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Assessment of operational Feasibility

Dutch Network, Timetable 2014 and 2017

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Outline

1. Introduction
2. The Netherlands model (NL model)
3. Assessing operational feasibility of NL
4. Results
5. Next steps
6. Conclusion

Introduction

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- Infrastructure and timetable planning

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- Customers
  - ProRail (Dutch infrastructure manger)
  - NS (Dutch Railways) and other operators
  - Ministry of Infrastructure and Environment
  - Provinces

Growth of infrastructure Model

NL key facts (ProRail)

- 7030 km track
- 7151 Switches
- 11,944 signals
- 350 trains simultaneously

History

- Start 2005
- 2008 CoreNet
- 2009 Asd-Ehv
- 2012 North East
- 2013 NL Complete

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Facts and Numbers

7 infrastructure files

Track Kilometers	8164 km
Switches	6410
Stations/Services	545
Main Signals	9308
Instruments	6093
Double Vertices	38616
Edges	41277
Routes	11151
Paths	2752
Itineraries	707

Simulation: 06:00 - 13:00,

- step 2,0s, 2173 trains, 360 trains simultaneously

- 23 min timetable timetable statistics only
- 49 min with 46 train diagrams and output on.

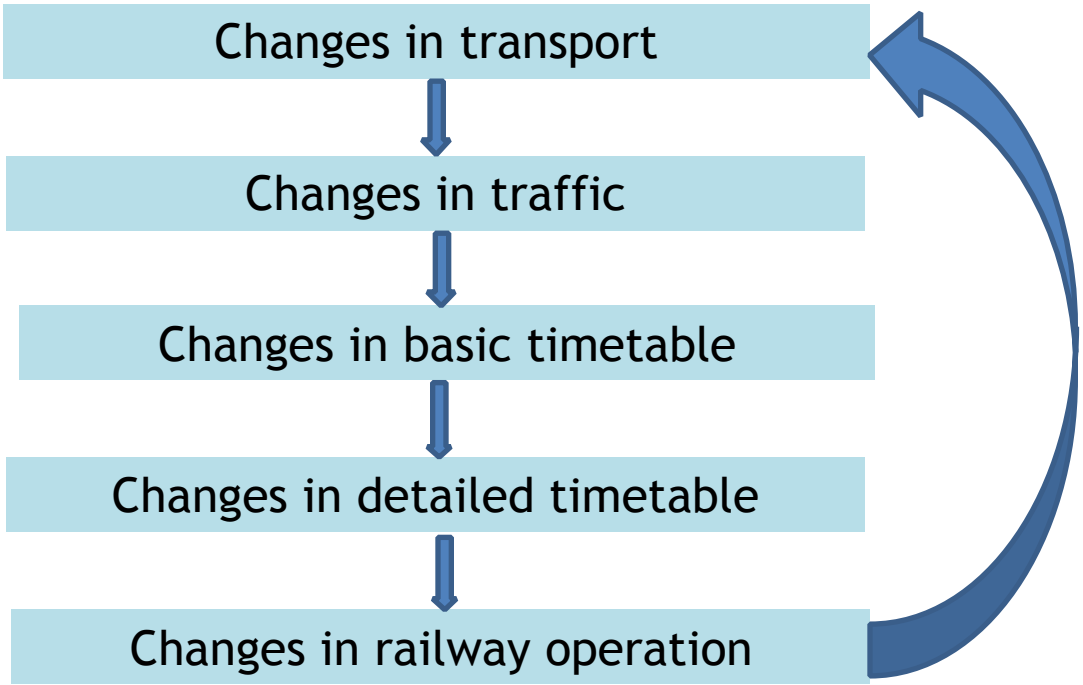
Assessing operational feasibility

Why a microscopic model with OpenTrack?

