



Energy metering in NSB Persontog

UIC Energy Efficiency Days, Antwerpen, 18th June 2014

NSB Persontog, Marie Loe Halvorsen, marie.loe.halvorsen@nsb.no

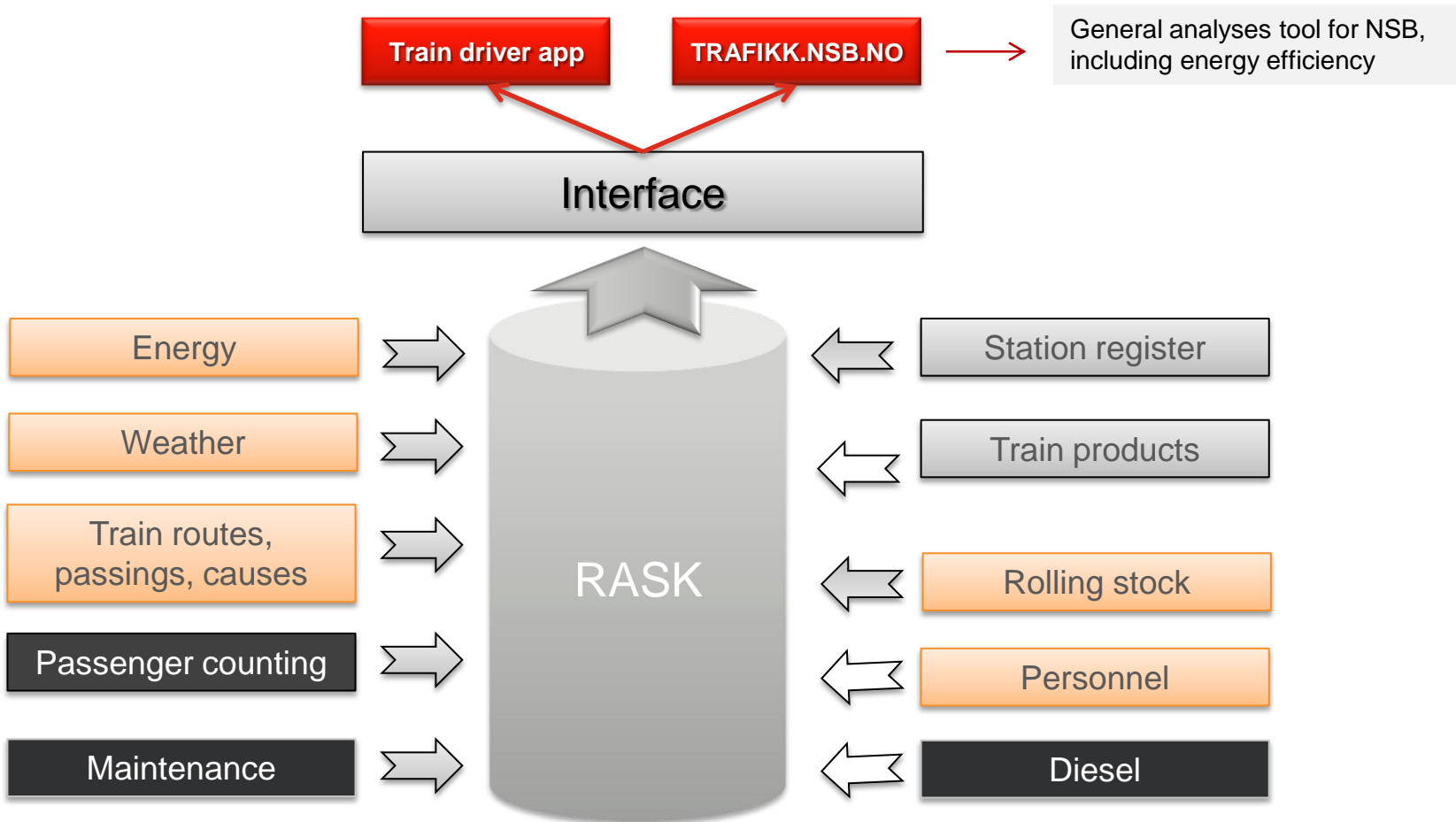


Electricity metering



- Energy meters in all trains
- Owned by the infrastructure manager (Jernbaneverket)
- Data are sent from the energy meters to ERESS at five minute intervals
- In the case of a defect meter, the energy consumption is estimated through tariffs set by Jernbaneverket

RASK – A common database



Diesel metering



- No energy meters
- Diesel consumption is metered at the filling stations



Responsibility



- Energy meters are owned by Jernbaneverket
- Mantena is responsible for maintenance
- NSB is responsible for taking the trains out of service



Our challenges



Data quality and maintenance routines

- Data quality labelling
- Maintenance manuals
- Error reporting



Energy metering – SBB situation and expectations

Eress Forum
Antwerp, 18th June 2014

Gisela Hinrichs
Programme Manager
Energy settlement and billing

→ Energy consumption rates per train type are established based on reference measurements

Train type I-Prix	Vehicles with regenerative braking	Vehicles without regenerative braking
1 InterCity/EuroCity	0.0029	0.0033
2 Fast train/InterRegio	0.0029	0.0033
3 Regional train	0.0049	0.0071
4 S-Bahn	0.0049	0.0071
5 RegioExpress	0.0029	0.0033
6 Long-distance freight train	0.0028	0.0033
8 "Tractor-hauled" freight train	0.0043	0.0050
9 Light engine(s)	0.0050	0.0057
10 Empty passenger stock train	0.0039	0.0045

train-path kilometres

×

gross tonnes

×

energy consumption rate

×

network load coefficient

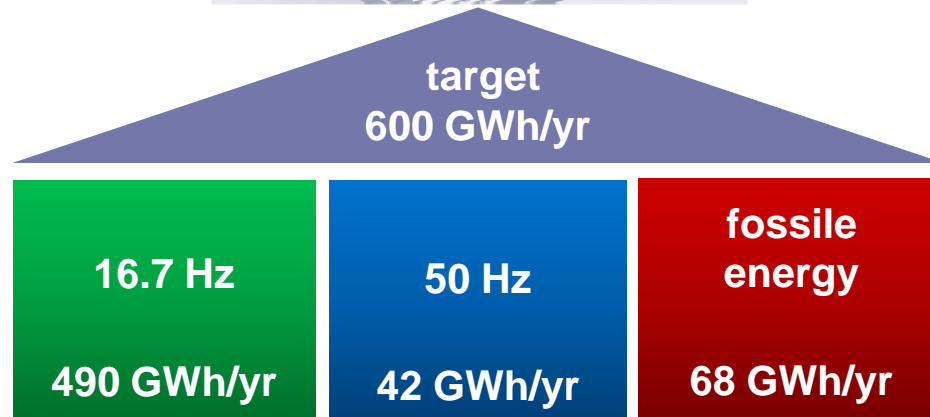
→ Train-path kilometres are taken from the SBB planning systems with current data up to approximately one hour before train run.

→ Energy consumption for additional services such as shunting is billed based on flat rates.

