CIESSE S.p.A.®
Your Partner In Railway Interiors

RAILware®

EcoS

Railway Energy Meter

Agenda

- Energy liberalization
- EcoS overview
- Compatibility
- Normative context
- Main features
- Web Interface
- EN 50463 Conformity
- Catenary diagnostics
- Technical details

Now a days

The total estimated consumption for the railway operation is recorded but it is not possible to accurately apportion the energy consumed by an individual railway undertaking.
It is even more difficult to determine the amount of energy used by a particular train

So…

They estimate energy consumption per user, based on a set of :

- theoretical train characteristics
- plus an assumed standard driving technique

Energy Liberalization

The European Commission requires the implementation of Third Party Access (TPA) for all consumers including those in the rail sector, which means that:

Railway Undertakings (RUs) can purchase energy from suppliers of their choice

Impact on the Railway Industry

The liberalization of the Energy Market has brought in new challenges for the Railway Sector.

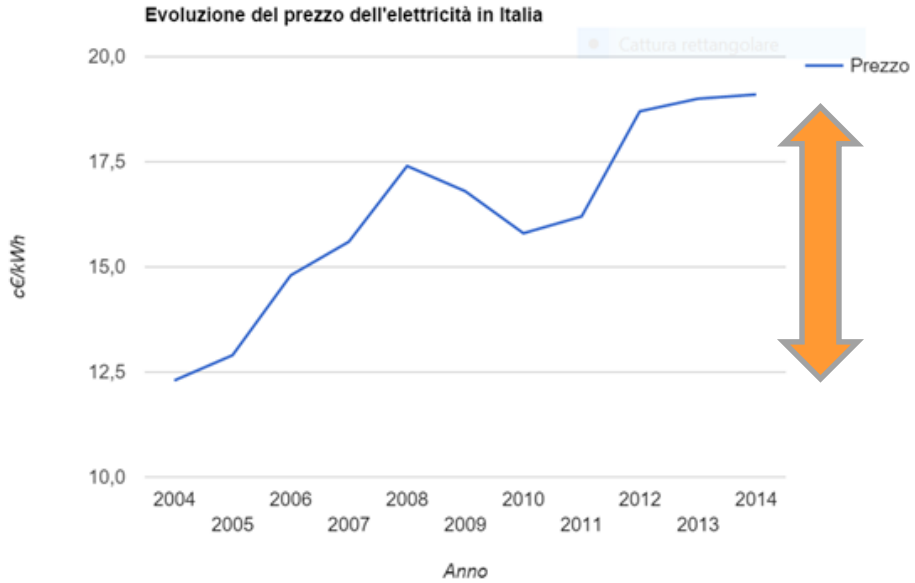
The changes in regulation, for both energy and railways, towards liberalization and unbundling has changed the framework and the practice in energy supply, distribution and billing.

Why is on-board metering important for the EU?

1) Energy meters are needed <u>to make energy savings visible.</u>

2) Energy meters are needed <u>to allocate the profits</u> of these savings correctly to the respective Railway Undertakings.

The cost of electricity is increasing year by year



Stakeholders has many different interests

#TOCS
I want to pay only what I'm consuming

#TOCS
I want to buy energy from the open market

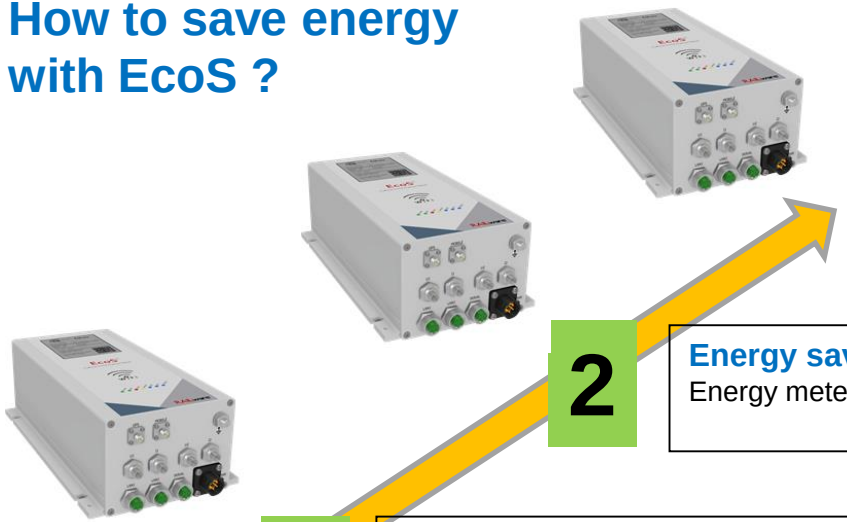
#TOCS
By training my driver I could save...

#FLEET MANAGER
I can't stop the train for a week to install an energy meter

#WORKSHOP
I need a compact device easy to be installed

#USERS
Is this train Green?
I want to pay less.

How to save energy with EcoS ?



1 **Measuring Consumption**
Modifying the driving style as feedback from the consumption report

2 **Energy savings linked to parked trains.**
Energy meter helps to know if a train is in parking

3 **Paying per Consumption**
Energy meter measures it!

Based on metering data

Tuning arrival and departure time of stations
while a train is starting braking another one has to start moving to use the regenerated energy by the train that is braking.

EcoS – Energy Meter for Railway

- EN 50463 with 0,5R accuracy class
- EN 50155, wide range 24-110Vdc
- Two independent measurement channels (V/C)
- Support DC and AC
- SoftPLC for expansions and customisations
- Connectivity: Wi-Fi, ETH, 2G/3G/4G
- Web interface

EcoS: plug and play solution

EcoS is fully compatible with E-Meters widely used on the market.

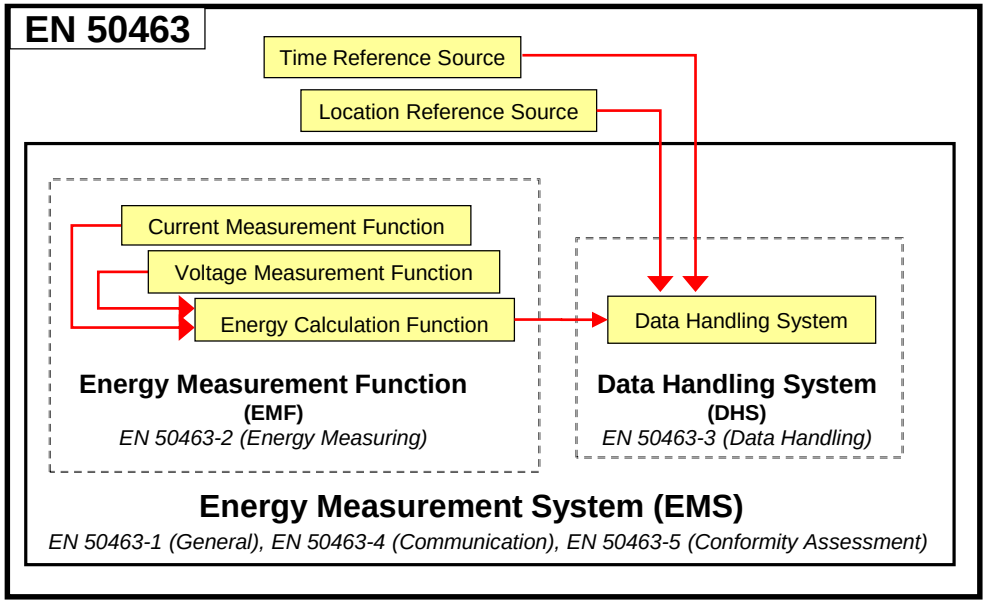
Connectors have been chosen not to change matching connectors.

