Railway simulation using OpenTrack in Finland

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- All OpenTrack simulation studies done in Finland
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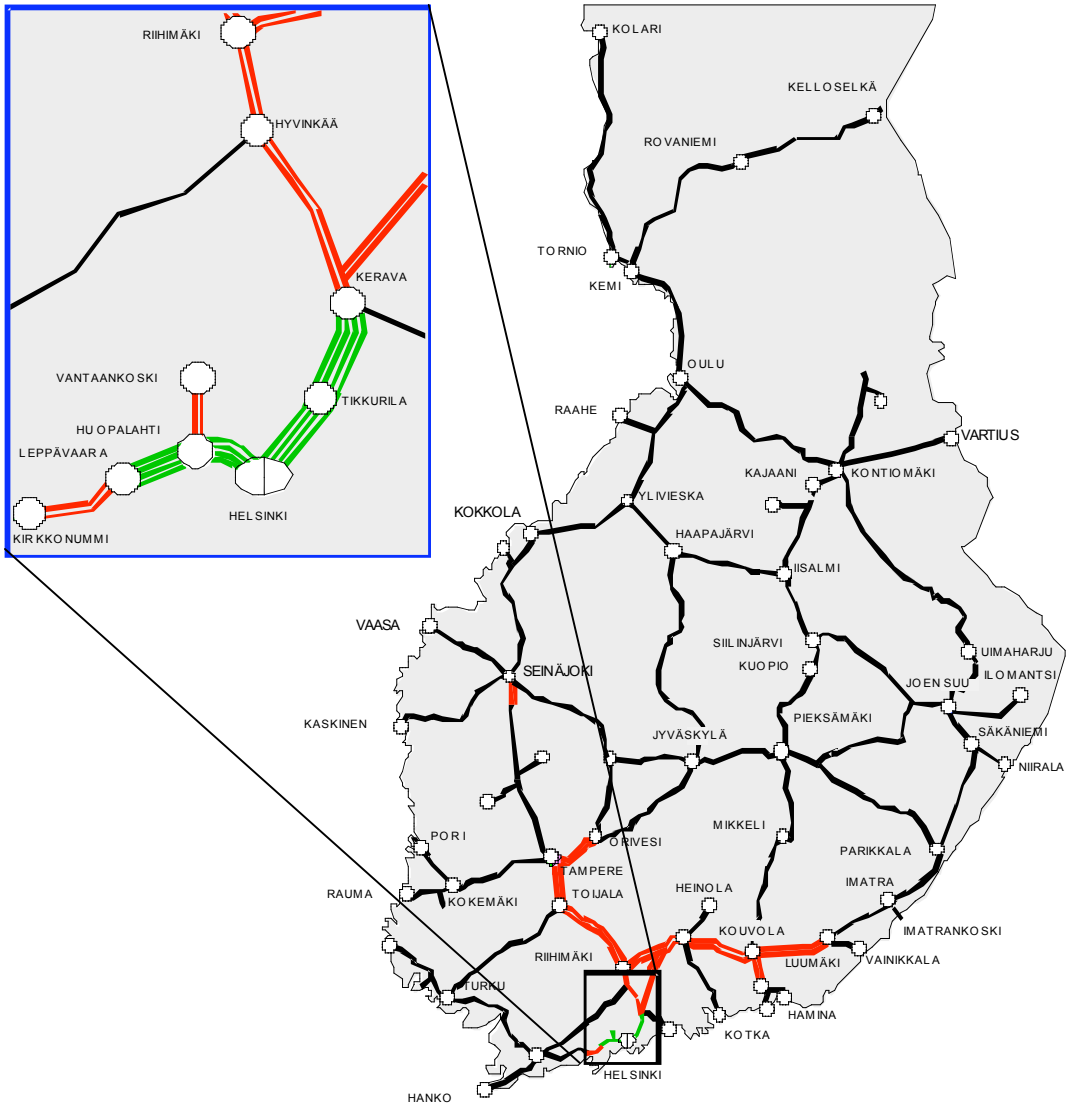
- Summary

