The wait for ERTMS
Keeping conventional systems safe

Harm van Dijk

Paper prepared with Bas Hendrix and René Koopal, ProRail

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The wait for ERTMS – Keeping conventional systems safe

Summary

- ERTMS in the Netherlands is expected to be the nationwide system
- Conventional systems will be replaced
- Implementation takes many years

- Is the safety performance of the conventional system at risk, now or in the future ?
- Can a conventional system efficiently be improved?

- The development of the Electronic Track Relay – too little, too late?

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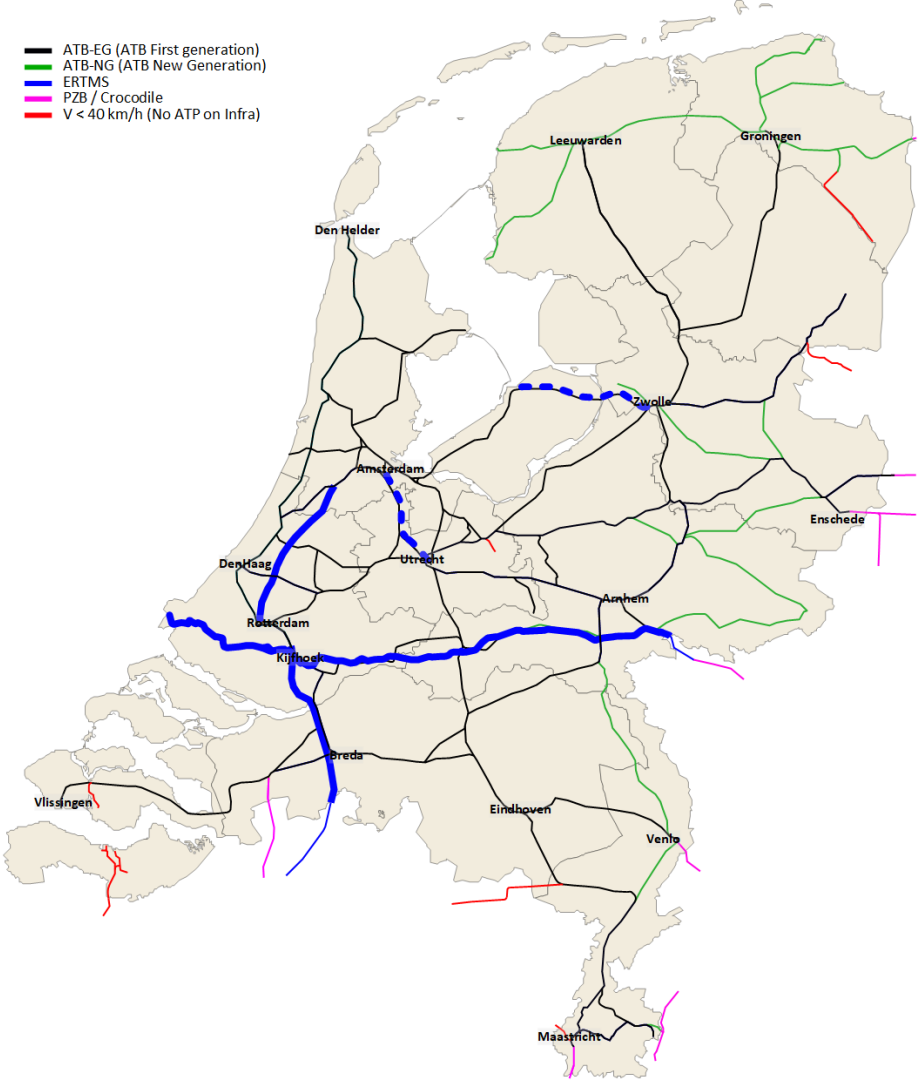
ERTMS scope
Current Status



All blue lines are ERTMS

Dotted: dual signalling

All lines have ATP

Black lines: ATP with Track Circuits

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Track Circuits and ATP
do they have a future?

Track circuits:

a) Rely on good shunting of the rails by train axles
b) Impose a maximum on interference by traction system
c) Require insulated joints

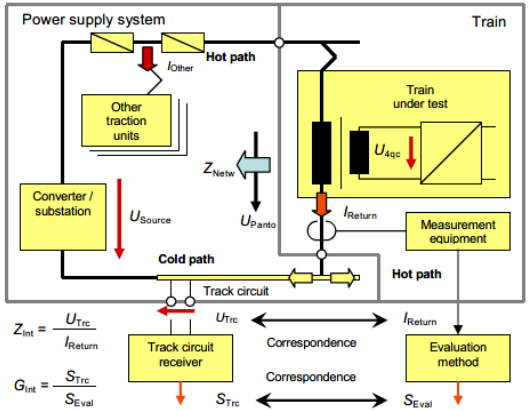
Developments in trains and infrastructure:

- Lighter trains
- Smoother riding, improved traction and braking control
- Increase in electrical power

Leaves on line (with frequent traffic!)

Small running areas

Burned insulated joint



Traction compatibility case ??

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ERTMS in the Netherlands
track circuits have no future

- In the Netherlands, ERTMS policy is level 2
- Train detection is required, but conventional ATP not
- Without conventional ATP, track circuits are unnecessary
- Axle counters to be the main detection system

So…. problems solved?