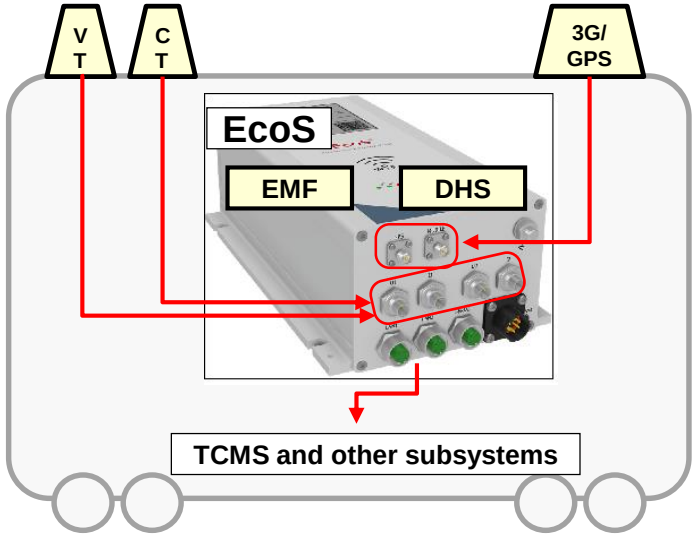
Minimum levels of integration & design works based (plug and play in existing train fitment envelope)

EcoS: fully compliant with Erex billing system

Normative context (1/2)

- EN50463: 2012 (on going)
- EN50463: 2015 (draft ready)
- EcoS integrate EMF and DHS





Normative context

Differences between EN 50463-2012 and EN 50463-2015

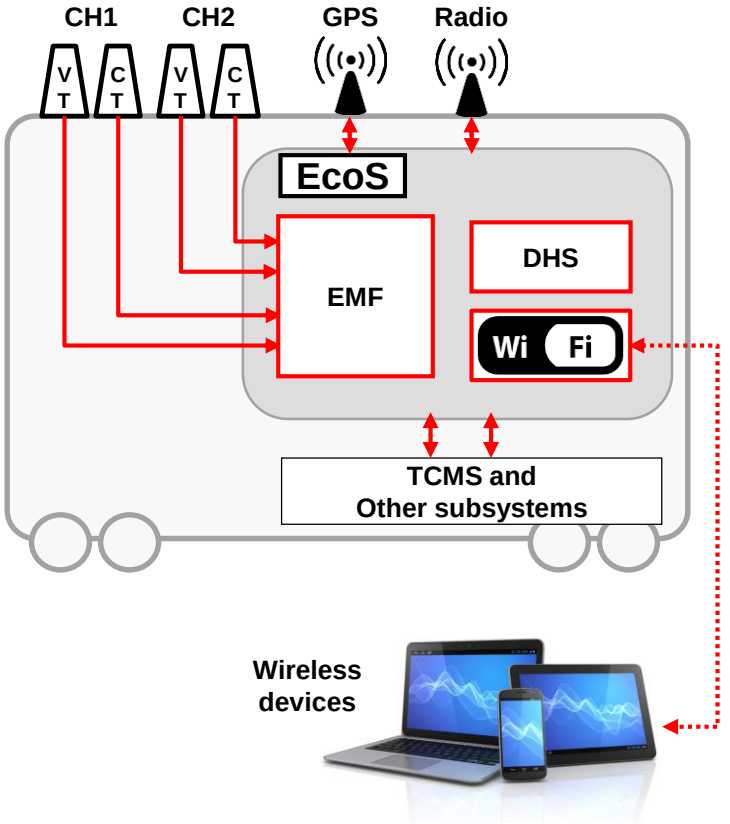
Major Changes	EN 50463 - 2012	EN 50463 - 2015
Communications compliant to IEC 61375	no	yes
Automatic communications CEBDs (*)	yes	yes
Automatic communications Maintenance data	no	yes
On demand communications CEBDs	no	yes
On demand communications Mantenence data	no	yes
File signature	no	yes
Dynamic change of DCS (Cross Border)	no	yes
Multiples ground server DCS	no	yes
Events Communications (device diagnostics)	no	yes

CEBDs : Compiled Energy Billing Data
DCS: Data Communication Server

EcoS – Main features

Hardware

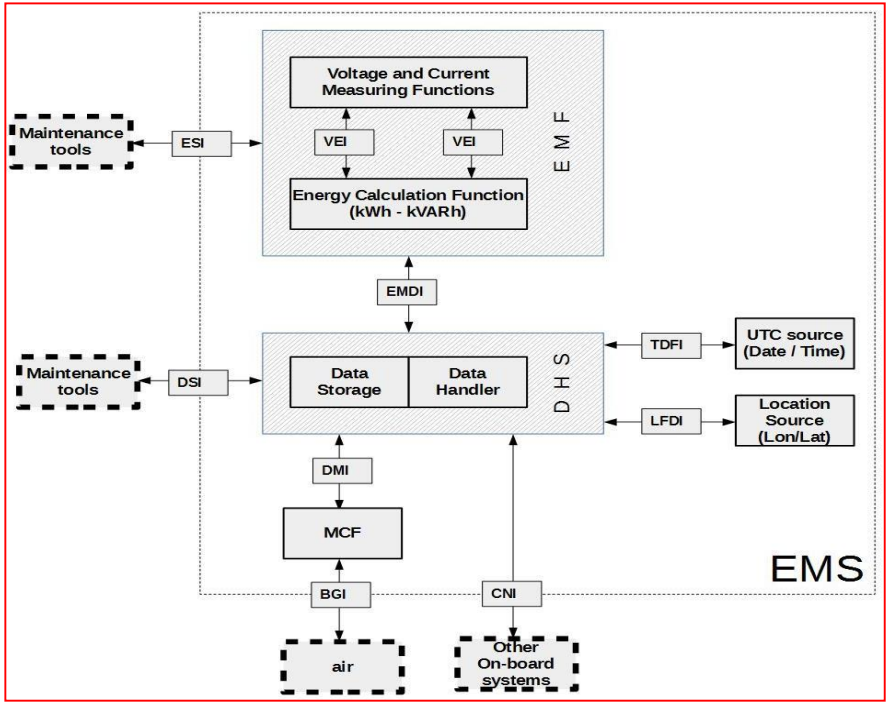
- EN 50155, wide range 24-110Vdc
- Two DC/AC inputs channels (V/C)
- TCMS and Maintenance Ethernet interfaces
- Integrated WiFi Access Point and Interface
- GPS and TCMS localization and time sync
- Radio interfaces (2G/3G/4G)
- IP54 case with anti-tampering



EcoS – Main features

Software

- EN 50463 EMF and DHS
- SoftPLC for custom triggers/functions
- TCMS protocols (eg. TRDP, Modbus)
- Web maintenance interface
- Web real-time data access
- FTP and Web XML data access
- Field upgradable