- Current timetable planning tools limited
- Focus on planning without conflicts
- Significant timetable change in 2017 planned

- Complete NL model available
- Computation time has decreased
- Modeling time has decreased

Old timetable planning process



Old approach

- Local headway times according to rules
- Running times not accurate
- Feedback in planning process is limited. Real proof of the pudding is in the operation

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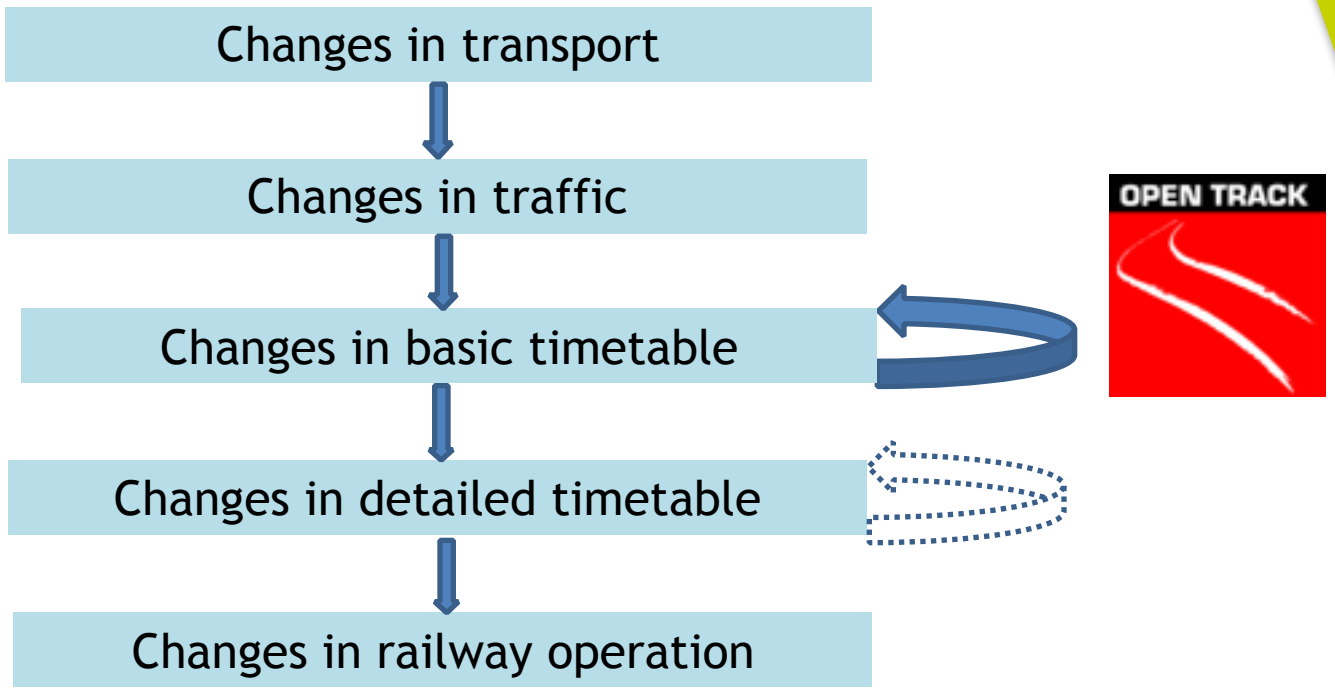
Current planning process with OpenTrack



New ProRail/NS/RHDHV approach

- Take into account all constraints from trains, infrastructure and timetable
- Check on nationwide feasibility and stability in every planning step
- Stable and safe base for operation
- Less start-up problems when timetable is implemented

Assessing operational feasibility of NL

How?

- Deterministic (First step)
- 2014 – Day
- 2017 – Hour pattern

- Modeling of running time variation with extra slack according to planning rules (passenger trains):
  - 7,5% running time slack compared to the 10th percentile train
  - +1 minute additional release time

- The output creates understanding of the conflicts in the timetable for planners

Results

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- Planning issues
- Train diagrams
- Delay lists
- Conflicts
- Resulting secondary delays

ProRail/NS

- Asses the quality of the planned timetable based on these outputs and expert judgement.
- Uses the quality assessment for decision-making
- Improves all the weak spots in the timetable based on these outputs