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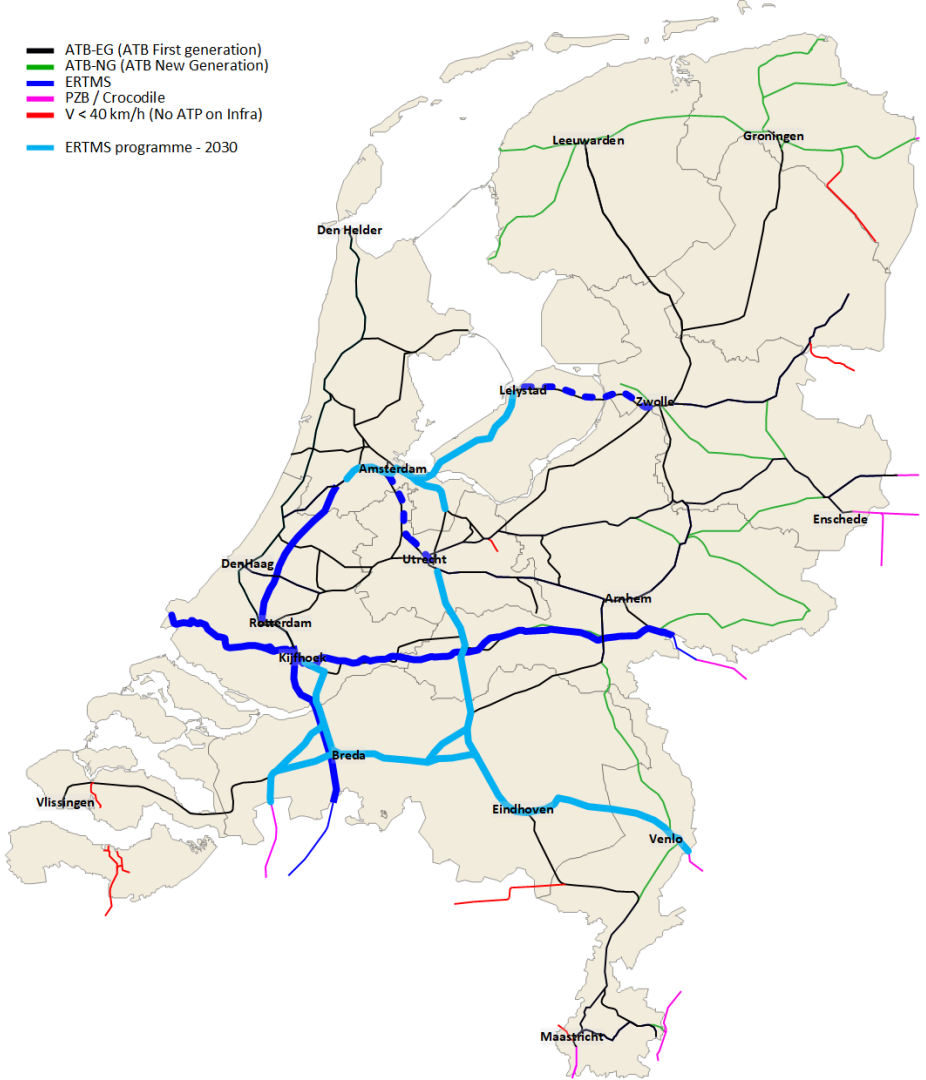
ERTMS scope
Expected status in 2030



All blue lines are ERTMS

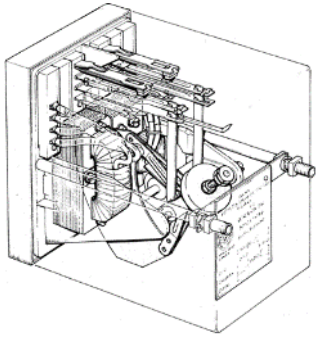
Light Blue lines are planned to be ready in 2030

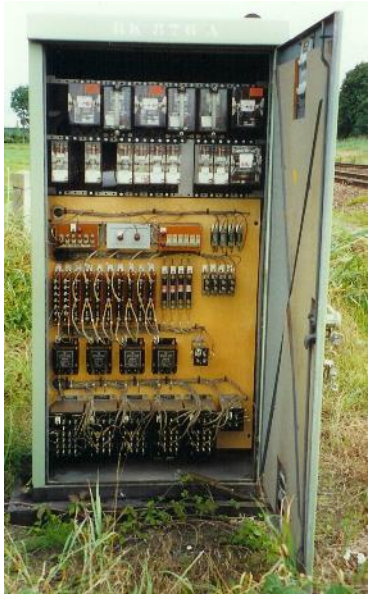
The rest is not ERTMS

Improve the conventional system
A case for track circuits

- ETR – Electronic Track Relay
  - Improved behavior with bad shunts
  - Improved immunity to transients
  - Remote monitoring and fault finding

- Ideas for an intelligent TR have been posed since the ‘90s.
- 2012: proposal by Movares and Wabtec Mors Smitt
- Business case: improve availability by monitoring and fault finding
- 2014: start of development => specification and prototype





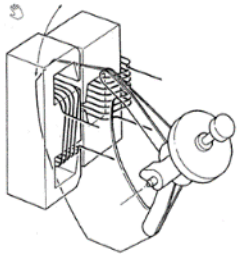
Concept of the ETR

- Objective: maintain safety while ERTMS is not yet implemented, preventing expensive other safety measures
- One-on-one replacement of the track circuit relay
- No modifications in track side cabinets
- Sufficiently improve behavior with bad train shunts
- Remote Monitoring and Diagnostics with remote updates to improve availability and reduce maintenance costs

