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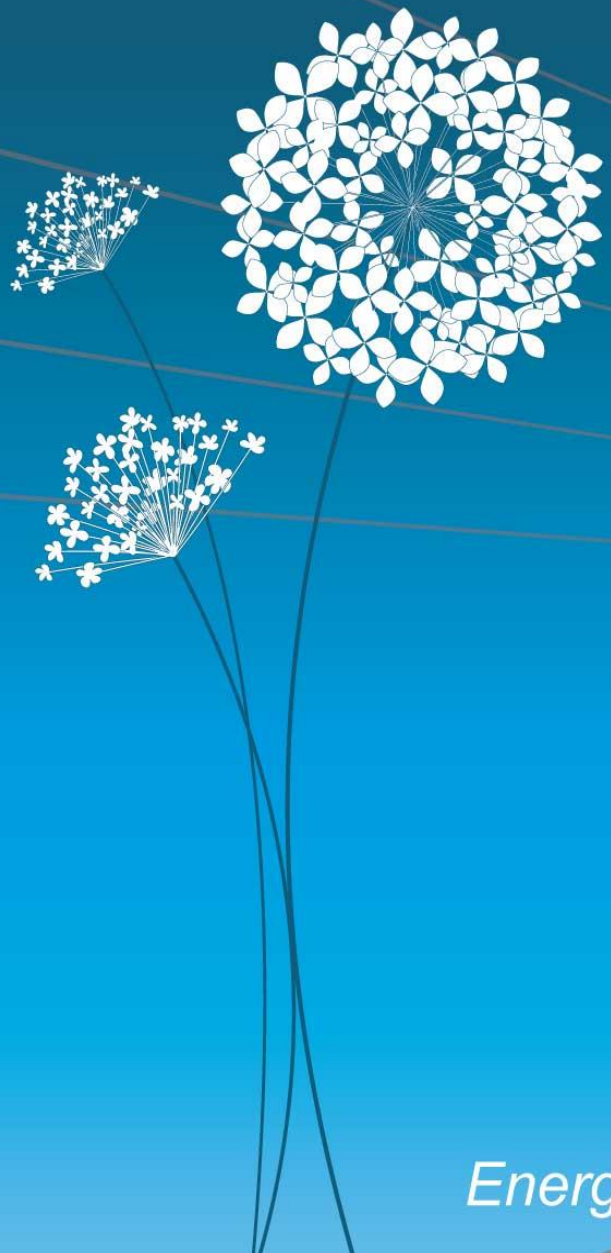
UIC

UIC Energy Efficiency Days 2014

Antwerpen, 16 - 19 June



Traffic Management Systems

Communication to board

Energy Efficiency, the best fuel to move our trains!

AGENDA

- Conflict handling and fluent traffic at SBB
- Need for communication: view from DAS-suppliers
- Brainstorm
- Smoother Train Traffic

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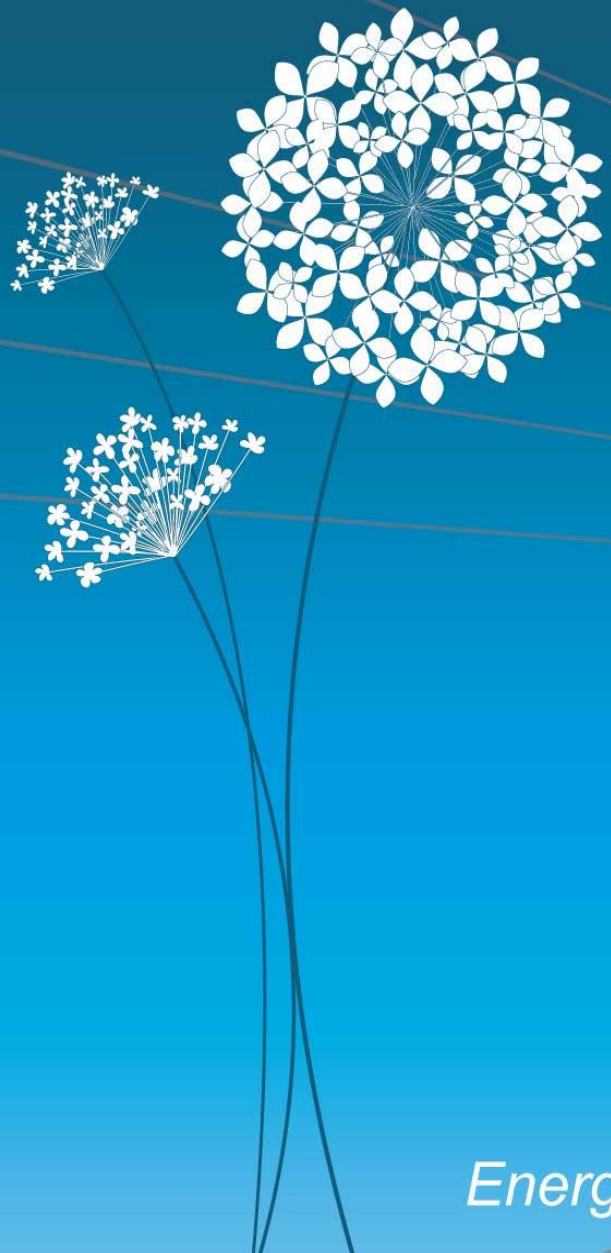


CONFLICT HANDLING AND FLUENT TRAFFIC

THE ADL-PROJECT OF SBB

ARNOLD TRÜMPI, SBB

Energy Efficiency, the best fuel to move our trains!

AGENDA

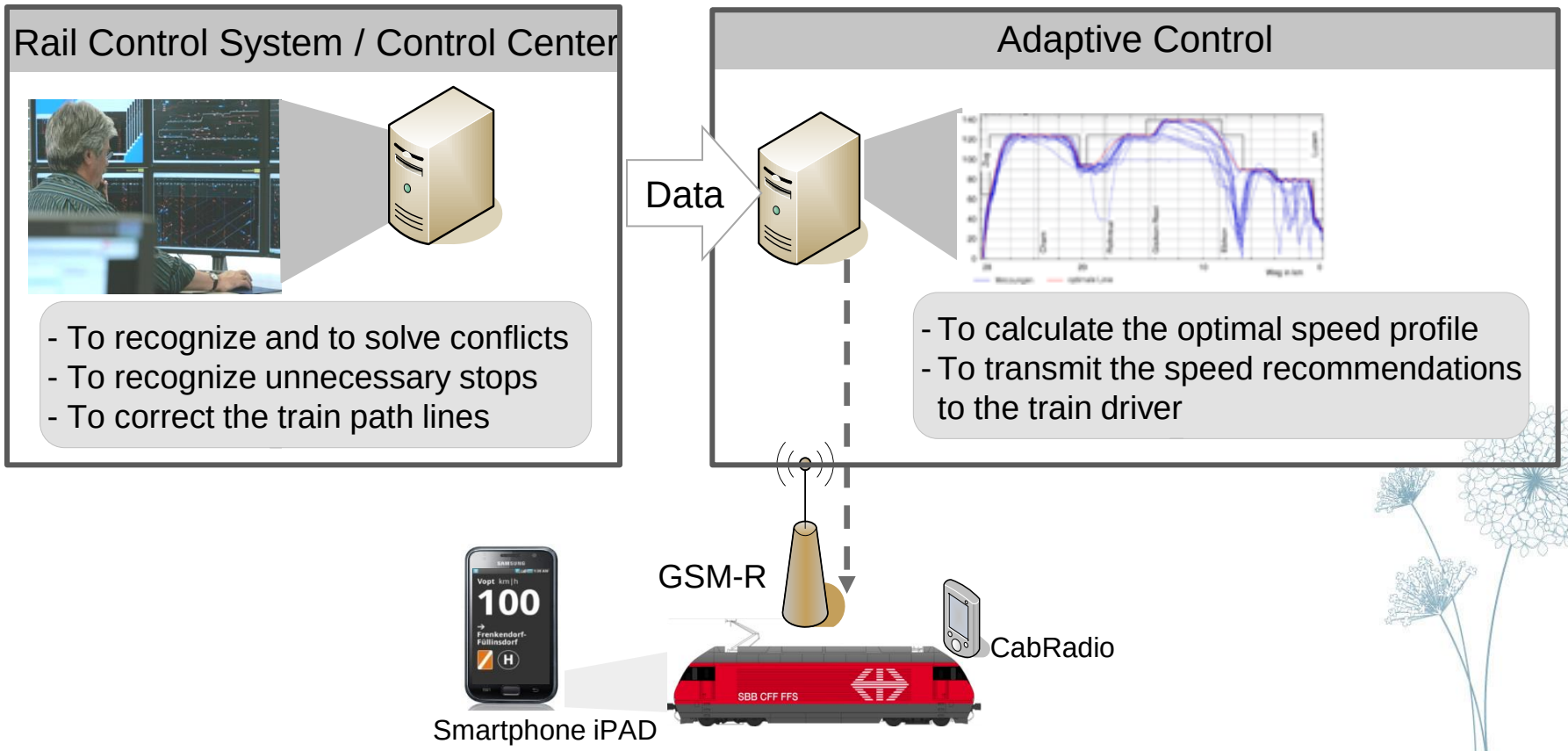
- The Adaptive Control (ADL) project
- Conflict detection in Rail Control System
- Conflict solving (Hub Optimisation Technology)
- Potential for energy saving
- Status of the project

ADL* Project Objectives

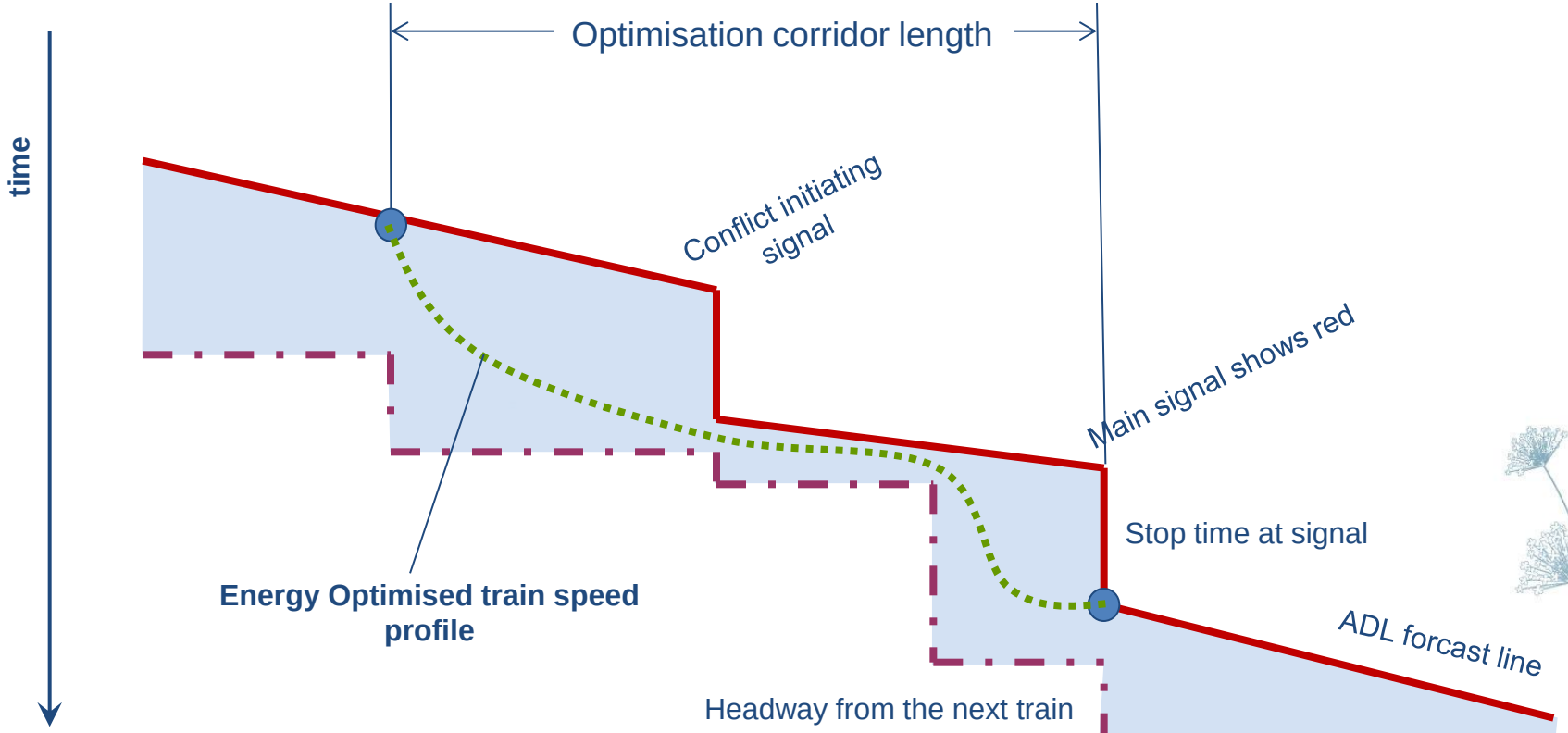
- Reduction of unnecessary stops (2500 per day).
- Increase of punctuality.
- Increase of network capacity through accurate driving recommendations.
- Reduction of energy consumption (- 4 %)
  - Reduction of losses in acceleration and braking sequences
  - Reduction of max. speeds (reduced air resistance)

