Image: ETCS Level 3 test, Deutsche Bahn Living Lab in Annaberg - 06-09-2018

Joost Jansen | 23 – 10 – 2019

ETCS Hybrid Level 3

a simulation-based impact assessment for the Dutch railway network

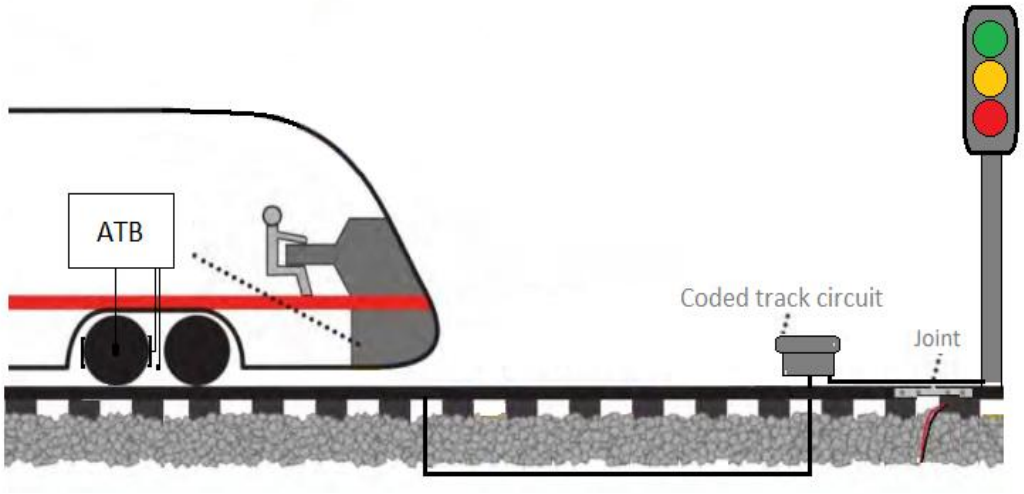
ProRail

TU Delft

Content

- Introduction
- Research question & method
- Results
  - Capacity assessment
  - Assessment of trackside equipment & reliability
- Conclusions & recommendations