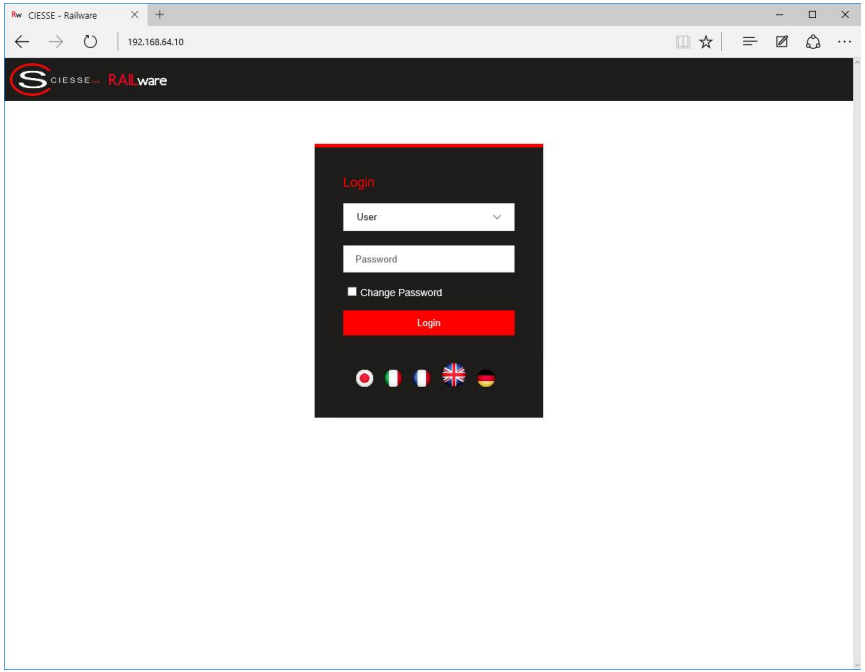


Web Interface – Overview

- User friendly responsible interface
- Multilanguage

Web Interface – Integration

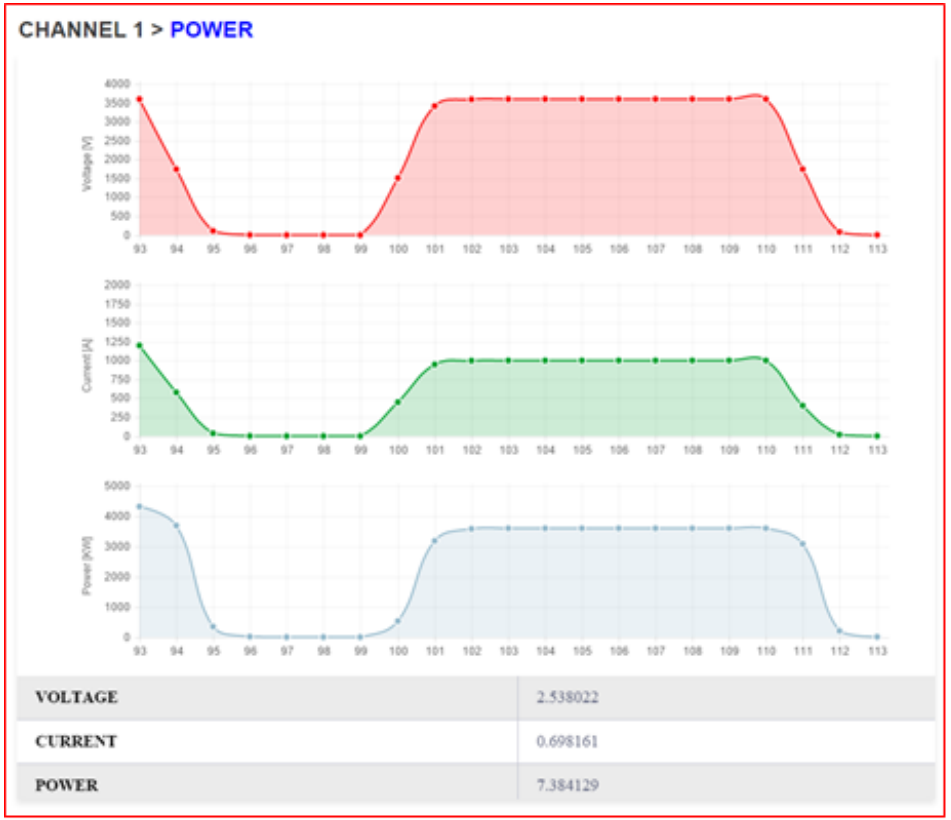
- Available on WiFi and Ethernet interfaces
- Easy integration on existing HMI using browsers



Cross Browser

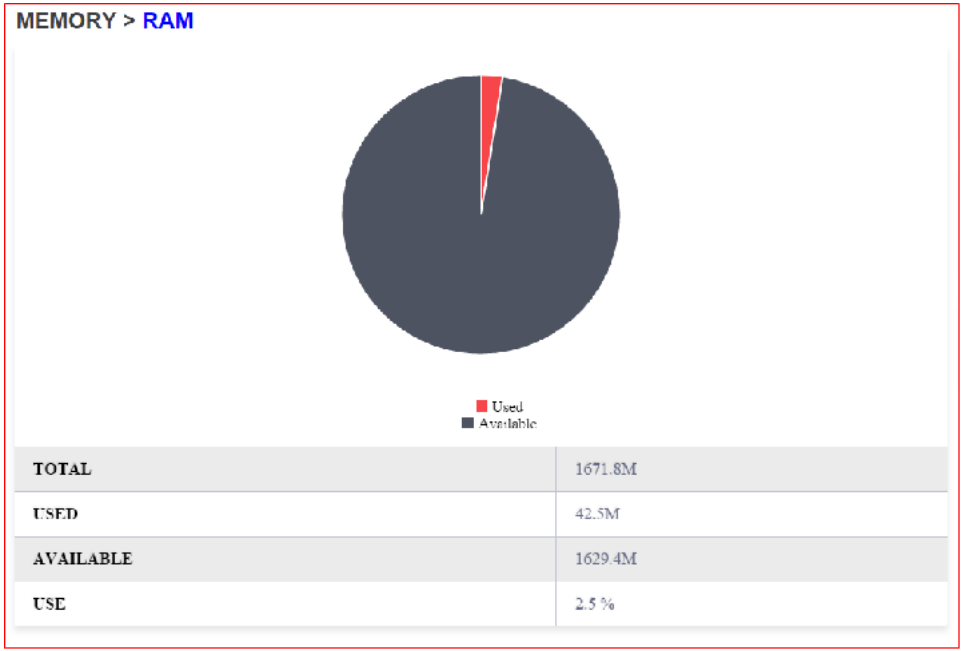
Web Interface – Real Time Monitor

- Real-time visualization
- Multi channel
- Graphics plots
- Voltage, current, power
- Energy, active and reactive



Web Interface – Status

- User access
- Real Time Clock
- Memory
- Network
- Configuration file
- Data Handling Management
- Device software Update



TOTAL	1671.8M
USED	42.5M
AVAILABLE	1629.4M
USE	2.5 %

EN 50463 - Conformity (1/2)

Conformity requires Design Review, Type Test, Routine Test on

a. each Energy Measurement System function:
   - EN 50463-2 EMF (most important, meter and sensors)
   - EN 50463-3 DHS
   - EN 50463-4 COM

b. integrated system (EN 50463-5)

c. installed system (EN 50463-5)

EN 50463 - Conformity (2/2)

CIESSE-RAILware can also certificate the “system” to help car builders and integrator in the installation qualification