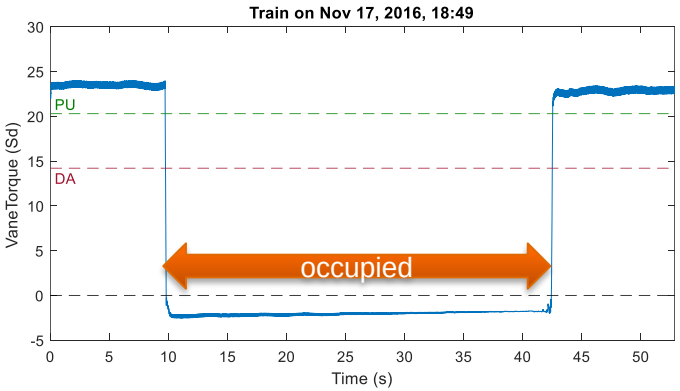
Improving behavior with loss of shunt

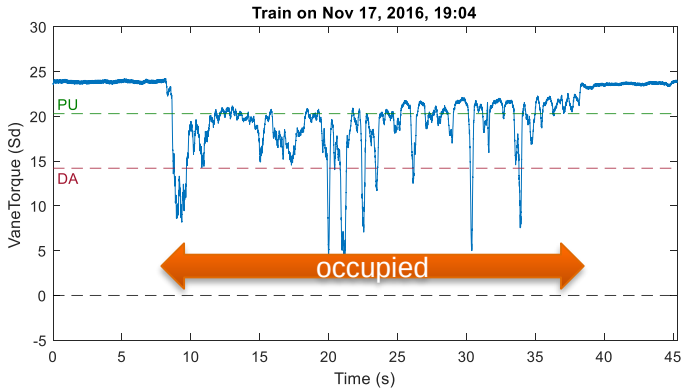
Same type of train, same track, same day, **15 minutes** time diff…

Relay torque



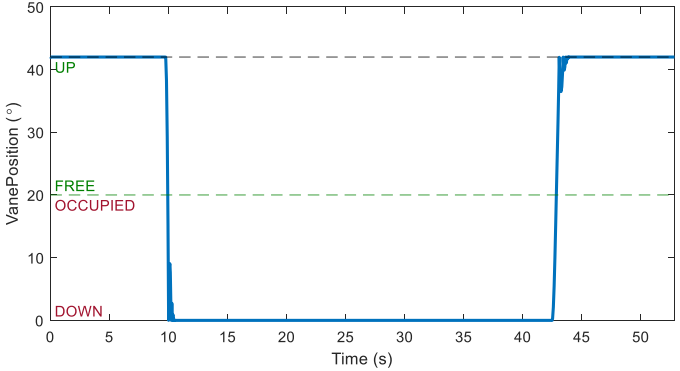
Vane position

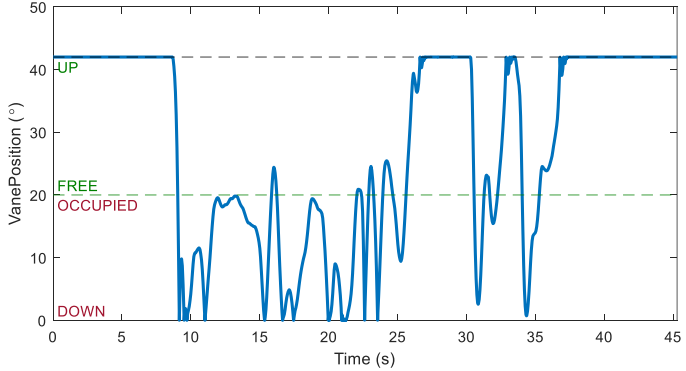




18:49

19:04





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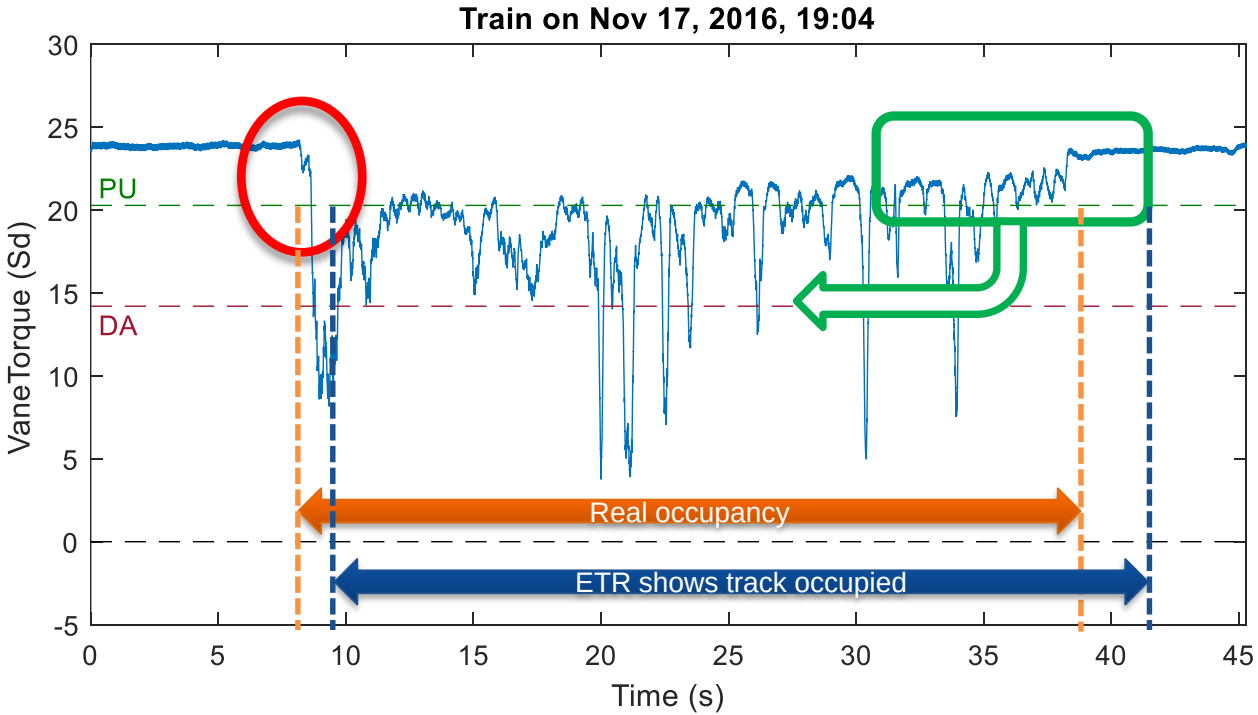
Improving behavior with loss of shunt