Introduction | NS’54/ATB-EG

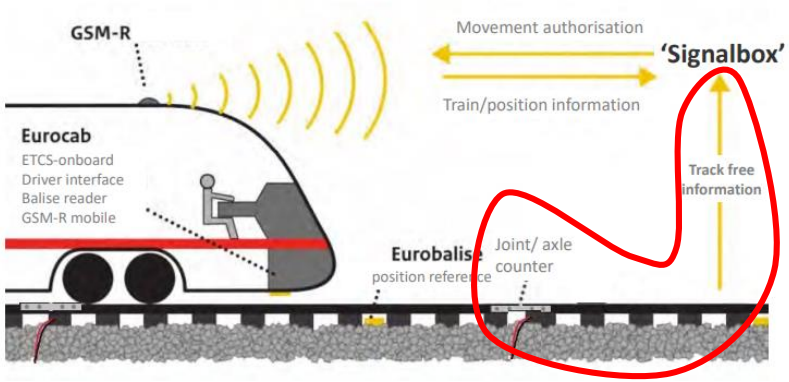


Signalling: NS’54
ATP-system: ATB-EG
Train Detection: Track circuits

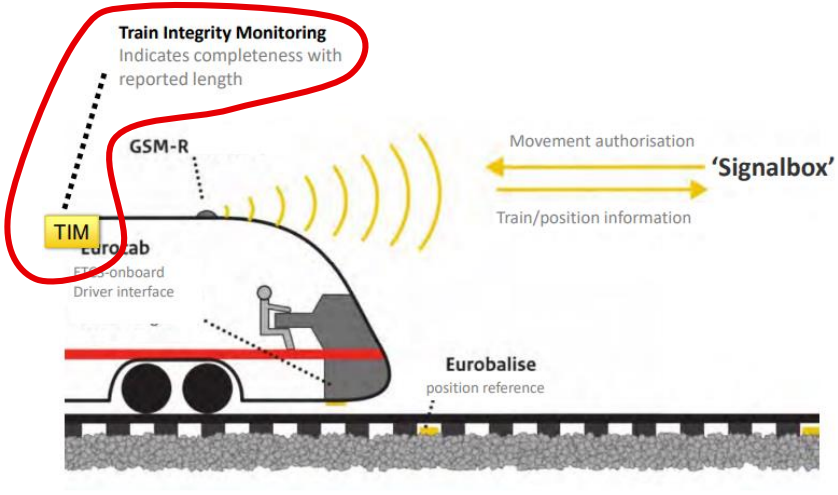
Drivers for system replacement

(1) Capacity, (2) Renewal, (3) Safety, (4) European policy

Introduction | ETCS Level 2 and Level 3

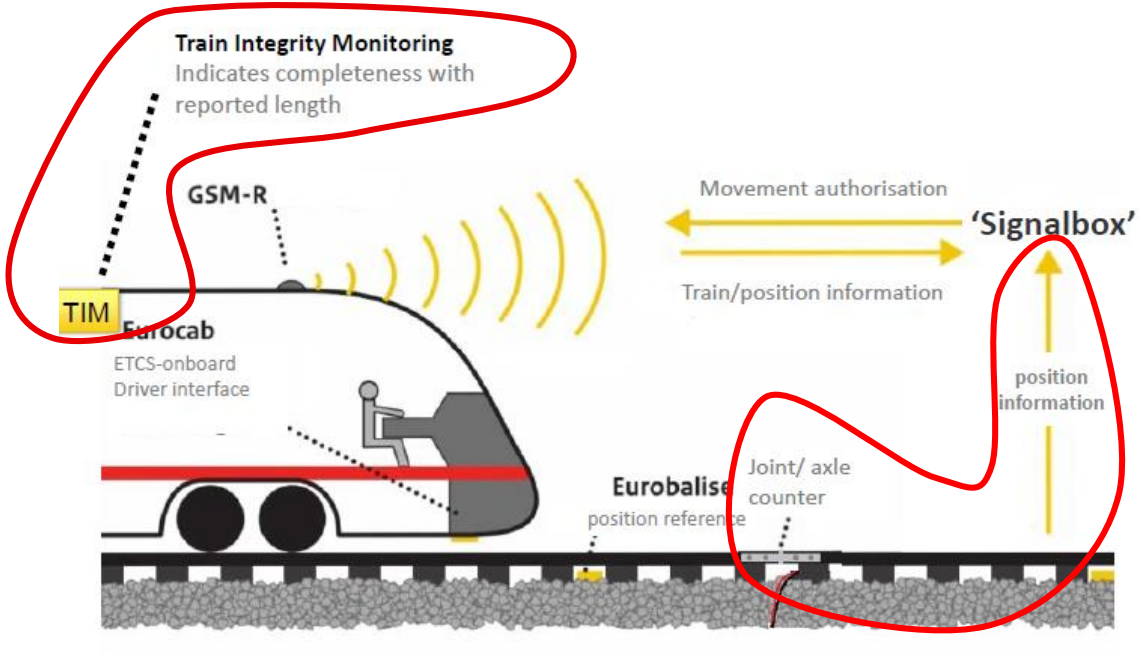


ETCS Level 2



ETCS Level 3

Introduction | ETCS Hybrid Level 3



- Capacity & trackside equipment benefits
- Handles trains with and without TIMS
- Robust recovery/operation
- Approach with fixed virtual blocks fits existing procedures

TU Delft
ProRail

Research question & method

"What is the contribution of ETCS Hybrid Level 3
*in terms of **capacity increase** and **reduction of trackside equipment**?"*