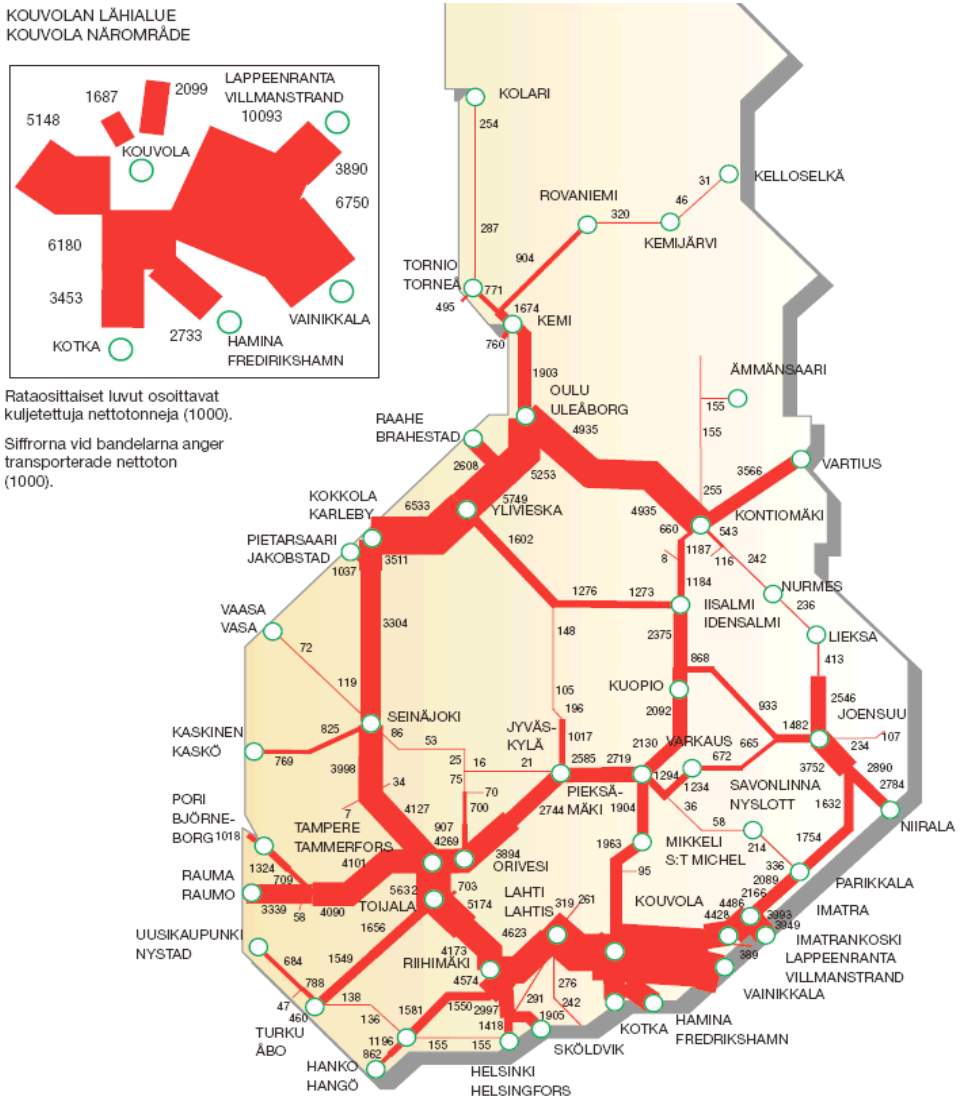
Track network in Finland

- Length of track network **5,700** kilometres
- Electrified track **2,600** kilometres
- Remote-controlled track **2,500** kilometres
- Railway service locations **480**



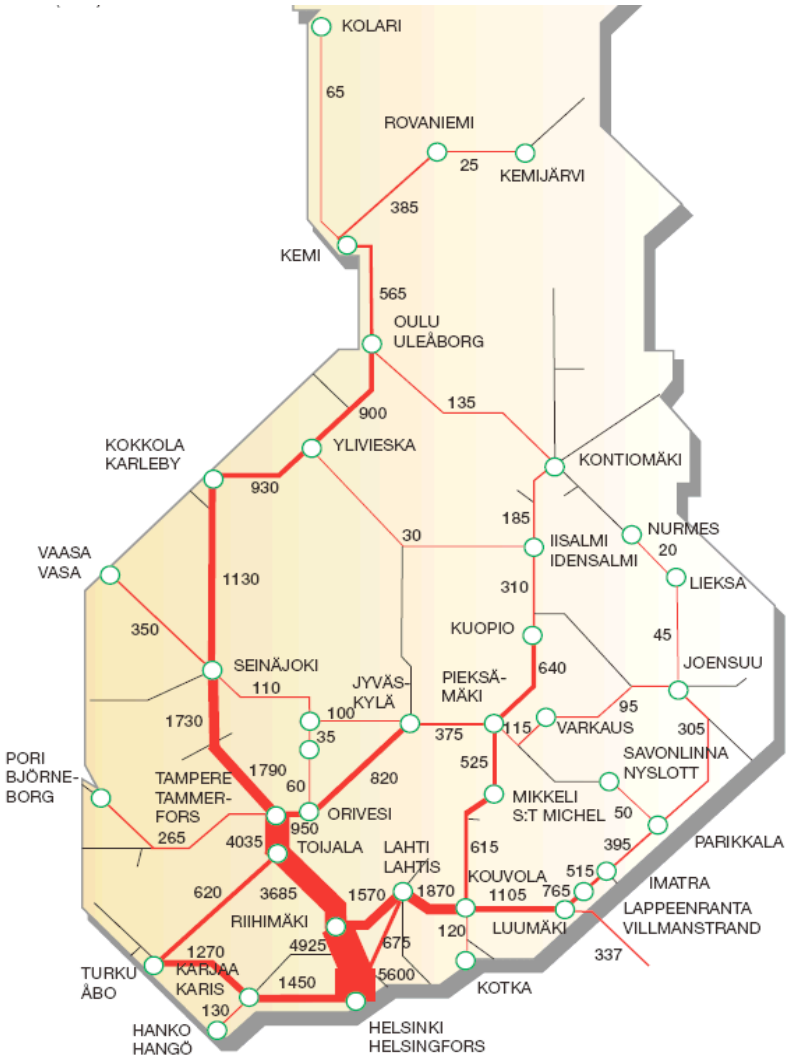
— Single track
— Double track
— Four track

