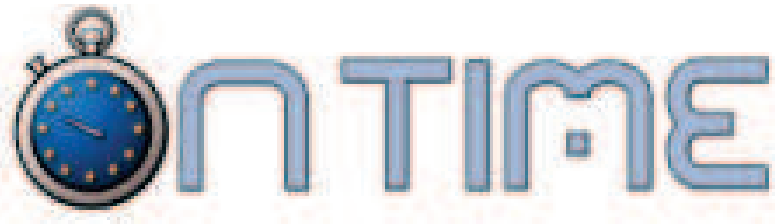
WP05

EAG meeting

Hitchin, 25 June 2014



[Optimal Networks for Train Integration Management across Europe]

Collaborative Project

7th Framework Programme

Rob Goverde

WP5: Operations management of large scale disruptions

Outline

- WP5 objectives
- Main reports so far
- WP5 disruption management approach
- WP5 demonstration

WP5 objectives (DoW)

- **Objective 3:** To reduce overall delays and thus service dependability through improved traffic management techniques that can recover operations following minor perturbations as well as major disturbances

- Focus: blocked tracks

Main reports so far

1. **ONT-WP05-I-UDB-013-01 -** State-of-the-art of Recovery Algorithms for Real-time Railway Optimization

2. **ONT-WP05-D-IFS-015-03** - D5.1 Functional and technical requirements specification for large scale perturbation management

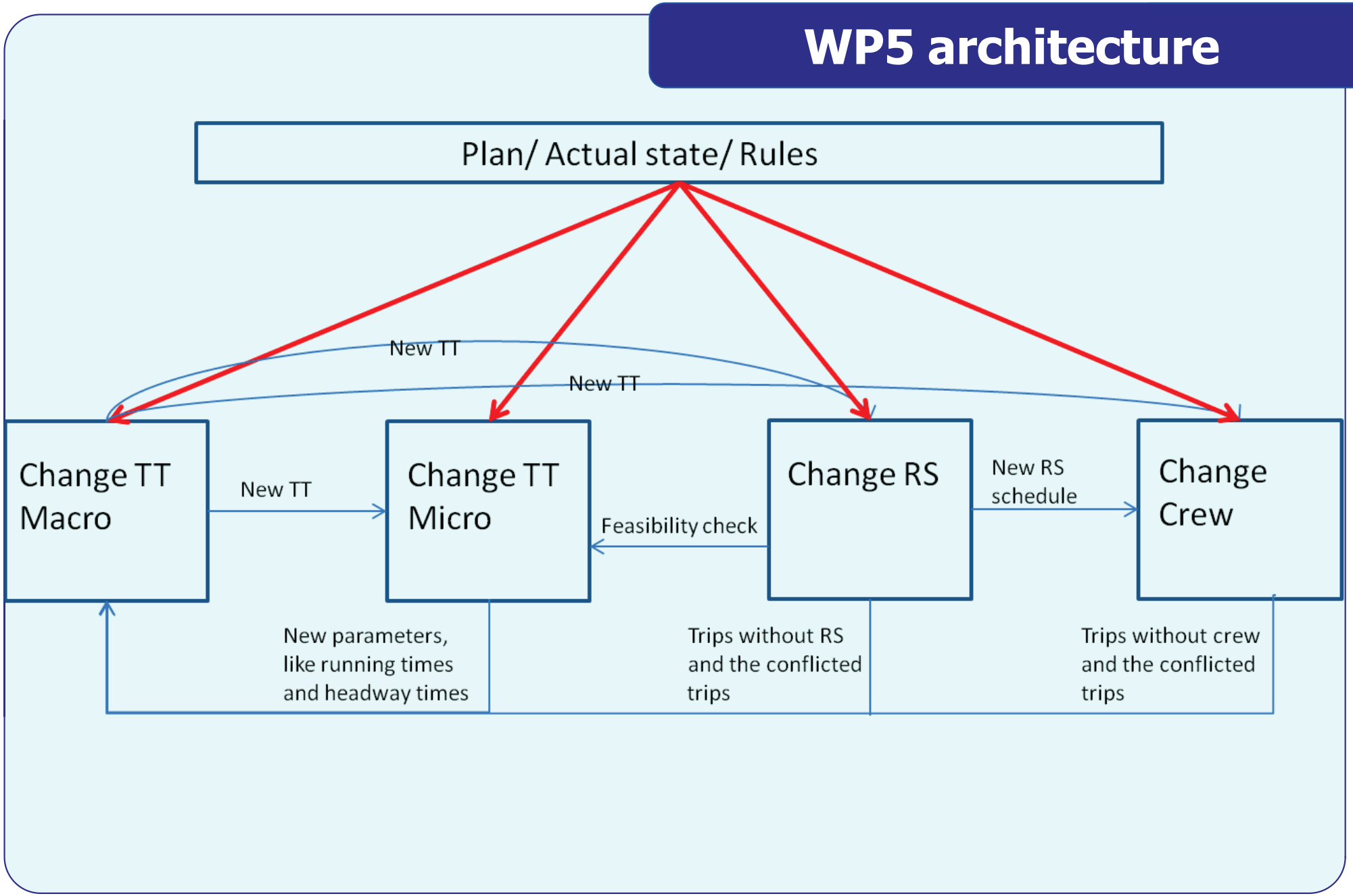
3. **ONT-WP05-T-UON-011-01** - HF ANNEX TO D5.1