* ADL = Adaptive Lenkung, Adaptive Control

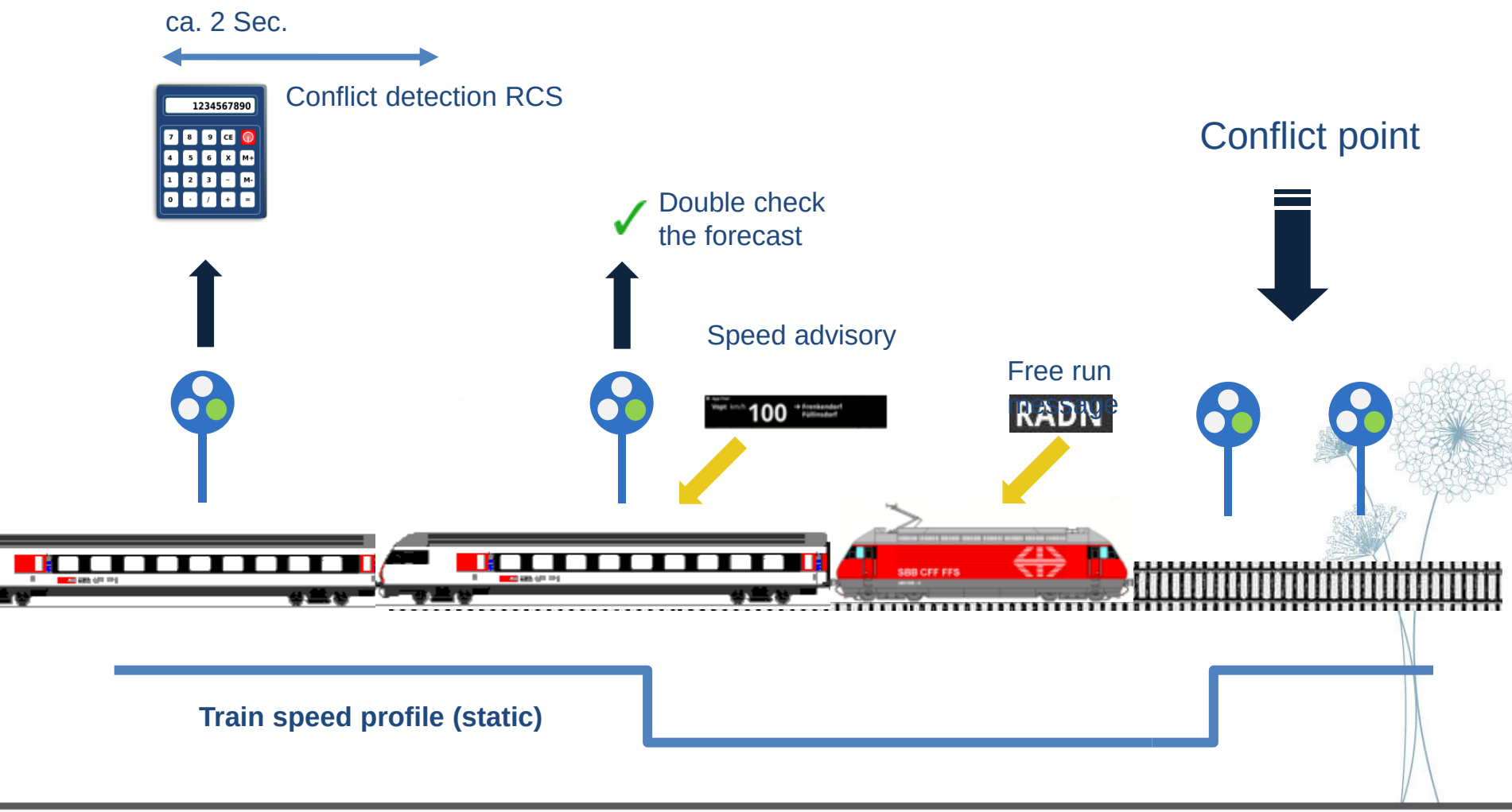
ADL: HOW IT WORKS.



ADL: AN EXAMPLE OPTIMISATION CORRIDOR.

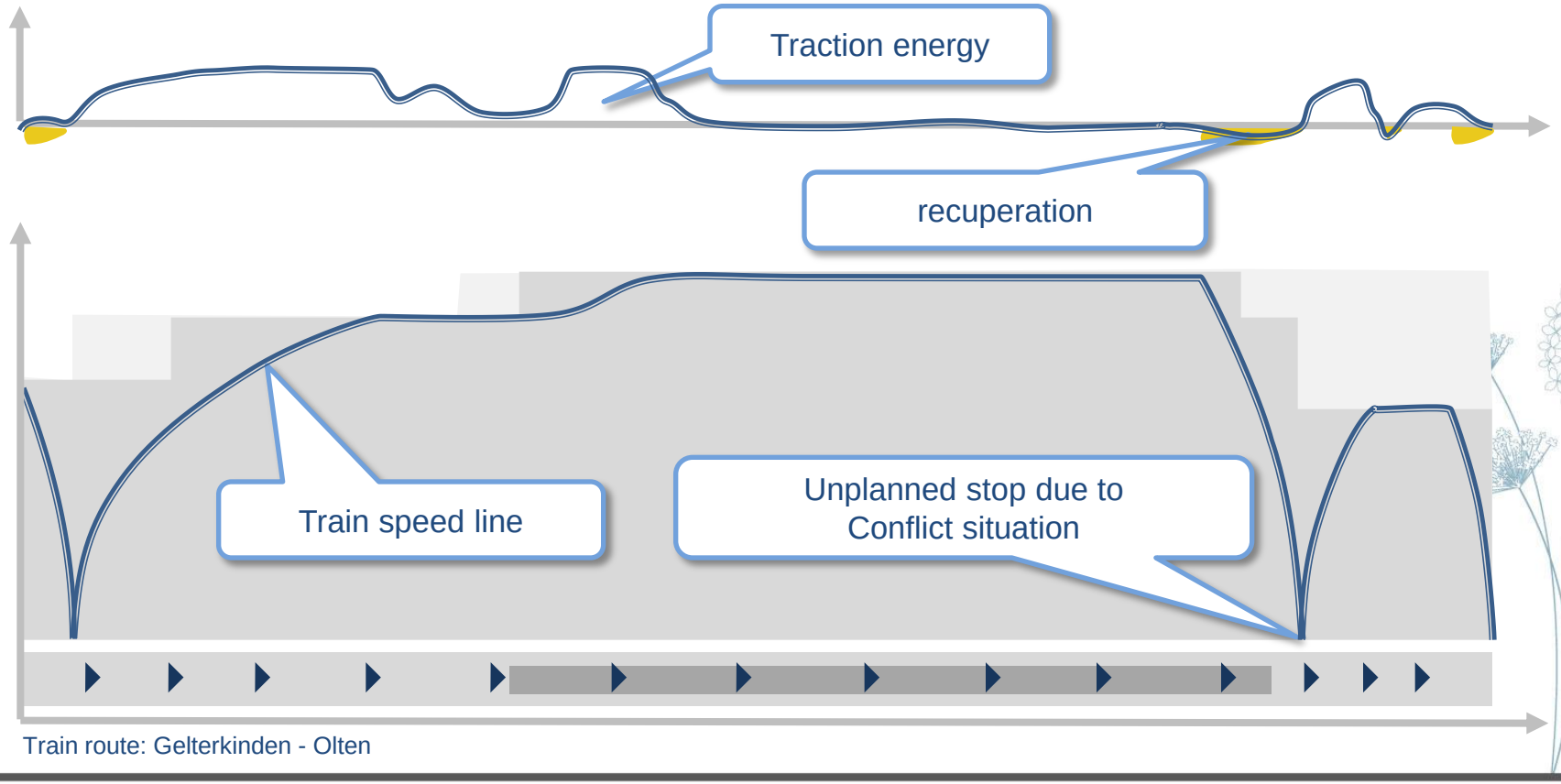


ADL: AVOIDING CONFLICTS.



UNPLANNED STOP DUE TO A CONFLICT WITH TWO TRAINS.

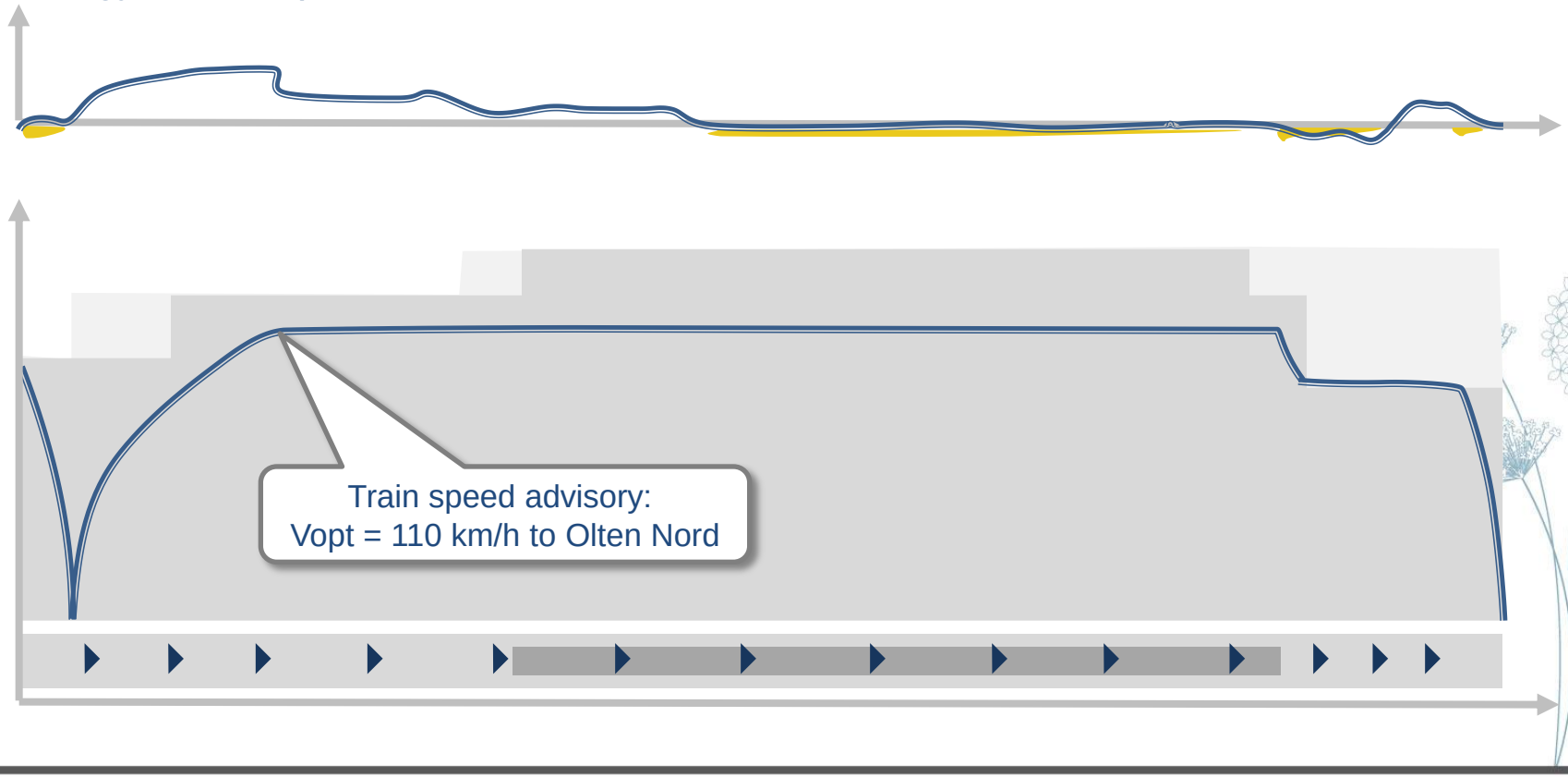
Energy consumption: **350 kWh** Runtime: **651 sec** (incl. unplanned stop)



Train route: Gelterkinden - Olten

40 % OF ENERGY CONSUMPTION AND 25 SEC. TRAIN RUNTIME SAVED.

