Railenergy WP 4.3
DMI and integration of DAS

Berlin, 18th March 2009

BOMBARDIER

Agenda

- Introduction
- DMI
- Integration

© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Introduction

© Bombardier Inc. or its subsidiaries. All rights reserved.

Gasoil price Rotterdam 60 months

esyoil 16.3.2009

© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

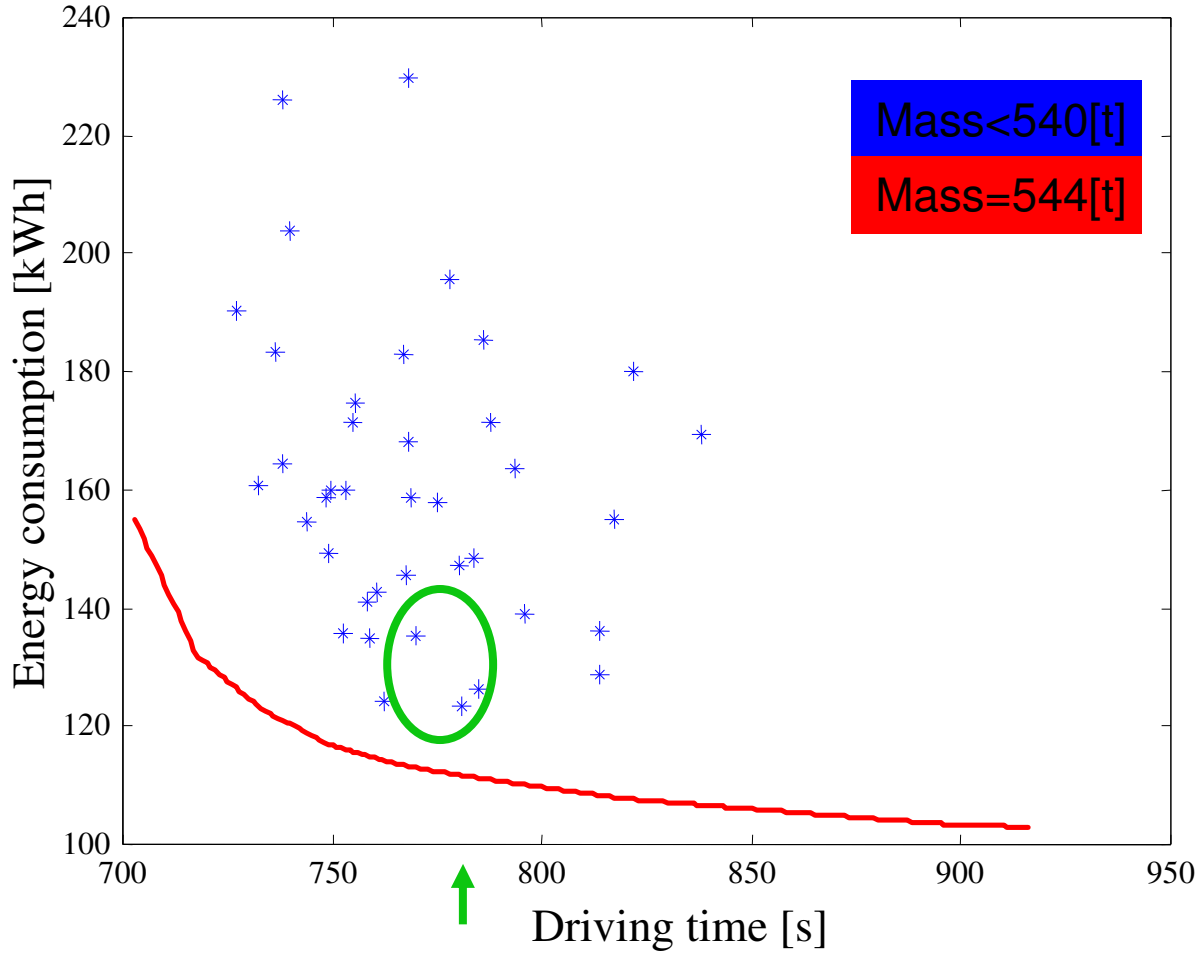
Different drivers – different driving styles

- **Different drivers develop different driving styles depending on**
  - Knowledge
    - Education
    - Training
  - Experience
  - Boundary conditions
    - KPIs (punctuality, energy saving,…)
    - Bonus systems
    - Personal preferences

- **Driving styles manifest themselves in**
  - Speed profile
    - Travel time
  - Traction force profile
  - Brake usage
- **Different driving styles result in different energy consumption**

© Bombardier Inc. or its subsidiaries. All rights reserved.