Traffic volumes – Freight



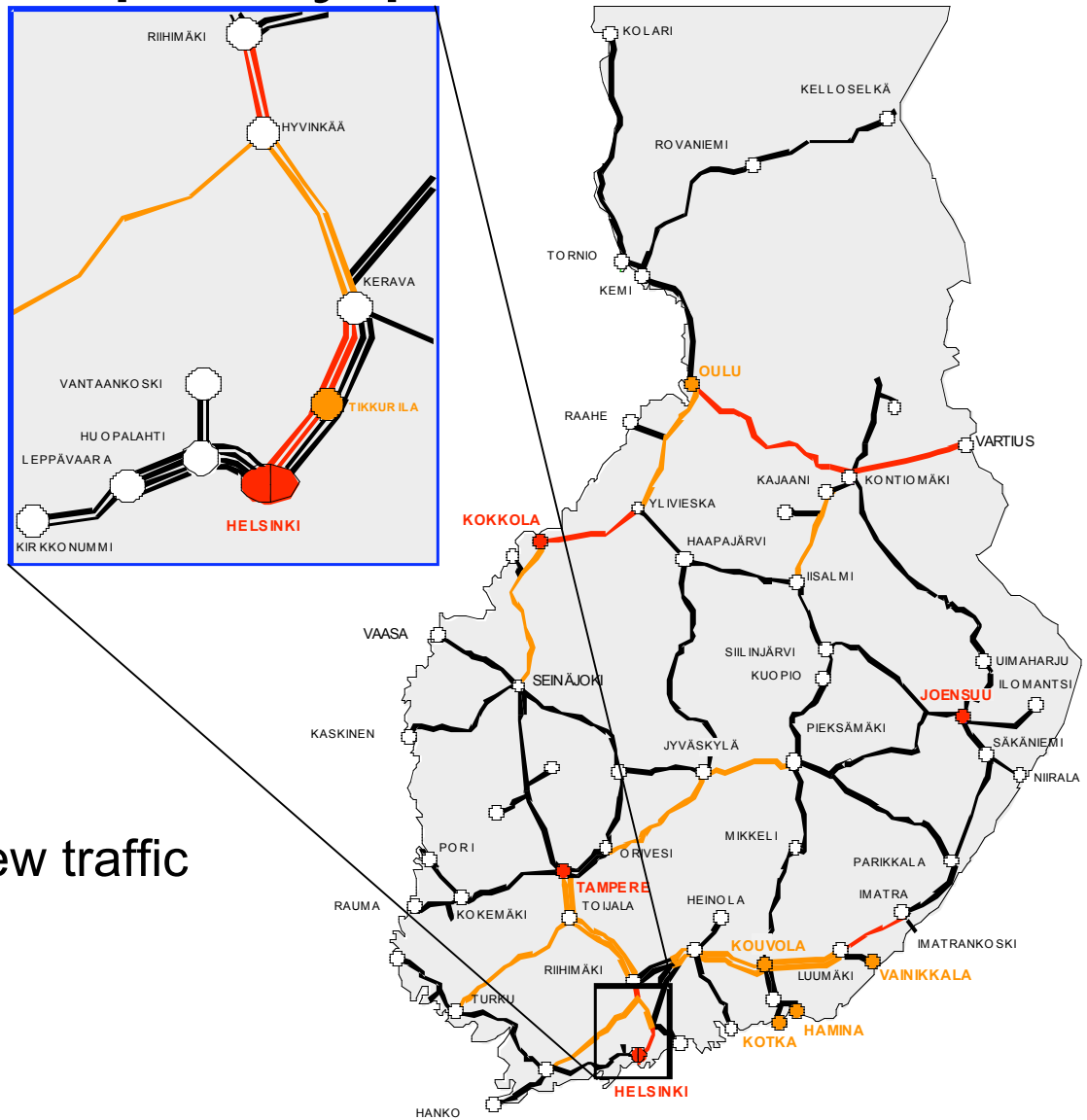
- Total amount of freight on rail is about 45 Mio tonnes / year
- Traffic is quite well distributed around the network
- Largest traffic volumes are in Eastern Finland (on some sections over 10 Mio tonnes / year)
- Russian import and transit traffic is about 30 % of the total volume (wood, oil, ore etc.)

Traffic volumes – Passenger long distance



- Total amount of long distance passenger trips is about 12 Mio / year
- The system and most of the traffic is Helsinki-based
- Northern mainline between Helsinki and Oulu has the largest volumes (about 5 Mio / year Helsinki–Riihimäki)
- Western and eastern main lines have over 1 Mio passengers
- Traffic to Russia is about 350 000 passengers / year