4. **ONT-WP05-D-EUR-026-03** – D5.2 Decision support tools for the optimal human super-visory control of the recovery processes

WP5 approach

- Set of exchangeable modules to prove concept
- Standardized RailML I/O data format (with extensions)
- Internal data structure with transformations between micro/macro models
- Four-level iterative approach by team of three partners
  - Microscopic timetable rescheduling and data transformations
    - Detailed computations on local level, including local rerouting and conlict-free timetable at all stops
  - Macroscopic timetable rescheduling
    - Timetable optimization at (affected) main stations only
  - Rolling stock rescheduling
    - Feasible rolling stock assignment to non-cancelled train services
  - Crew rescheduling
    - Feasible crew duties to non-cancelled train services

WP5 architecture



Microscopic timetable model

Objectives

- Conflict-free and realizable adjusted timetable

Approach

- Replatforming and rerouting for short-turning trains
- Running time and minimum headway calculations on alternative routes and temporary speed restrictions
- Operational speed profiles for given run time supplements
- Conflict detection using blocking times (rejection criteria)
- Aggregation to macroscopic model
- Partly the same algorithms as WP3

Macroscopic timetable model

Objectives

- Compute adjusted timetable w.r.t. disruption
- Minimize cancelled train services
- Minimize delays w.r.t. original timetable (departures after short-turning and delays elsewhere)

Approach

- Using short-turning of (partially) cancelled train services
- IP problem based on event-activity network
- Solution computed by C-PLEX commercial solver

Rolling stock model

Objectives

- Feasible rolling stock circulations to adjusted timetable
- Minimize additional cancelled train services
- Minimize deviations from original rolling stock circulations
- Minimize amount of shunting movements
- Minimize end-of-day balance at overnight stations

Approach

- MIP based on multi-commodity flow with extensions
- Split in model with no end restrictions and with day balance
- Model solved by C-PLEX (Branch & Cut)
- Model by Lars Nielssen (EUR PhD thesis 2011) based on Fioole et al. (EJOR 2006) and Maróti & Kroon (TS 2005)

Crew rescheduling model

Objectives

- Feasible crew assignments to adjusted timetable (with cancelled train services)
- Minimize additional cancelled train services
- Minimize deviations from original crew duties

Approach

- Driver and guard are a team
- MIP based on a set covering model
- Solved by Lagrangian relaxation and column generation
- Model developed by Daniel Potthof (EUR PhD thesis 2010; Potthof et al. TS 2010) based on Caprara et al (1999)

WP5 demonstration

Dutch case study

- Two intersecting corridors
  - Utrecht-Eindhoven and
  - Tilburg-Nijmegen
- Hourly timetable pattern with
  - 4 IC and 6 Local train lines
  - 2 trains/h each
- Blocked tracks between s' Hertogenbosch and Oss from 7:30-8:30 AM