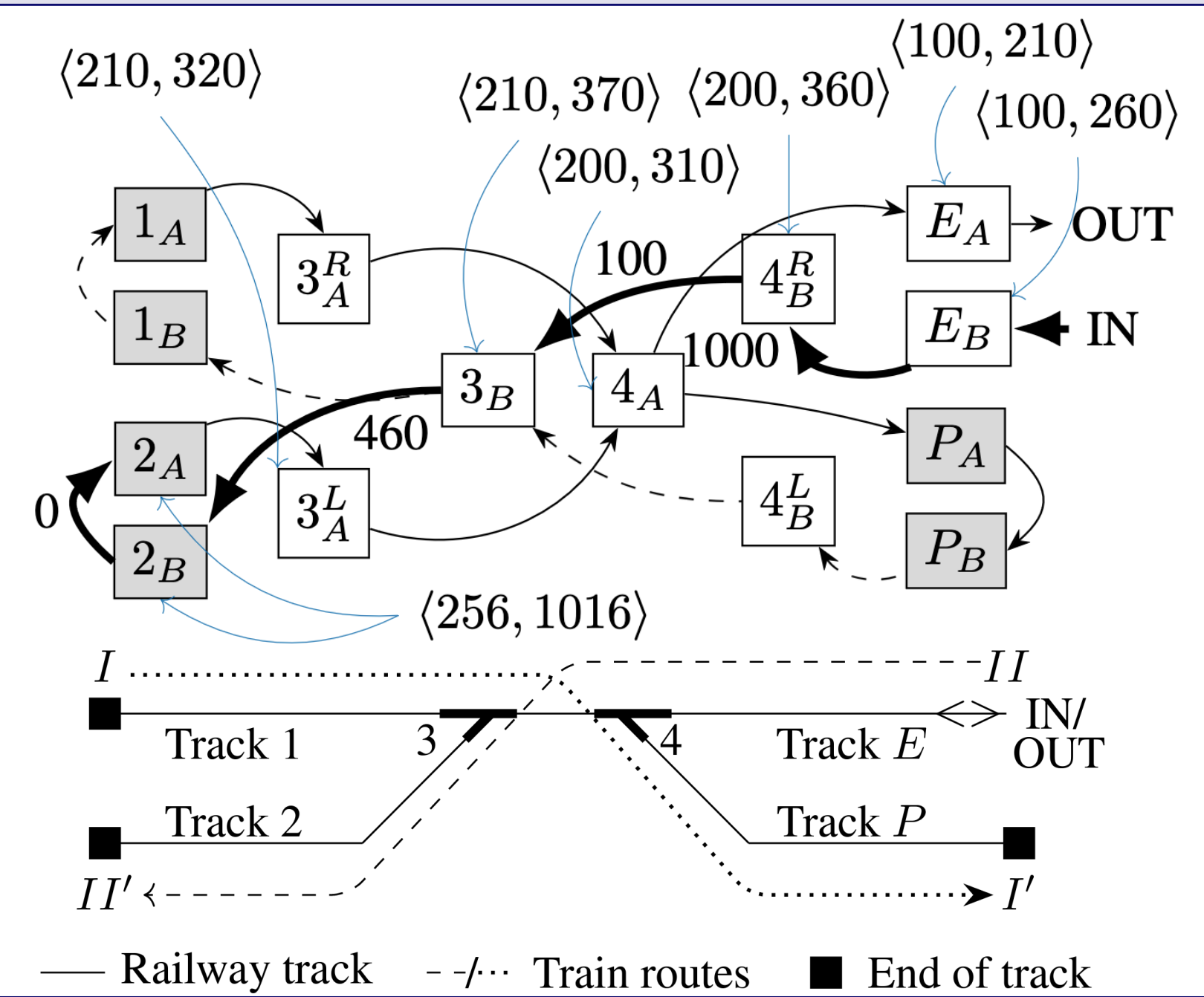
BASELINE

- Our lab is developing an open-source railway hub planner
- Planning of routing, matching, parking, cleaning, servicing of trains
- Combined with instance generator and simple evaluator for easy comparison with other methods
- Local search method on partial-order schedule



REPLANNING

- Replanning in advance by precomputing possible alternative routes
- Instant lookup of alternative plan at time of delay
- Minimize the interval of uncertainty to preserve safe plan execution
- Resolve delayed train without affecting operations of other trains
- Follow-up with ProRail for decision aids for train dispatchers
- Multi-Agent Delay Replanning: applications in other domains
- First application of any-start-time planning



FREIGHT

- Many disturbances during both planning and operation due to dealing with international traffic
- Prevent double work due to these disturbances
- Use algorithms to make a planning that accounts for some disturbances
- Use simulation to predict the resistance of current planning



ALLOCATION

- Avoid infeasible instance on the shunting yard by evenly distributing trains during the hub planning
- Depends on the number of trains, service tasks, etc.
- Analyze the impact of these factors on the difficulty of the shunting yard problem
- Use the results to guide the hub planning