Energy consumption of different drivers



acc. time table: 780 s

Blue: measurements,
same track, same train,
same time table,
but different drivers

Red: simulation wit DSM algorithm

Green: Expected variation when following EODS recommendations

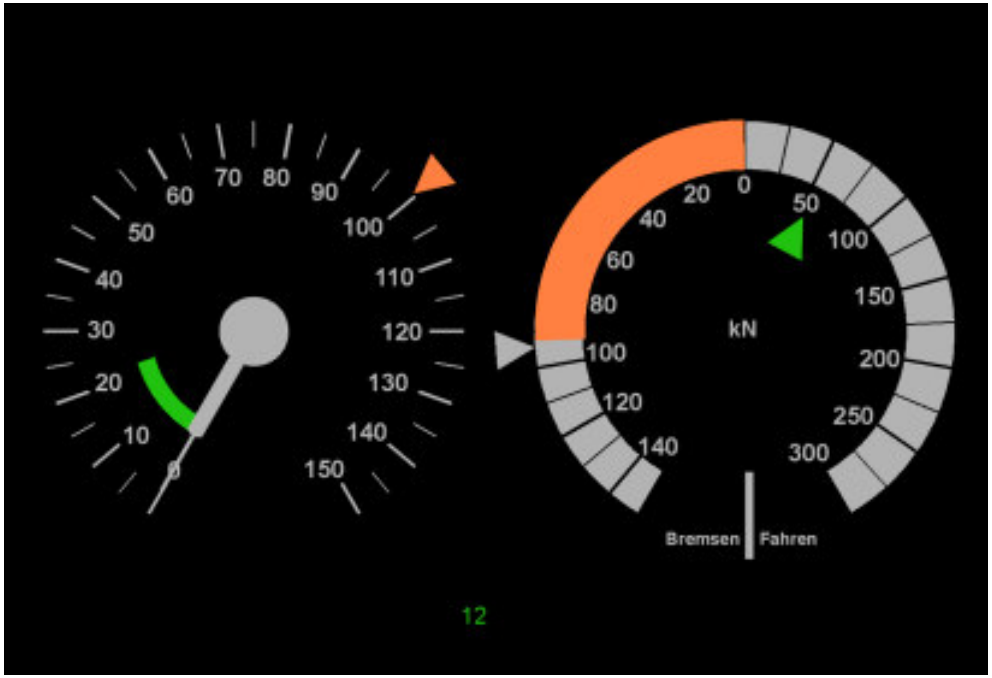
DAS helps to make use of the full technical potential of trains.

© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Driver assistance system (DAS)

- **Mission**
  - Assist drivers to use the full potential of a given train
- **Goals**
  - Punctuality
  - Energy savings
  - Emission reduction
  - Reduced wear
- **Definition in Railenergy WP 2.3**
  Energy efficient train operation (EETROP)



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Driver Machine Interface (DMI)

- **As much information for the driver as he needs to be in time with minimum energy consumption**
- **As less information as possible to not distract him from safe driving**
- **Customer orientation**
  - Integration into standardized DMIs
    - Fleet design
  - Use of customers proven elements
  - Taking care of cultural differences

© Bombardier Inc. or its subsidiaries. All rights reserved.

DMI

© Bombardier Inc. or its subsidiaries. All rights reserved.

Technical Specification

- **Design**
  - Digital
  - Alphanumerical
  - Graphical
- **Interfaces**
  - Ethernet
  - MVB
  - Serial interface
    - RS 232
    - RS 422
- **Data input capability**
- **Internationalization**
- **Railway compatible**
  - Readability
  - Robustness

© Bombardier Inc. or its subsidiaries. All rights reserved.