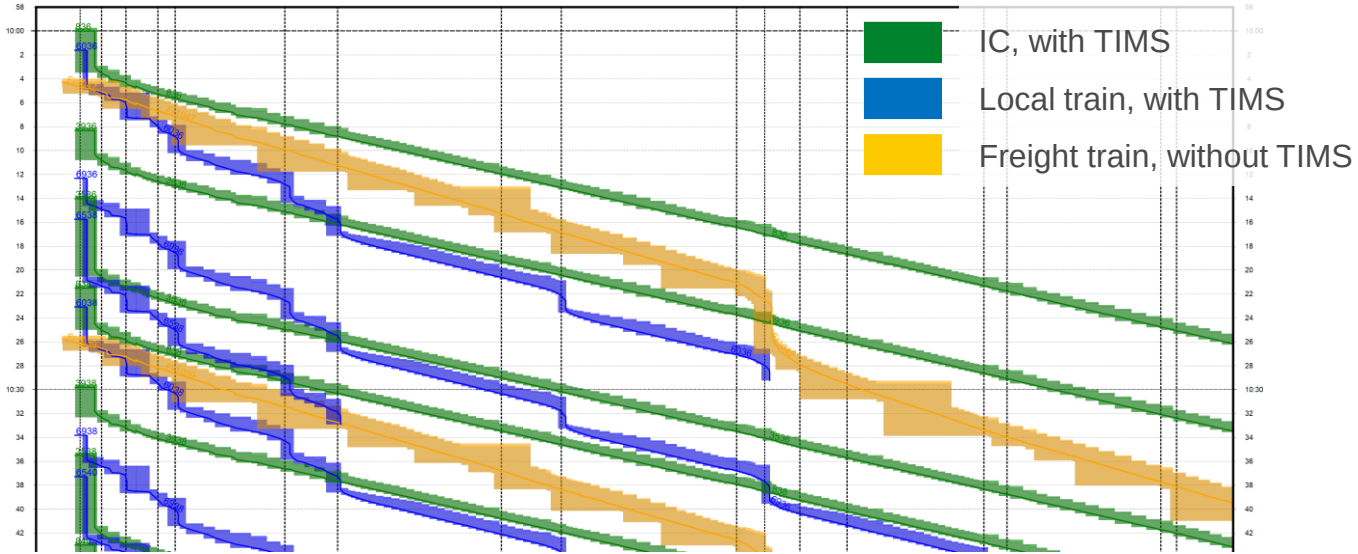
Capacity assessment:
- Microscopic simulation
- Blocking time theory
- Timetable compression method

Assessment of trackside equipment:
- Trackside irregularities
- Scenario based predictions

Capacity assessment | Method

Corridor: Utrecht – Den Bosch

- Tool: RailSys V11 (timetabling & simulation)
- Timetable: 2019 timetable (12 passenger trains, 2 freight slots)
- Five signalling models: NS'54, ETCS L2 and 3 different ETCS HL3 models



Capacity assessment | Results

Infrastructure occupation & capacity consumption

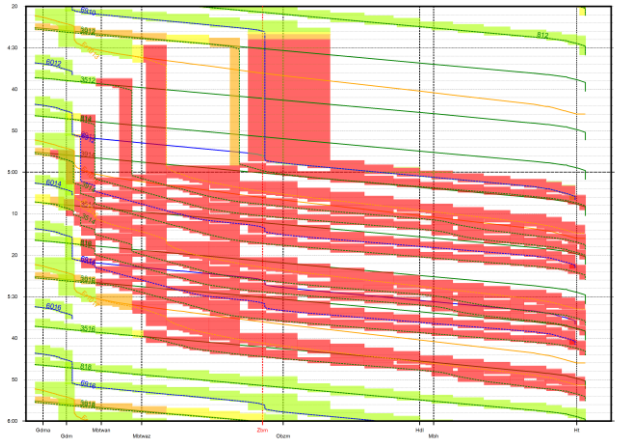
		Infrastructure occupation	Capacity consumption
NS'54/ATB-EG		**84,0%**	**104,0%**
ETCS L2		74,3%	90,9%
ETCS HL3	500m virtual subsections; existing TTD	70,4%	87,2%
ETCS HL3	Virtual subsections up to 100m existing TTD	66,7%	82,4%
ETCS HL3	Virtual subsections up to 100m, reduced TTD	71,7%	88,8%

Maximum capacity:

