

Preceding slides are unrelated to R2DATO and not included for review

R2DATO - WP38 Demonstrator

Automatic Stabling, Shunting, and Noncommercial runs Demonstrator

Jeroen Braakman, NS

- Horizon Europe
- R2DATO – Digital & Automated up to Autonomous Train Operations
- Digitalisation and automation to enhance the capacity of existing rail networks

Internationale samenwerking en deelname

Infrabeheerders en vervoerders



Kennisinstututen en internationale railorganisaties



Industrie



Co-funded by the European Union



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- Automatic Stabling, Shunting, and Noncommercial runs Demonstrator
- NS, ProRail, CAF, KB, SBB, DB
- Multiple demonstrators:
 - Remote Shunting (Zürich)
 - Remote Stabling (Enschede)
 - ATO-GoA4 (Enschede)







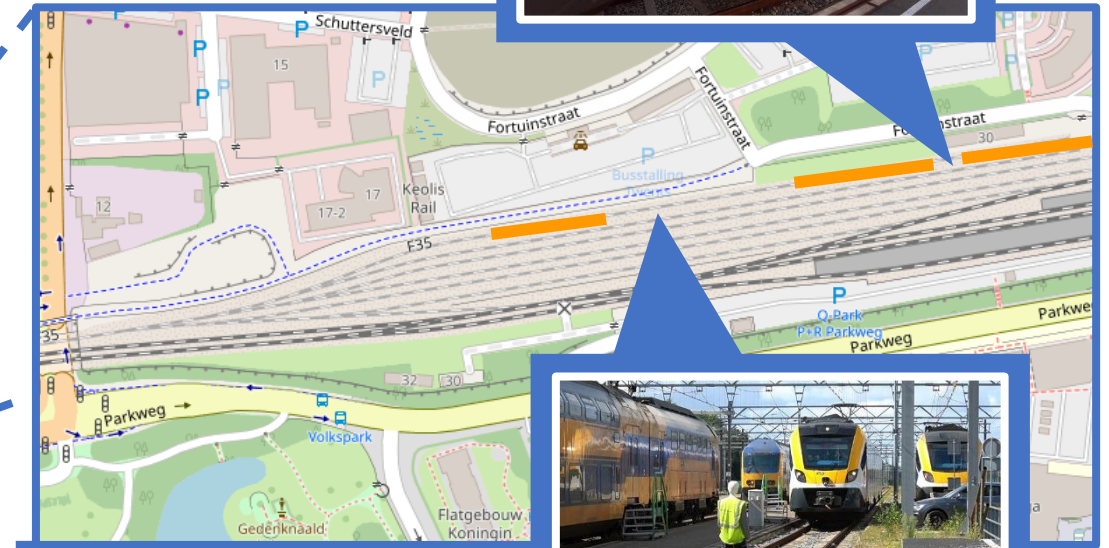
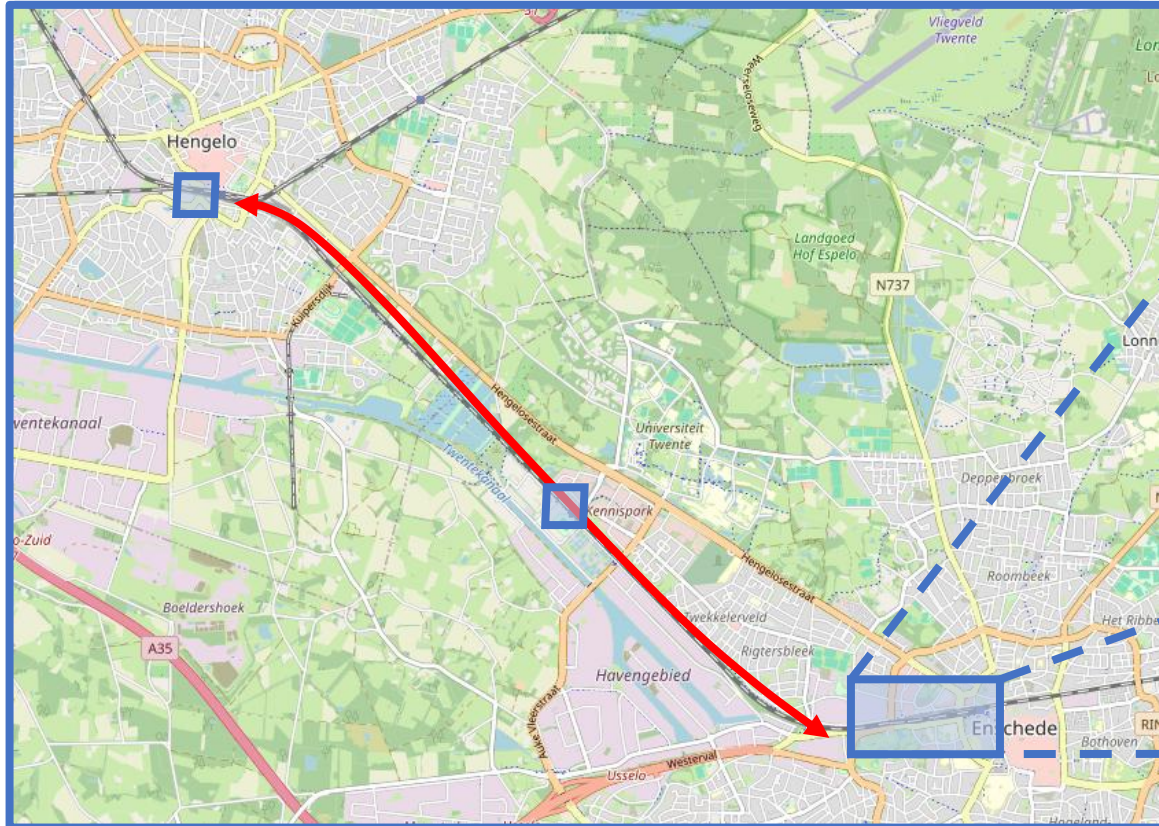
TRAIN LOCATION (Hengelo - Enschede)