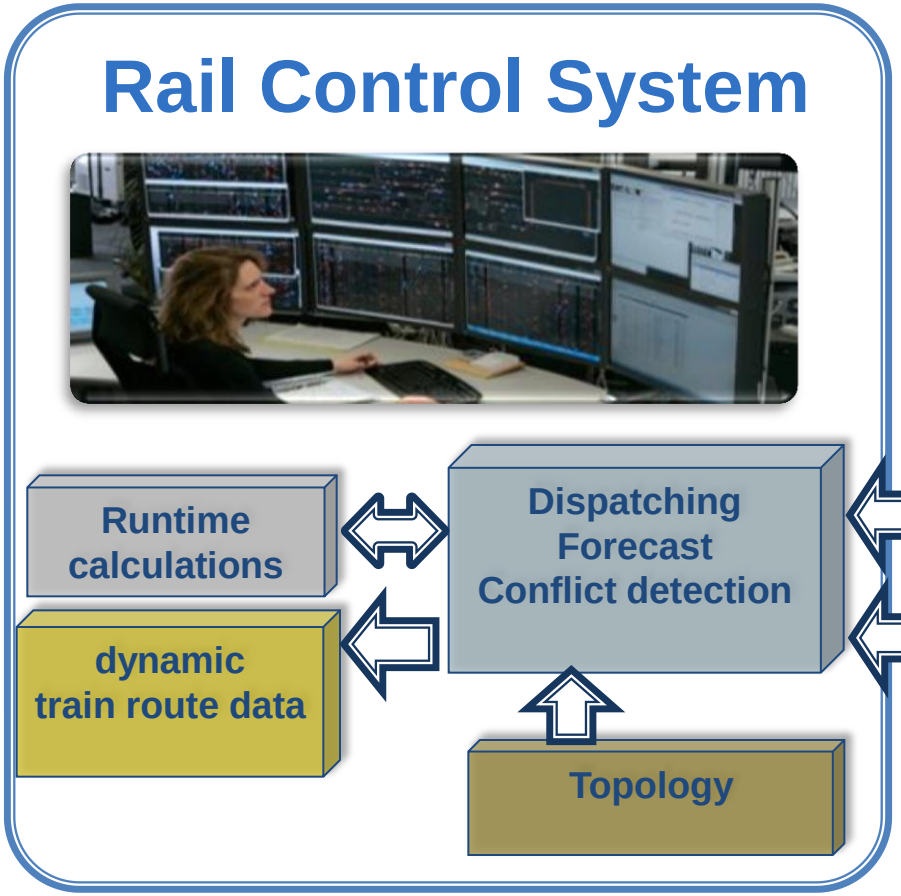
Energy consumption: **204 kWh** Runtime: **626 sec**



ADL Eco-Drive

- ADL system will also be used for energy efficient driving – independent from conflict solving.
- Train drivers get a speed recommendation when they have a time reserve of more than 1 min. and no secondary conflicts are caused.

Basis for ADL: Conflict detection in Rail Control System (RCS)

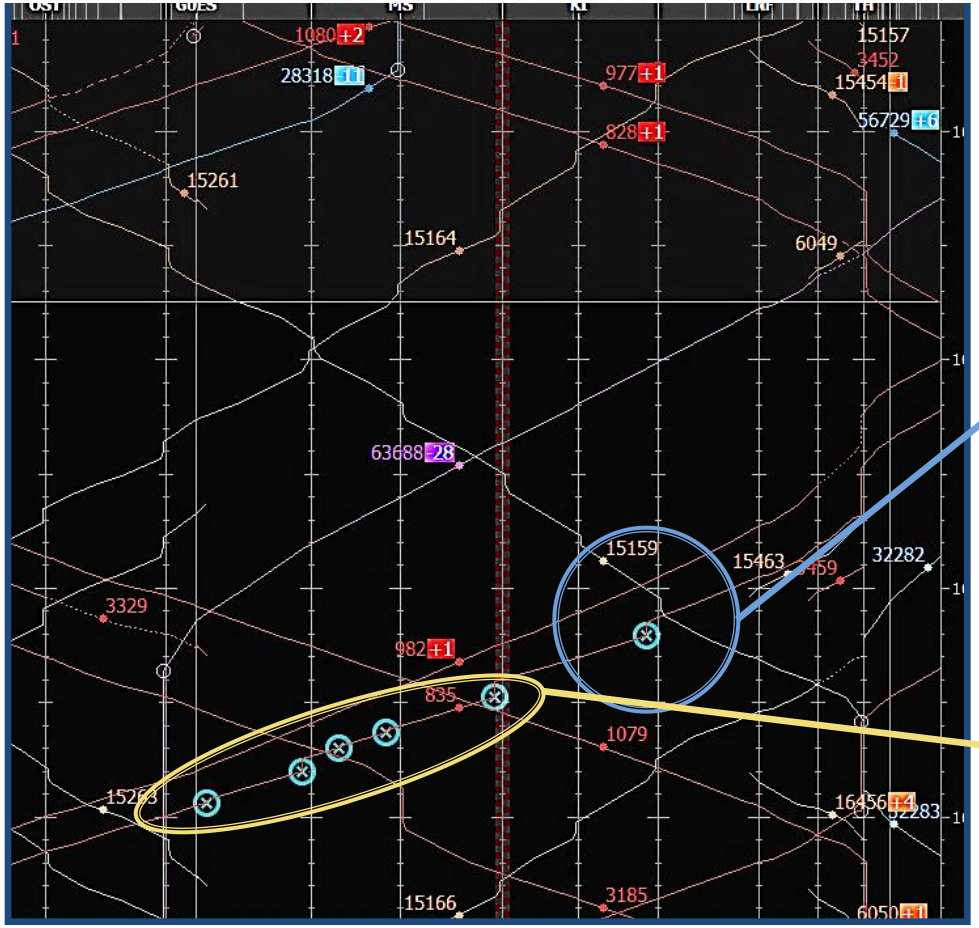


RCS MONITORS CONFLICTS OF VARIOUS TYPES ON THE ENTIRE RAILWAY NETWORK

- Train run conflicts
  - connection, circulation, succession, formation conflicts
  - platform / track number allocation conflicts
  - minimum-time conflicts (i.e. minimum run time as planned not achievable)
  - absolute time conflict (i.e. all manual dispatching actions that explicitly change a time)
  - inbound conflicts (trains entering with delay the SBB railway network)

- Topology conflicts
  - track allocation conflicts (>1 train will use same track within same time frame acc. to forecast)
  - train route conflicts (>1 train will use same pre-set route within same time frame acc. to forecast)
  - track lengths conflicts (e.g. profile conflict with other train route)
  - platform lengths conflicts (e.g. to short for train)

AUTOMATIC CONFLICT DETECTION WITH SIMULATION OF THE RESULTING SITUATION



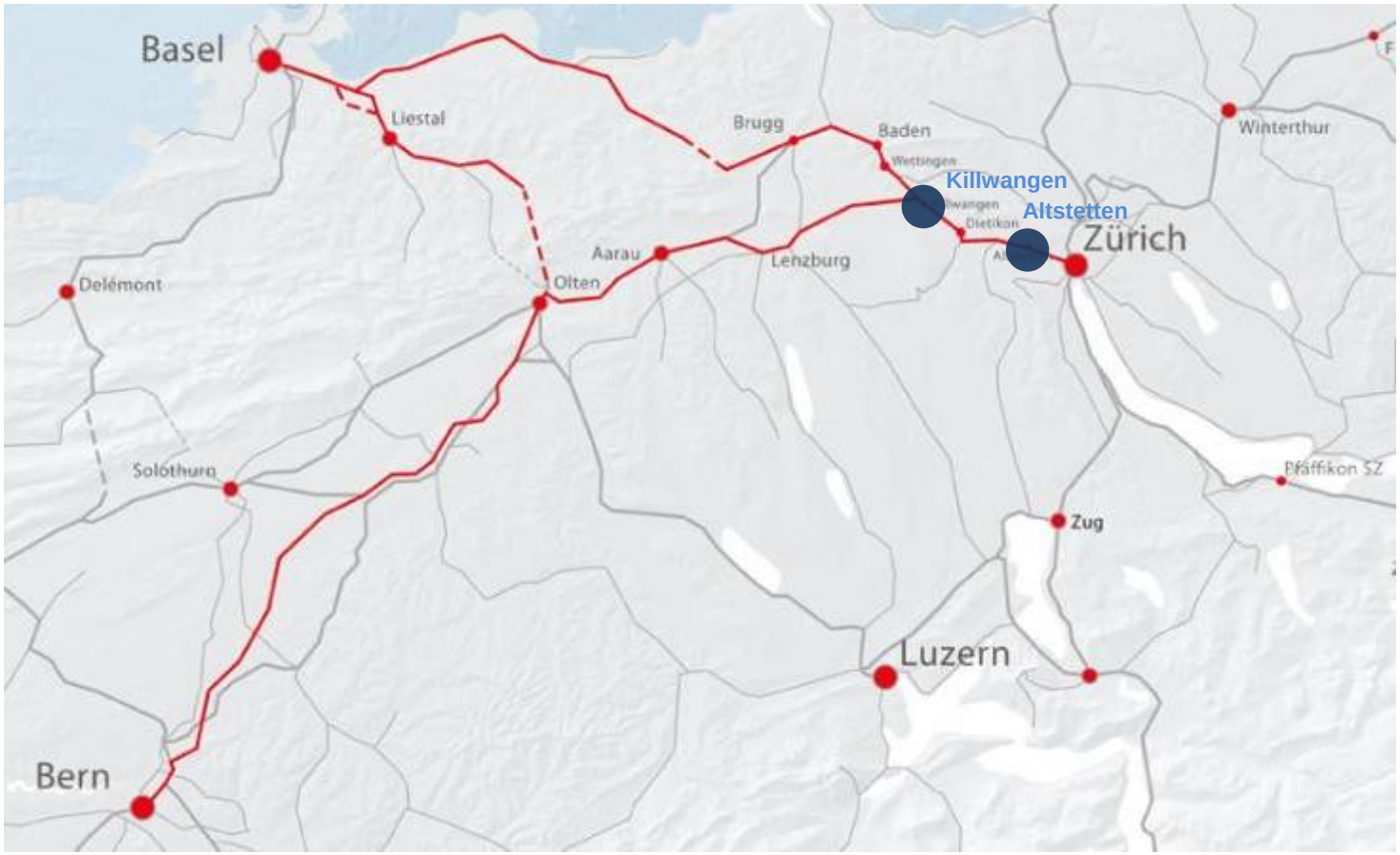
Follow up conflict

Secondary conflicts

AUTOMATIC CONFLICT SOLVING: HOT (HUB OPTIMISATION TECHNOLOGY)

- Is filling the gap between dispatching and operation.
- Detects conflicts automatically.
- Solves conflicts automatically at bottlenecks using a target function.
- Direct link to signalling system.