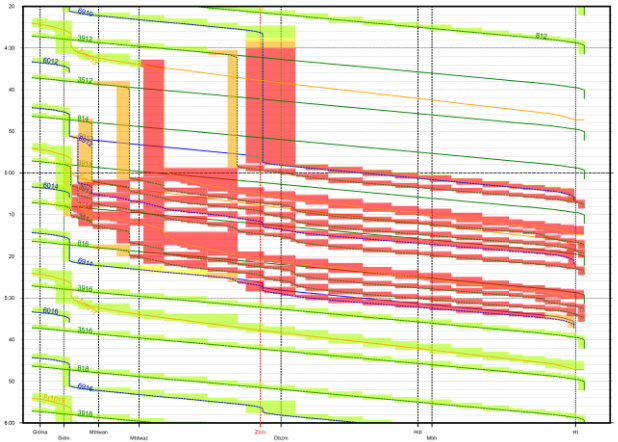
- Infrastructure occupation (UIC proposal: **<75%** for mixed traffic lines)
- Capacity consumption (incl. buffer time): **>100%** impossible without measures

Capacity assessment | Perturbated scenarios

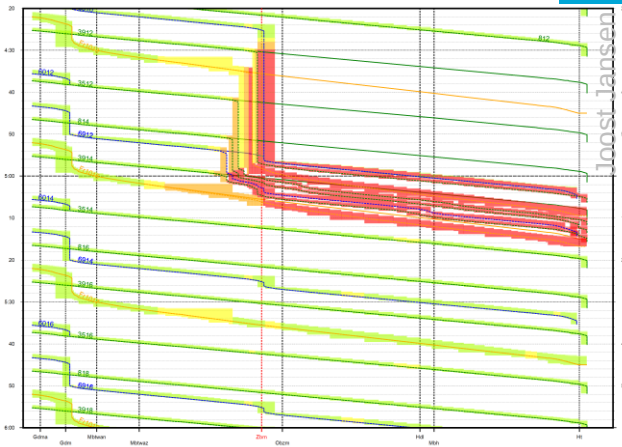
Perturbation-solving characteristics of ETCS Hybrid Level 3