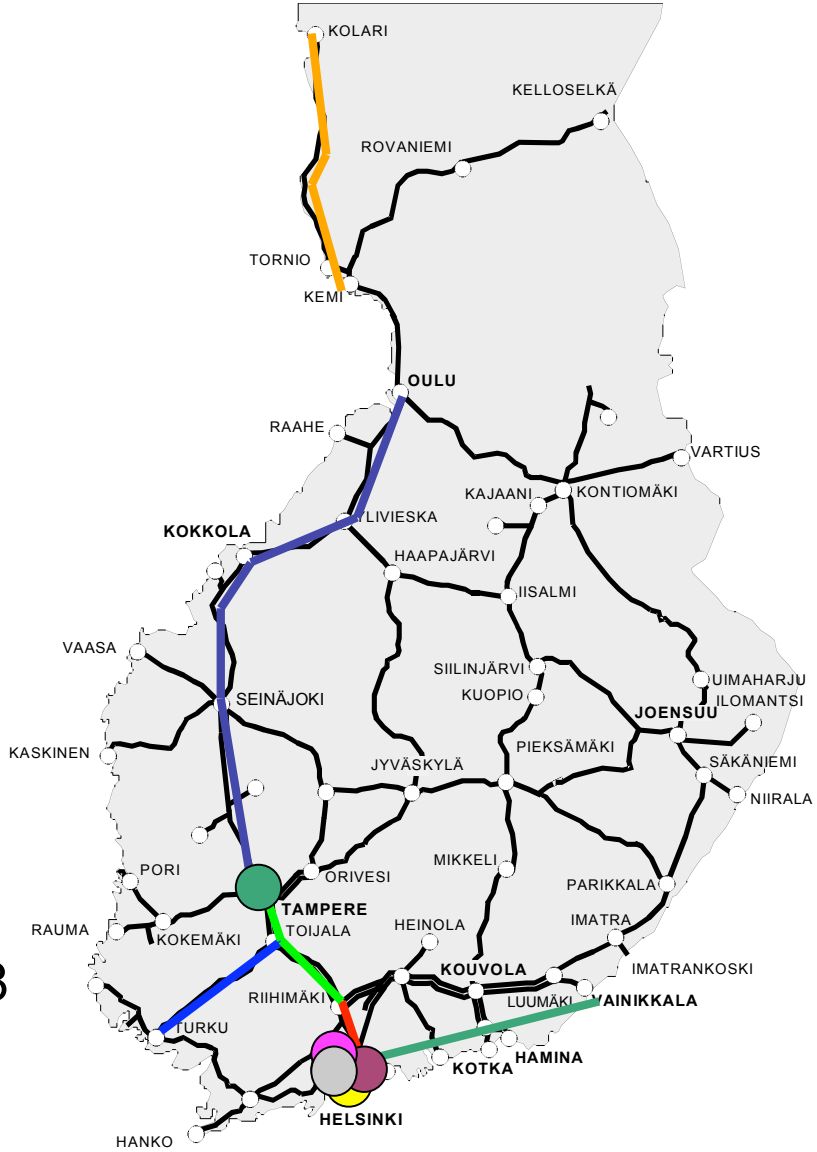
Current capacity problems



- Capacity totally in use
- Possibilities of adding new traffic limited

OpenTrack simulation studies in Finland

- Helsinki main station study 2004
- Ilmala passenger depot study 2005
- Turku–Toijala traffic analysis 2006
- Tampere area traffic study 2006
- New eastern high speed line study 2006
- New Vuosaari harbour study 2006
- Master's thesis of OpenTrack calibration 2007
- New airport line traffic study 2007
- New car-carrier terminal study 2007
- Master's thesis of using OT in capacity allocation process 2008
- Helsinki–Riihimäki capacity increase 2008
- Kolari iron ore mine study 2008



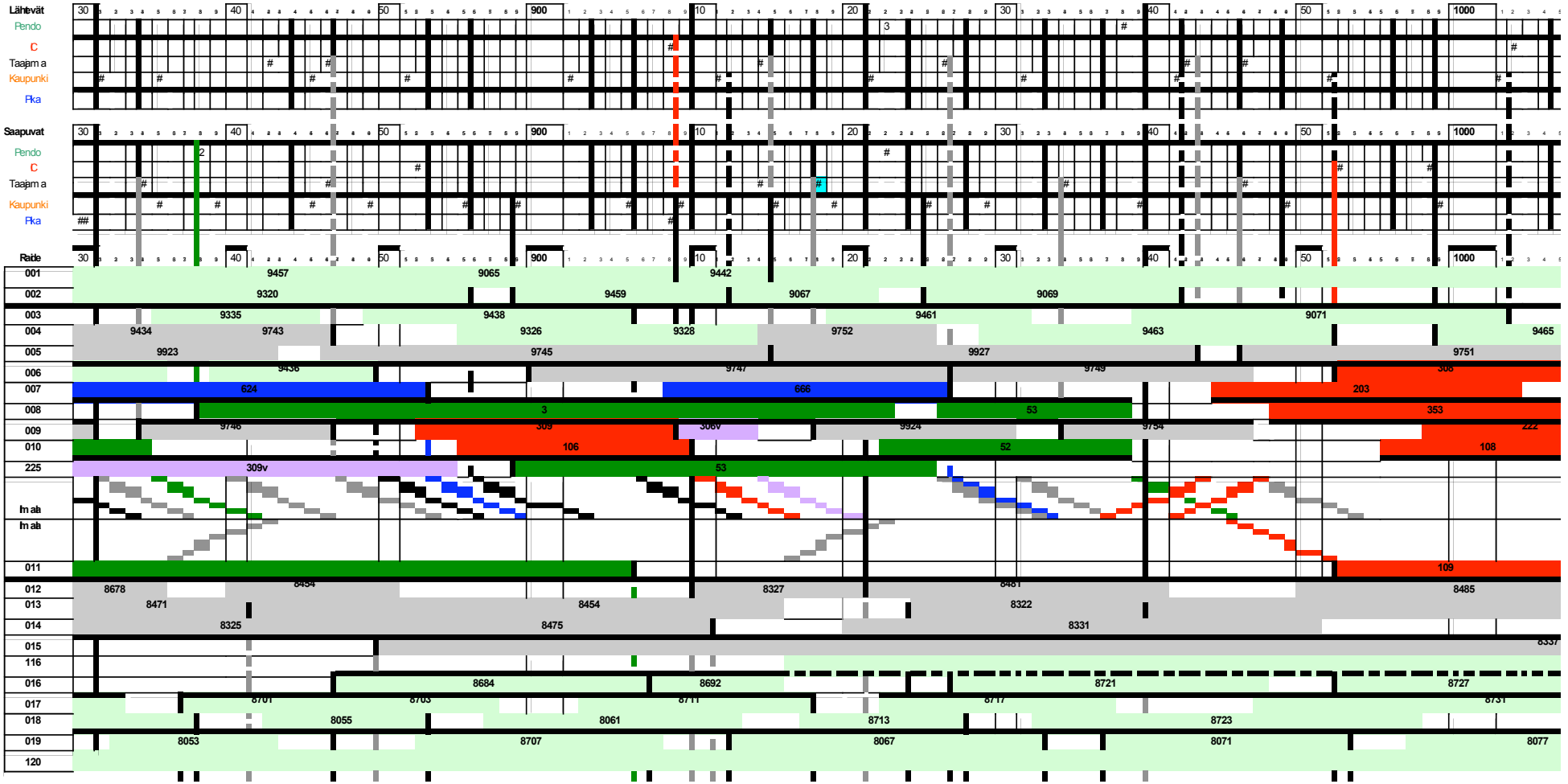
Examples of finished studies

Helsinki main station study 2004

- Study was made for analyzing significant traffic increase planned for 2006 (from 967 trains/day to 1040 trains/day)
- Train amounts had increased in 1995–2003 over 70 % → would there be capacity left for additional increase?
- For initial data we had only preliminary future timetable structures, all the rostering and track usage had to be planned during the project
- Three different traffic scenarios were simulated
  - Existing production timetable 2003 (for comparison)
  - 2006 traffic planned with existing operation principles
  - 2006 traffic planned with alternative operation principles
- This combination made possible:
  - Analyzing the traffic increase without operation principle change
  - Would there be advantages in changing them