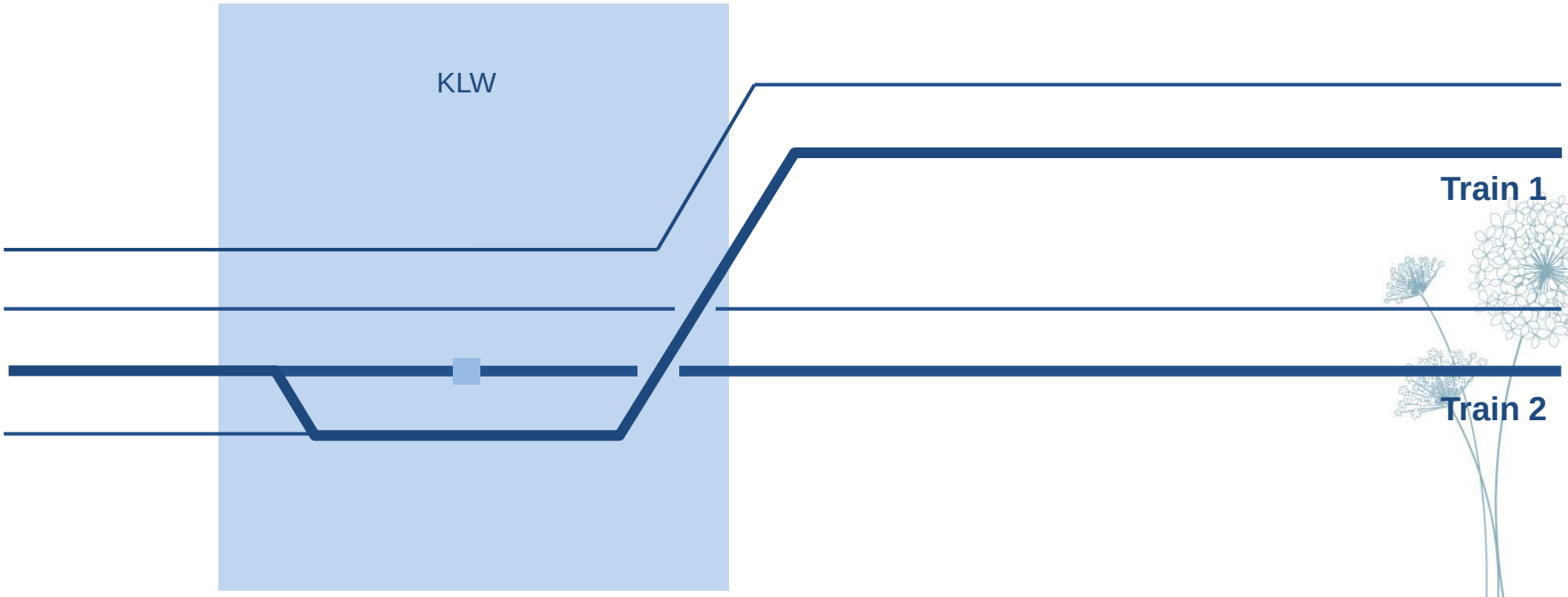
HOT IN USE AT KILLWANGEN AND ALTSTETTEN



USE CASE EXAMPLE IN KILLWANGEN

Situation without HOT:

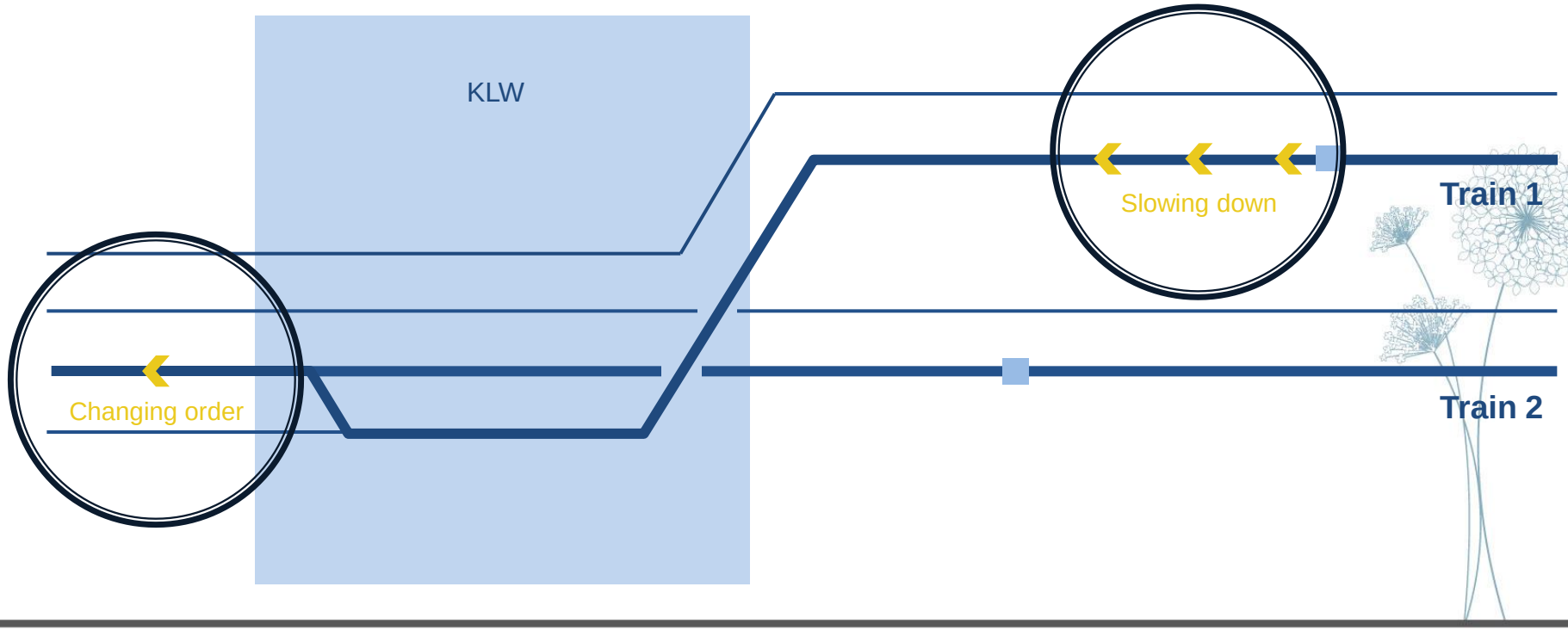
Train 1 is delayed, train 2 has to wait.



USE CASE EXAMPLE IN KILLWANGEN

Situation with HOT:

Order of trains is changed, train 2 runs before train 1.



ADL: Energy Saving Potential

Measure	Energy saving potential	Project
Reduction of unexpected impacts (braking) at signals.	2-3 %	ADL Conflict Optimisation
Support for energy efficient driving linked to traffic management.	1-2 %	ADL Eco-Drive
Including energy efficiency in target function for automatic conflict solving.	0.5 – 1 %	(RCS HOT)

Assumed energy saving potential based on study of Swiss Federal Office of Energy SFOE with SBB: “Verifizierung der Stromeinsparung durch energieeffizientes Zugsmanagement”, Nov. 2009

STATUS AND OUTLOOK

- 2013-14: Field tests for ADL conflict optimisation.

  Challenges:

  – Communication to iPad (new device for driver timetable)
  – Change management / training for dispatchers and drivers
  – Controlling of saved energy based on successfully avoided conflicts.
- 2nd half 2014: Additional testing of ADL Eco-Drive.
- End 2014: ADL net wide in full operation.

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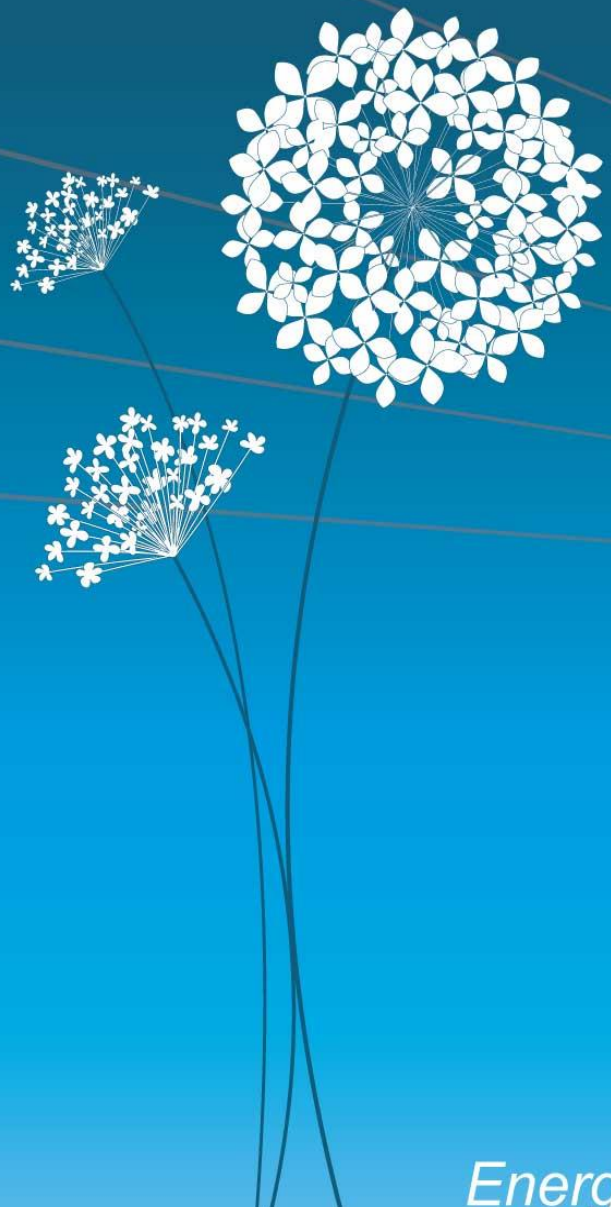


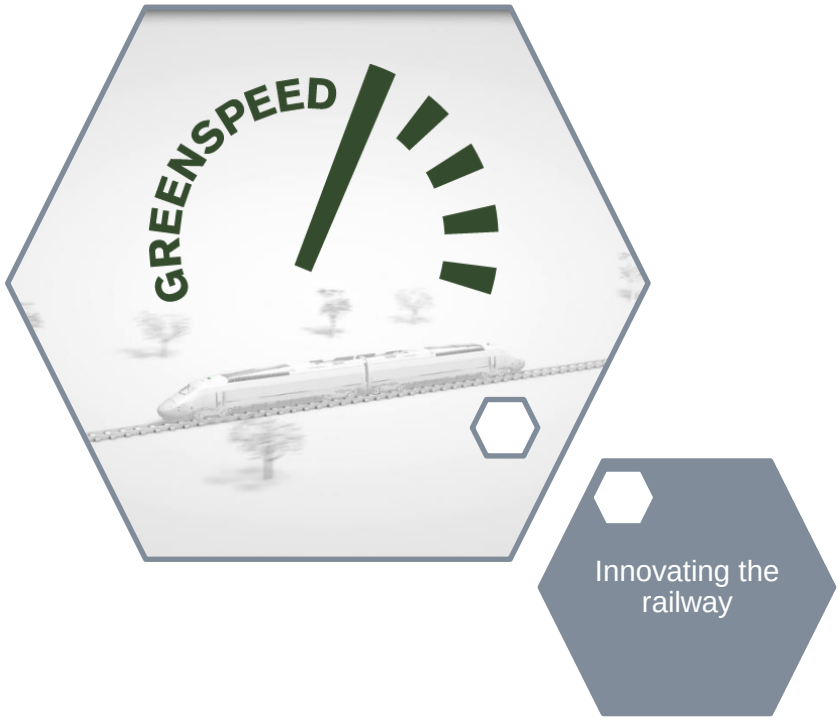
CUBRIS GREENSPEED
C-DAS OPERATION AND TMS

MADS BERGENDORFF, CUBRIS

CHIEF CUSTOMER RELATIONSHIPS OFFICER

Energy Efficiency, the best fuel to move our trains!