Data input

- **Driver / Train ID**
  - Alphanumerical input
  - ID token
  - Train control system
- **Train weight**
  - Numerical input
  - Train sensors
- **Train length**
  - Numerical input
  - Train sensors – train composition
  - Train configuration from central database

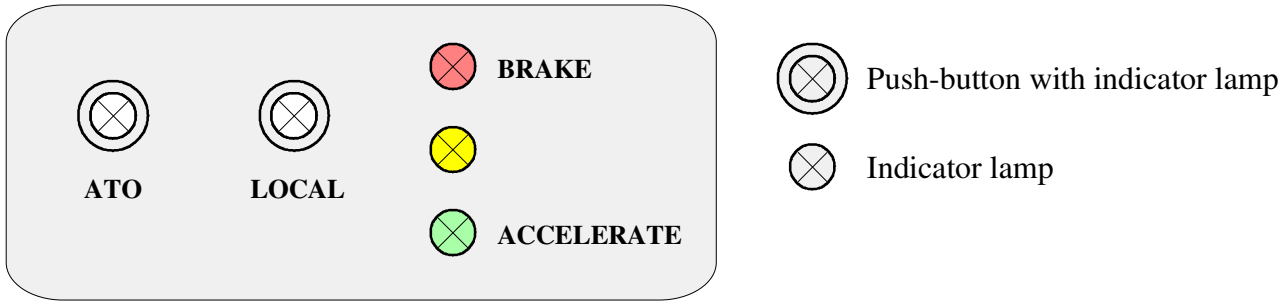
© Bombardier Inc. or its subsidiaries. All rights reserved.

Data output

- **Standard**
  - Recommended velocity
  - Recommended traction force
    - kN
    - level
- **Optional**
  - Countdown towards parameter change
    - Next parameters
  - Max. allowed speed
  - Delay
  - Score

© Bombardier Inc. or its subsidiaries. All rights reserved.

Digital design – EETROP proposal



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Relative design – prototype

- **Interface**
  - RS232
- **Data shown**
  - Relative traction force
  - Relative velocity
  - Countdown indicator

© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

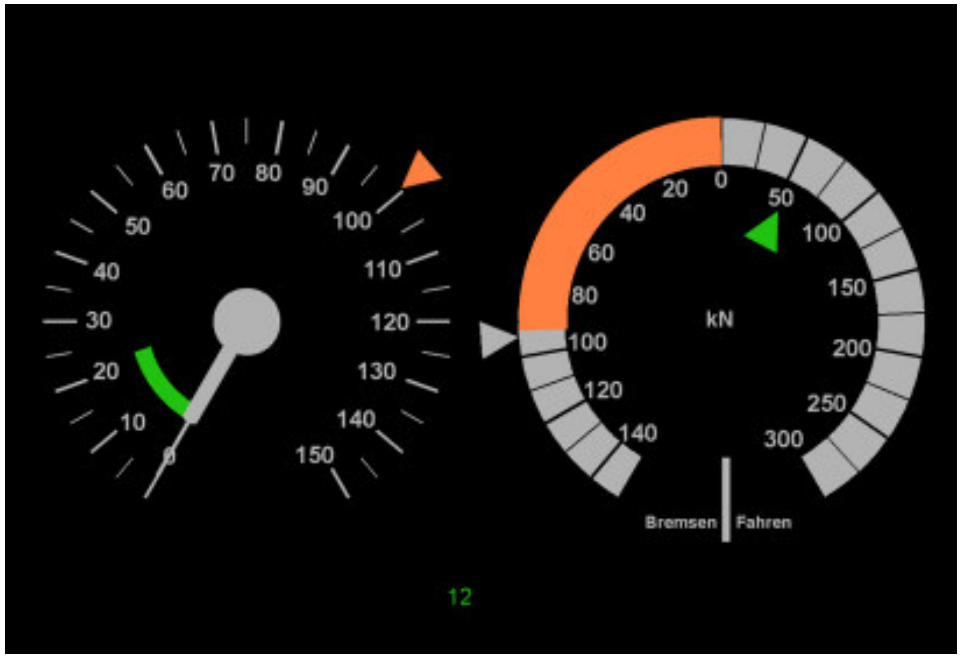
Analog design – prototype 1

- **Interface**
  - Ethernet
  - UDP messages
- **Data shown**
  - Recommended speed
  - Recommended traction force
  - Countdown

© Bombardier Inc. or its subsidiaries. All rights reserved.