NS'54/ATB-EG



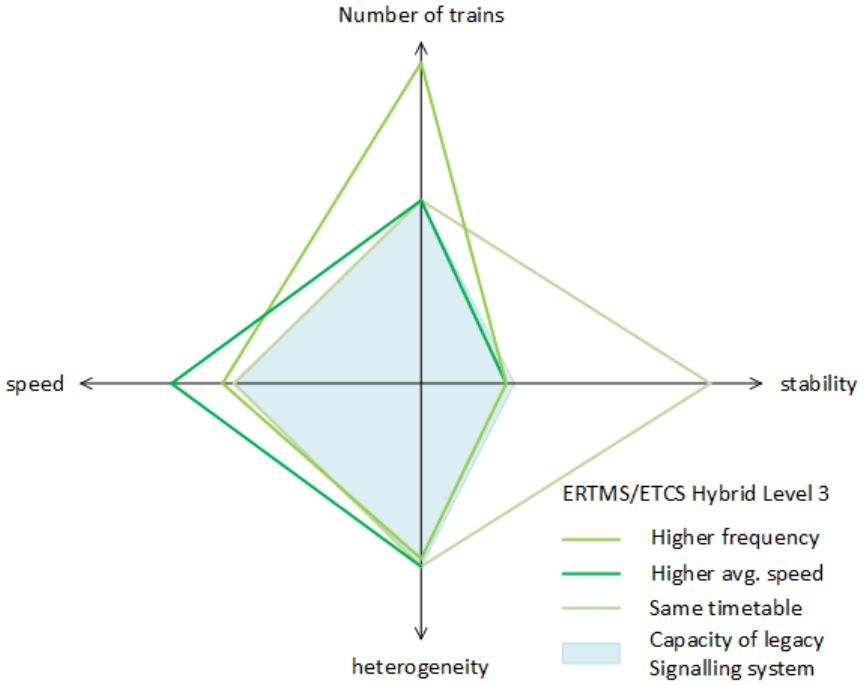
ETCS L2



ETCS HL3

Joost Jansen

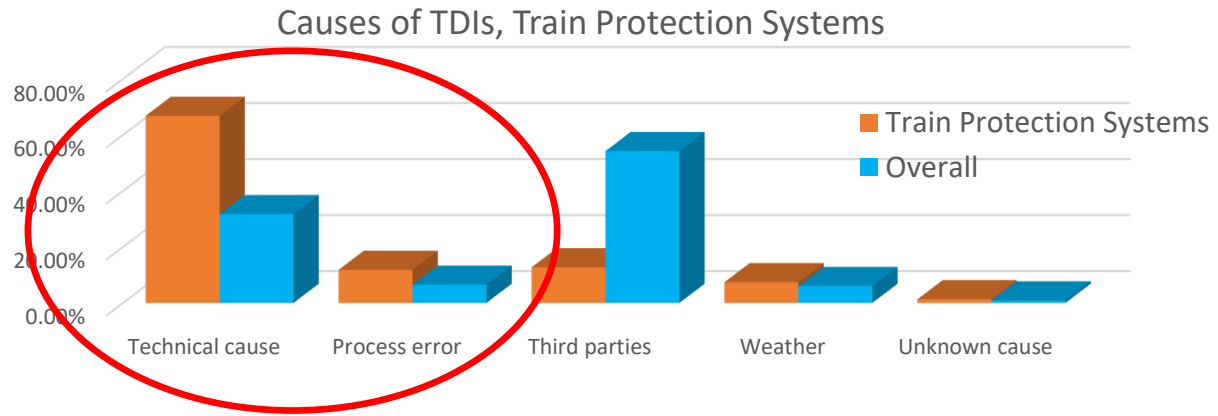
Capacity assessment | More trains, more services?



Assessment of trackside equipment | Irregularities

Track unavailability: infrastructure related irregularities

- 2018: >10.000 irregularities
- 2.098 were related to Train Protection Systems: >60% due to failing track circuits & insulated joints



Failures with technical cause or process error: **responsibility of IM**

- Improvements required
- Reduction / change of components might result in less irregularities

Assessment of trackside equipment | Findings

(1) Improved reliability of ETCS components compared to NS'54/ATB-EG components

(2) Axle counters up to 50% more reliable than GRS track circuits + insulated joints

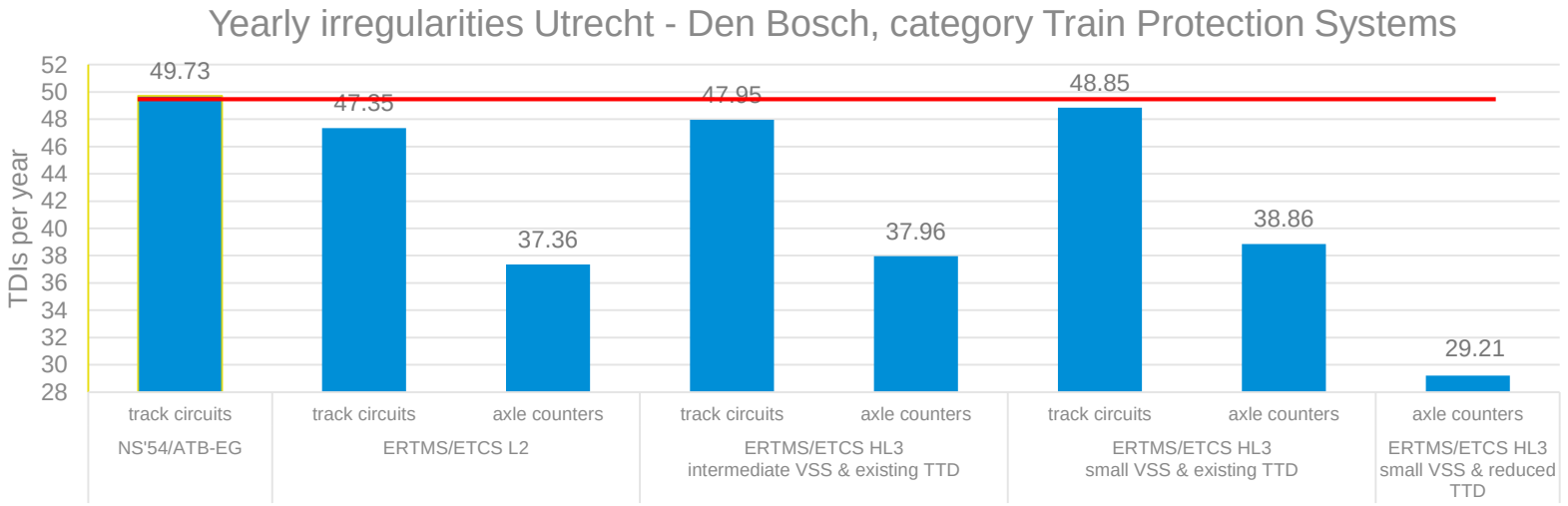
(3) Reduction of Trackside Train Detection: axle counters required