Energy settlement and billing situation at SBB today

SBB's energy saving target:

20% by 2025



- Energy saving programme
- RUs will invest in energy efficiency if they can save money
- Billing of exact energy consumption establishes immediate link between energy efficiency and cost savings
- Plus: data for analysis and proof of effectiveness of energy measures is available

Reasons for introducing metering at SBB

Vehicle factors

- 33 vehicle types
- Various primary voltages (AC and DC)
- Various on-board power supplies (24V, 36V, 110V)
- Various transformer types or none
- Various antenna types, partly already several on the roof
- Partly existing on-board communication system including GPS.
- Very low availability of vehicles due to very high operating grade

Success factors

- No impact on passengers
- One proven product
- Small / modular solution
- No need for intervention in vehicle construction or electrics
- Simple installation and maintenance
- Least possible interfaces for minimizing difficulty of vehicle re-approval
- Just-in-time-availability of vehicles for installation

Challenges regarding the introduction

Supplier

- Basic understanding of railway business and customer needs and restrictions as a minimum
- Overall concept for energy efficiency
- Monitoring of new developments and proactive development of solutions
- Involvement in further development of standard



Product

- Small product or modular solution: “one fits all”
- Quick installation and removal
- Maintenance-free, highly available and reliable, long lifetime
- No need for calibration
- Remote diagnostics and remote software upgrade possible
- Cross acceptance assured by compliance to standards
- Standard, non-proprietary interface between DCS and EMS
- Additional usability for energy controlling and energy efficiency measures
- Reasonable prices

Expectations towards products and suppliers – the SBB wish list

Thank you for asking!



You can only manage what you measure

***UIC Energy Efficiency Days 2014
Antwerp, June 18***

Luca Carusi

*“To meter or not to meter:
that is the question”*



What we measure...



IM's side:

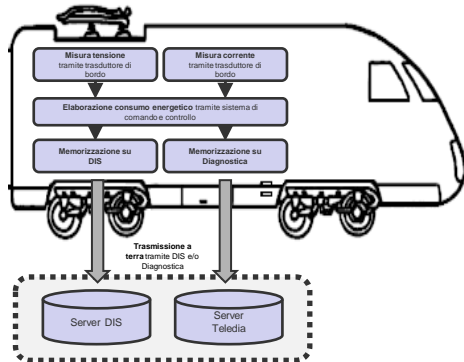
- ❑ energy consumption metered at substations
- ❑ billing system regulated by model based on train-km



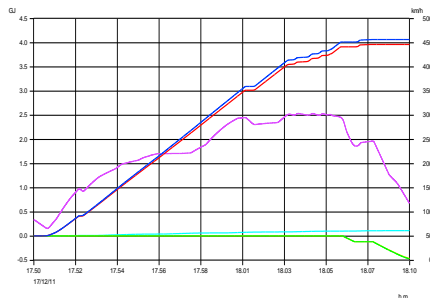
RU's side:

- ❑ energy consumption may be measured on-board for large part of HS and Regional fleet

...how we measure...



- ❑ Consumption calculation based on on-board transducers readings and sent to ground
- ❑ Separate energy measurements for:
 - absorption from line
 - traction
 - auxiliary systems
 - regenerative braking
- ❑ Good accuracy (2,5% AC; 0,8% DC) for our aims

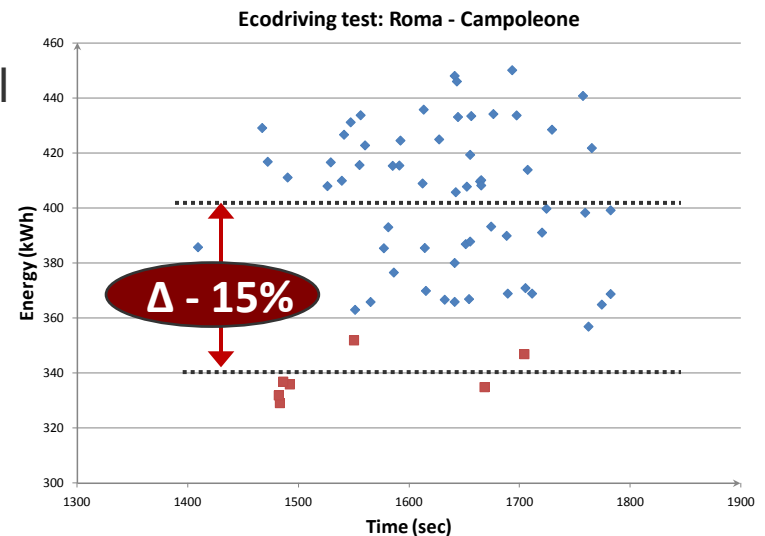


...and why we measure

- Energy efficiency is high priority
- Metering/measuring provides baseline and enables optimization



- Ecodriving campaign
 - good results from pilot tests (~ 100 runs)
 - extending trial in 2014
 - deployment at regional/national level



Final thoughts about...*”metering the future”*

- ☐ Business case drives decisions
- ☐ Investing in energy efficiency more than in retrofiting
- ☐ Procurement of new rolling stock equipped with meters
- ☐ Compliance to evolving regulations and prescriptions
- ☐ Evolution of billing model
- ☐ Opportunities enabled by adoption of new or more complex solutions for energy efficiency

Thank You!