Analog design – prototype 2

- **Interface**
  - Ethernet
  - TCP/IP messages
- **Data shown**
  - Recommended speed
  - Recommended traction force
  - Countdown
- **Integration into Standard**



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Analog design – prototype 2: Elements

- **Tachometer**
  - Green tachometer circle segment — recommended speed
  - Tachometer needle — actual speed
  - Orange triangle — maximum allowed speed
- **Traction force (braking/accelerating)**
  - Green triangle — recommended traction force
  - Grey triangle — actual set traction force
  - Orange[/blue] circle segment — actual applied traction force
- **Countdown**
  - Green digits — countdown towards next recommendation

© Bombardier Inc. or its subsidiaries. All rights reserved.

Demonstrations

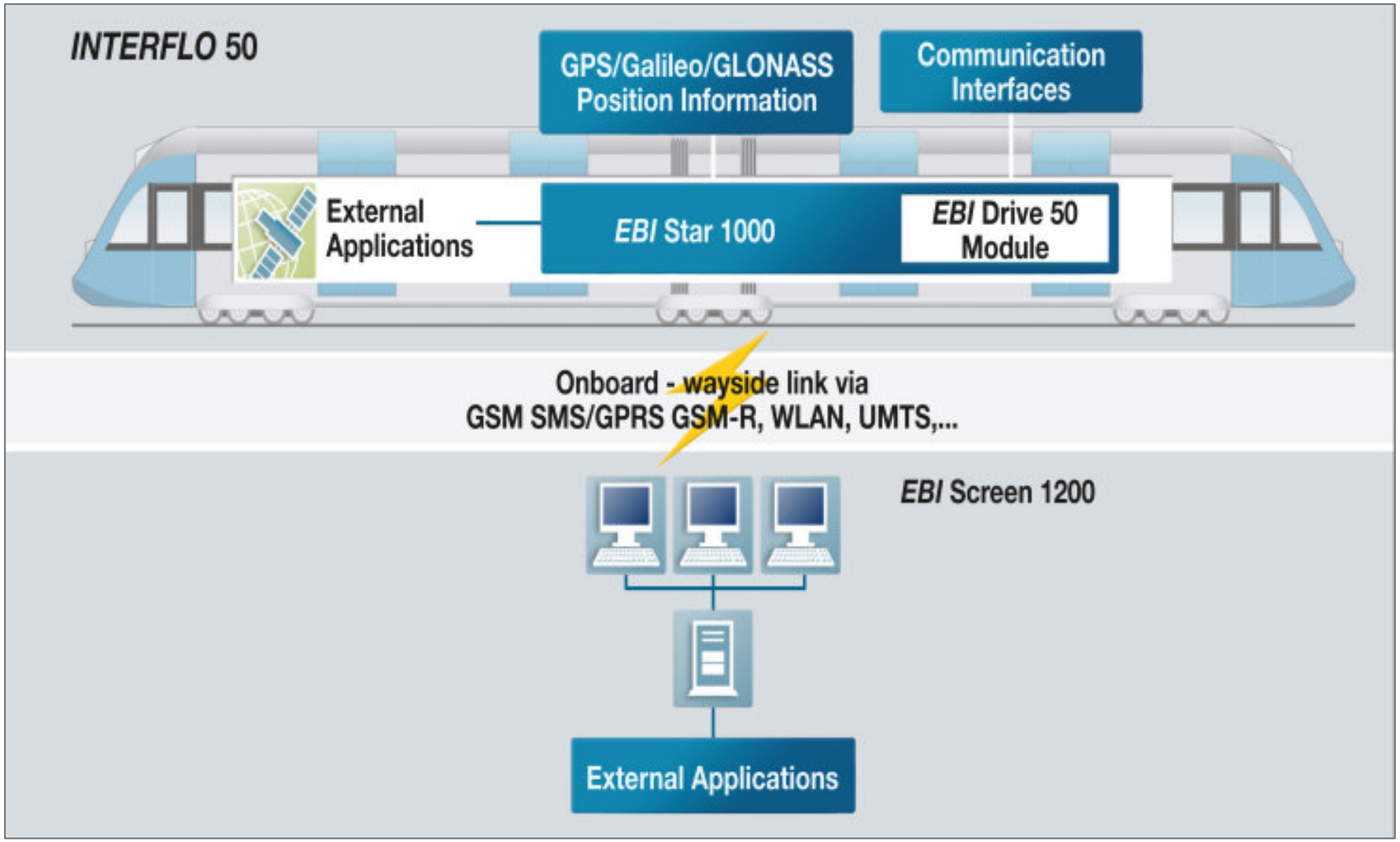
© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Integration

© Bombardier Inc. or its subsidiaries. All rights reserved.