About Cubris



- Based in Copenhagen, Denmark
- An engineering company specializing in IT systems for the railway industry
- More than 7 years of experience in developing the eco-driving system GreenSpeed
- Project driven approach. We like to work with local partners to deliver high quality every time
- References:

DSB banedanmark SOUTH WEST TRAINS NetworkRail

CUBRIS

About GreenSpeed

Fleet-wide operation in DSB since March 22nd 2012 in 430 cabs
(DMU, EMU, locomotive, DVT)

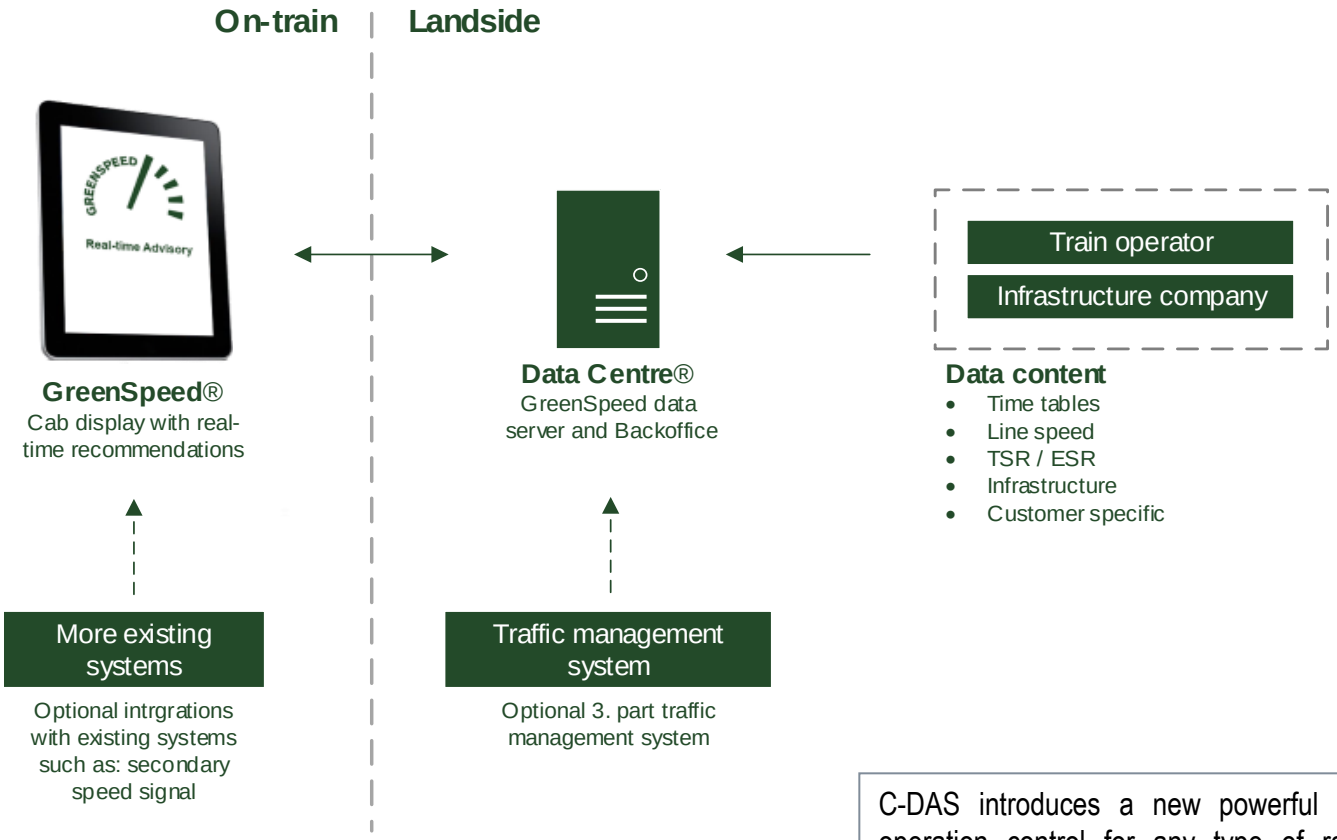
DSB

WHY DO WE NEED DRIVER ADVISORY SYSTEMS?

The growing demand for sustainable green technology and the ever rising energy costs calls for driver advisory systems.

Around the bigger urban agglomerations there is a need for higher capacity, reliability and efficiency of rail borne commuter traffic.

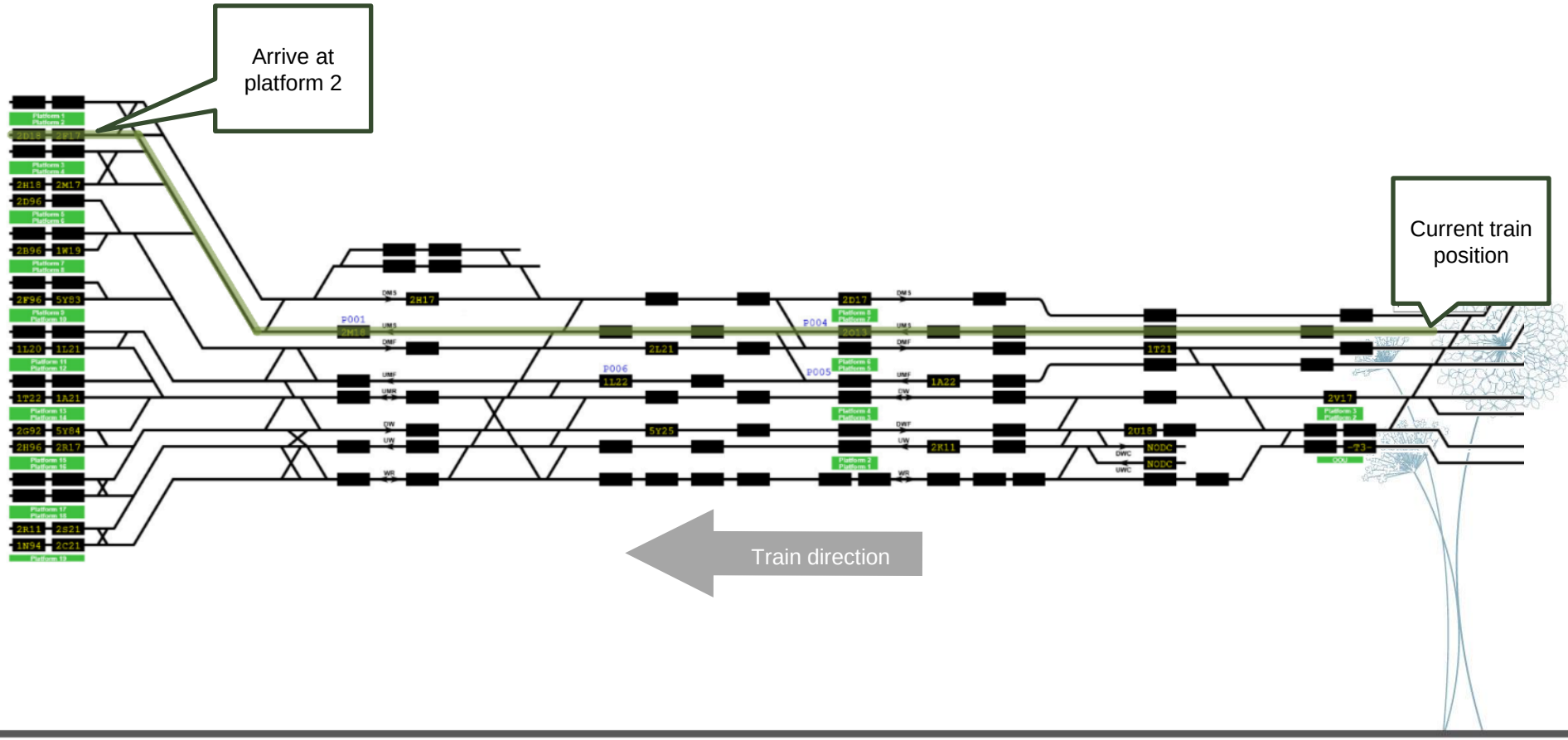
WHAT IS A CONNECTED DAS (C-DAS)?



C-DAS introduces a new powerful level of exercising operation control for any type of rail service: It links timetable planning with optimized train driver execution under any operational condition and provides feedback with the aim of harmonizing individual driver behavior.

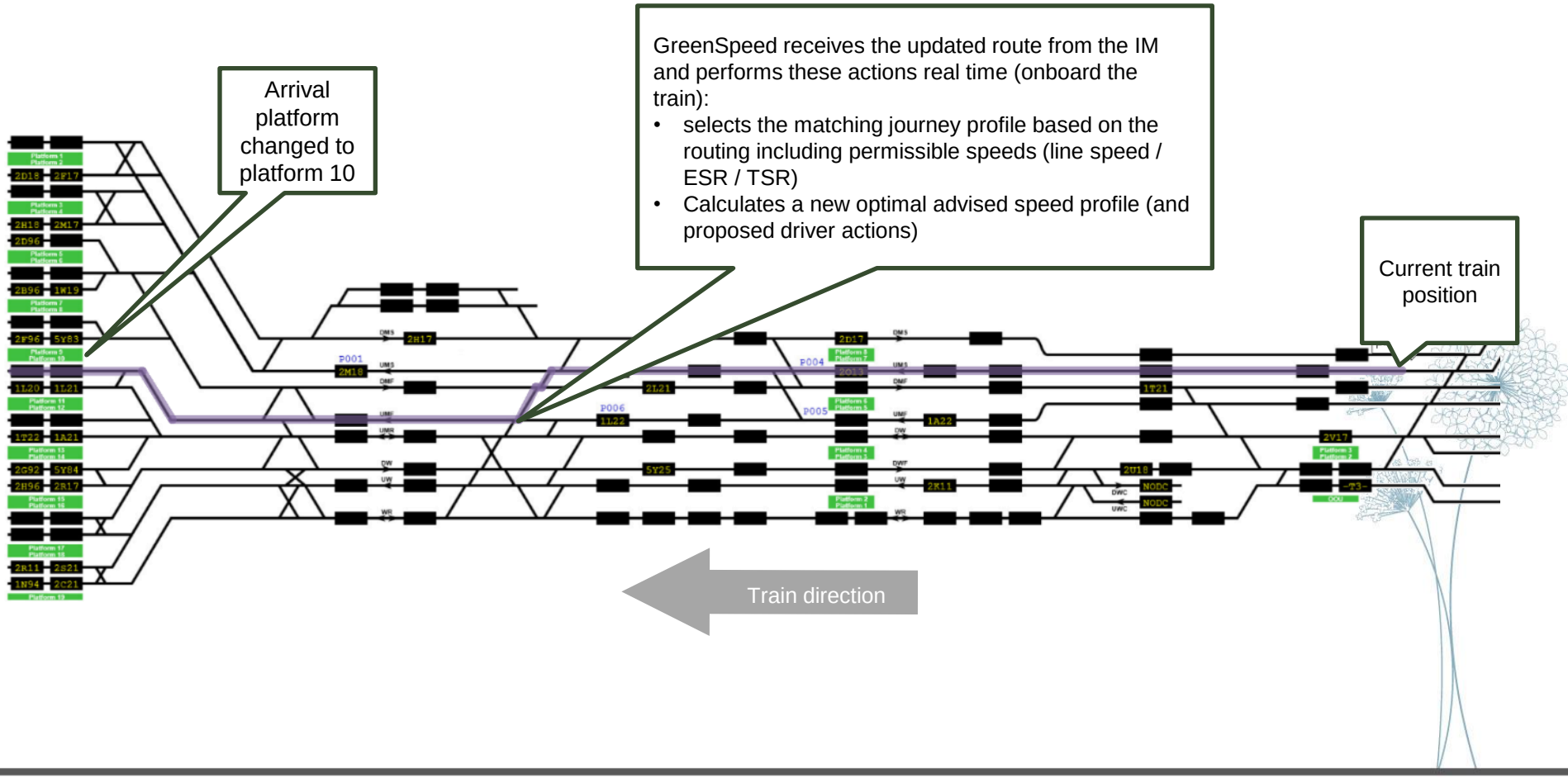
EXAMPLE OF CURRENT C-DAS OPERATION IN DENMARK (DSB)