Luca Carusi

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railpower
box

THE POWER OF CLEAR ENERGY

THE ENERGY METERING SYSTEM FOR FUTURE RAILWAYS



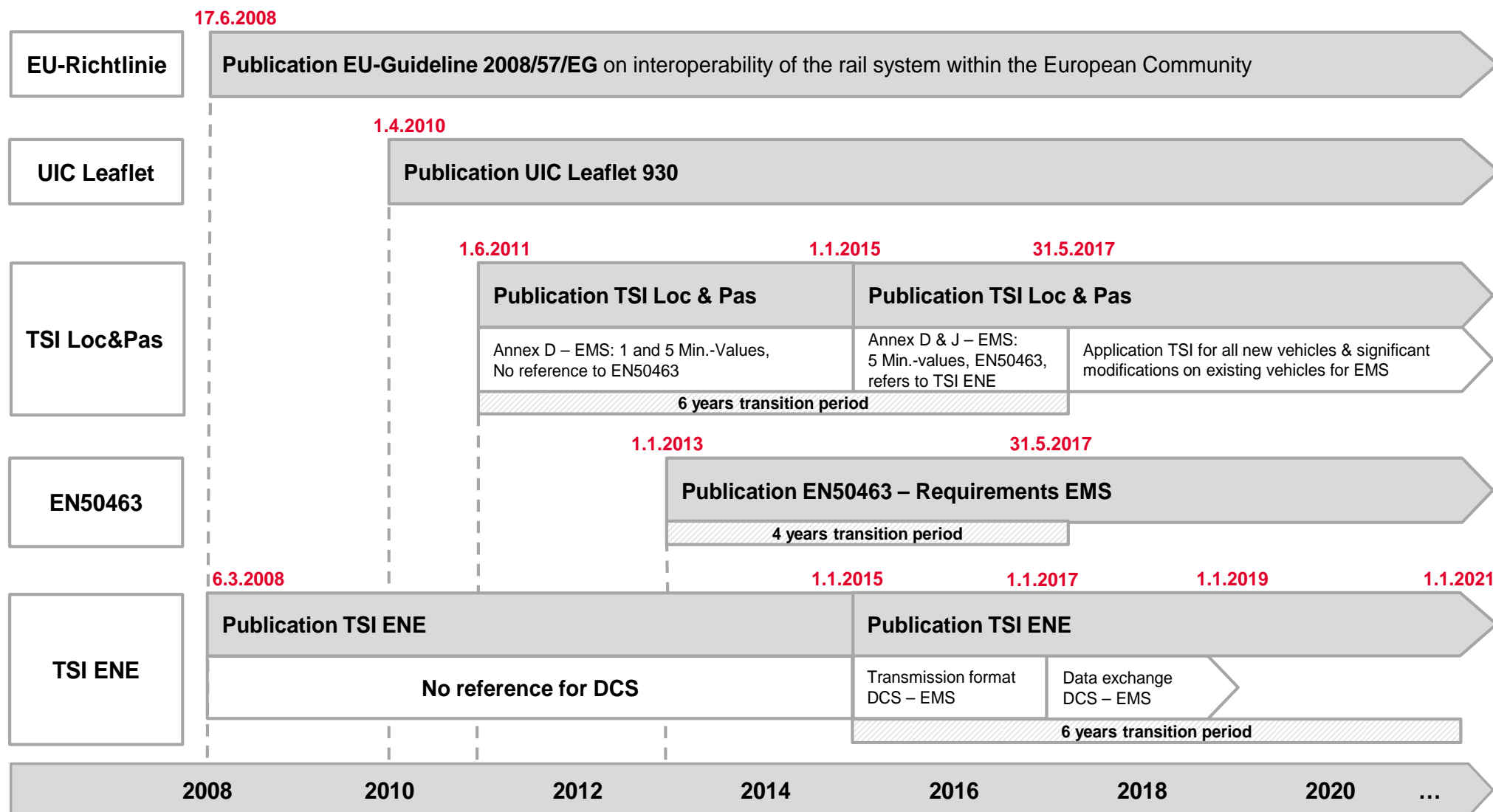
railpower box

Simple and accepted comprehensive package for energy metering with cross-boarder railway traffic for capturing and billing the demand of traction power on european railway corridors

- **Infrastructure managers**
- **Railway undertakings**
- **Leasing providers of traction vehicles**
- **Manufacturers of traction vehicles**



International requirements for energy metering



Certification process

- **Base for the certification of the rail vehicle according to TSI**
 - Intermediate Statement of Verification (Level of device railpower box)
 - EC Certificate of Verification (level of rail vehicle)
- **Certification for vehicles not requiring official approval for installations**



- **Vehicle registration according to TSI**
 - Intermediate Statement of Verification for the railpower box is provided by ÖBB ✓
 - Submission of EC Certificate of Verification is done by the owner of the vehicle

Contact information



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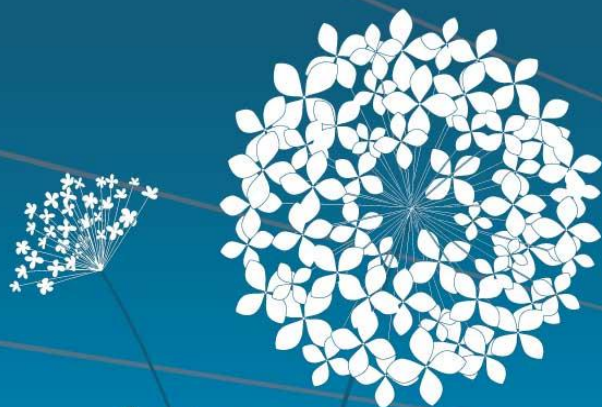
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ANTWERPEN, 16 - 19 JUNE



SAIRA ELECTRONICS

INTEGRATION LEADS TO EFFICIENCY

SIMONE DANIELI
SALES EXPORT SUPPORT

Energy Efficiency, the best fuel to move our trains!



ELECTRONICS
ELECTRONIC
SYSTEMS
FOR TRANSPORTATION

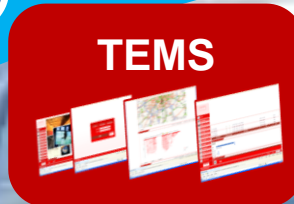
SAIRA ELECTRONICS Energy Management Vision

WE CAN IMPROVE WHAT WE MEASURE

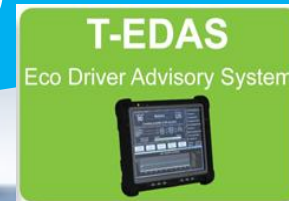
MEASURE



MANAGE



IMPROVE



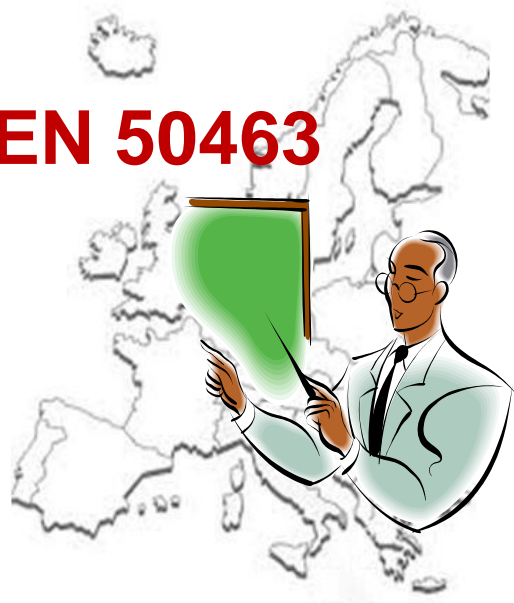
SAIRA Solution for MEASUREMENT REM101

OUR COMMON ROOT

TC9X - WG11

Energy Measurement
System Onboard of Trains

EN 50463



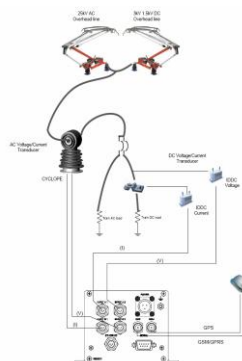
- COMPACT
- EMF
- DHS
- COM

TRANSDUCERS



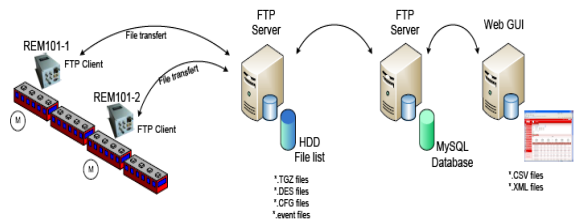
- V / I
- AC / DC
- INDOOR
- OUTDOOR

SYSTEM



SAIRA Solution for MANAGEMENT

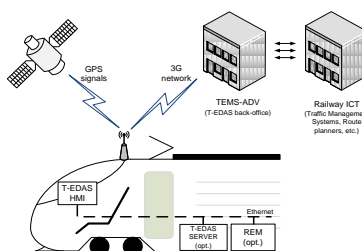
TEMS BVT



ERESS
Interface



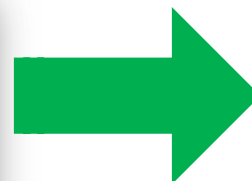
EDAS



**OPERATOR
ENERGY
POLICY**



SENSOR MONITORING



ON BOARD ACTIONS:

- Turn off HVAC
- Turn off Diesel Engine
- Enable Regeneration Systems



RaPLC-RIO

SAIRA TEMS FIGURES

- ✓ More than 1.000 systems ordered
- ✓ More than 850 systems installed
- ✓ REM integrated solution always chosen
- ✓ Fitted all types of train power supply (AC- DC- Single Voltage, Dual-Voltage, Quadri-Voltage)
- ➔ billing operating for operators in Belgium and Norway



INFRABEL

press



Jernbaneverket



- ✓ More than 7 years of experience in Energy Measuring markets
- ✓ Leader in U.K. market
- ✓ Presence in more than 6 Countries in Europe
- ✓ More than 12 customers operating
- ✓ EDAS trials ongoing with big player in Germany and Belgium





ELECTRONICS
ELECTRONIC
SYSTEMS
FOR TRANSPORTATION

IMPROVE

FUTURE = INTEGRATION

Once upon a time ...