- certification Body already selected

25 kV current transformer

25 kV Voltage transformer

Sensors: AC up to 25KV

OcTo sensors: AC

25 KV AC

OcTo-i 25kv

Current trasformer:
- **measurement output**
- **traction output**

OcTo-v 25kv

Voltage trasformer:
- **measurement output**
- **traction output**

OcTo-vi 25kv

Voltage and Current Sensor

Sensors: DC up to 4KV

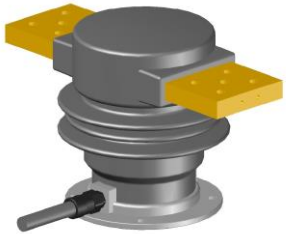
OcTo sensors: DC

4 KV DC

OcTo-DC

Voltage and current sensor:
- **Indoor installation**
- **Diagnostic output**

OcTo-DC roof



Voltage and Current Sensor:
- **Roof mounting**
- **Integrated shunt**

OcTo-DC bar

Voltage and Current Sensor:
- **Integrated shunt**
- **Roof mounting**
- **Bus bar installation**

Sensors: AC and DC

EcoS + OcTo = *FULL SOLUTION*

Billing
Saving
Diagnostic

OcTo 4 KV DC

OcTo-DC

Voltage and current sensor:
- Indoor installation
- Diagnostic output

OcTo-DC roof

Voltage and Current Sensor

OcTo-DC bar

Voltage and Current Sensor:
- Integrated shunt
- Bus bur installation

OcTo 25 KV AC

OcTo-i 25kv

Current trasformer:
- measurement output
- traction output

OcTo-v 25kv

Voltage trasformer:
- measurement output
- traction output

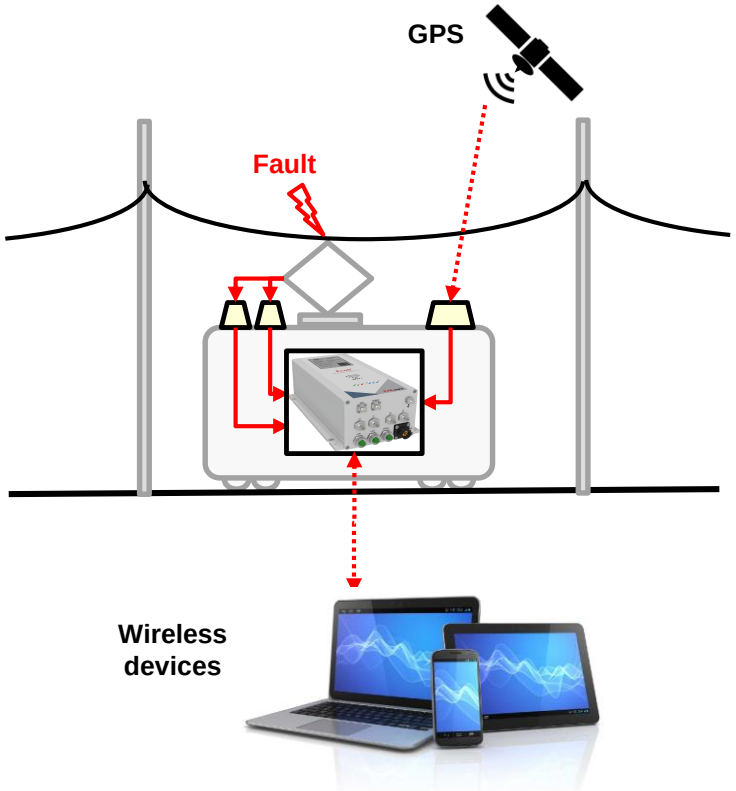
OcTo-vi 25kv

Voltage and Current Sensor

OHL: Catenary diagnostics

Features OHL diagnostic (OverHead Line)

- Real-time catenary voltage monitor
- Triggers on EN 50163 §4.1 values
- Programmable triggers and conditions
- GPS and odometry event tagging
- Log event registration
- Log access from Web interface and FTP



Agenda

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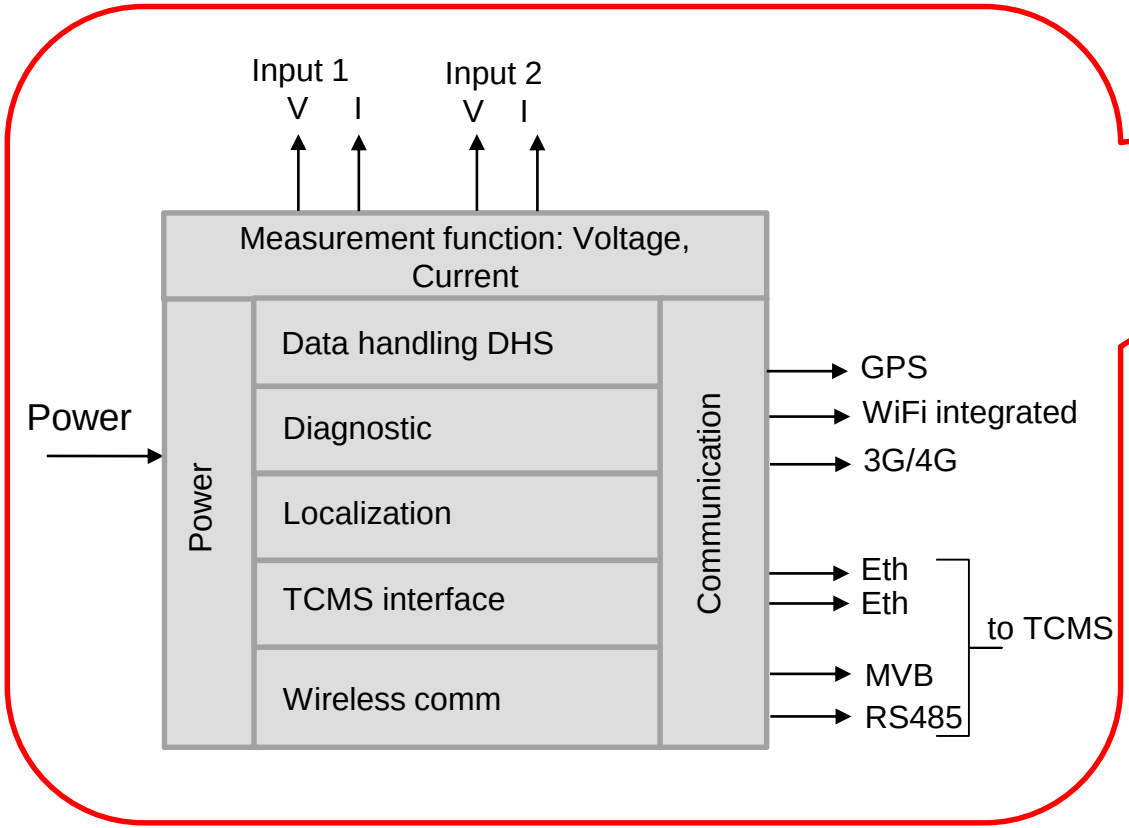
EcoS: Energy meter

- EN50463: 2012 (on going)
- EN50463: 2015 Draft: ready
- Accuracy class 0,5 R
- All in one: DHS & EMF integrated
- Soft PLC for fast expansions and customisations
- Large connectivity: LTE, UMTS, GPRS, Wi-Fi integrated, ETH
- Easy WEB management
- Customizable protocols (TRDP ready, TCNOpen)
- AC and DC operations
- Fully Compatible with existing products