- Track circuits: section length limited
- Safe operations: platforms, junctions/crossovers, level crossings require train detection

(4) Strategy for trackside ETCS-equipment differs from corridor to corridor

- Depending on track & train

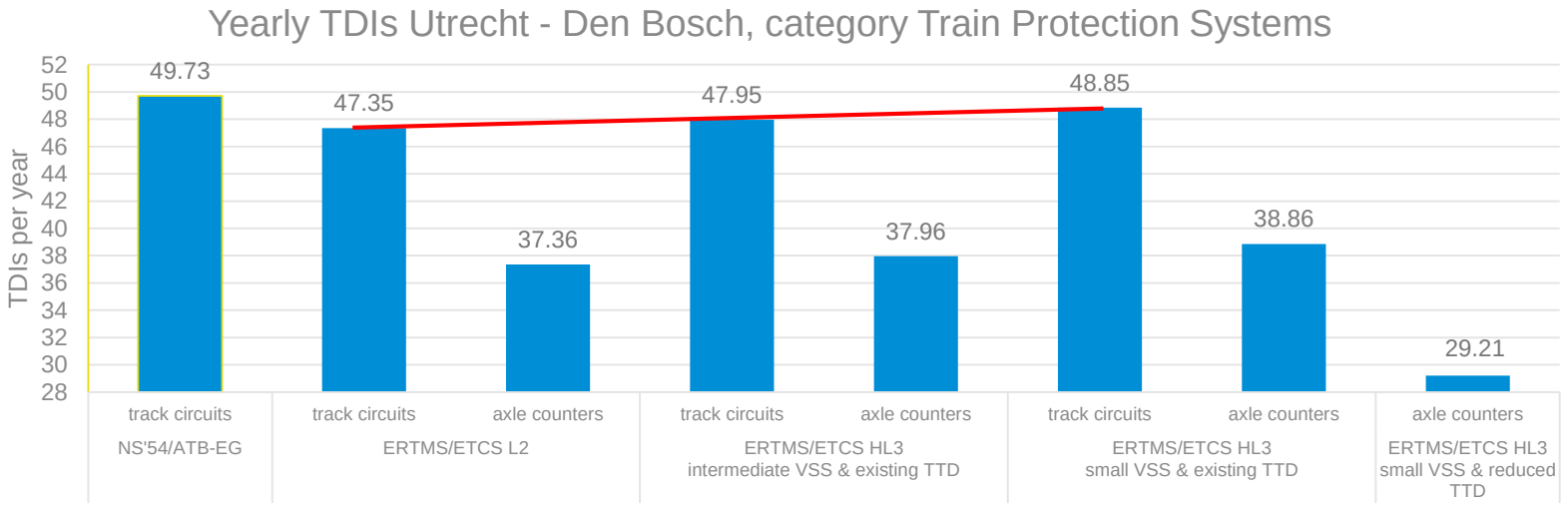
Assessment of trackside equipment | Results



Main results:

- ETCS: asset reliability improvement
- VSS: software configuration - little additional unavailability
- ETCS HL3 & reduced TTD: reduction track unavailability of >40%!