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Results

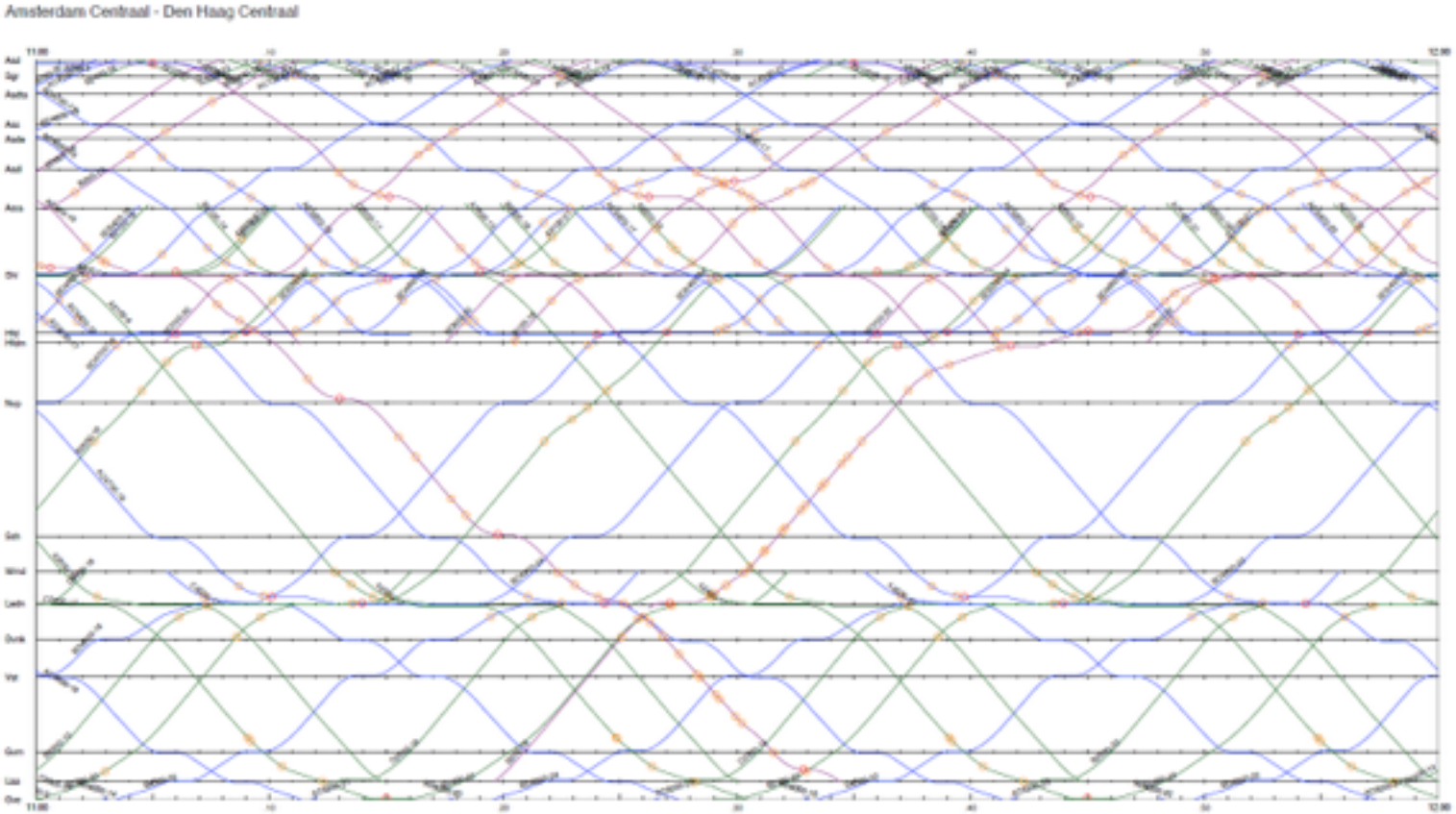
Planning issues

When modeling we encountered and solved these issues

- Track usage
- Route usage
- Shapeshifting trains
- Use of non existing routes
- Infrastructure constraints

Results

- 46 Train diagrams



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Results

- Conflict example

Priority	Train 1	Train 2	Station/ Junction	Type	Time	Delay train 1 [s]	Delay train 2 [s]	Headway norm [s]	Headway planned [s]	Headway measured simulation [s]
1	B1600-6	B11400-10	Amf	Stop at Signal	8:54:58	-86	-4	180	0	158
2	AC6000-5	BD3200-12	Ht	Braking for Signal	9:54:42	82	52	180	0	154
3	AC4700-5	B2100-10	Ledn	Braking for Route	8:43:34	144	16	180	0	138