PLANNED ROUTE



EXAMPLE OF CURRENT C-DAS OPERATION IN DENMARK (DSB)

CHANGE TO PLANNED ROUTE PUSHED TO GREENSPEED



DATA TRANSMISSIONS GROUND - TRAIN – GROUND

From ground to train (at start-up):

- Permanent speed limits
- Temporary speed restrictions
- Timetable

From ground to train real-time:

- Changes to planned track usage
- Changes to timetable
- Changes to temporary speed restrictions (emergency speed restrictions)

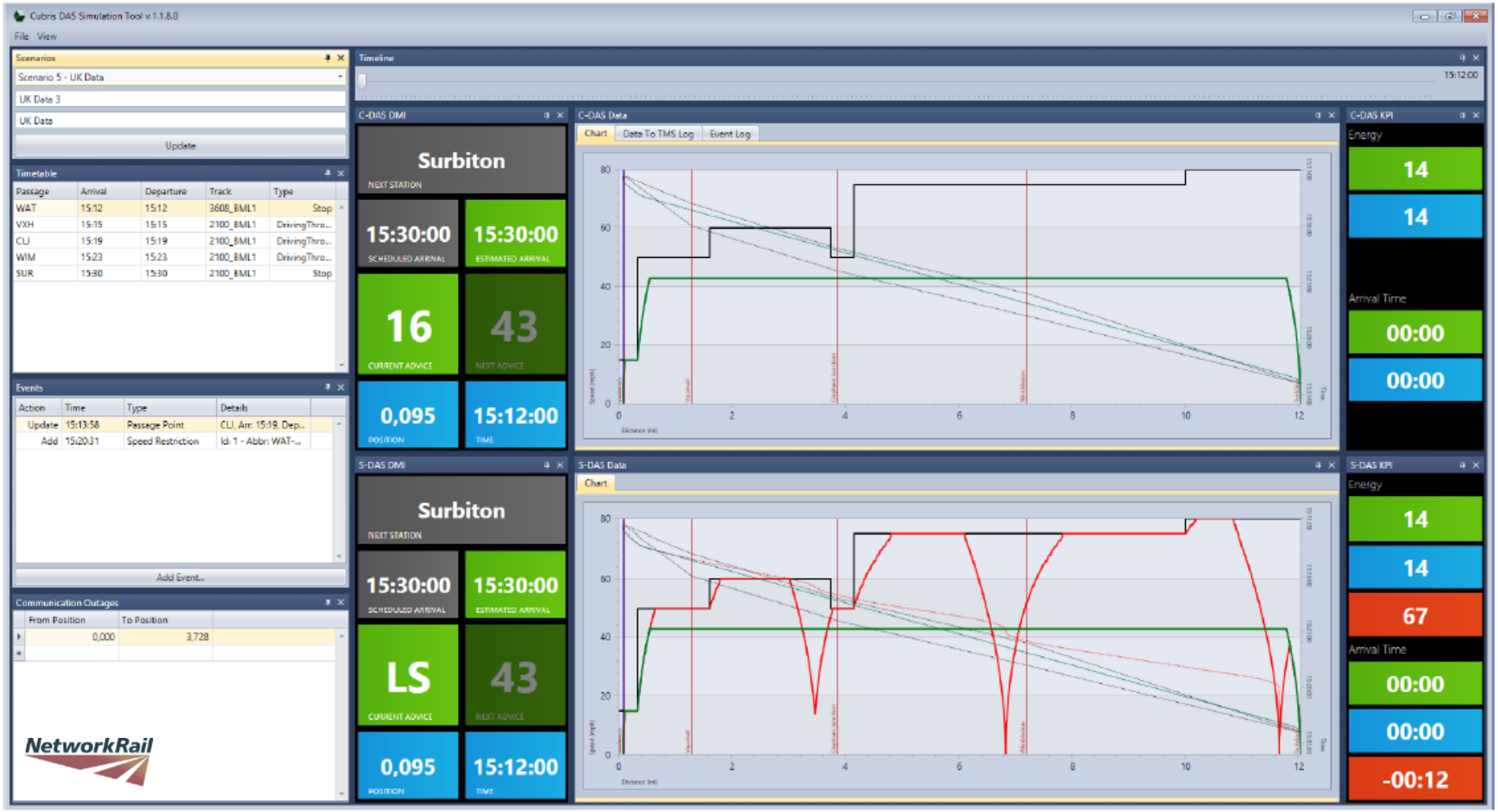
Static data on-board:

- Infrastructure (track locations, height profile, stations…)
- Train characteristics (could be dynamic depending on vehicle)

From train/on-board equipment real-time to ground:

- Position from GPS
- Speed (GPS and tachometer)
- Maximum speed (from safety system)
- Actual train performance (acceleration and braking)
- Train length and weight

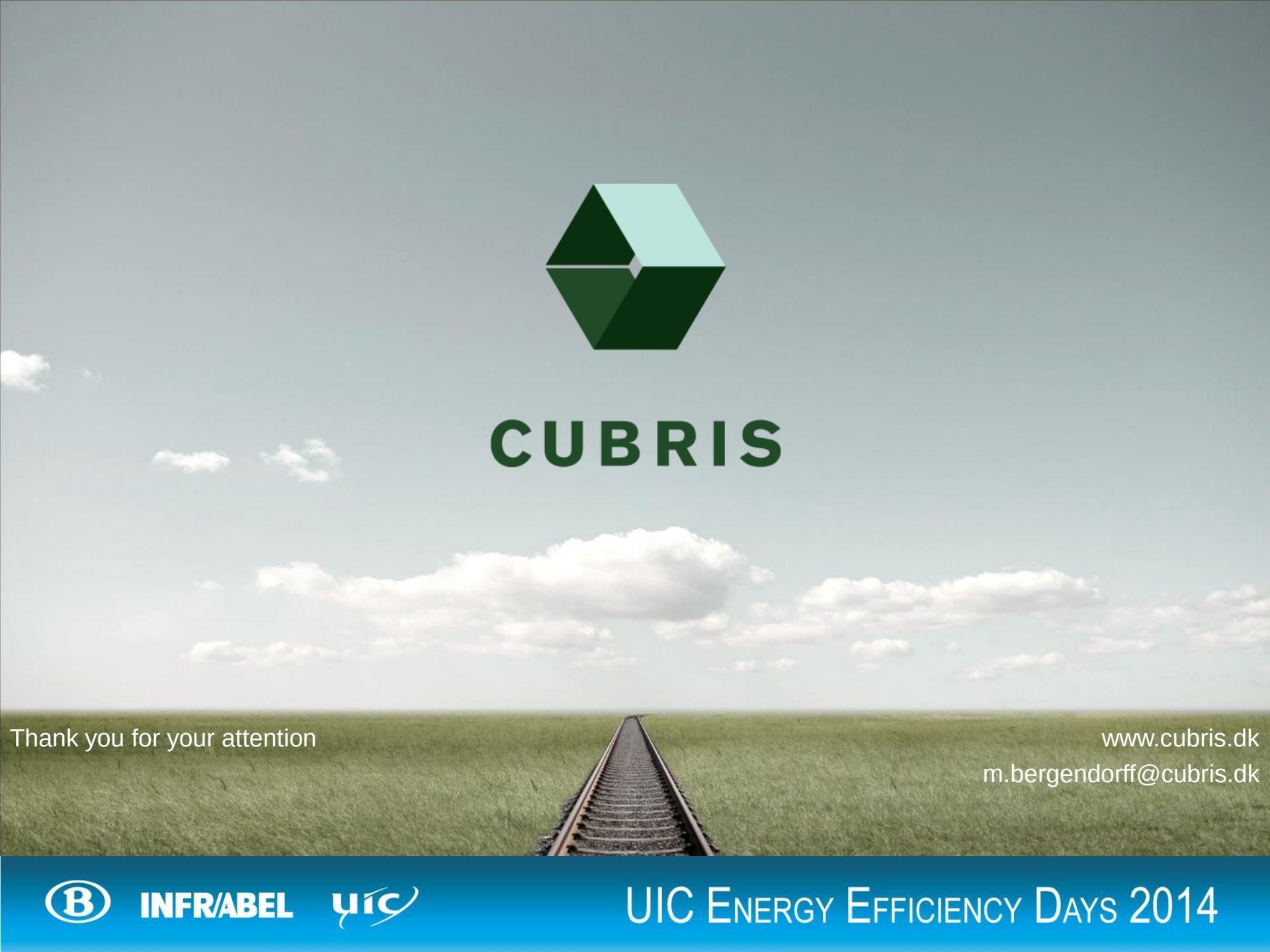
CUBRIS C-DAS PROOF OF CONCEPT FOR



CUBRIS GREENSPEED C-DAS SOLUTION FOR SSWT

The Project Facts:

- Turnkey project by Cubris
- First C-DAS implementation in the UK
- 500 train cabs
- Roll-out 2015
- In co-operation with Network Rail to improve punctuality and capacity



Thank you for your attention

www.cubris.dk
m.bergendorff@cubris.dk

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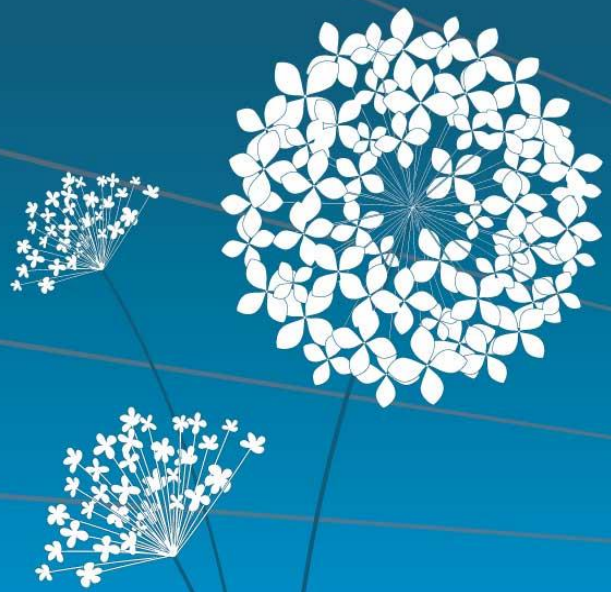


Efficient Train Operation by Connected DAS/ATO

Per Leander, CEO Transrail Sweden AB

Energy Efficiency, the best fuel to move our trains!

BART'S AGENDA FOR THIS PRESENTATION

- What is a DAS?
- Why do we need this?
- Why does a DAS need data from ground?
- What data do you need to reach an optimal DAS?

WHAT ARE WE TALKING ABOUT?

1. Any type of information to support driving?
2. Advice for punctual driving? — Based on actual operative schedule?
3. Advice for eco-driving? — Performance?
4. Advice for any type of optimal driving? — What?
5. and/or something else?