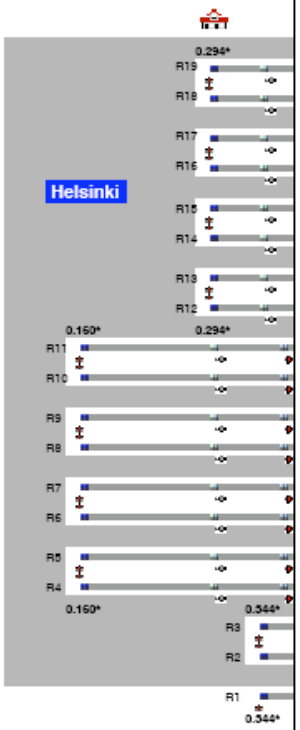
Examples of finished studies

Helsinki main station study 2004 – track usage schedule



Examples of finished studies

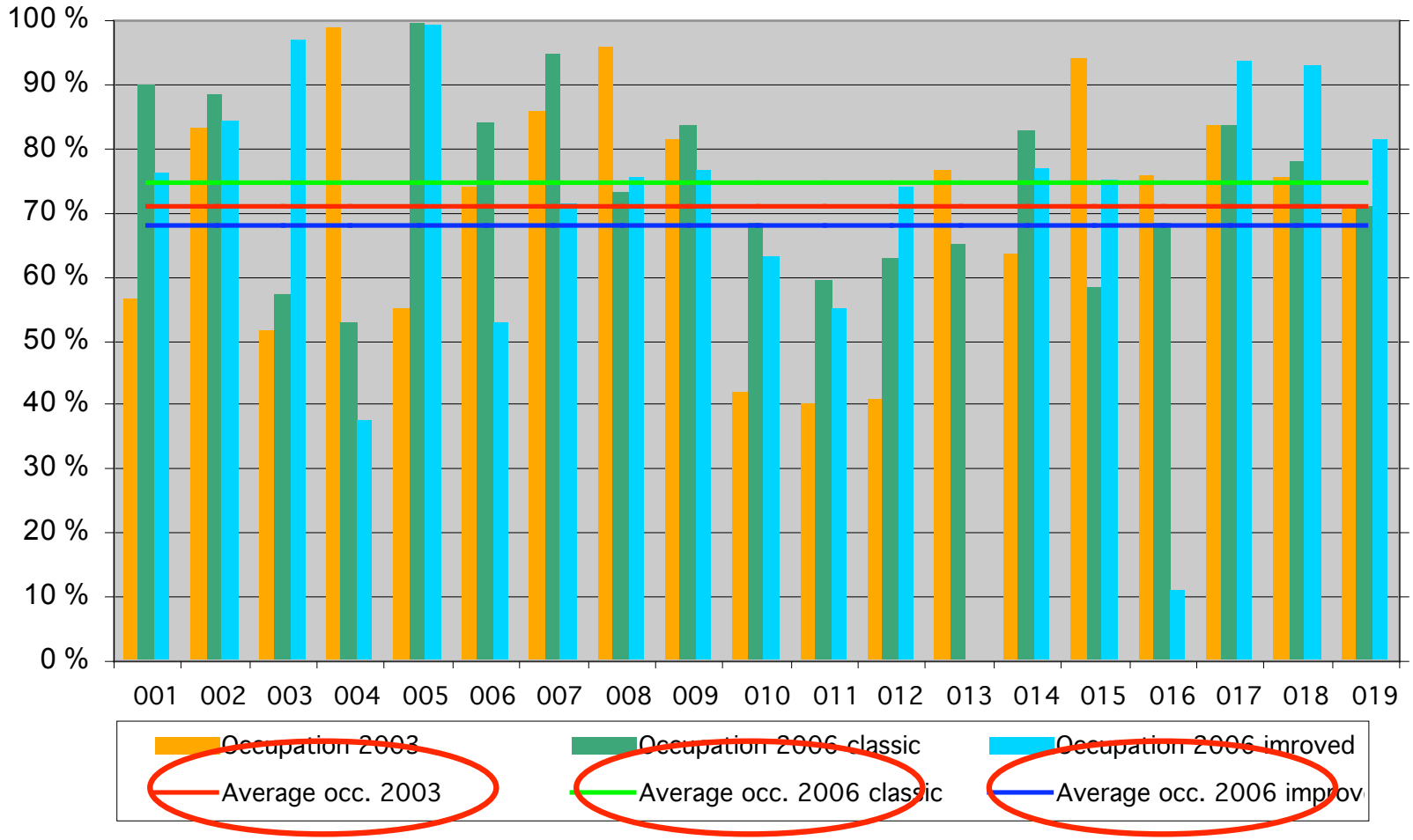
Helsinki main station study 2004 – simulation model



Line length	11.5 km
Total track length	85.0 km
Number of „stations“	13
Number of signals	225
Number of routes	680
Number of elements	1280
Number of train movements per simulation run	
- timetable 2003	350
- timetable 2006	380
- timetable 2006 improved	370
Duration of a simulation (from 4 to 10 am)	~ 15 min
Number of output files per simulation run	~ 8200