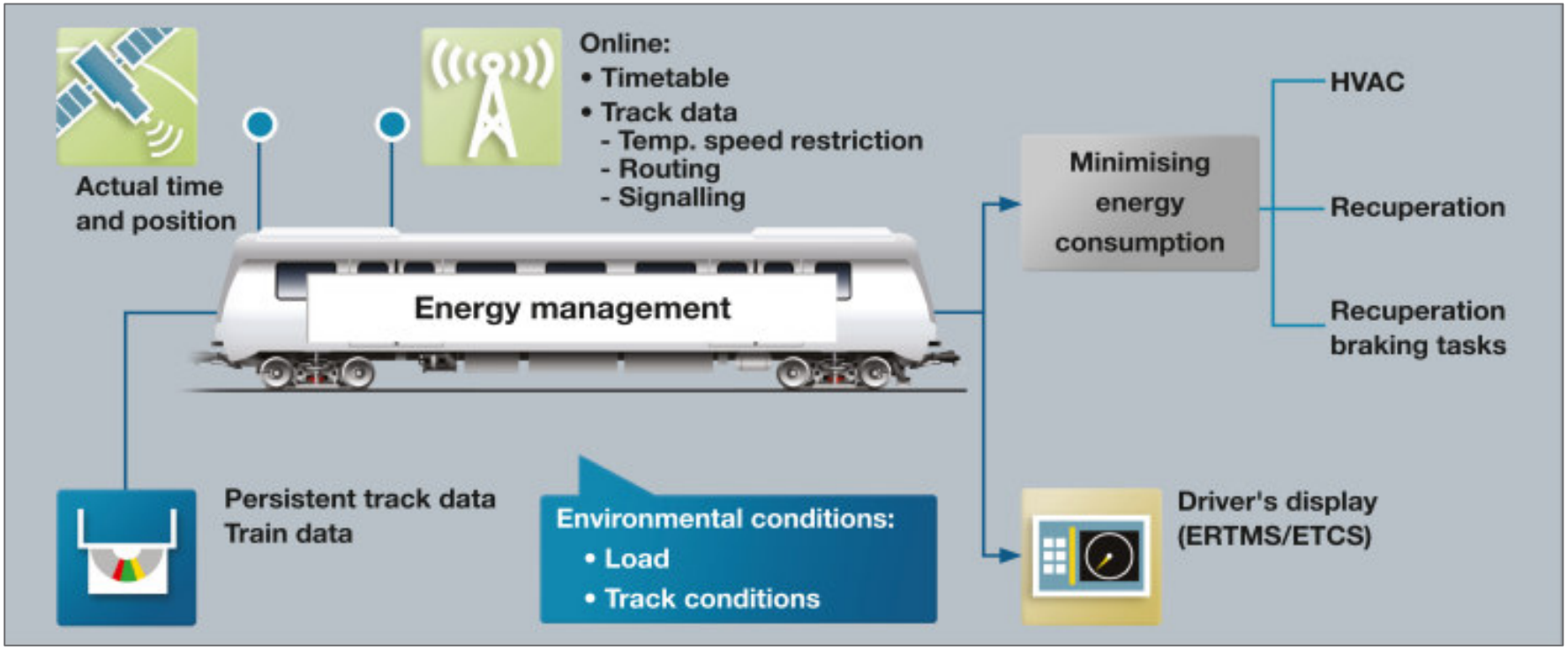
INTERFLO 50 system, comprising *EBI* Star 1000, *EBI* Drive 50 and *EBI* Screen 1200