Basic solution

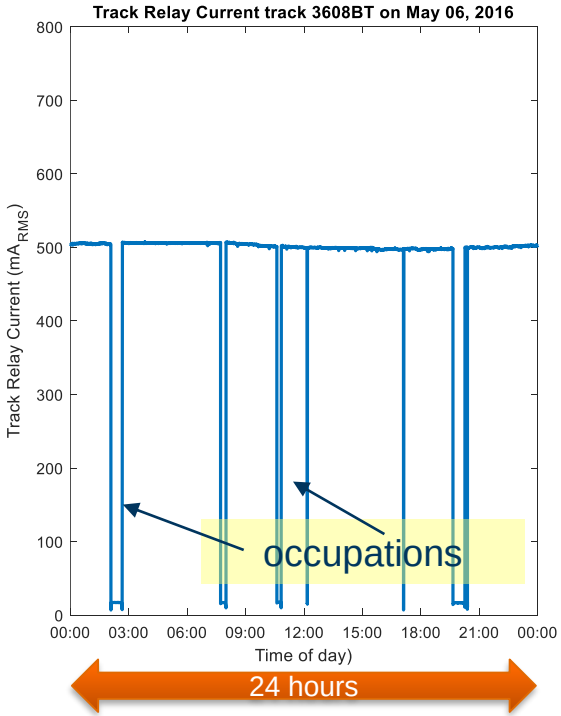


1. Calculated torque
2. Relative change
3. Slower release when the past data shows bad shunt

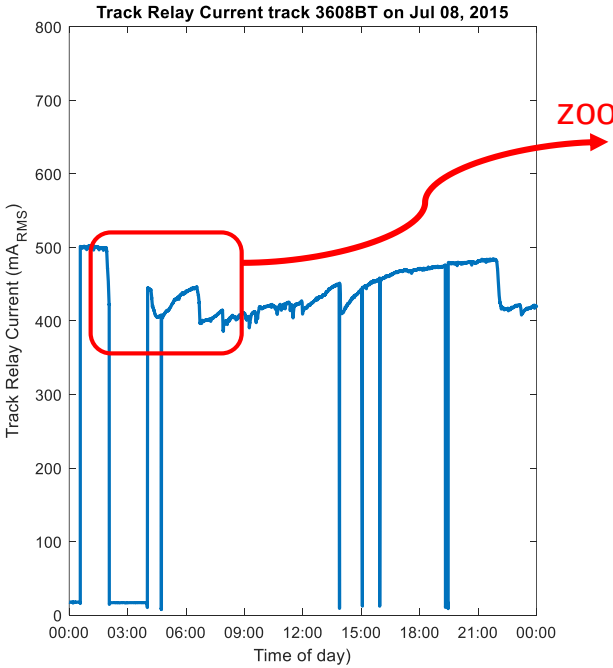
Improving behavior with loss of shunt

Variation of torque

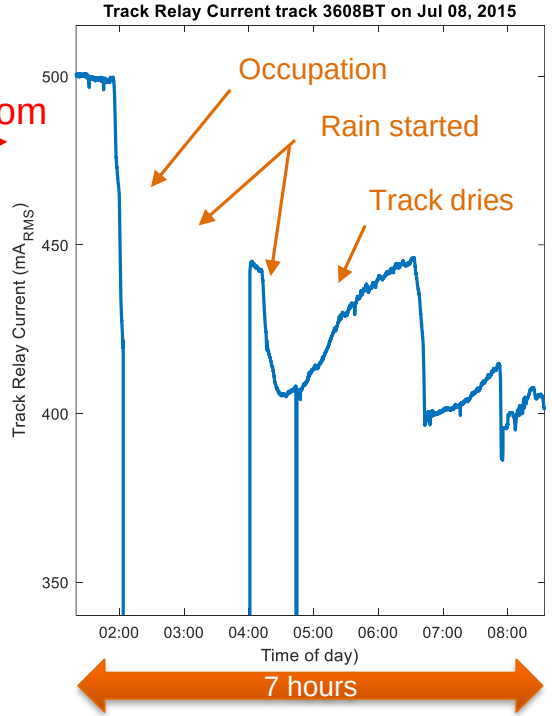
dry day



rainy day



zoomed in



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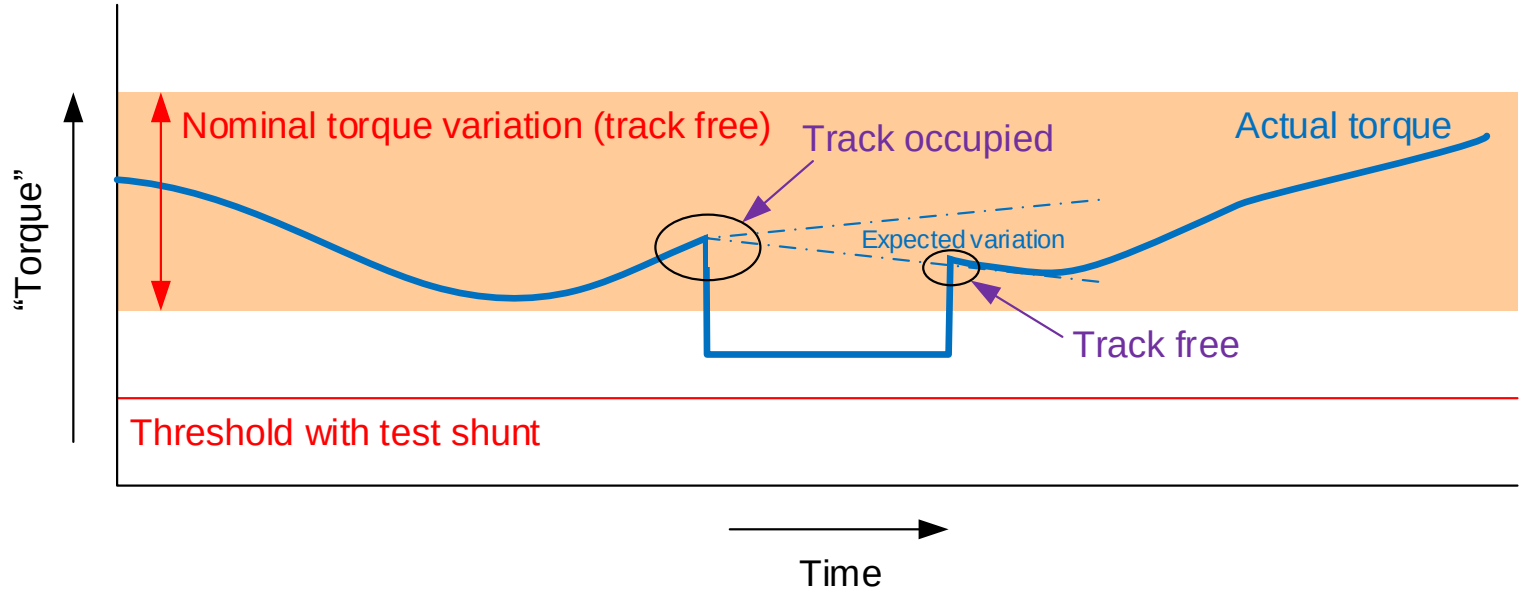
Improving behavior with loss of shunt

Taking into account of torque variation



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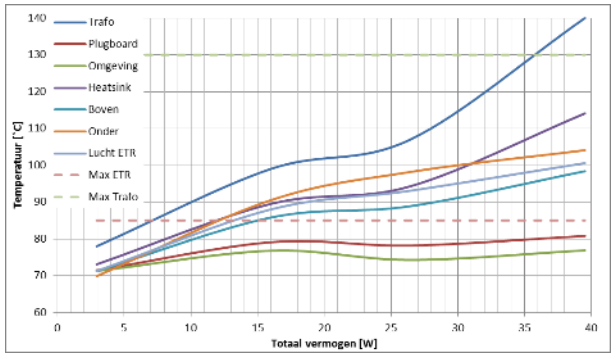
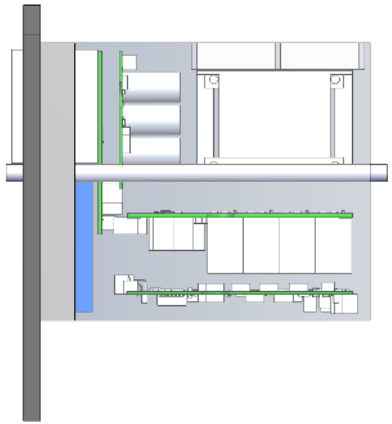
ETR
Proof of Improvement

- Correct behavior in case of loss of shunt is hard to prove
- Testcases with different kinds of LOS, based on measurements, extrapolation and synthetically prepared signals
- Pass/fail criterion per testcase
- Algorithm can be tested in software. Output can also be compared to behavior of the conventional relay, much faster than real time.
- Set of test cases (2653) agreed by ProRail
- Process accepted by ISA

ETR
Other challenges





No modifications to the track circuit allowed:

- No galvanic isolation and high voltages
- Interface to B-style (very high inductance!) relays
- Relay impedance with high losses and thus heat dissipation

Relay cabinets can become hot in summer (up to 70 °C). This leaves just a 15 degrees increase for electronics.

Opted solution: forced ventilation to the cabinet

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ETR
Status of development

- Specification of requirements
- Detection Algorithm proved
- Technical Solutions “in control”
- Proof of concept

- Ready for next step …

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ETR
worth the wait ?

- Potentially ETR is a success.
- A full one-on-one replacement is a lot more difficult than expected given the development boundaries

- The next step is still a big one
- Development Risk and Cost
- ETR will be too late to be beneficial
- ProRail policy: more quickly phasing out of track circuits
- Other (proven) measures to mitigate risk of loss of shunt