A phone !



A telex !



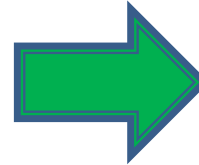
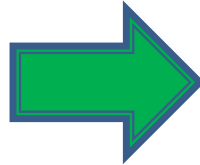
A modem !



A fax !



A navigator !



.... and today



INFRABEL



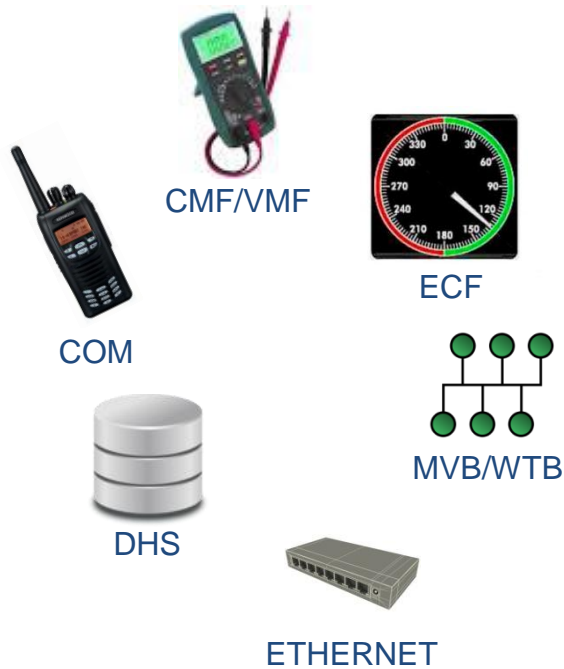
UIC ENERGY EFFICIENCY DAYS 2014



ELECTRONICS
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SYSTEMS
FOR TRANSPORTATION

IMPROVE

Why shouldn't you think in energy metering and management in the same modern way?!



Go for the all-integrated REM !!!

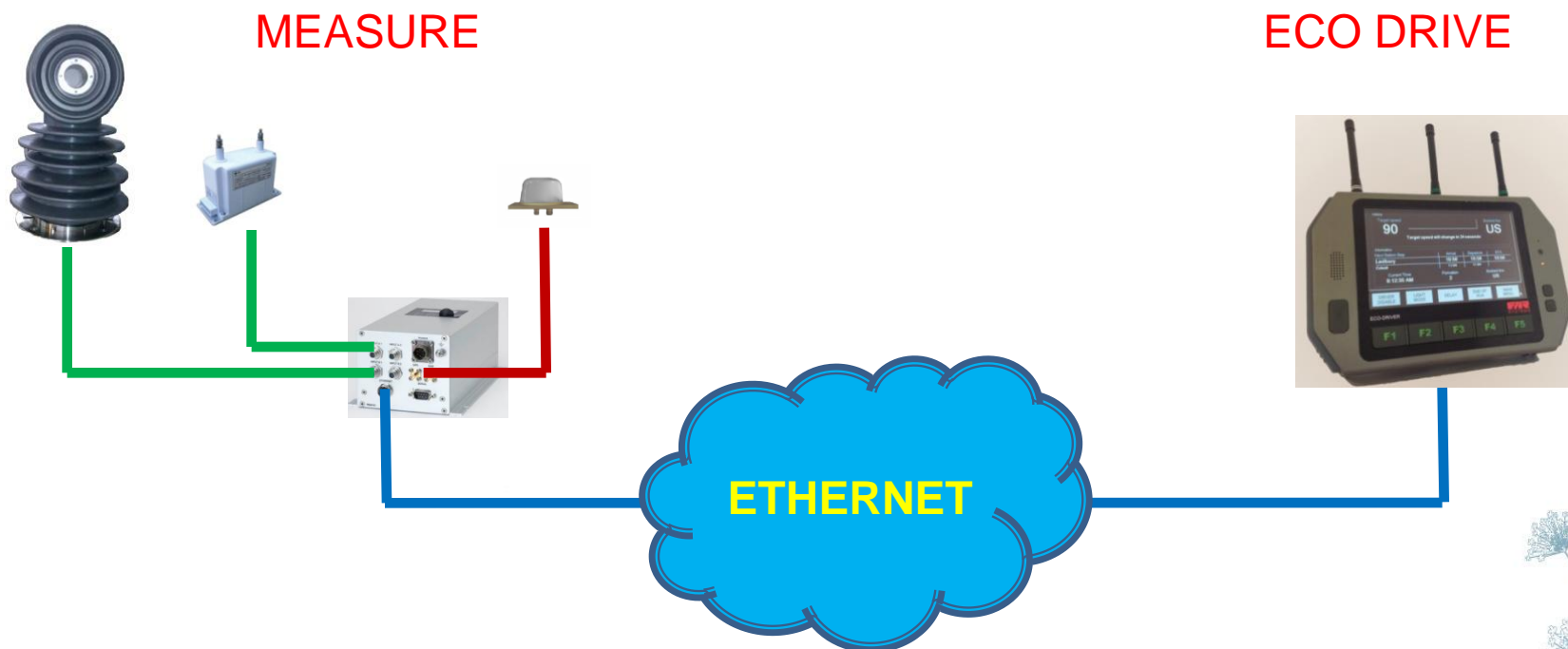


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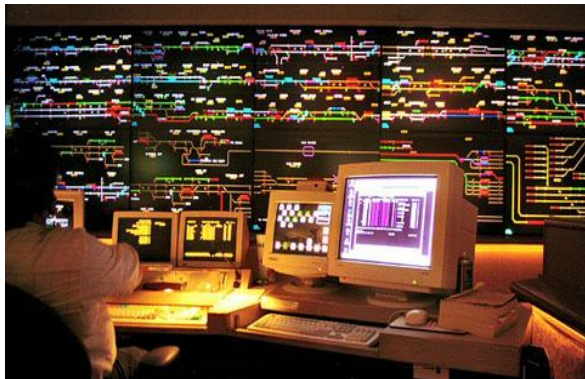
Integration Energy Measure & Eco Drive