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

EBI Drive 50 – systems scheme



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

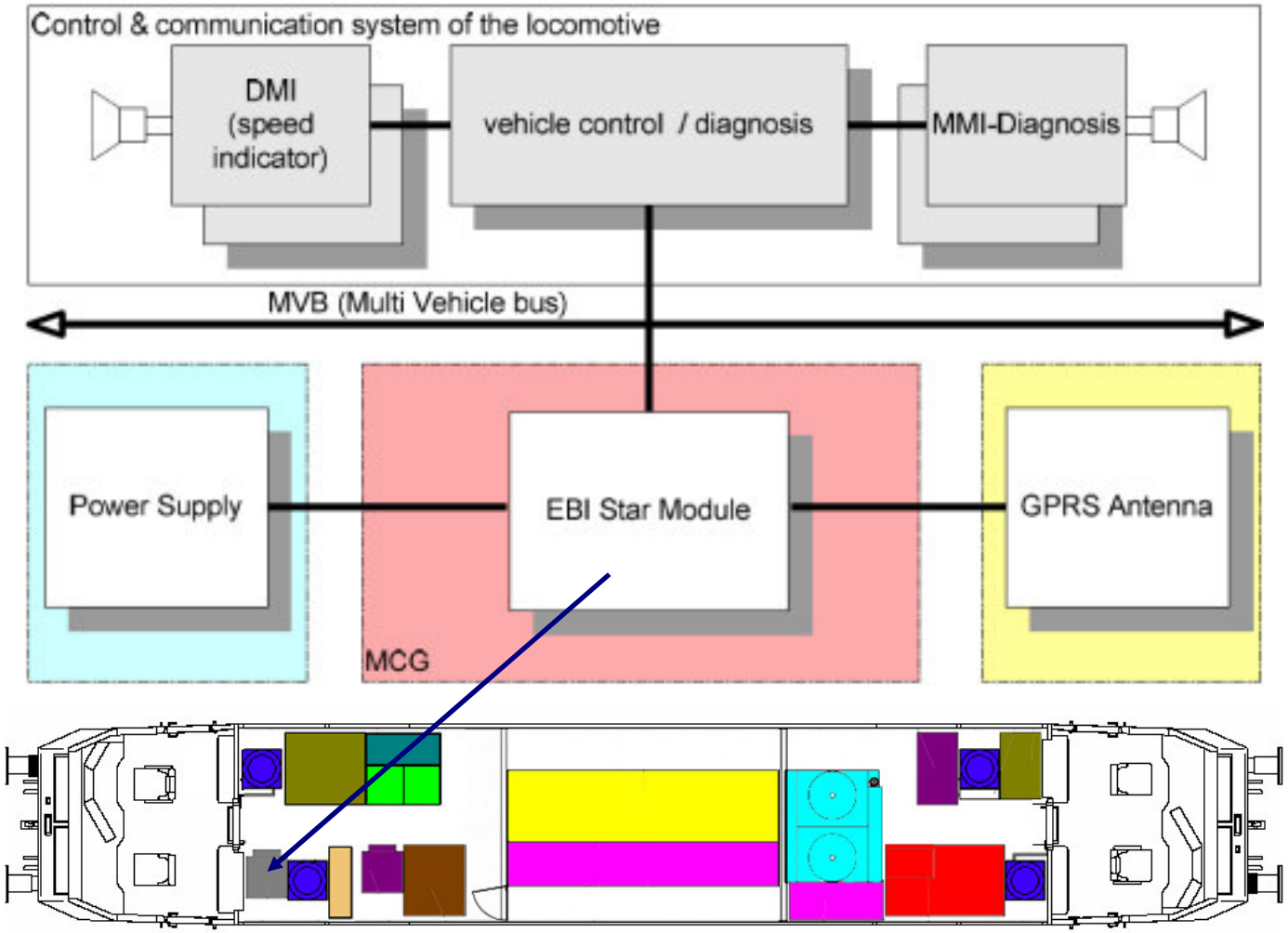
Interface definitions

EETROP Railenergy WP 2.3

- **DMI messages**
- **Train status messages**
- **Data formats**
  - Train data
  - Track data
  - Time table
- **Communication infrastructure**

© Bombardier Inc. or its subsidiaries. All rights reserved.

Integration into TRAXX locomotive



© Bombardier Inc. or its subsidiaries. All rights reserved.

BOMBARDIER

Demonstrator – Railtex 2009

© Bombardier Inc. or its subsidiaries. All rights reserved.

Energy consumption certificate

BOMBARDIER eco4

EBI Drive 50
Driver assistence system
Fahrerassistenzsystem

Marcus Lindemann

Result / Ergebnis

39 Liter Diesel

Consumption diesel/ltr
Verbrauch Diesel/l

00:10:50

Driving time sec / Fahrzeit Sek

23.09.2008

© Bombardier Inc. or its subsidiaries. All rights reserved.

Thank you

Marcus Lindemann
Bombardier Transportation (Signal) Germany GmbH
Neustadter Straße 62
68309 Mannheim, Germany

marcus.lindemann@de.transport.bombardier.com

BOMBARDIER