ROADEF / EURO Challenge 2014
Trains don’t vanish!

Final phase results announcements

François RAMOND
(SNCF / Innovation & Research Department)
Christian ARTIGUES, Eric BOURREAU, Vincent JOST,
Safia KEDAD-SIDHOUM
(ROADEF Challenge team)
Marc SEVAUX
(EURO representative)
SNCF, a leading mobility operator

‑ One of the leading mobility groups worldwide
  ‑ Train operating company
    ‑ High-speed: TGV (2 billion passengers since 1981)
    ‑ Regional trains
    ‑ Suburban trains (3 million passengers per day in the Parisian area)
  ‑ Urban transportation (Keolis)
  ‑ Global logistics (Geodis)
  ‑ Infrastructure management
    ‑ Traffic control and regulation
    ‑ Maintenance of infrastructure
Why this problem?

- Managing rolling stock units around stations is becoming more and more difficult
  - Fast-growing traffic
  - Less space for railway premises in cities

- Trains don’t vanish!
  - Need to be managed between commercial trips
Challenge problem overview (1/2)

- **Perimeter**
  - Large railway premises (platforms, yards, maintenance centers, tracks)
  - Planning horizon: a few days

- **Decisions to make**
  - Manage trains from their arrivals to their departures
    - Assignments
    - Operations (maintenance, junctions/disjunctions)
    - Move over the different resources

- **Objective function**
  - Weighted sum (uncovered arrivals / departures, operations, dwell time, preferences...)
Challenge problem overview (2/2)

Constraints
- Train categories
- Resources capacity
- Maintenance of trains
- Traffic conflicts
- Junctions / disjunctions
- …
Objectives from the business perspective

Prospective approach
- Completely new approach: mixture of individually hard problems
- What if all features were handled simultaneously?
- Proof of concept

Ultimate goal
- From algorithms to an industrial tool
  - Refine requirements
    - Users
    - Addressed time horizons
    - Adjustments
  - Adapt algorithms and plug into information system
Challenge planning

- **Sprint 1:** 15\textsuperscript{th} November 2013
- **Sprint 2:** 11\textsuperscript{th} December 2013
- **Qualification:** 15\textsuperscript{th} January 2014
- **Final:** 22\textsuperscript{nd} June 2014
- **Scientific:** 29\textsuperscript{th} June 2014
Challengers: 36 teams from 20 countries
Intermediary results

**Sprint 1: J4**
- Luc Arnaud, Siao-Leu Phouratsamay, Guillaume Pataut, Grigori German
  - ENSIMAG, Grenoble, France

**Sprint 2: S18**
- Mirsad Buljubasic, Michel Vasquez, Haris Gavranovic, Said Hanafi
  - Nîmes/Lille/Sarajevo, France/Bosnie

**Qualification winner: S1**
- Sandra Huber, Ulrich Tüshaus, Martin Josef Geiger, Sebastian Langton, Marius Leschik, Christian Lindorf, Manabu Geiger
  - Helmut-Schmidt-University, University of the Federal Armed Forces Hamburg, Allemagne

**Qualified: 13 teams**
- S1, S9, S11, S14, S18, S19, S20, S22
- J3, J4, J9, J10, J11
Subject modification

- Subject modification for the final phase
  - Anticipated from the start of the challenge
  - Motivations
    - Prospective approach
    - Industrial challenge reflecting industrial world
      - Organizations and requirements are constantly changing
      - Software need to be flexible to be easily adapted
- Improvements identified with sprint / qualification results
  - TrackGroup conflicts and yards capacity
  - Performance cost
- Some objectives turned into constraints, and weighted sum instead of lexicographic order
## Instances B

<table>
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<th>Nb days</th>
<th>Arrivals</th>
<th>Departures</th>
<th>Resources</th>
<th>% covered arr</th>
<th>% covered dep</th>
<th>Nb maintenance operations</th>
<th>Junctions</th>
<th>Disjunctions</th>
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</table>
One final word…

✦ Problem was extremely difficult
  ✦ Mixture of difficult problems
  ✦ Large instances

✦ Amazing experience for us
  ✦ Interactions on the forum

✦ You did a great job, thank you!
  ✦ Hope you could get a taste of optimization in the railway industry
  ✦ Hope you enjoyed it as much as we did

✦ Many thanks to ROADEF / EURO team!
And now… the challenge results!

<table>
<thead>
<tr>
<th>Team</th>
<th>Total score</th>
<th>Award</th>
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<tbody>
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<td>Winners !</td>
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<td>J10</td>
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<td>3rd Junior !</td>
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<td>57 199 217</td>
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Scores relative to best solutions
Per team (1 = best solution)
Scores relative to best solutions
Per instance (1 = best solution)
Congratulations and thank you all!