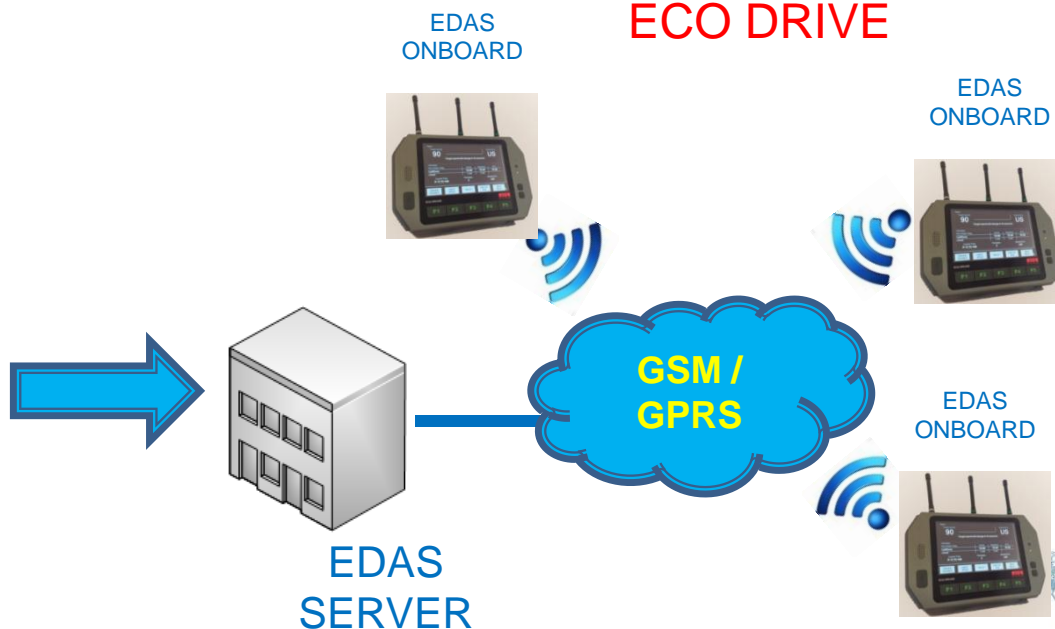
- ✓ Data of real consumption transmitted to EDAS
- ✓ Comparison between theoretical consumption data (EDAS) and real data
- ✓ Continuous EDAS algorithm parameter update
- **Driver guide always optimized**

Integration Eco Drive & Traffic Control

TRAFFIC CONTROL



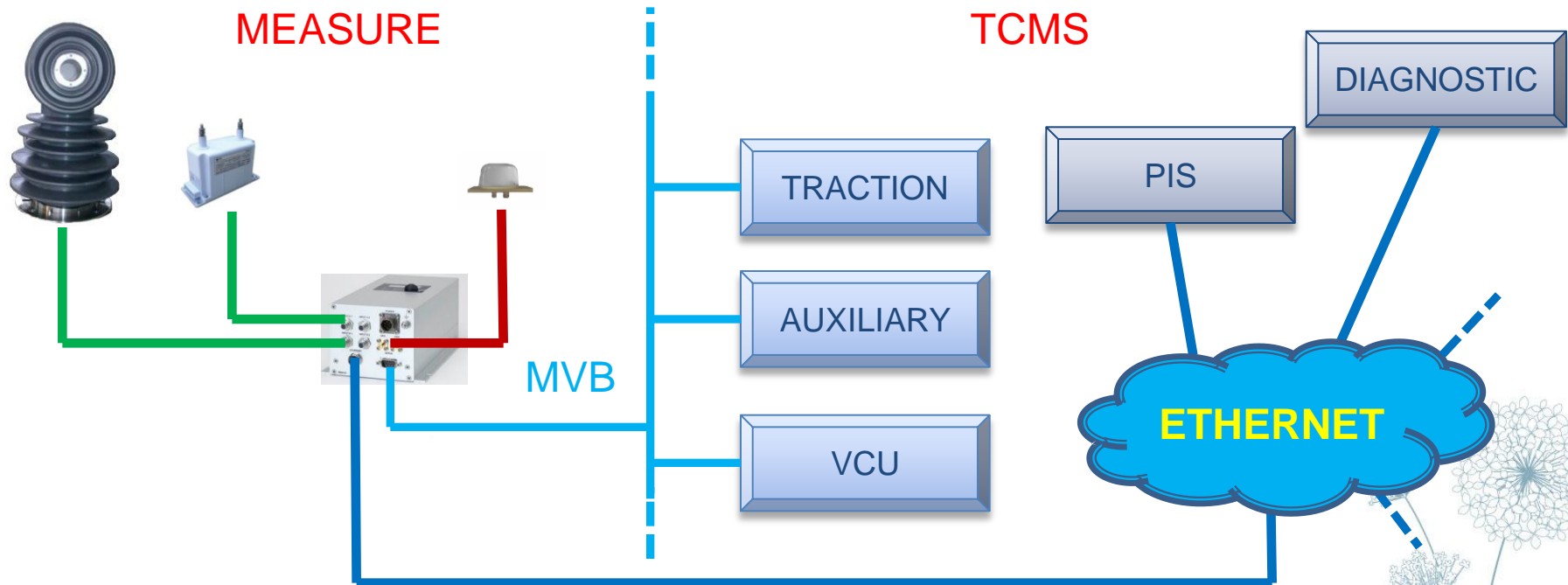
ECO DRIVE



- ✓ Temporary speed restrictions
- ✓ Information on presence of obstacles
- ✓ Time table modifications
- ✓ Maximum allowed speed

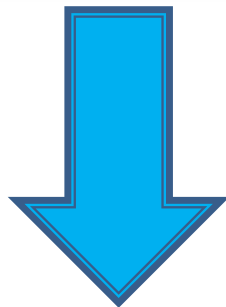
✓ Driver guide always optimized

Integration Energy Measure & TCMS



- ✓ Transmission of Voltage, Current, $\cos\phi$ and energy data to VCU
- ✓ Integration of REM diagnostics into Train diagnostics
- ✓ GPS and Time Reference data got by REM from TCMS
- **Energy Measure Information integrated in TCMS**

- Open to use already installed transducers and aerial
- Open to interface different TCNs standards (MVB, Ethernet, CAN, ...)
- Ready to implement standard train-to-ground communication protocols
- Ready to interface different billing systems
- Configuration via web-based interface tool



REM102





ELECTRONIC
SYSTEMS
FOR TRANSPORTATION



THANK YOU



UIC ENERGY EFFICIENCY DAYS 2014

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FOR ALL THE TRAINS IN THE WORLD

Energy Metering Solution For Railway application

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++++++
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DEMETRA: Smart Metering solution

Driving aid
Equipment

Targeted,
tested
innovation
you can trust!

Demetra

the **complete** energy meter system,
quick & simple to install



Plus Driver's
display option
eco-driving



Faiveley has a large range of products...

ENERGY & COMFORT

- 1 CAB HEATING VENTILATION AND AIR CONDITIONING (HVAC) SYSTEM
- 2 SALOON HEATING VENTILATION AND AIR CONDITIONING (HVAC) SYSTEM
- 3 AIR DISTRIBUTION DUCT
- 4 EXHAUST DEVICE
- 5 URS DOLDER HEATERS
- 6 PANTOGRAPHS & SWITCHES
- 7 ENERGY METER
- 8 AUXILIARY POWER CONVERTERS
- 9 MASTER CONTROLLERS & DRIVERS VIGILANCE SYSTEM

BRAKES & SAFETY

- 1 COUPLERS
- 2 BRAKE CONTROL UNIT
- 3 OIL FREE BURAN™ AIR GENERATOR
- 4 NOWE SANDING
- 5 AXLE MOUNTED DISC
- 6 MAGNETIC TRACK BRAKE
- 7 DISC BRAKE STATIONS
- 8 AIR GENERATION & TREATMENT UNIT
- 9 PANTOGRAPH COMPRESSOR