Direct distance
(Utrecht – Enschede/Hengelo):
120KM



TRAIN LOCATION (Hengelo - Enschede) (II)

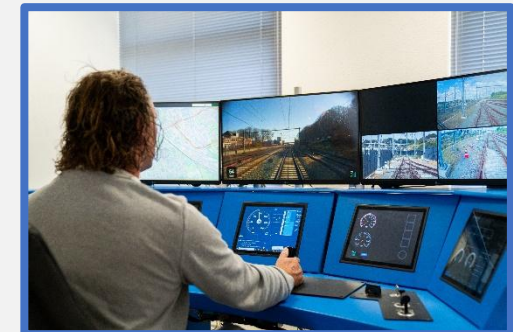


• Studying the impact of remote driving on regular train drivers:

- Different drivers with no previous experience of remote driving
- Test day set-up (4-6h)
 - Phase 1: Driver training on remote driving
 - Phase 2: Remote Driving basic use-cases
 - Phase 3: Remote Driving + Special Procedures
- Questionnaires, observations & eye-tracker analysis
- Performing of simple tasks
 - Driving from A to B under lineside signalling
 - Accurate stopping

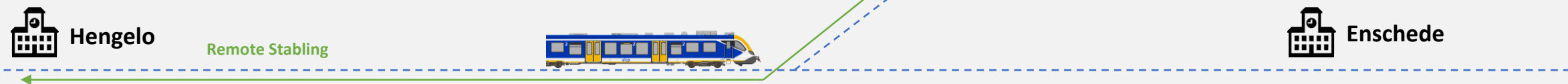
Test environment – ROC

- Utrecht (NS Office)