Examples of finished studies

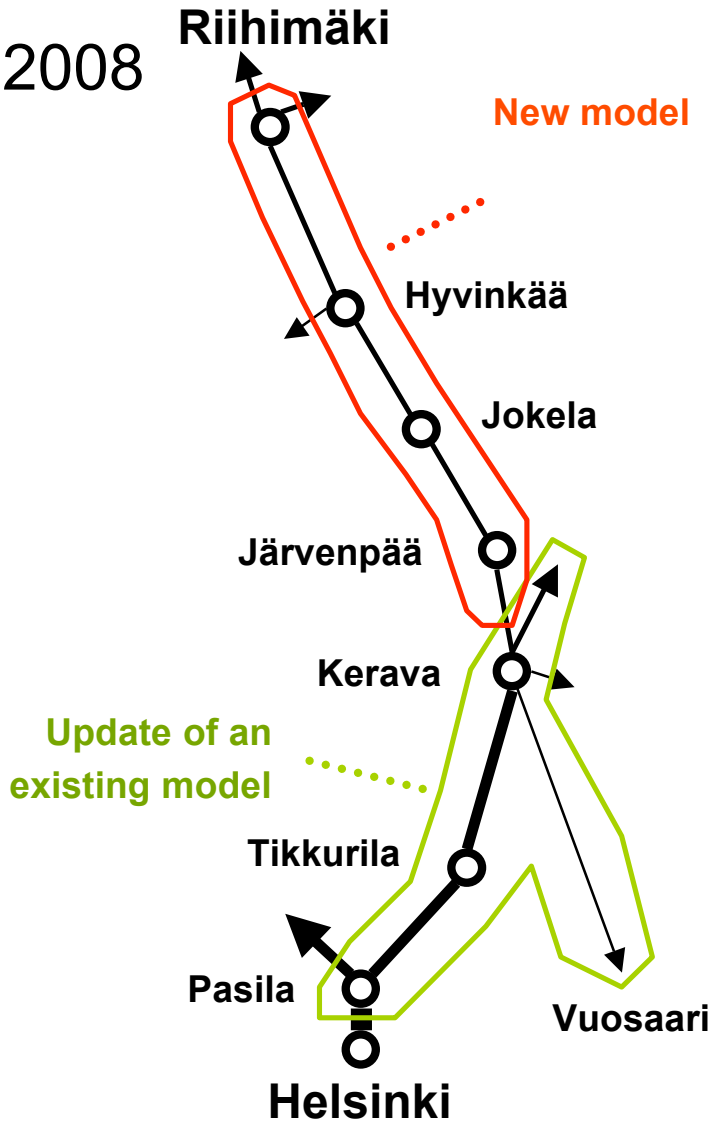
Helsinki main station study 2004 – results



Examples of finished studies

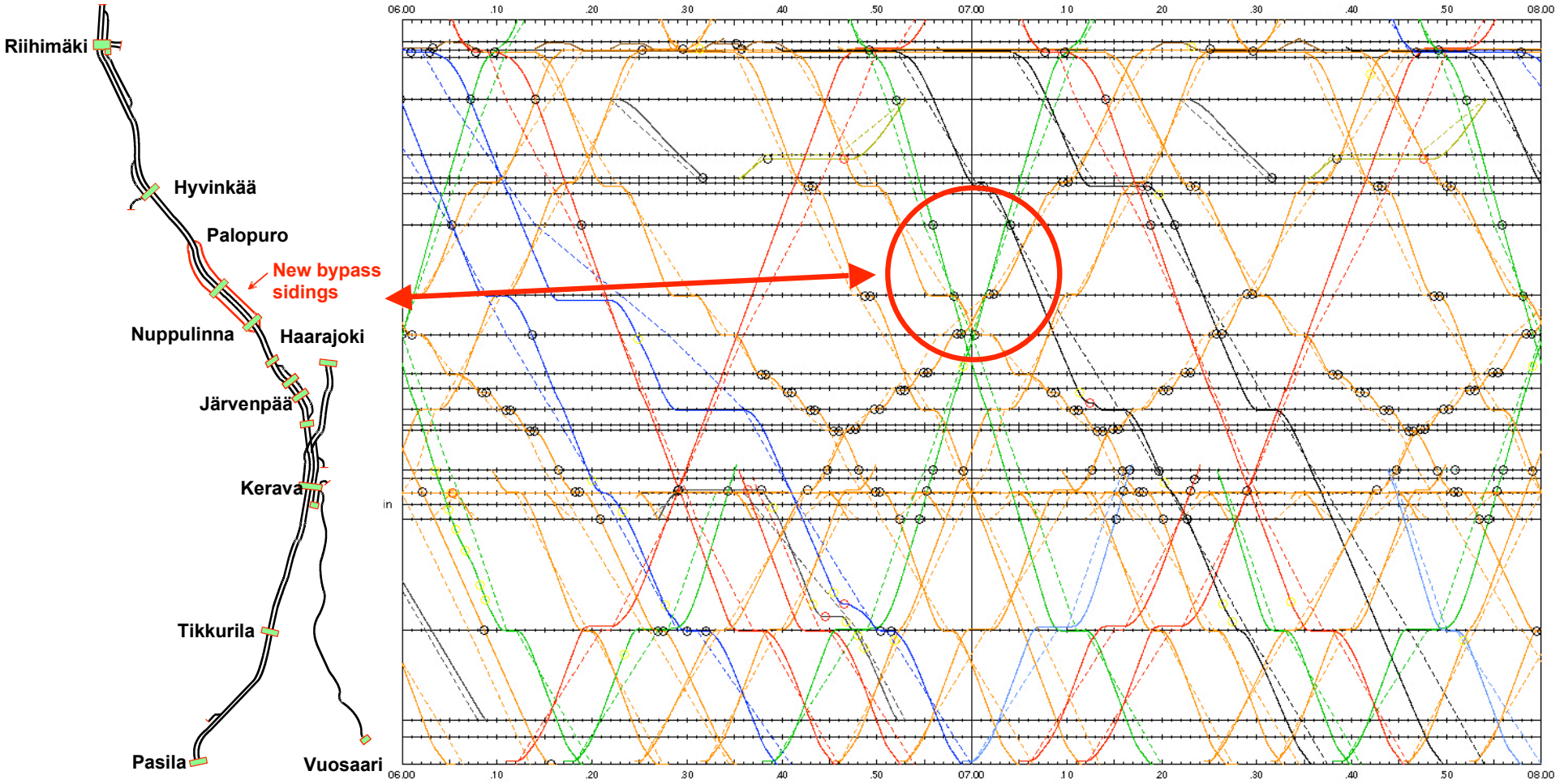
Helsinki–Riihimäki-line capacity increase 2008