ACCESS & INFORMATION

- 1 PLATFORM DOORS
- 2 AUTOMATIC PLATFORM GATE
- 3 BEACON
- 4 ACCESS DOOR
- 5 STEP
- 6 INTERIOR DOOR
- 7 PASSENGER INFORMATION SYSTEMS
- 8 CCTV SURVEILLANCE
- 9 INFOTAINMENT

€ 988M*

SALES

50

SITES WORLDWIDE

6000

EMPLOYEES

++++++
++++++
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++++++
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DEMETRA: Universal metering solution

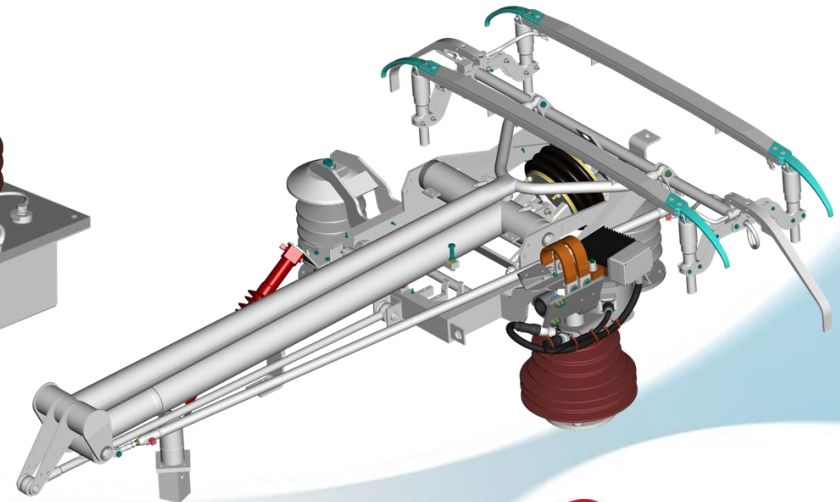
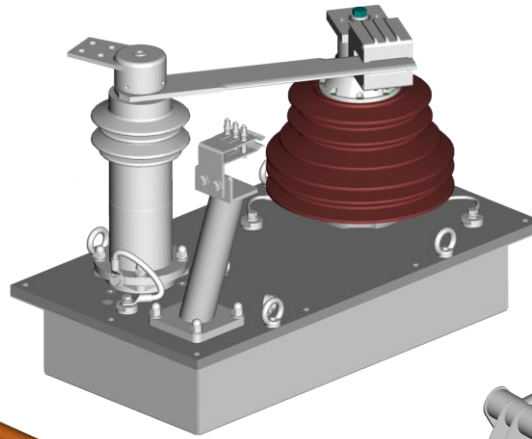
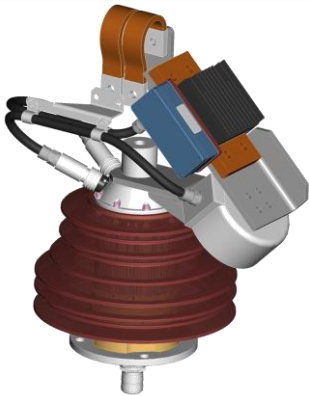
1: Compact solution, half a day installation

2: EN 50463 / EN 50155

3: Available now, production ongoing

4: Versatile over 25kVac, 15kVac, 1.5kVdc, 3kVdc

... Platform for future energy saving



Many implementations



Today's DEMETRA Architecture

Current sensors

AC & DC



Voltage Sensor AC/DC & Wattmeter

power measurement



Integrated/external Antenna(s)

GPS & GSM

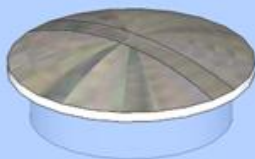
Traction unit roof

Outside

Inside

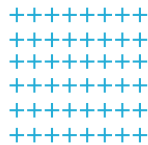
Additional functions

LCD MMI



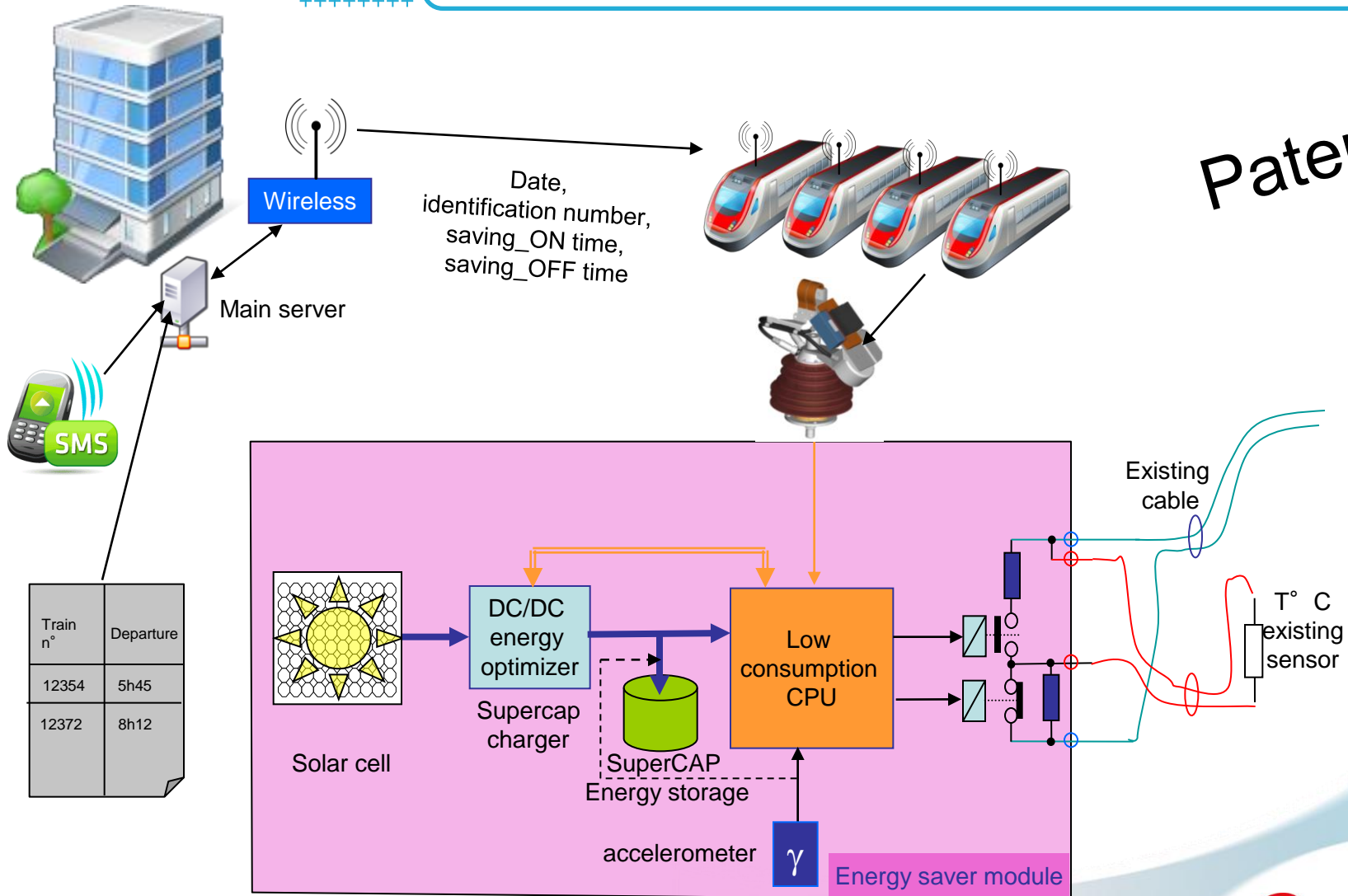
... and tomorrow, you will save 30%...