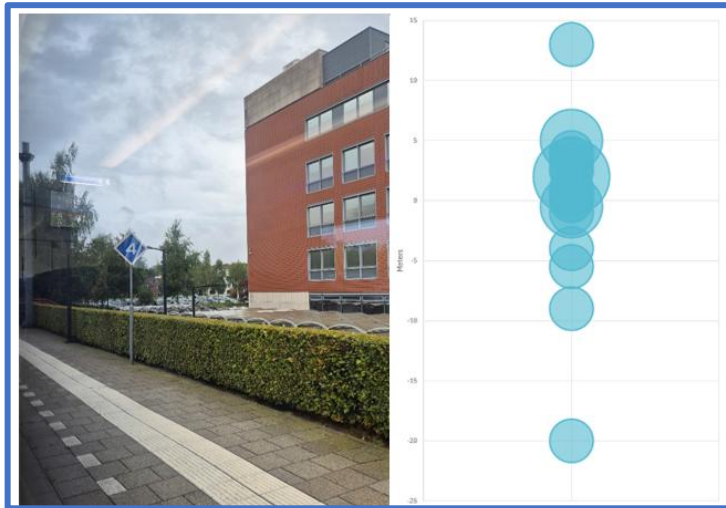
Test environment - Field

- Hengelo to Enschede station or shunting yard (10km)
- Lineside signalling with automatic switches
- Test train equipped with remote driving technology
- Tests according to special derogation
- Two test drivers onboard for safety purposes

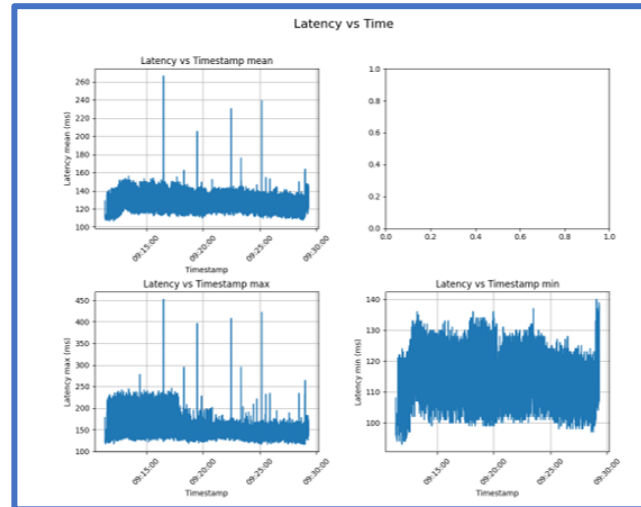




- **92 RTO testruns - 18h of remote driving - 750km covered**



Stopping Accuracy



Latency

- **150-200ms** glass-to-glass latency
- **1200ms** peaks (network saturation)
- **Music Festival**



Interventions

- **Network**
- **ORBIT**
- **Safety Driver**

- Signal Recognition
 - Motion Sickness
 - Workload (Speed & distance estimations)
 - Route familiarity
-
- Expected TRL: 6



DEMO: Autonomous Driving (GoA4)

| Mission Profile ID | Task | Time |
|--------------------|------------------|--------------------------------|
| 1 | Cabin Activation | 2023-06-15 11:00:00 - 11:02:00 |
| 2 | JP | 2023-06-15 11:01:50 - 11:02:00 |
| 3 | Cabin Change | 2023-06-15 11:02:00 - 11:02:00 |
| 4 | JP | 2023-06-15 11:04:00 - 11:05:00 |
| 5 | Coupling | 2023-06-15 11:04:01 - 11:05:00 |
| 6 | Decoupling | 2023-06-15 11:04:01 - 11:05:00 |

JOURNEY PROFILE 1 (DEPOT TO MAIN STATION)

JOURNEY PROFILE 2 (MAIN STATION TO DEPOT)

COUPLING

DECOUPLING

END OF DEMO

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