- Objective of the study was to determine necessary infrastructure improvements in order to increase commuter traffic amount
- For initial data we had preliminary timetable structures and suggestions of the infrastructure improvements
- Rostering and track usage schedules for Riihimäki had to be planned during the project
- Helsinki main yard was left out from the model because of its complexity
- The simulation process was done in two different companies – VR-Track and Ramboll Finland



Examples of finished studies

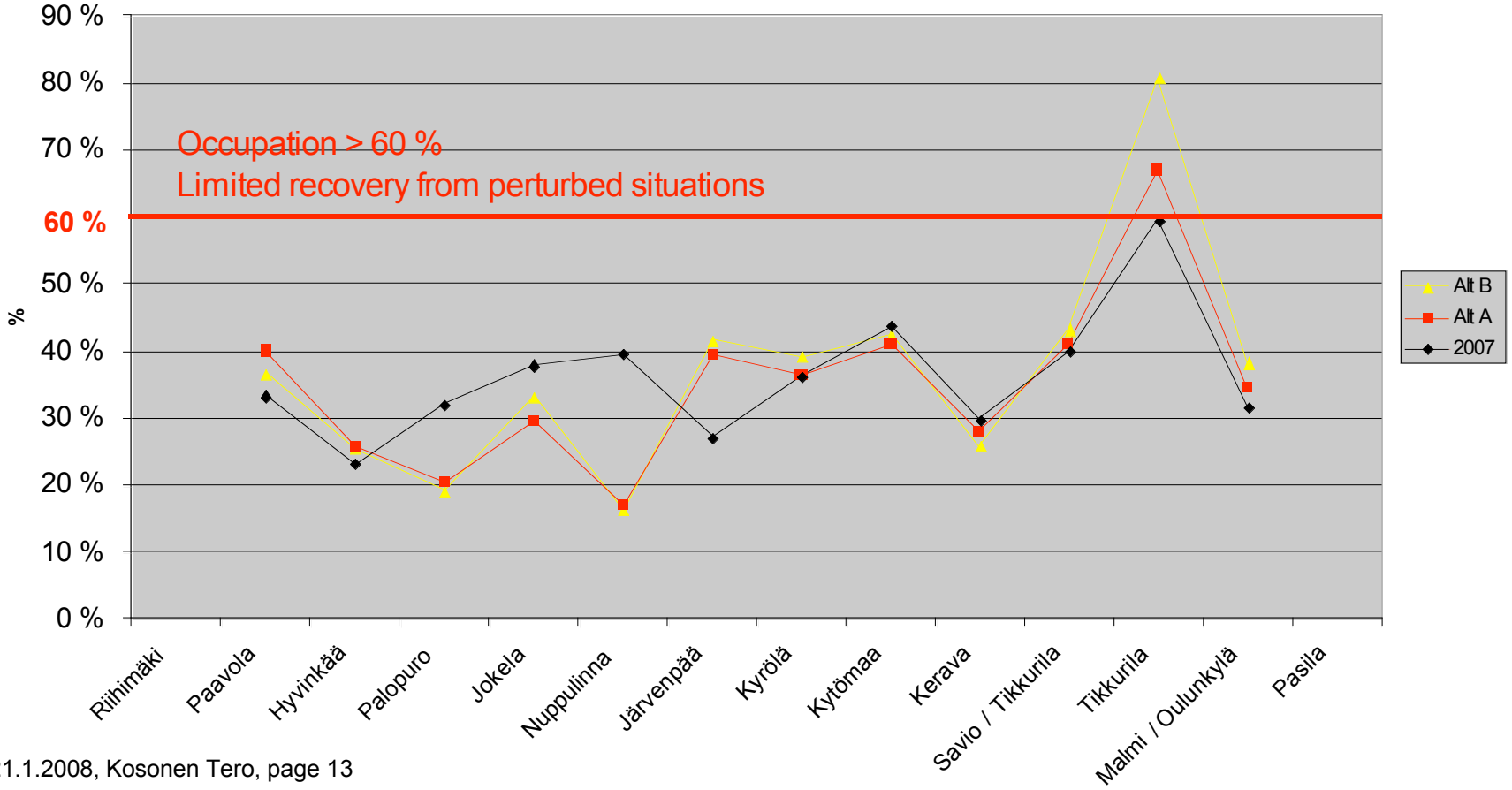
Helsinki–Riihimäki-line capacity increase 2008 - model