Thank you

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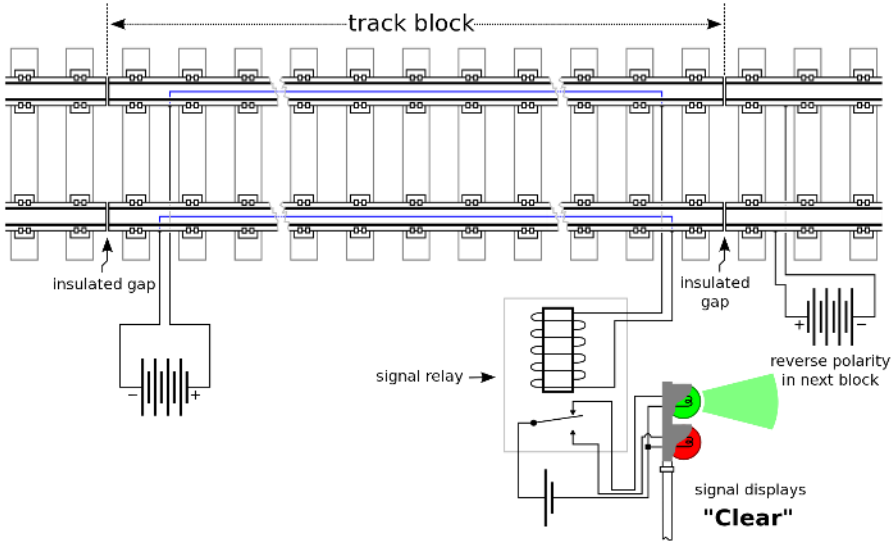
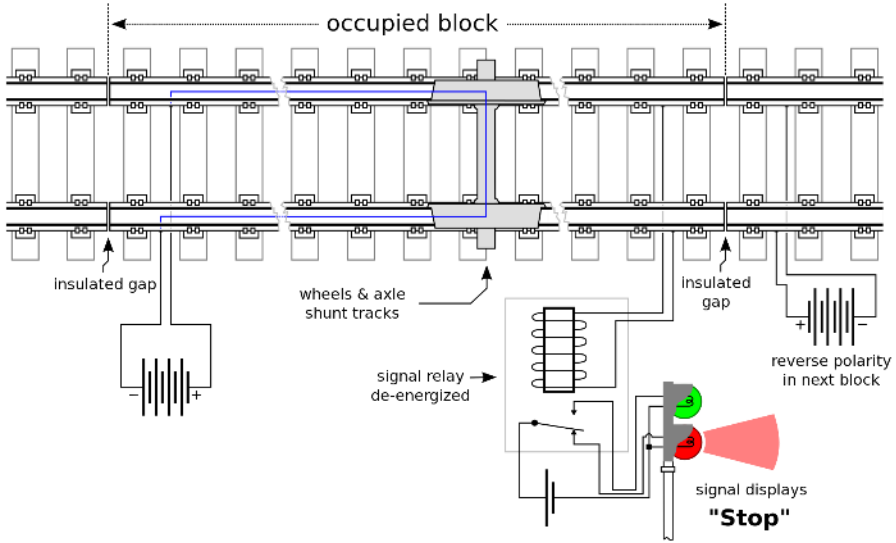
Spare sheets for questions

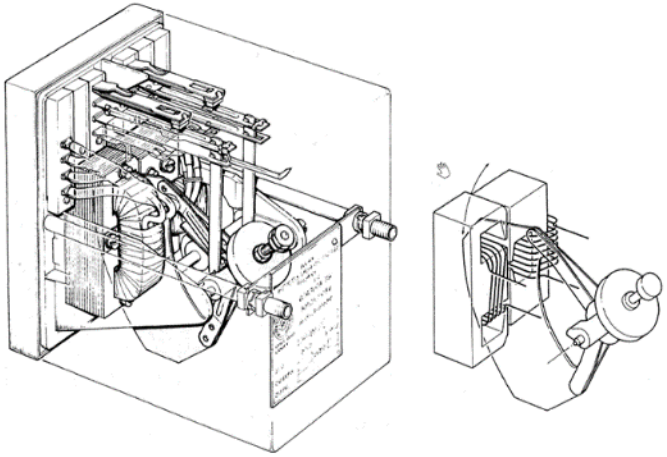
Just in case …

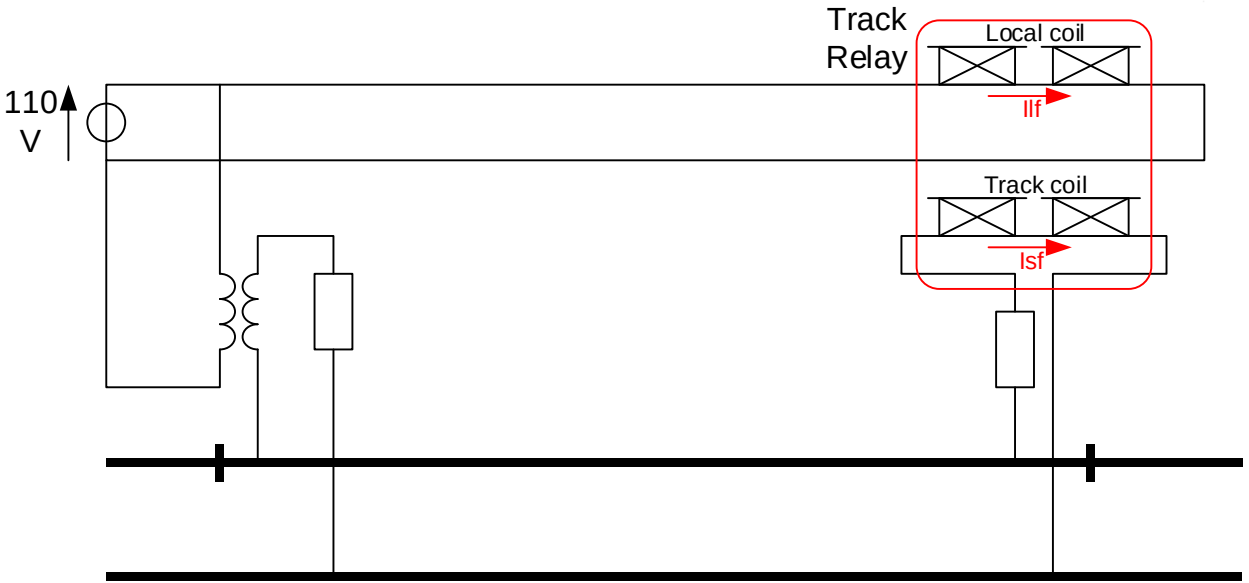
- Plaatje spoorstroomloop
- Plaatje TR
- Plaatje ATB
- Plaatjes trafo
- Plaatje relaisinterface
- Plaatje core
- Plaatje UI





Pictures by Mangoevector from Wikipedia




Track
Relay
Local coil
110
V
Ilf
Track coil
Isf

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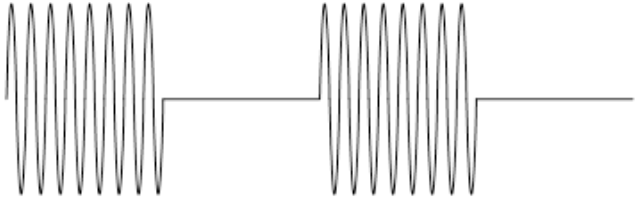