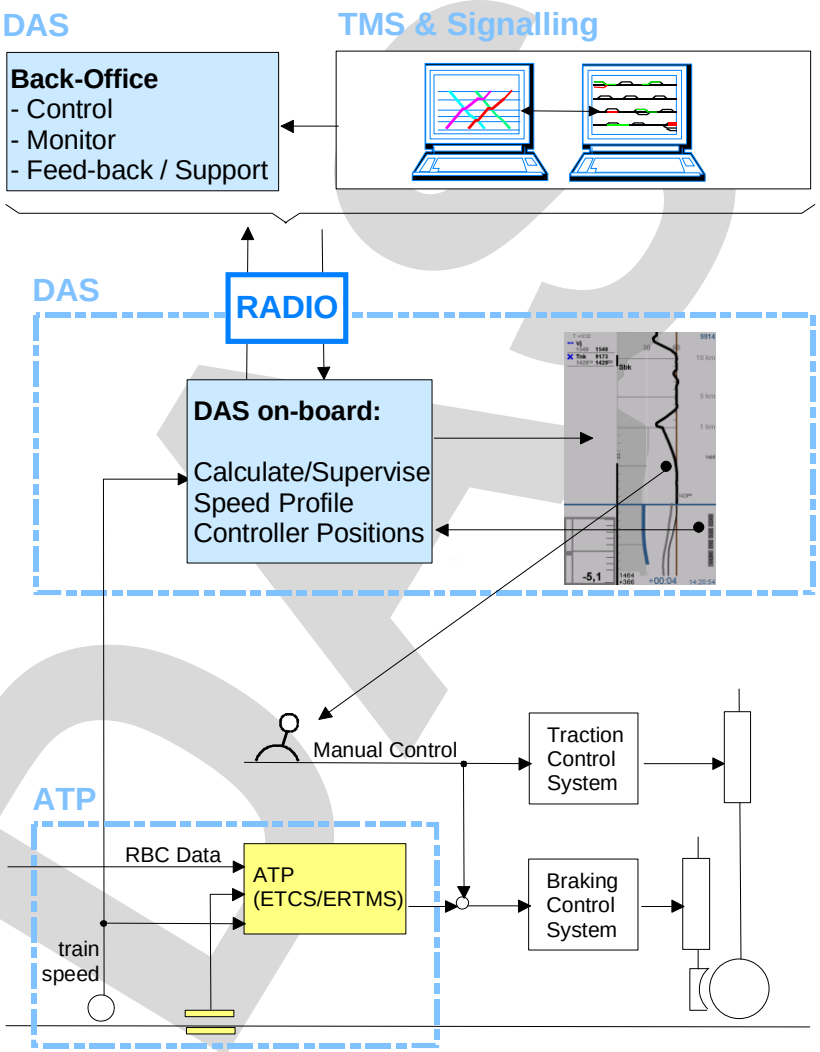
- What should be the definition of DAS?

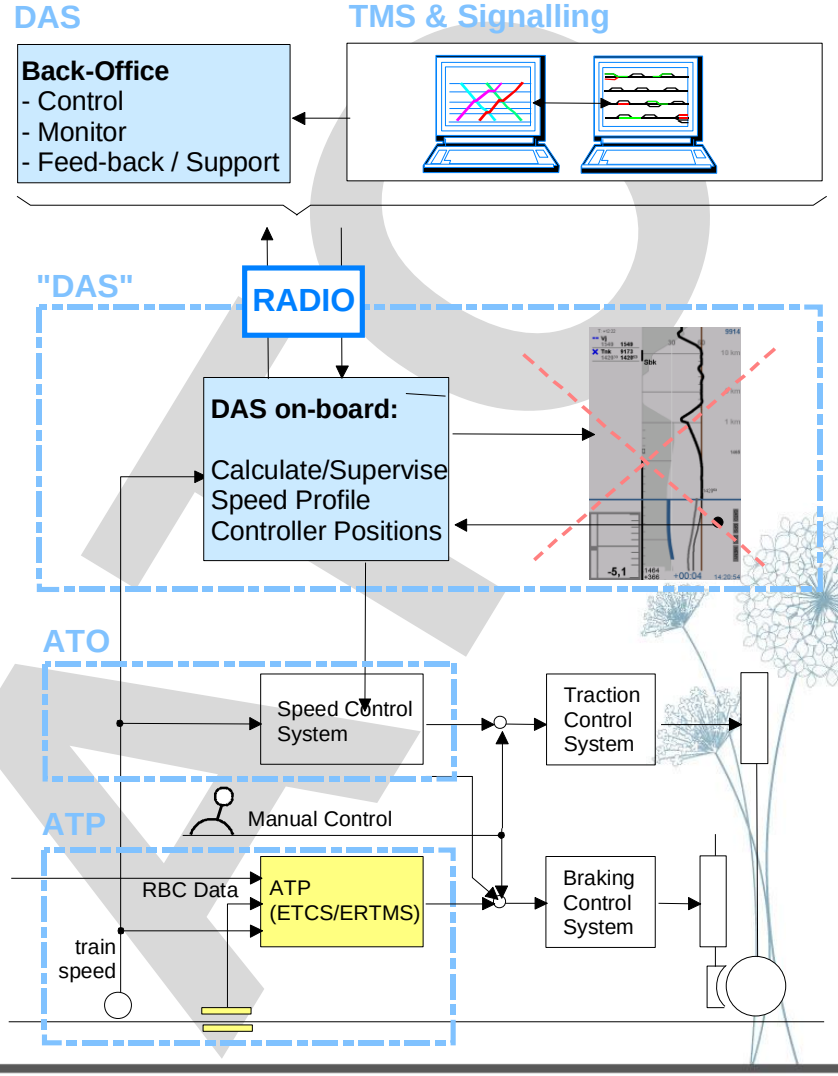
  Why limit the new technology to DAS?

THE RAILWAY INDUSTRY NEED DAS/ATO IN ORDER TO:

- Improve punctuality — Customer acceptance — Control train movements to avoid/resolve conflicts
- Improve capacity — Minimum headways
- Sustainability — Customer acceptance
- Reduce maintenance
- Reduced operative costs — Make the rail mode more competitive
- Reduce investments

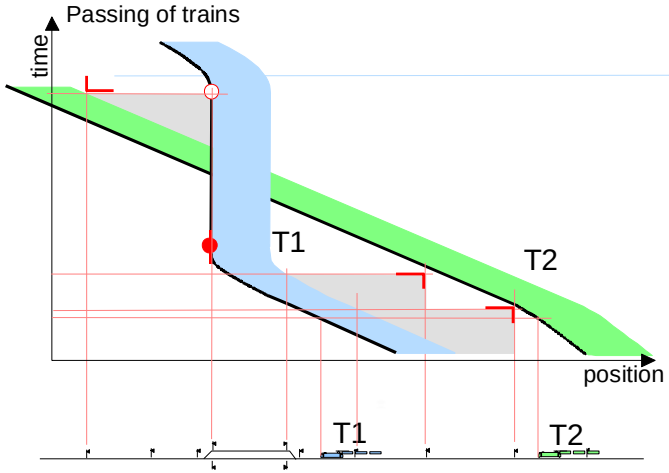
THE WAY TO GO (1)

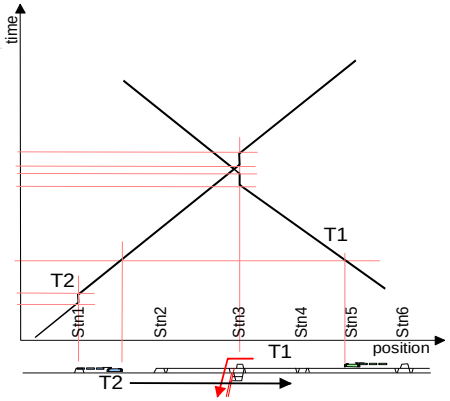


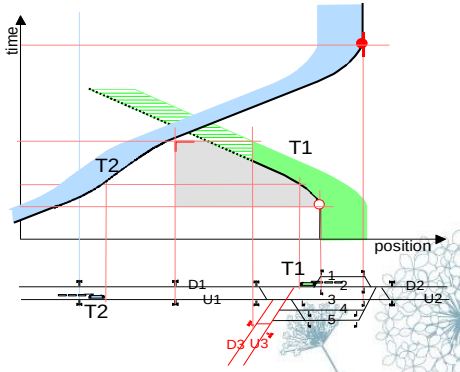


THE WAY TO GO (2)

- Fullfilling detailed TMS timing demands





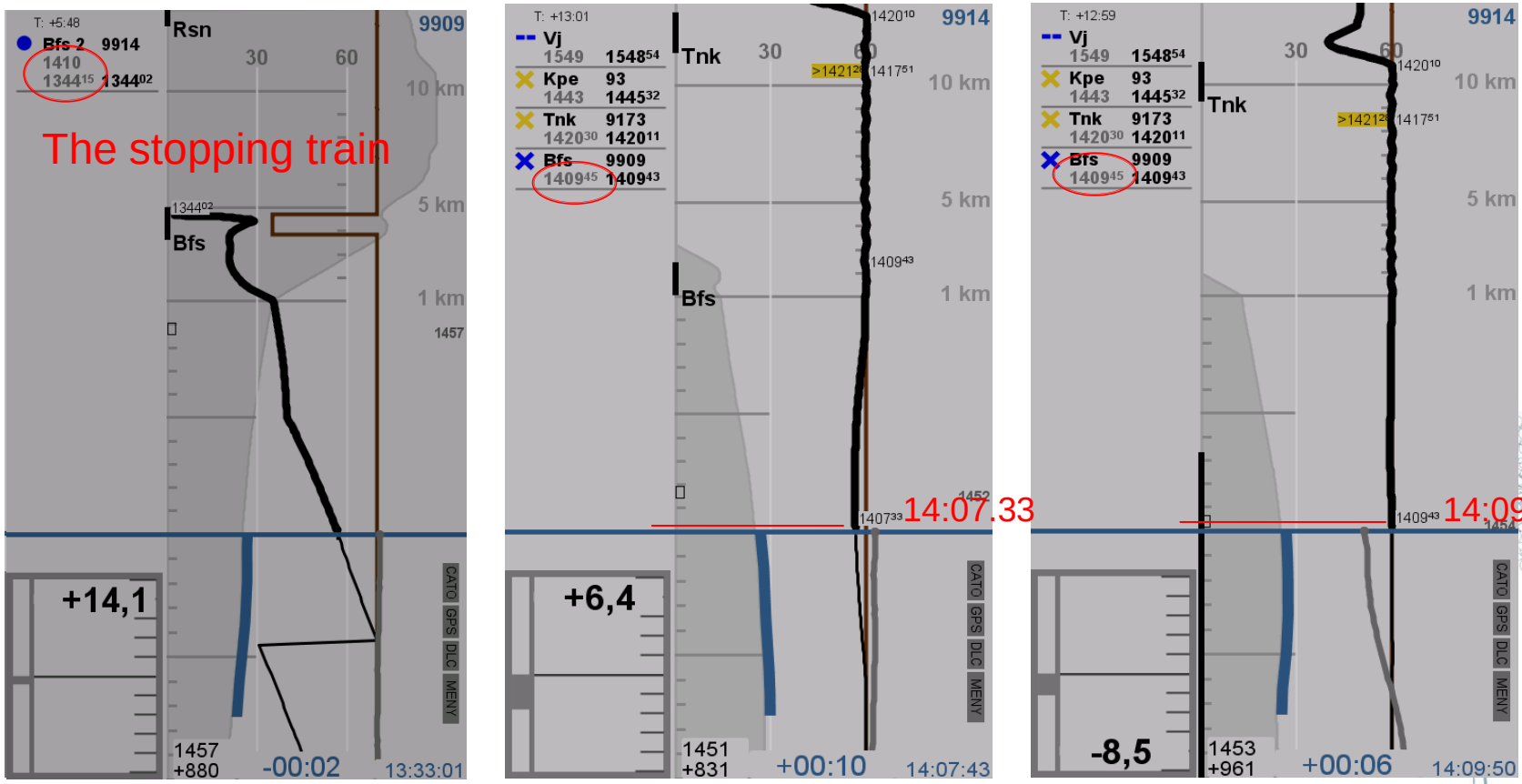


- Interoperable with TMS and ATP systems
- Optimisation to any criteria needed by the user

$$C = c_1 \times f_1(TPC) + c_2 \times f_2(TPC) + c_3 \times f_3(TPC) + \cdots$$

THE WAY TO GO (3)

Example: cato



For more information, se our stand in the exhibition!