Examples of finished studies

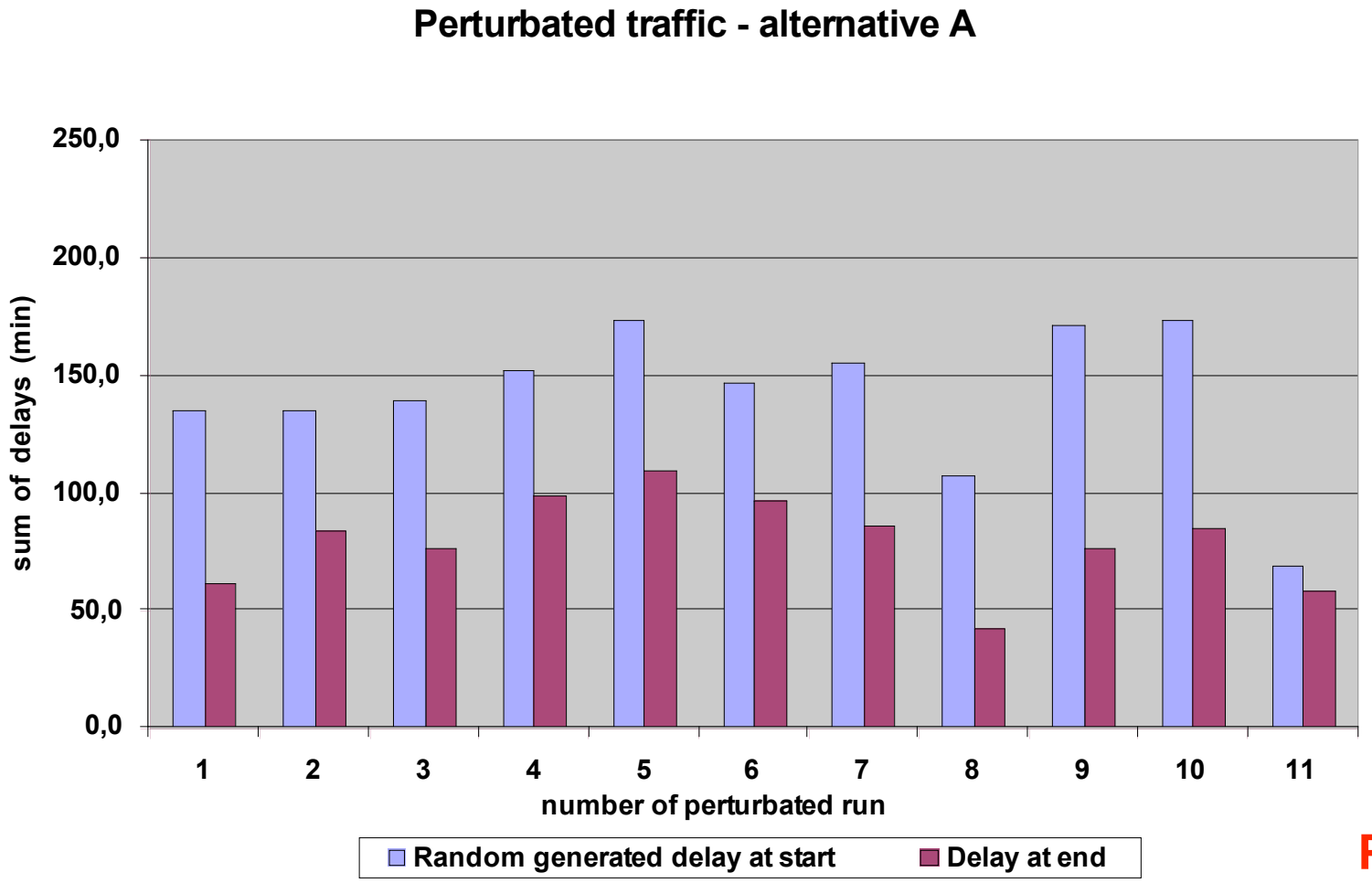
Helsinki–Riihimäki-line capacity increase 2008 - results

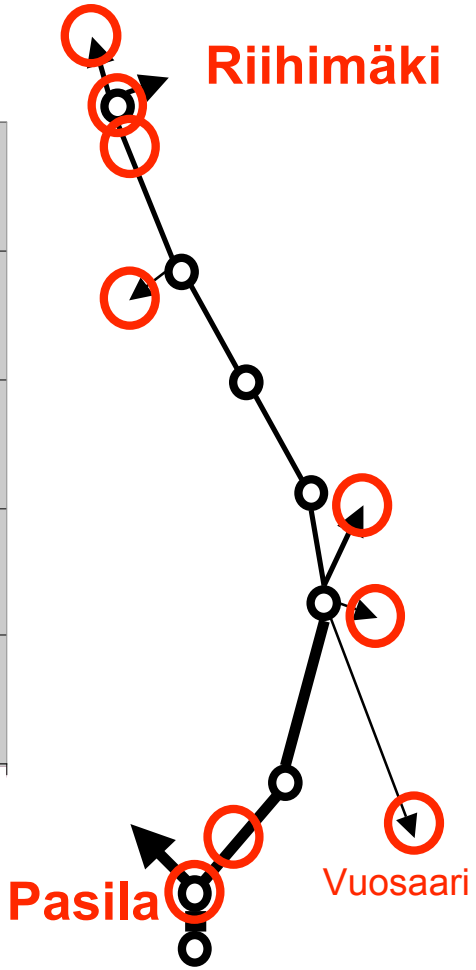
Occupations / morning peak hours to south



Examples of finished studies

Helsinki–Riihimäki-line capacity increase 2008 - results





Examples of finished studies

Helsinki–Riihimäki-line capacity increase 2008 – results

- With simulation we were able to define following infrastructure improvements
  - By-pass sidings should be longer than first suggested
  - Tikkurila station proved to be a bottleneck → changes to layout should be made
  - Also minor changes to other station layouts should be carried out
  - Some additional improvements suggested before the simulation could be dropped out
- Certain improvement requests to OpenTrack were made during the project
  - Ability to define track occupation observing intervals → under way?
  - DelEnd-file observation point should be changed → done

Summary

Experiences from OpenTrack

- With OT we have been able to study and analyze wide variety of rail traffic problems starting from small travel time analysis ending to complex dead-end track yard studies
- After implementing OT our scope of simulation studies has widened quite much
- Simulation itself is still only a tool, the user has to know exactly what he/she is doing to get correct results
- Until now we have focused on double track studies → considering the situation in Finland, single track studies are inevitable

Future challenges

- Single track section modelling with heavy traffic?
- Construction works modelling with the machine movements?