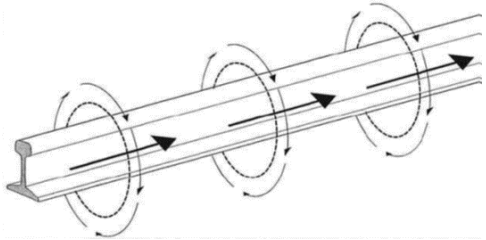

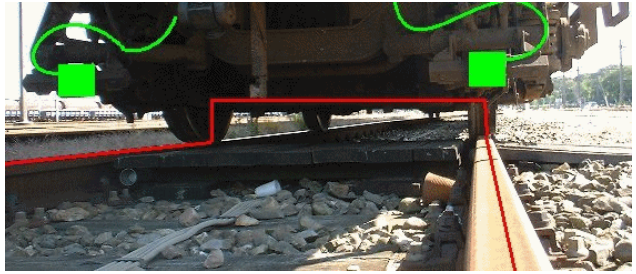

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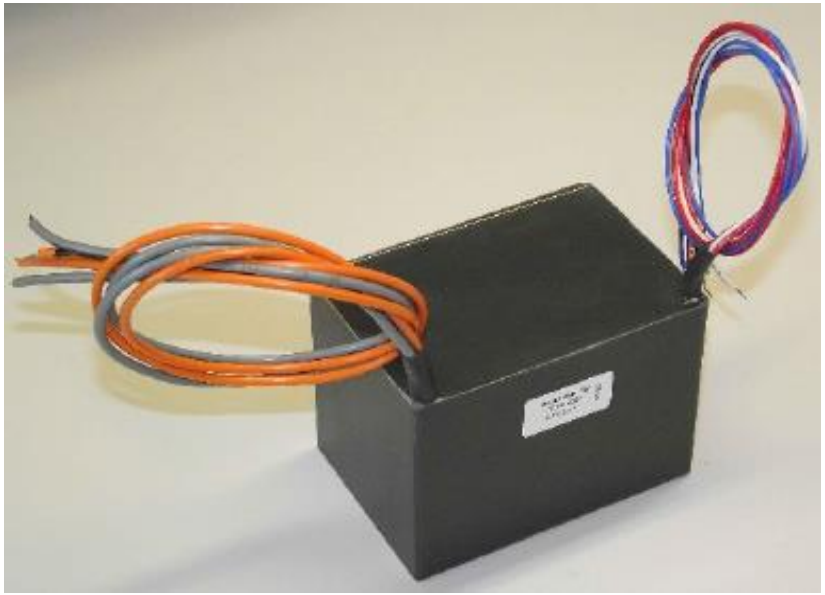

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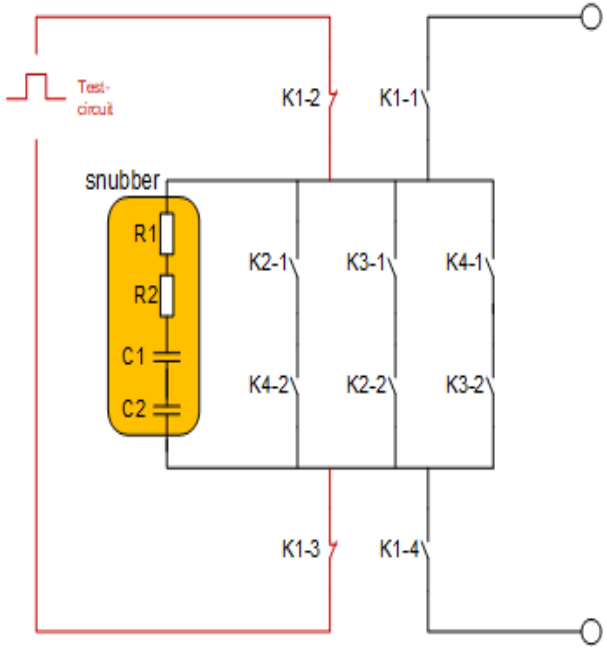