(mechanical & electrical)

EcoS: block functions



Functions:

- Measurement function
- Data handling
- Diagnostic (optional)
- Localization (Gps or via TCMS)
- TCMS interface (ETH, MVB, RS485)
- Wireless comm (optional)

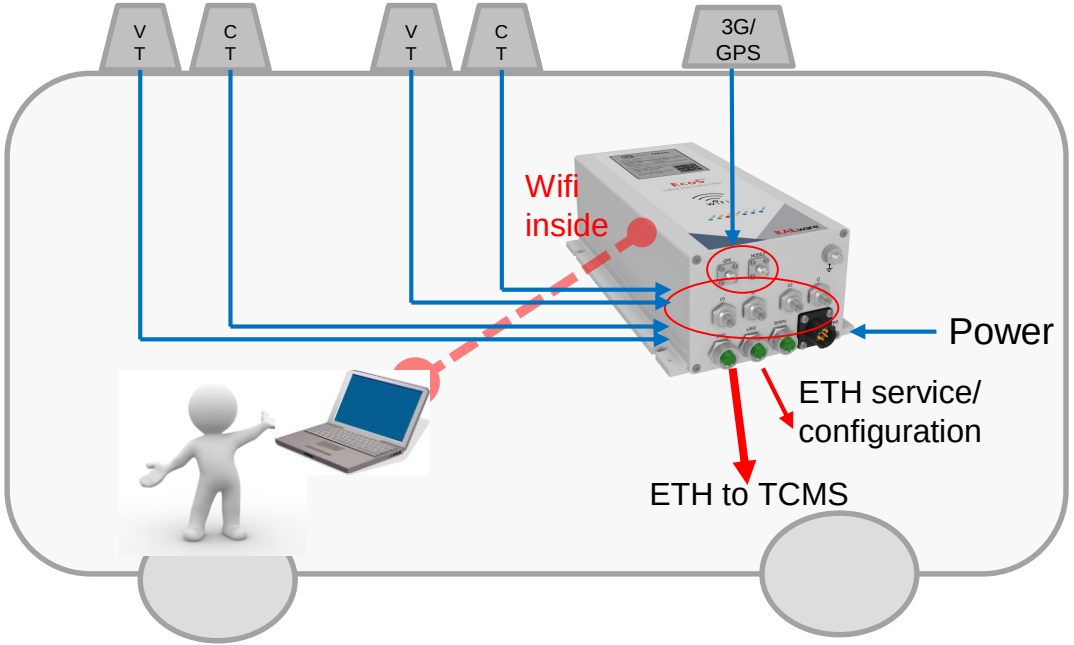
Interfaces:

- Power Wide range 24V-110V
- 2x analog measure V inputs
- 2x analog measure I inputs
- 2x ETH (MVB opt)
- 1x GPS (optional)
- 1x 3G/4G (optional)
- 1x Wifi integrated

EcoS: system overview

Hardware

- ✓ (two) independent measure CHs (V+I)
- ✓ Ethernet to TCMS
- ✓ Ethernet test/configuration
- ✓ Gps for localization & time sync
- ✓ 3G wireless (2G/3G/4G) with external antenna
- ✓ Wide range power supply: 24-110V
- ✓ Aluminum case IP54
- ✓ Anti-tampering protection



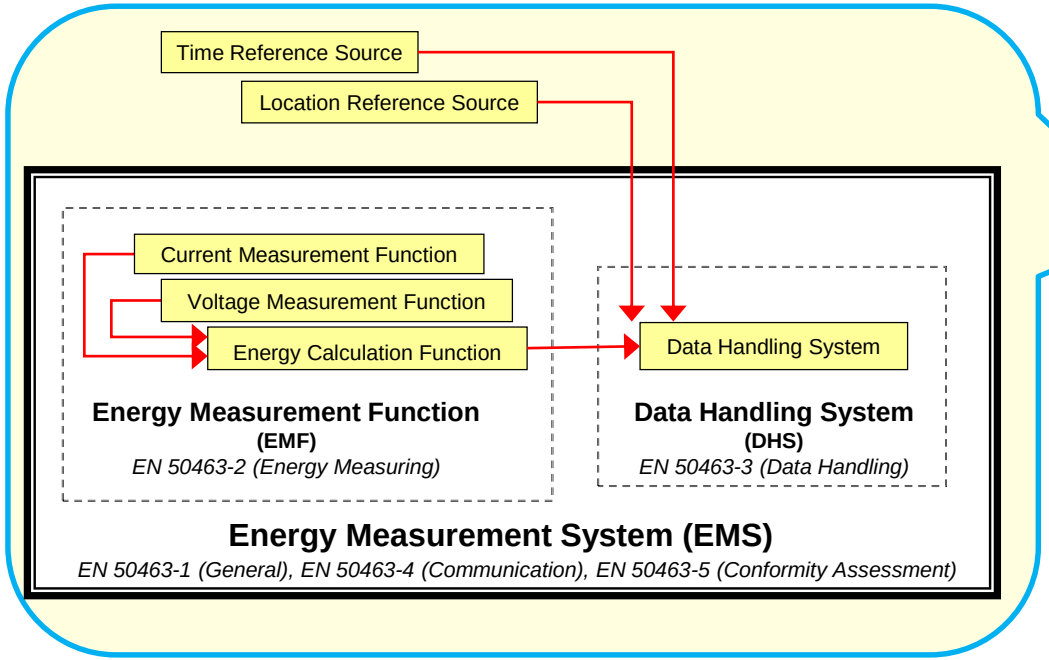
Software
SW measurement EN50463:2012
ready for "EN50463:2015 draft"
SW interface TCMS: TRDP or Modbus

Service & Configuration
Eth & Wi-Fi integrated:
configuration & energy display data

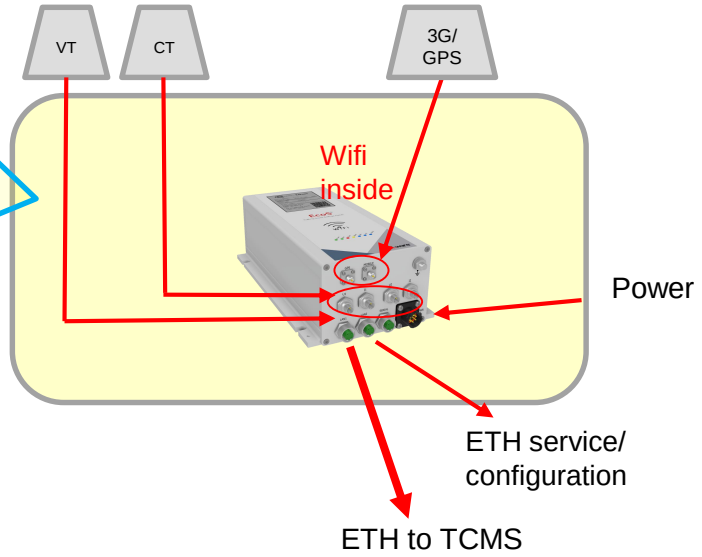
Energy Data and diagnostic:
XML file sent using FTP protocol to different servers (billing, diagnostic, maintenance)