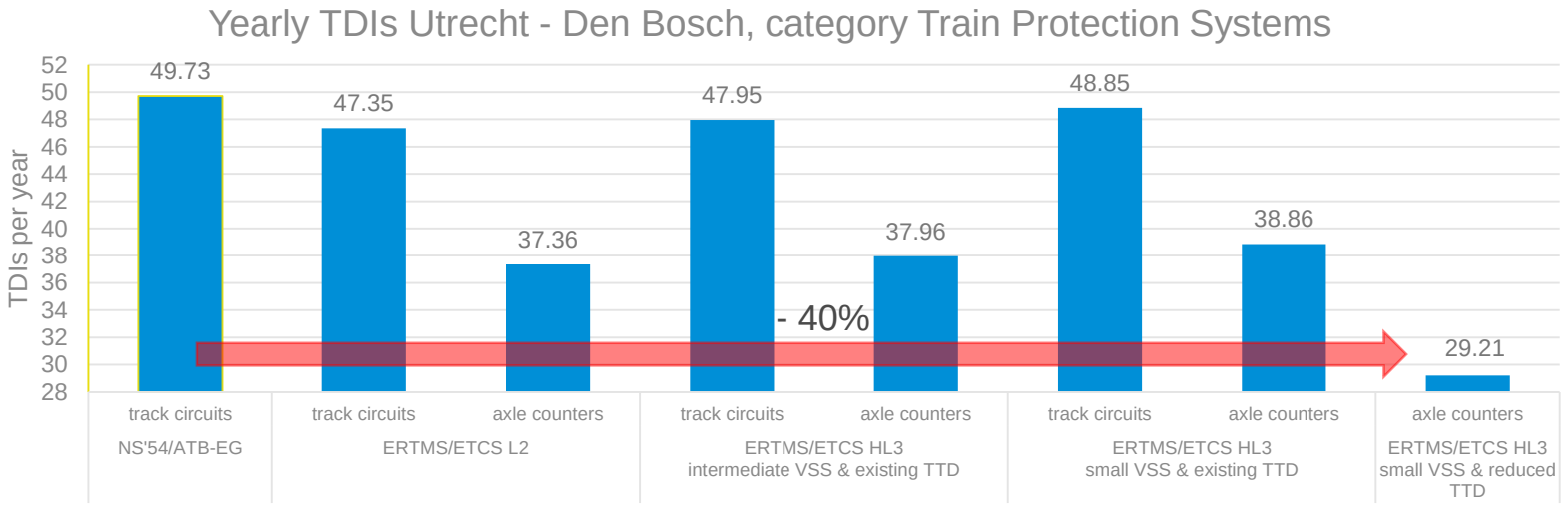
Assessment of trackside equipment | Results



Main results:

- ETCS: improvement of asset reliability
- VSS: software configuration - little additional unavailability
- ETCS HL3 & reduced TTD: reduction track unavailability of >40%!

Assessment of trackside equipment | Results



Main results:

- ETCS: improvement of asset reliability
- VSS: software configuration - little additional unavailability
- ETCS HL3 & reduced TTD: reduction track unavailability of **>40%**

Conclusions & recommendations

Based on this case study, ETCS HL3 offers compared to NS'54/ATB-EG:

- up to 17% reduction of the infrastructure occupation
- and/or up to 40% unavailability reduction

On both aspects a better performance than NS'54/ATB-EG and ETCS Level 2

Based on this case study, it is recommended that:

- the capacity benefits of ETCS HL3 to be used for service increment
- an ETCS HL3 implementation strategy to be developed for each corridor
- reconsider applicability of code UIC-406
- reconsider buffer time

QUESTIONS?

Image: ETCS Level 3 test, Deutsche Bahn Living Lab in Annaberg - 06-09-2018

ERTMS specification, ERA, TSI CCS, annex A, set #3 https://www.era.europa.eu
Hybrid ERTMS/ETCS Level 3 Principles, EEIG User group https://ertms.be/workgroups/level3, 2017
Waterfront presentation Maarten Bartholomeus http://waterfront.mbartholomeus
Movie: ERTMS HL3 test, DB Living Lab https://youtu.be/K6mS6akRmvA, 2018
Movie: ATO & ERTMS HL3 test, ENIF https://youtu.be/kqYq4WJq1FI, 2018