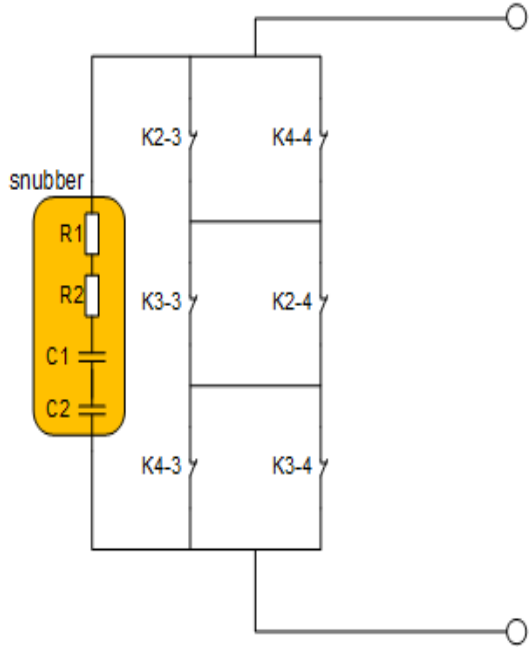

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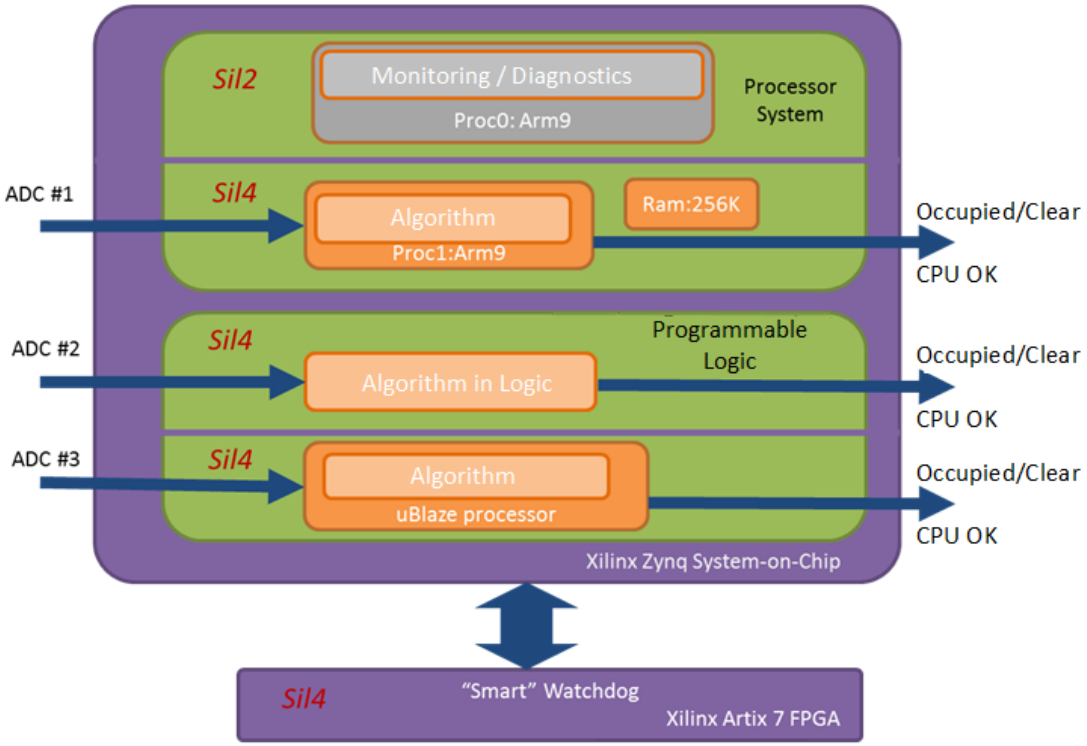

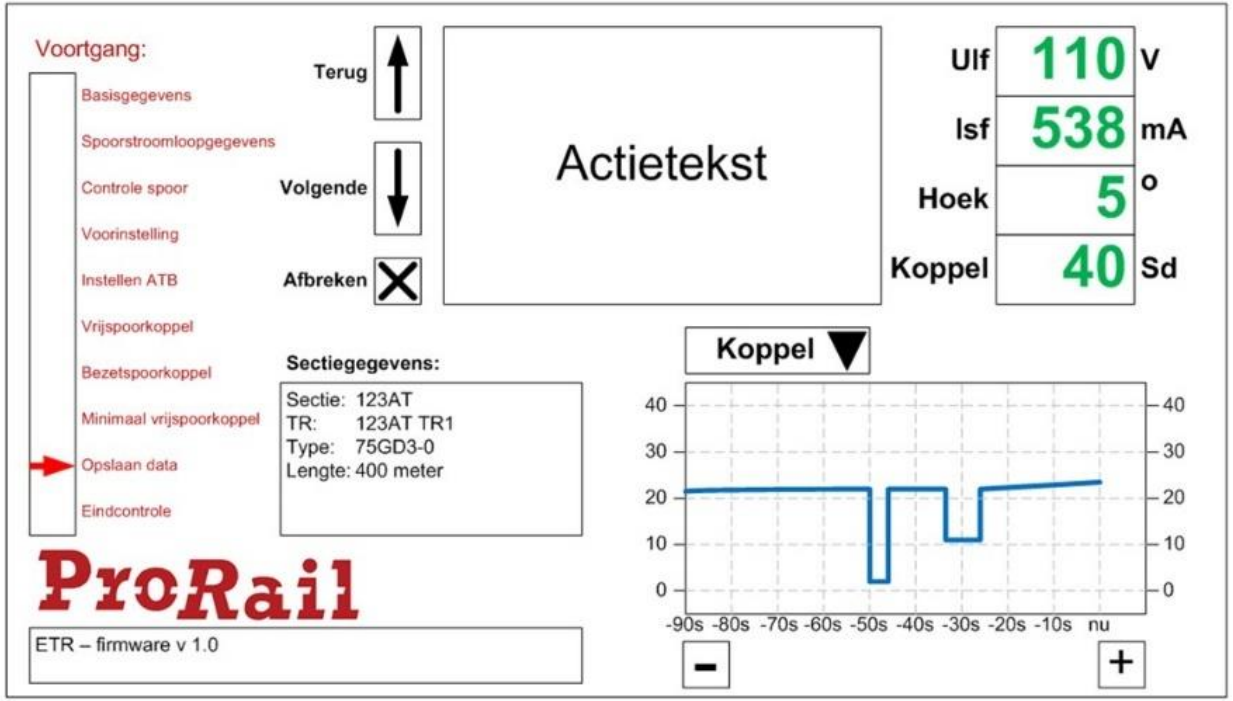
Voortgang:
Basisgegevens
Spoorstroomloopgegevens
Controle spoor
Voorinstelling
Instellen ATB
Vrijspoorkoppel
Bezetspoorkoppel
Minimaal vrijspoorkoppel
Opslaan data
Eindcontrole
Terug
Volgende
Afbreken
Actietekst
Ulf 110 V
Isf 538 mA
Hoek 5 o
Koppel 40 Sd
Sectiegegevens:
Sectie: 123AT
TR: 123AT TR1
Type: 75GD3-0
Lengte: 400 meter
Koppel
40
30
20
10
0
-90s -80s -70s -60s -50s -40s -30s -20s -10s nu
ProRail
ETR – firmware v 1.0