WHY DOES A DAS NEED DATA FROM GROUND?

- To get the correct information for the optimisation and advice!
- To be able to control train motions in detail

WHAT DATA DO YOU NEED TO REACH AN OPTIMAL DAS?

- From TMS and IM
  - Current plan for the traffic (detailed timings!)
  - Route/path for the train
  - Current infrastructure data

positions of objects
speed limits
vertical and horisontal profiles
GPS vs track coordinates

- DAS/ATO product specific data
- Customer back-office information

From train: Feed-back (to TMS and Back-Office)

Train performance, Estimated time of arrival (ETA) for defined locations, (Current position and speed)

WITH COMPLIMENTS

transrail cato

Chosen by the IRRB jury as winner of the 2012 UIC Award for the best innovation for sustainable development within the railway sector.

SUSTAINIA

Chosen for Sustania100 2014, the annual guide to the globally 100 most inspiring available solutions for a green and desirable future within our reach. CATO the only choice for rail.

For more information: visit our stand at the EED exhibition
see www.transrail.se
www.transrail.se/catofilm.php

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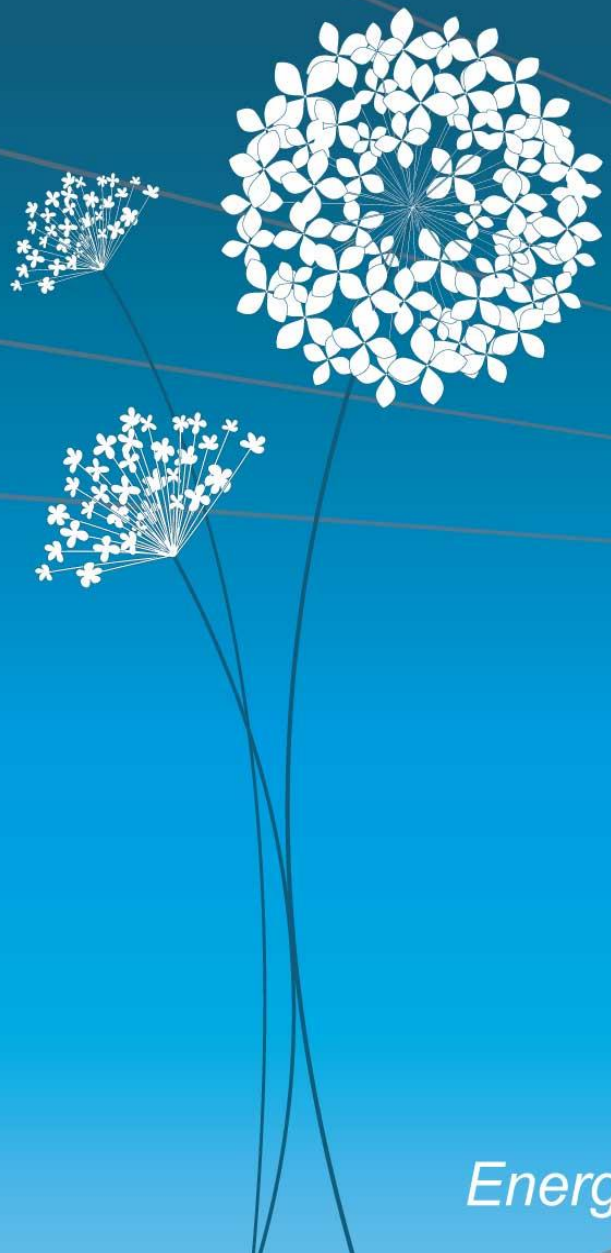

Results of brainstorming

Energy Efficiency, the best fuel to move our trains!

Do we need communication between Traffic Management Systems and DAS?

- *Yes*

Where should we have the intelligence?

- *On-board (cfr. advanced DAS) => responsibility of RU*
- *On-ground (cfr. SBB) => responsibility of IM (or also possible of RU?) But likeky ground will not know that train has e.g. only 50% of motorisation available (no real time feedback available).*

What aspects should be handled in applications on ground? What aspects should be handled in applications on-board?

	Board	Ground
S-DAS	Theoretic speed profile Train systems integration	-
C-DAS <=> TMS	Real-time speed profile On time optimisation	Dynamic timetable Boundary conditions (route, speed limits) Conflict resolution

What information should get exchanged between an application on ground and tools on-board like Driving Advisory Systems?

	From ground to train	From train to ground
Static data	Infrastructure (track locations, altitude profile, stations, …) Permanent speed limits	Train characteristics
At start-up	Temporary speed restriction Timetable Not yet available static data Requested speed profile	Train composition: consists (including train length and weight)
Real time	Changes to planned track usage Changes to time table Changes to temporary speed restriction Changes in requested speed profile Low adhesion ares (when already known from other trains) Request to increase/decrease power offtake	Position from GPS Speed (GPS and odometry) Changes in actual train performance (acceleration and braking) Low adhesion areas (detected by train) Changes in train composition Anouncing of recuperative braking or of voltage drop (results in request to increase/decrease power offtake for trains nearby) Consumption (over predefined period)

How can we organise the work in order to come to an interoperable protocol?

Two trajectories in parallel:
- *Included in ERTMS*
- *Parallel a solution for short term, e.g. TecRec or International Railway Standard*

Included in ERTMS:
- *It would be much more consistent to the driver to integrate the DAS in the driver machine interface of ETCS.*
- *This is only possible while having a standardised and protected link with EVC (on-board vital computer for ERTMS).*
- *Only SIL 0-communication (not safety related).*
- *Risk: high homologation costs if such information exchange should get integrated in ETCS-communication.*
- *DAS is supporting equipment. This should be easy to install and not too expensive => not integrated in ETCS.*

International Railway Standard:
- *Risk: This interoperable communication is needed between systems of different suppliers on ground and on-board.*

Other input:
- *Migration period needed.*
- *Could this work become part of Shift2Rail?*

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Smoother Train Traffic

Bart Van der Spiegel, Energy expert, Infrabel

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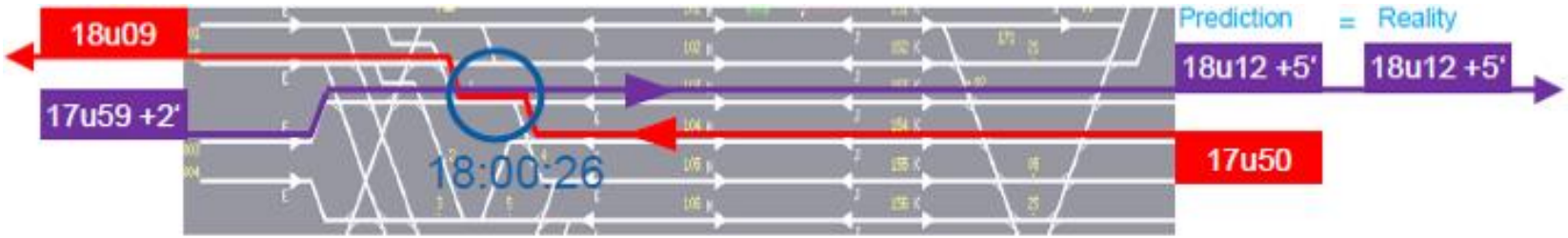
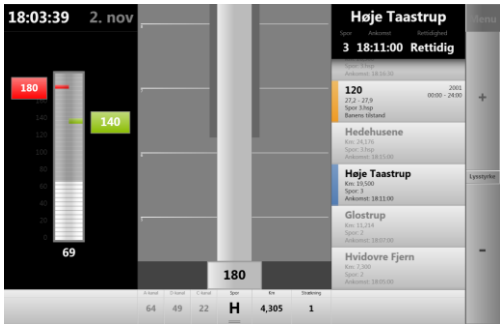
Ongoing trends

- *New Traffic Management Systems detect conflicts*



- *New rolling stock has Driving Advisory Systems (or even Automatic Train Operations)*



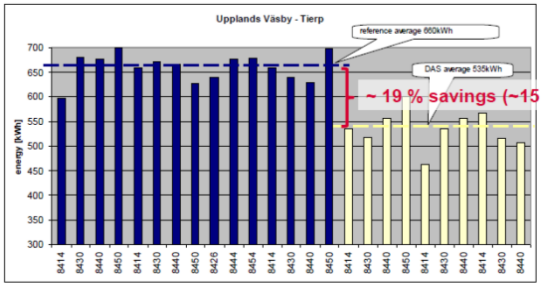
What do we need?

- *Standardized communication between new Traffic Management Systems and on-board tools like Driving Advisory Systems.*
- *This communication should include real time changes in Time Table in order to reach the optimal solution for detected conflicts.*

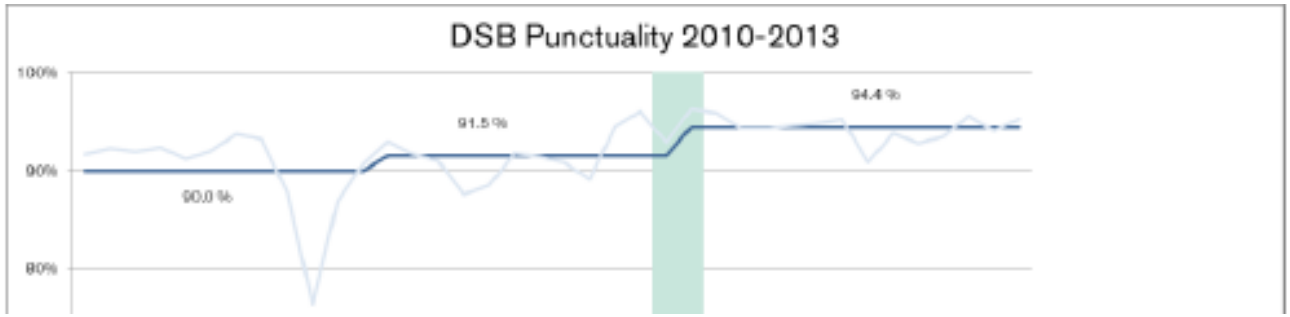
What will be the benefits?

- *Increase capacity:*
  Crossrail will introduce Automatic Train Operations to enable 24 trains/hour on same track

- *Reduce energy consumption:*
  SBB Energy Strategy intends to cut consumption with 600 GWh by 2025
  Test in Sweden: 19% less consumption on train-sets
  with Driving Advisory Systems



- *Increase punctuality:*
  Punctuality increased from 91% to 94% at DSB after introduction of Driving Advisory Systems



Approach of new UIC-project

- Defining what should get exchanged between ground and on-board (= defining use cases)
- Identifying best suitable protocols, preferably by extending already defined protocols like RailML© 3
- Creating International Railway Standard describing requirements for communication between ground and on-board
- During project frequent feedback with all stakeholders is essential
- We need to reach consensus with all stakeholders to reach optimal usage of new standard
- Testing and demonstration

What will be results of new UIC-project?

- New International Railway Standard
- Proposal to RailML consortium to adapt data exchange format (RailML© 3)
- Workshops

The total amount of annual traction energy cost within Europe lies between 5 and 10 billion euro. A reduction of energy consumption with 5% will result in an annual cost reduction of 250 to 500 million euro.

This project will also result in a gain of capacity and of punctuality.

What can you do?

- Next months UIC will ask approval for new projects at members.
- Support the opt-in to project ‘Smoother Train Traffic’ inside your company!

Also suppliers of Traffic Management Systems and of Driving Advisory Systems and communication experts are welcome to support this UIC-project.

- You are welcome to visit workshop ‘eco-driving and Driving Advisory Systems’ this afternoon after lunch.