Results

Stop at signal geographical example

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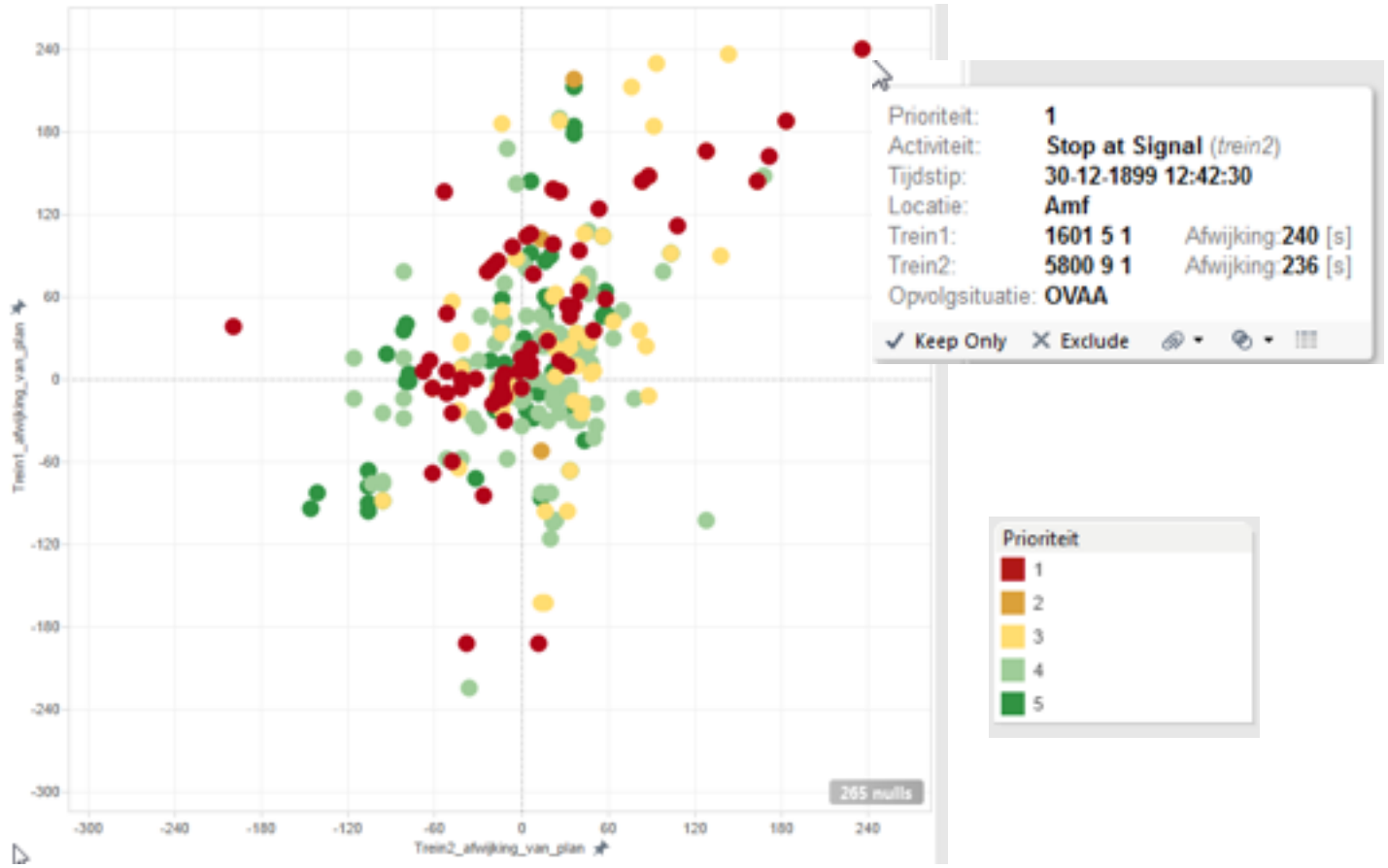
Results

- Conflict scatterplot example



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Next Steps

- Support implementation OpenTrack and model within ProRail
- More frequent checks on planned timetable
- Smaller area's / direct feedback for planner
- Faster checks
- When planning is stable in deterministic version:
  - Prepare model for stochastic simulation
  - Setup a stochastic simulation with TrenoLab

Conclusion

- 10 Years of OpenTrack usage has lead to:
  - 10 years of experience in modeling and maintenance
  - A complete model of the Netherlands
  - 4 licenses (including 64-bit)
  - 10 OpenTrack users
  - Quality control
  - Data processing
- A micro simulation is feasible for a whole network
- Gives useful results
- Conflict detection is possible
- Data processing increases

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