train dispatching building



Energy Saver module

Patented



Each HVAC is fitted with one energy saver module

++++++
++++++
++++++
++++++
++++++
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Energy Saver module

1: No problem of train availability

Even in case of failure, the normal HVAC behavior is not impacted

2: No maintenance

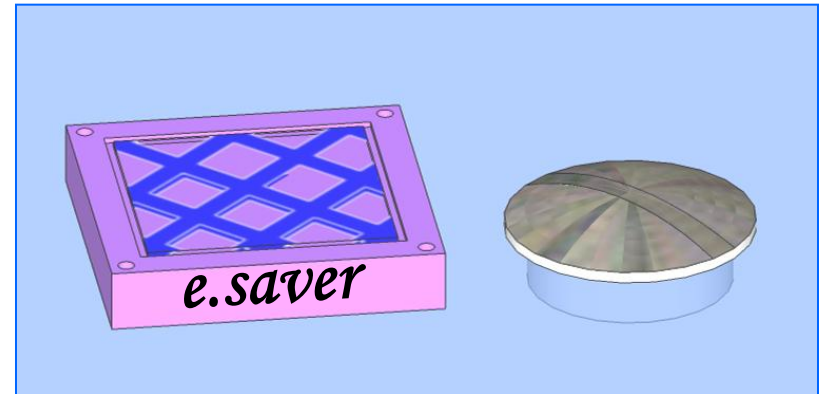
a damaged module do not have to be replaced!

3: Non intrusive, and easy to be installed

Installation in less than 1 hour, no heavy modification, auto-powered

4: Very short ROI

1 or 2 years to reach the pay back



Bombardier Energy Metering

UIC Energy Efficiency Days – 2014

You can only manage what you can measure

Enrique Vila, 17th, June 2014



AGENDA

1

ABOUT BOMBARDIER

2

BOMBARDIER ENERGY METERING SYSTEM

3

REAL EXAMPLE. RENFE HST ENERGY REDUCTION PROGRAM

BOMBARDIER

Overview









Bombardier is the world's only manufacturer of both planes and trains, with a worldwide workforce of 76,400* people.

Bombardier is headquartered in Montréal, Canada. Our shares are traded on the Toronto Stock Exchange (BBD) and we are listed on the Dow Jones Sustainability World and North America indexes. In the fiscal year ended December 31, 2013, we posted revenues of \$18.2 billion USD.

* as at December 31, 2013 (includes 200 employees at our corporate office in Canada)

OUR PRODUCTS AND SERVICES

The broadest portfolio in the rail industry

Rail Vehicles	Transportation Systems	Services	Rail Control Solutions	Propulsion & Controls	Bogies
 <ul style="list-style-type: none"> ▪ Light rail vehicles ▪ Metros ▪ Commuter trains ▪ Regional trains ▪ Intercity trains ▪ High speed trains ▪ Locomotives 	 <ul style="list-style-type: none"> ▪ Driverless Systems: Monorails, Metros, People Movers ▪ Light rail systems ▪ Metro Systems ▪ Intercity Systems ▪ E-mobility Solutions ▪ Operations and Maintenance 	 <ul style="list-style-type: none"> ▪ Fleet Management ▪ Asset Life Management ▪ Energy Management ▪ Material Solutions ▪ Component re-engineering and overhaul 	 <ul style="list-style-type: none"> ▪ Integrated control systems ▪ Automatic train protection and operation ▪ Interlocking systems ▪ Wayside equipment ▪ Services 	 <ul style="list-style-type: none"> ▪ Traction converters ▪ Auxiliary converters ▪ Traction drives ▪ Control and communication 	 <ul style="list-style-type: none"> ▪ Portfolio to match entire range of rail vehicles ▪ Full scope of service over the lifetime of a bogie

AGENDA

1

ABOUT BOMBARDIER

2

BOMBARDIER ENERGY METERING SYSTEM

3

REAL EXAMPLE. RENFE HST ENERGY REDUCTION PROGRAM

Bombardier Energy Metering System.

Features

- Valid to be used in the EU countries for billing purposes.
- Ready to communicate with ERESS, Soclee, Gefee or any protocol defined by the IM.
- Ready to interface with the vehicle TCMS.
- Valid to be used in vehicles of any manufacturer.
- Valid to be used with digital or analogical sensors.
- GPS positioning & 3G / GPRS communications.



**System certified with the
EN – 50463.**



Benefits

- By installing an EMS, train operators only pay for actual energy consumption.
- Energy saving initiatives will have immediately effect.
- Compliant with the EU interoperability requirements.
- The first step for managing is measuring. Allows the operator to fully understand the energetic balance of the train.
- Maintenance benefits – Predictive maintenance of the traction equipment.
- Operational benefits – GPS positioning & online access to the locomotive parameters.

BT EMS References

Operator	Fleet	Number	Voltage
RENFE	446 - EMU	141	3KV _{cc}
	447 - EMU	155	3KV _{cc}
	450 - EMU	36	3KV _{cc}
	269 - LOC Cargo	36	3KV _{cc}
	269 – Pass	30	3KV _{cc}
FGC	111 - EMU	19	1,5 KV _{cc}
	112 - EMU	7	1,5 KV _{cc}
	213 - EMU	6	1,5 KV _{cc}
SNCF (BT PGR)	Regio2N - EMU	129	25KV _{Ac} / 1,5KV _{cc}
ADIF	HST – 350	1	25KV _{Ac}
SNCB	Traxx Loco	1 (Prototype)	15KV _{Ac} / 1,5KV _{cc} /3KV _{cc}
RENFE	HST350	46	25KV _{Ac} /
RENFE	HST250	45	25KV _{Ac} / 3KV _{cc}
Metro Bilbao	S-500	1	1,5KV _{cc}

AGENDA

1

ABOUT BOMBARDIER

2

BOMBARDIER ENERGY METERING SYSTEM

3

REAL EXAMPLE. RENFE HST ENERGY REDUCTION PROGRAM

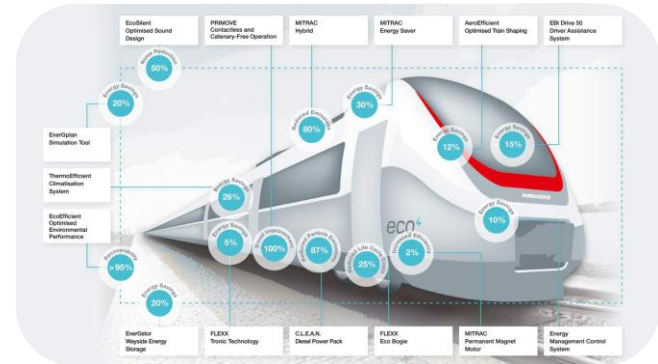
RENFE HST Energy Reduction Program. Background.

Bombardier is the manufacturer of part of the RENFE's High Speed fleet. RENFE has the necessity of reducing energy consumption.

Bombardier is a leader in the Rail sector and has developed many energy saving initiatives, grouped under the ECO4 program.