EcoS: EN50463 requirements

EcoS = EMF + DHS



Measurement and data handling in one device



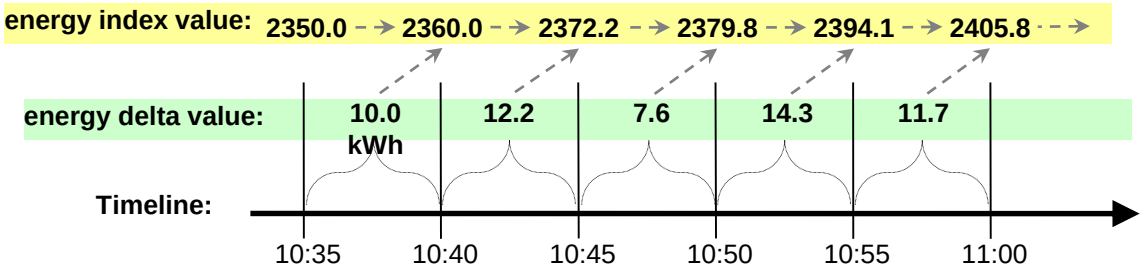
EcoS: EN50463:2015 draft

EN50463: 2015 Draft:

- final enquiry status
- published on 2016-17
- It will impact on the next projects

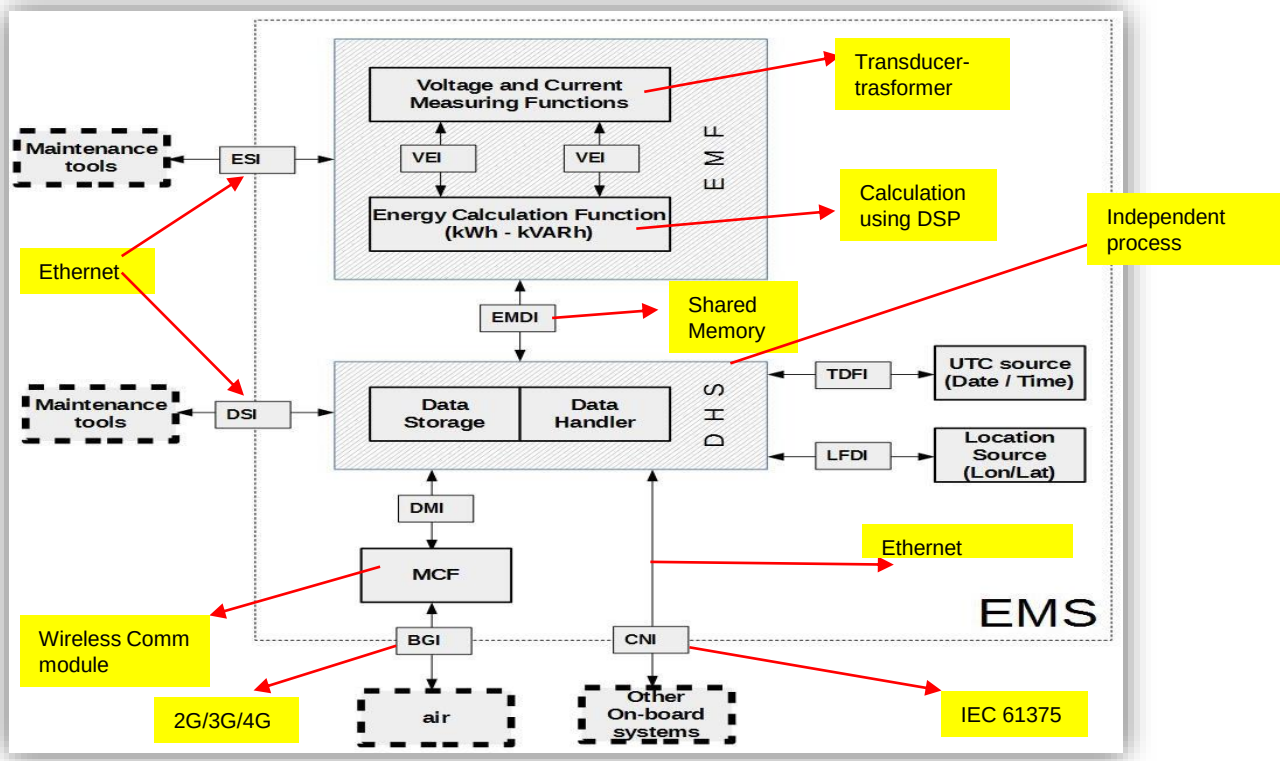
Changes on different parts:

Part 1, General;
Part 2, Energy measuring;
Part 3, Data handling;
Part 4, Communication;
Part 5, Conformity assessment.



EcoS: EN50463 General architecture

EN50463 General architecture



EcoS is compliant with 2012 & 2015 architecture

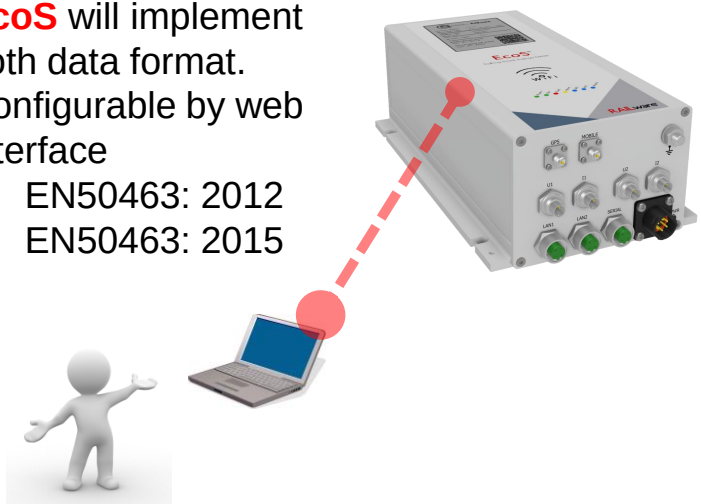
EN50463:2015 DHS and Comm new reqs

EN50463: 2015 Draft:

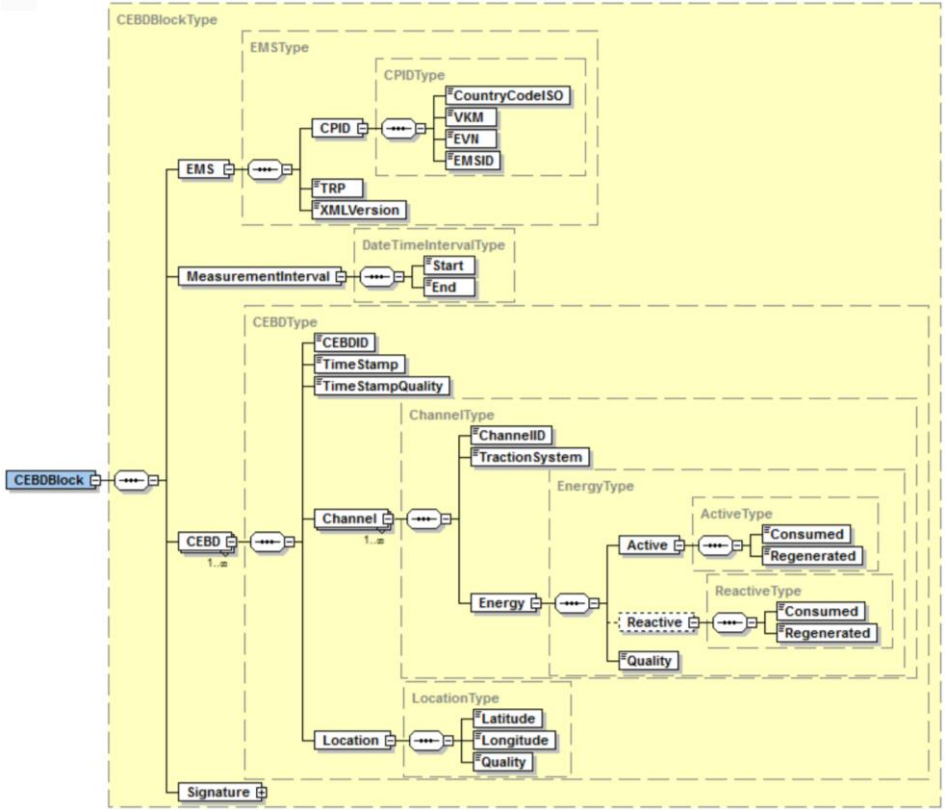
- DHS based on XML structure CEBD

EcoS will implement both data format. Configurable by web interface

- EN50463: 2012
- EN50463: 2015



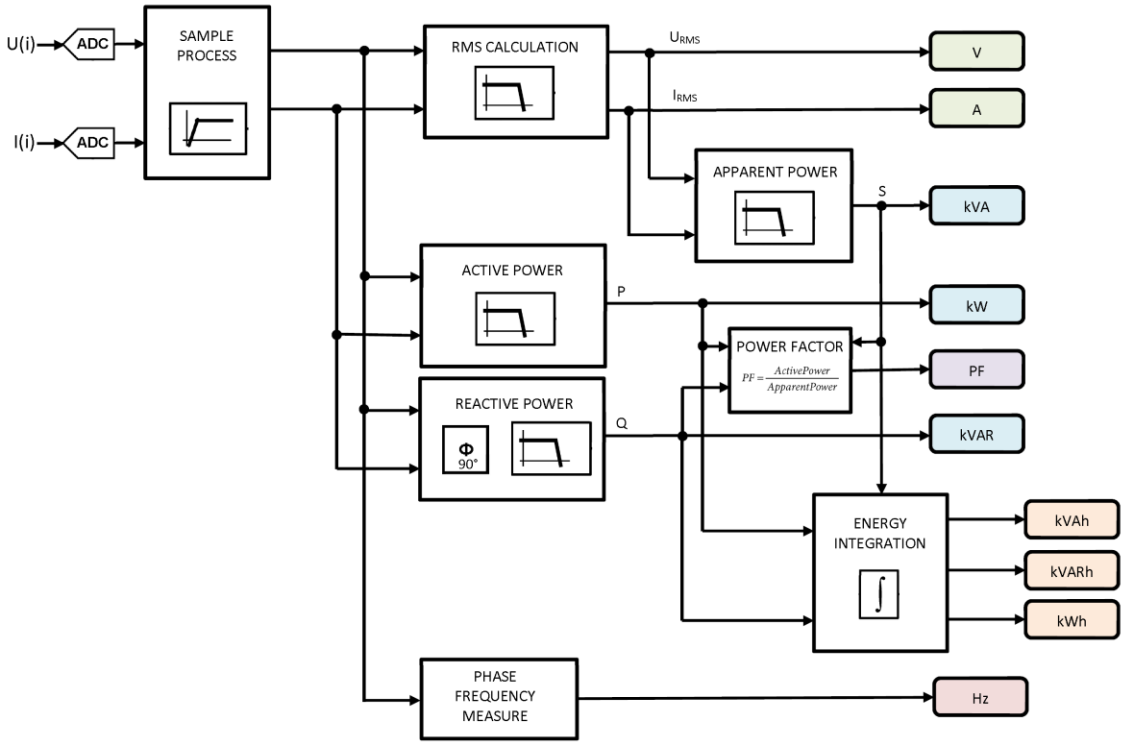
CEBD = Compiled Energy Billing Data



Technology:

- ✓ The HW system is based on TI DM8148 (ARM Cortex A8 + DSP C674x)
- ✓ The SW system is based on Linux SO
- ✓ The main application is based on **Straton** SoftPLC
- ✓ GCC compiler is used for drivers and libraries development
- ✓ Texas Instruments compiler is used for DSP firmware development
- ✓ HTML5 and jQuery for WEB development

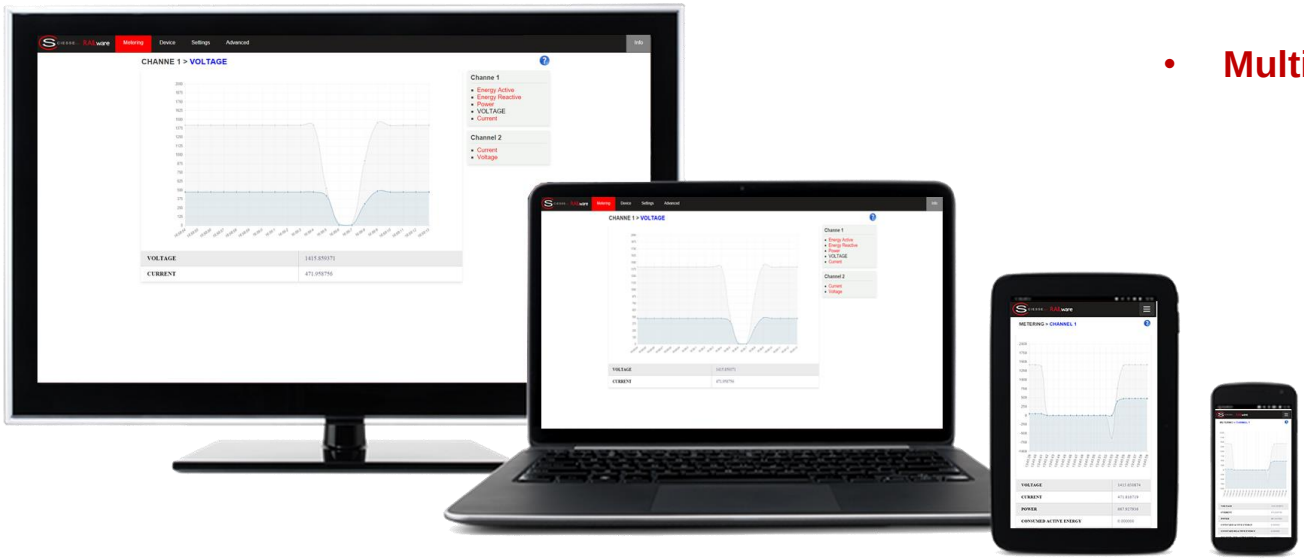
ECF : Energy Calculation Function



Digital Signal Processor (DSP)

Main Features	
Type of Meter	Two phases
Type of measurement	Energy calculation function (ECF) according with **EN 50463** 4-quadrant active and reactive energy
Quantities measured for each phase	- Voltage and Current RMS - Line Frequency (Hz) - Active, Reactive and Apparent Powers (kW, kVAR, kVA) - Power Factor (PF) - Active, Reactive and Apparent Energy (kWh, kVARh, kVAh) for each frequency
Metering algorithm	Filter-based with Digital Signal Processor (DSP TI C674x @700MHz)
Precision (accuracy)	EN 50463-2 class **0.5R**
Voltage/Current range	- 0.4%In < I < 120% In - Umin2 < U < 120% Umax2
Analog meter input	Current or voltage analog signal
Line Frequency range	**DC, 16 2/3 Hz, 50Hz**
Harmonic influence	Compliant with EN50463-2
Frequency band	up to 21th order harmonic
Update rate	8kHz
Upgradeable Firmware	Easy upgrading device firmware through Ethernet port
Programmable time period	30sec, 5min (EN50463)
Option capabilities	- AC catenary detection - Overload and Over current detection - Voltage and current THD (Total Harmonic distortion)
Option features (via PC)	- Real-time waveform monitoring capability 4-channel - Voltage and current harmonic spectrum
Development status	Completed. Certification process in progress.

