Train simulator the Swedish way
&
Impact on research possibilities

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”Train branch Sweden”

- Deregulated market
- Fragmented
- Competitive market
- Limited cooperation

almega

TCC

Branschföreningen Tågoperatörerna

BLÅ TÅGET
SKANDINAVISKA JERNBANOR

SJ

Strukton Rail

STOCKHOLMS TÅG

ProTrain

NORRTÅG
I SAMARBETE MED Tågkompaniet

green cargo

HECTORRAIL

SpårTrafik
ST vid Västtågen

ARRIVA
a DB company

MTR

NJS - Forum för Nordiskt Järnvägs Samarbete
Svenska avdelningen

vti

Train drivers – skill requirements

- Knowledge on rules and regulations
- Compliance
- Problem solving
- Stress resistant
- Endurance
- High demands for safety
- ….
- A demanding job with focus on safety
- Challenging education and training

Reality does not allow …

- Mistakes
- Repetition
- Demonstration
- Feedback in real time…

… but this is possible in a simulated world!

2 members 2015

10 members 2019

- Sharing knowledge
- Sharing resources
- Common education plan
- Eco-driving

Burst out of the successful progress

- 4 various types of train simulators
  - of high technical class
  - validated by many train drivers
  - price ~1/10 compared to commercial train simulators
- Collaborations with several universities and research institutes in Europe
- PhD in ERTMS and train simulation
- PhD in simulator based training
- PhD in drivability and driver behavior
- Planned initiations of similar developments with user groups
  - Simulators for drivers of emergency vehicles
  - Simulators for driver assessments at clinics and hospitals

Pre-study: ERTMS and train simulation

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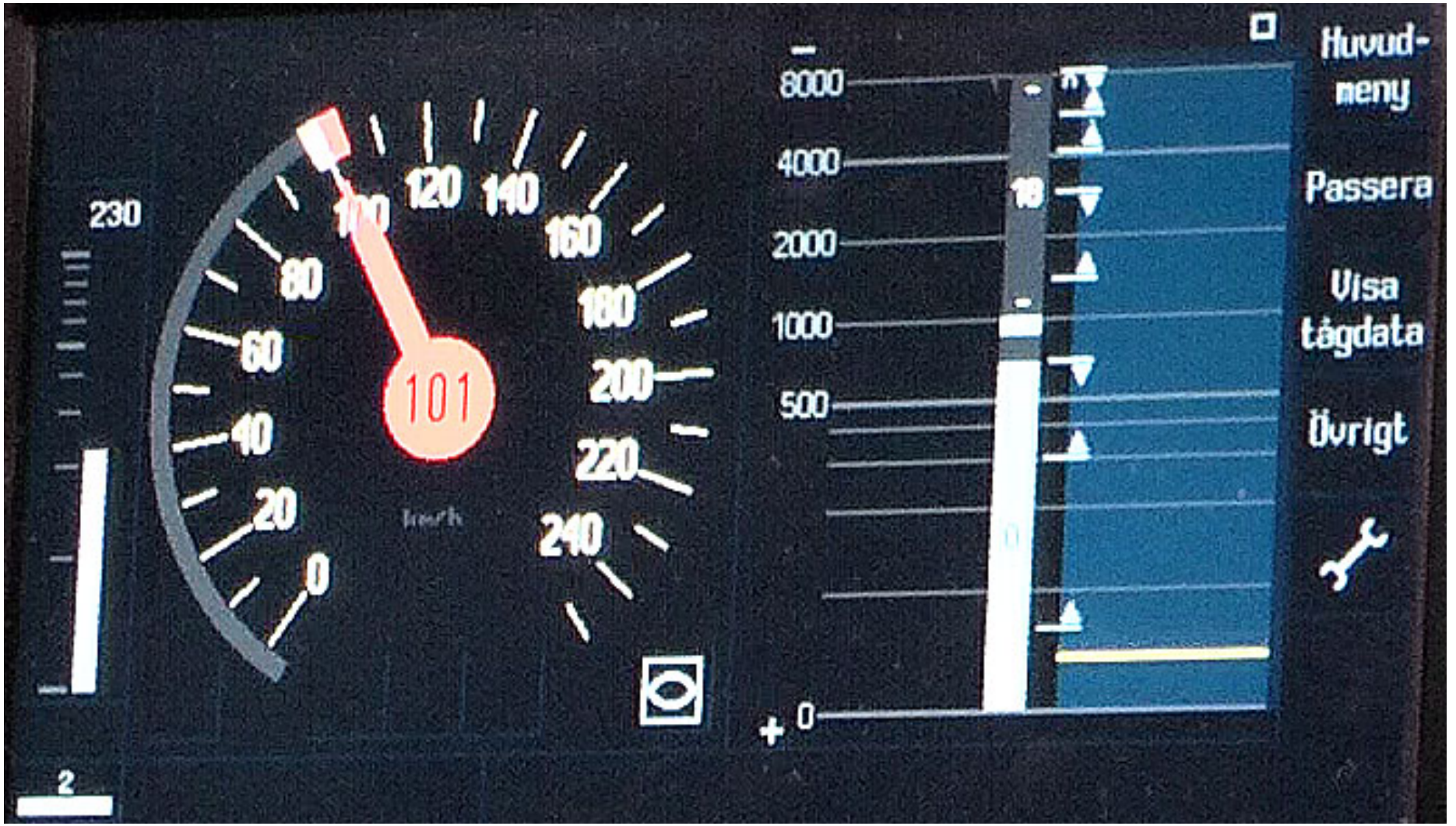
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Goals for the pre-study

- Study the field of ERTMS and simulation – overall objective
- Define the research area.
- Trafikverket and consultants **->**RailSys.
- Operators and educators **->**VTI train simulator.
- What happens when we combine these tools? What could we learn?
- Understand what affects the capacity and driveability.
- Inventory of available data from
  - train simulator
  - RailSys
  - reality

Overview – what is this about?