Under this framework, Bombardier & RENFE established a collaboration to reduce RENFE's energy expenditure.

Bombardier COMMITS to achieve a reduction of 4% of the total energy consumption.



RENFE HST Energy Reduction Program. Fleets & Savings technologies.

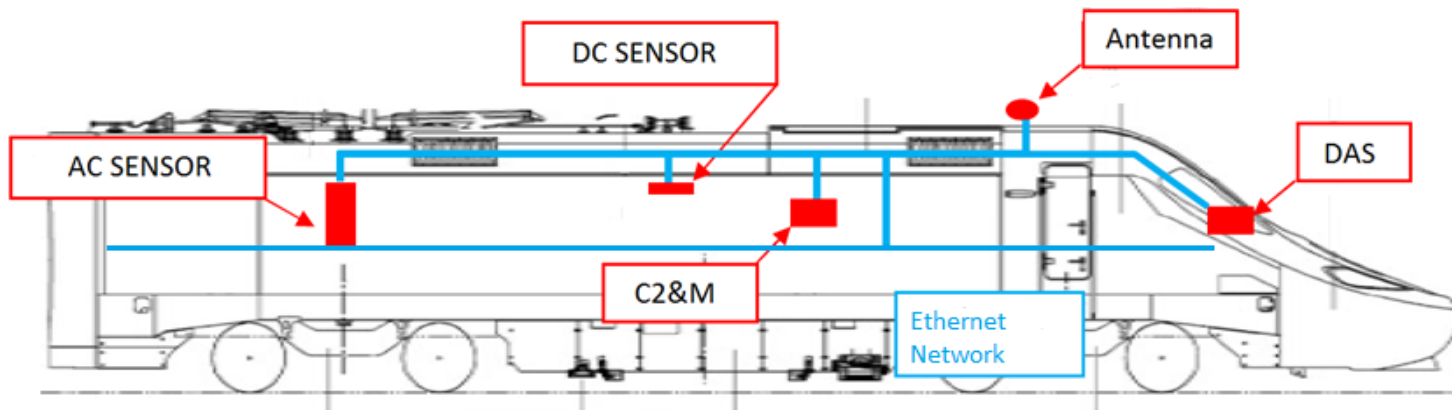
Fleet	Nr. of trains	Type of service	Rated Voltage
S-102	16	High Speed	25 kVac
S-112	30	High Speed	25 kVac
S-130	30	Intercity	25 kVac / 3 kVdc
S-730	15	Intercity	25 kVac / 3 kVdc / Diesel



- Energy savings to be generated by:
 - Driving Advisory systems (Energy savings from traction)
 - Smart – Stabling (Energy savings from auxiliaries)
- ***A Energy Meter compliant with the EN – 50463 is fitted in the trains to certified the savings achieved and to allow RENFE to get billed according the real energy consumption.***

RENFE HST Energy Reduction Program.

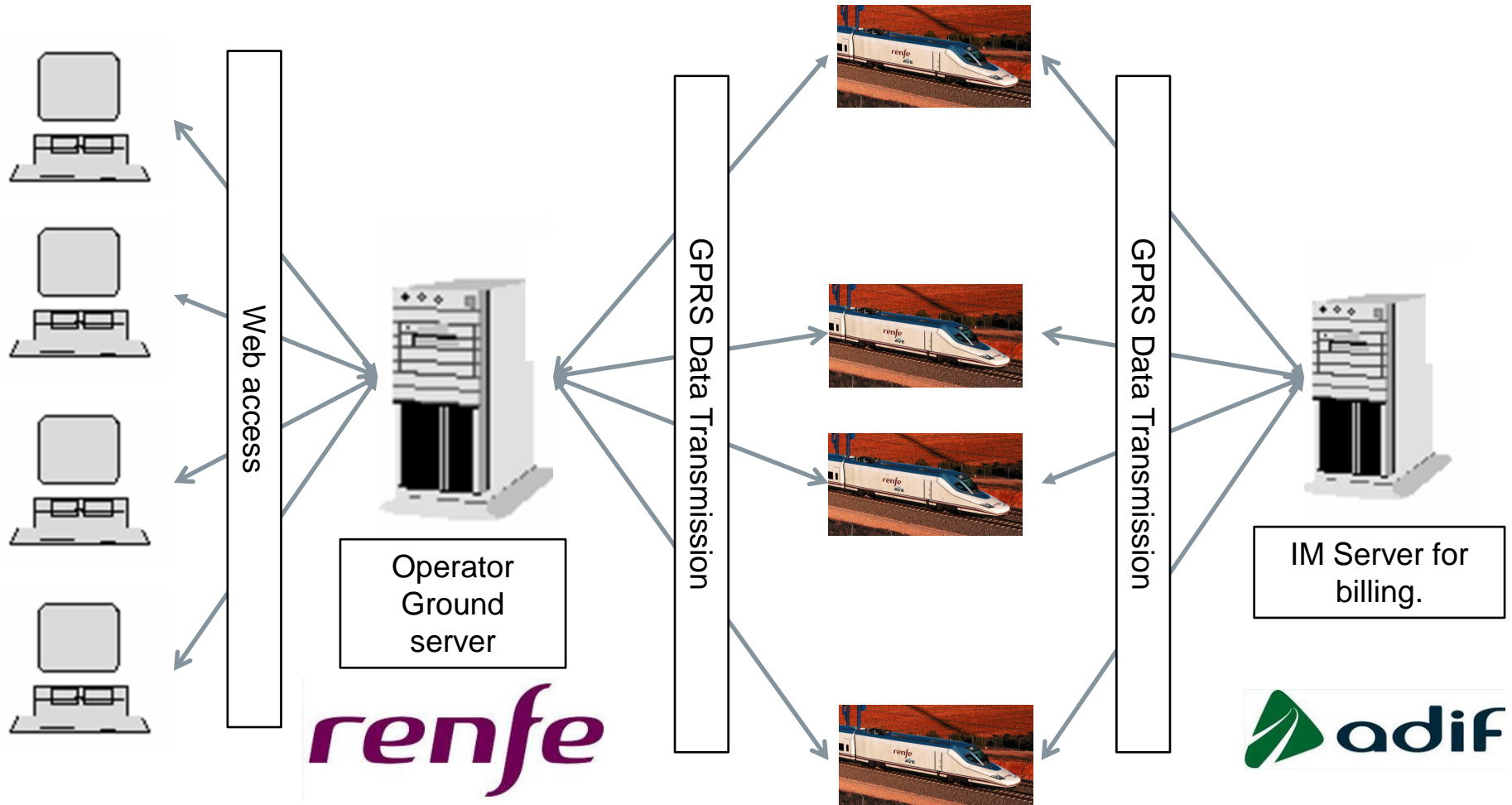
On board System architecture.



- All the components of the Energy Metering System and the Driving Advisory System are connected through an Ethernet network.
- For enhancing the functionality of the EMS and the DAS, they are fully integrated in the TCMS of the vehicle.
- All the communications train – ground are managed through one single gateway.

RENFE HST Energy Reduction Program.

Ground Server architecture.



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Conclusion.



There is a need in the rail industry for measuring energy consumption, for two main reasons:

- Real Energy Billing
- Energy Consumption Reduction

Using Energy Meters as a base, Bombardier is helping rail operators in reducing their energy consumption.



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