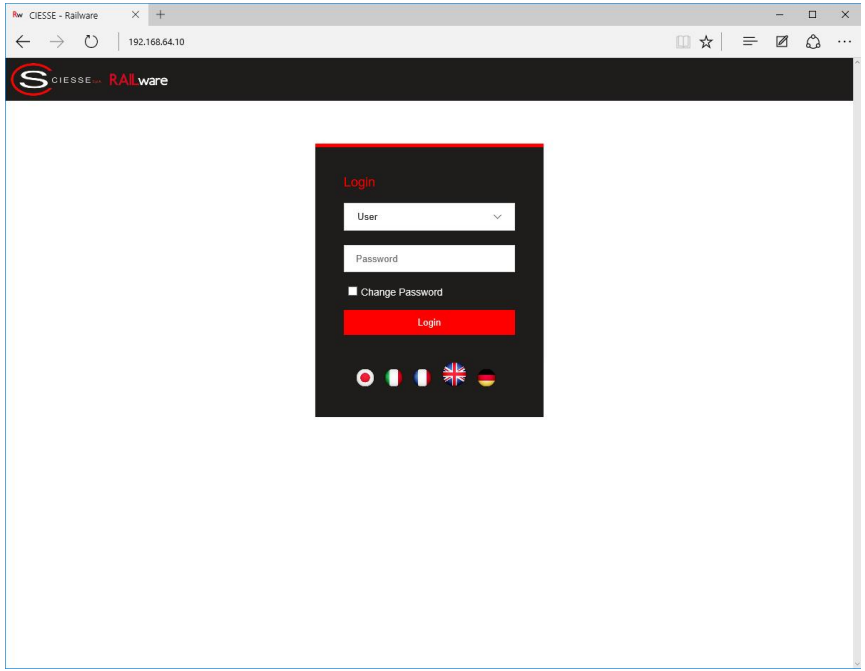
Development: Web Interface



- **User friendly**
- **Responsive**
- **Multilanguage**

Development: Web Interface

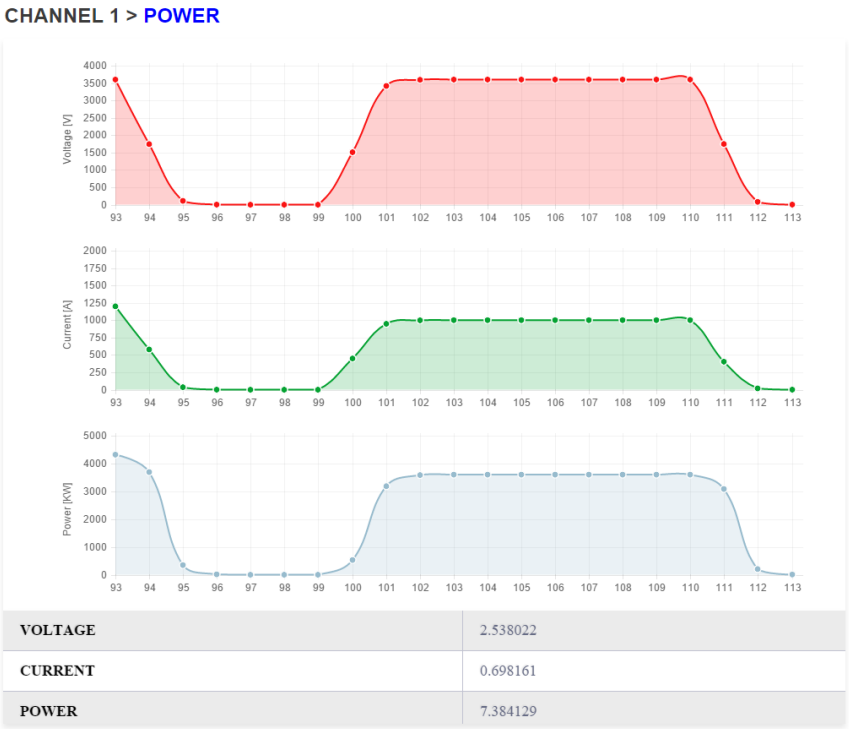
Available on Wi-Fi or Ethernet



Cross Browser

Development: Web Interface

Real Time Data Monitoring



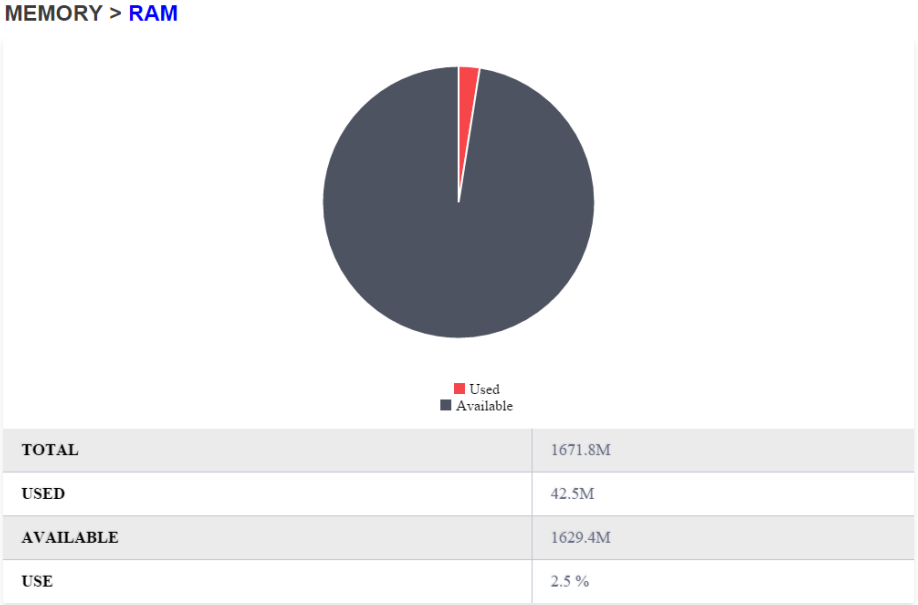
VOLTAGE	2.538022
CURRENT	0.698161
POWER	7.384129

For each Channel:

- Power, Voltage and Current
- Active Energy (Consumed and Regenerated)
- Reactive Energy (Consumed and Regenerated)

Device Monitoring and Configurator

- User access
- Real Time Clock
- Memory
- Network
- Configuration file
- Data Handling Management
- Device software Update



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USE	2.5 %

Our sites:

- Visiting CIESSE in Florence HQ
- Visiting RAILware electronics division in Verona

PIAN DELL'ISOLA PLANT

HEADQUARTERS & PRODUCTION

PAGNANA PLANT

SPECIAL PROCESSES-ASSEMBLY

VERONA OFFICE

RAILWARE ELECTRONIC ATELIER

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