Simulates Train traffic

RAILSYS

Simulates Signal system & train

VTI
TRAIN SIMULATOR

ERTMS in VTIs train simulator

Start up of pre-study

- Project reference group (Trafikverket Kapacitetscenter, ERTMS-projektet)
- Define PhD project
- Two workshops to identify needs
- Literature study
- Need for knowledge about ERTMS and
    - methods connected to simulation
    - planning
    - technical development
- Trainsim train vehicle model has limitations! Drive support has limitations.
- RailSys may need a driver behavior model

Literature study – three areas

1. ERTMS Implementation – not only a huge infrastructure project, but also 3500 drivers shall be ETCS educated!

2. User perspective – Differences in how a driver behaves depending if the lane is signal planned from scratch or re-planned from an ATC track.

3. Capacity simulation – study on Malmbanan (Köhler/Knutsen)
   - The overspeed possibility (9 km/h) have a large impact on running times and punctuality.
   - Increased running times for ETCS compared to ATC when braking is monitored by the service brake curve (SBD).
   - Need for a optimized speed profiles to decrease running time for ETCS compared to ATC.

How do signaling system, driving behavior and capacity interact?

1. Validation of RailSys/VTI trainsim/reality for 2 different systems (ATC, ERTMS)

2. Methods for parametrization in RailSys/VTI sim based on 1.

3. How can capacity bee optimized based on 1 and 2?

Research questions

1. Validation of two different systems (ATC & ERTMS) in 3 different traffic environments

Reality – RailSys - VTI train simulator

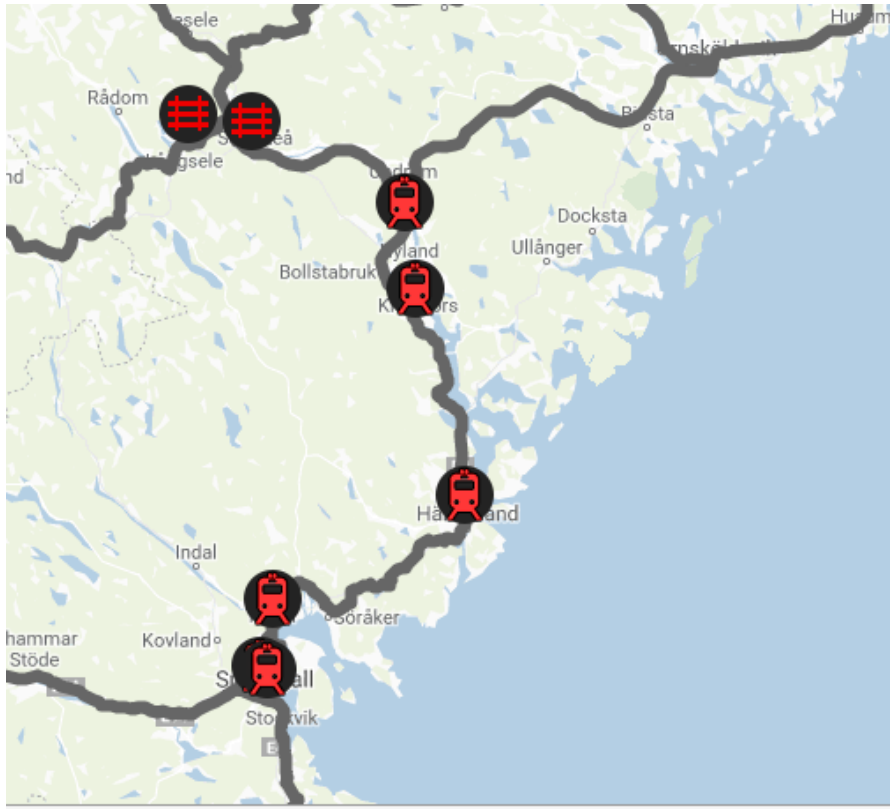
- ATC, Jönköpingsbanan. Single track.
- ERMTS, Ådalsbanan. Single track.
- Bombardier Regina and TRAXX/RD2
- Parameters of interest:
  - Running times
  - Driving behavior – braking/acceleration/foresight
  - How do the driver follow the braking P-curve (permitted curve)?
  - Overspeed (ATC/ERTMS)

2. Modelling and methods for parameters in RailSys/VTI trainsim based on validation studies (1).
   - Parameter setting in RailSys/VTI sim.
   - How could simulators be adapted to better describe reality?
   - Could different driver information/support increase capacity for ETCS lanes?

3. How do the planning affect the capacity, with respect to results from (1) and (2) ?
   - Speed profile optimization
   - Signal optimization
   - How does the line capacity change on line 711 in the transition from ATC/STM/ETCS?

Tracks, signals and vehicle data

Ådalsbanan – ERTMS



Jönköpingsbanan – ATC/STM