

FOSDEM'23



European Eichrecht

E-Mobility with Love & Security




/me

- Studied computer science (medical CS, network security) at TU Ilmenau, Germany
- Developing the student campus network, e.g. WLAN point-to-point links
- Worked for multiple startups (GraphDBs, Renewables, e-Health)
- Started my own Open Source & Open Data company in 2014



The E-Mobility User Story

- **Find a free, compatible & working charging station**
“Now free” or “Free at arrival”?
- **Charge as fast as possible?**
...or as it makes most sense?
- **Pricing should be correct and without surprises**
kWh (calibration law), time (relaxed regulation), starting/blocking fees
Getting paid for providing energy & grid stability in the future (V2G/H/X)?
- **Digital natives: “Is there an app for that?”**
Digital processes: real-time, secure, private
- **FOSDEM people: Open Source & **



EV Driver Authorization



- Standardized broken authorization is state-of-the-art, e.g. wrong usage of RFID cards
 - Not much security, no privacy at all
Inadequate work-arounds like **VDE-AR-E 2532-100** and **ISO 15118**
AutoCharge is even an act of **cyber terrorism**
 - Even not enough RFID UIDs for every EV driver
4 & 7 Byte RFID UIDs even fail on the **business level**
- Only apps will have a (digital) future...



The Charging Station Operator Story

- Wants €€€ for delivering energy
- Does not want to pay too much €€€ to the energy supplier
- Correct measurements are also important for load balancing services... more €€€
- Security & Safety is important in an un-supervised distributed sales process... or you lose €€€





The Engineers' Story

- Measuring energy is hard
- 100 years of measuring AC is a good start
- Measuring DC is harder
- Measuring High Power DC is even harder

- Cryptography provides good security...
- ...but now you have to solve key distribution



Measuring Energy Regulations

Measuring Instrument Directive (MID) (2004 & 2014)

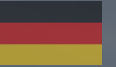
Technical design and construction requirements and conformity assessment procedures e.g. for the accuracy, reliability and local security of energy meters. Required all over Europe for billing.

[analog world]



German PTB-A 50.7-2 (2002)

Document describes additional security methods like digital signatures for remote meter readings over untrusted computer networks



German Calibration Law (Eichrecht, 2015-2019/04)

Additional requirements for metering in E-Mobility, as energy meters are used by multiple end users for a limited amount of time and billing is remote over untrusted multi-hop computer networks.

[connected world, with legacies]

Mess- und Eichgesetz (§32 MessEG)

<https://www.gesetze-im-internet.de/messeg/>

+ Ladesäulenverordnung (LSV)

+ Preisangabenverordnung (PAngV)

You mean Smart Meter Gateways, or?

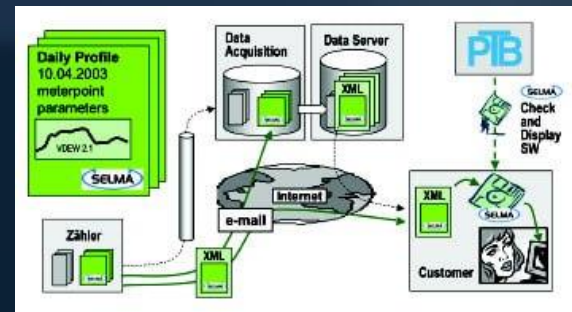
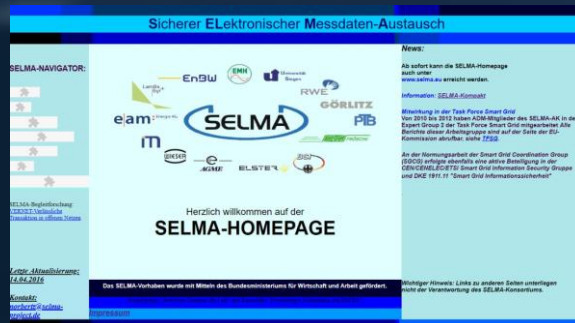
PTB-A 50.7 / SELMA

2000 - 2007

PTB-A 50.8

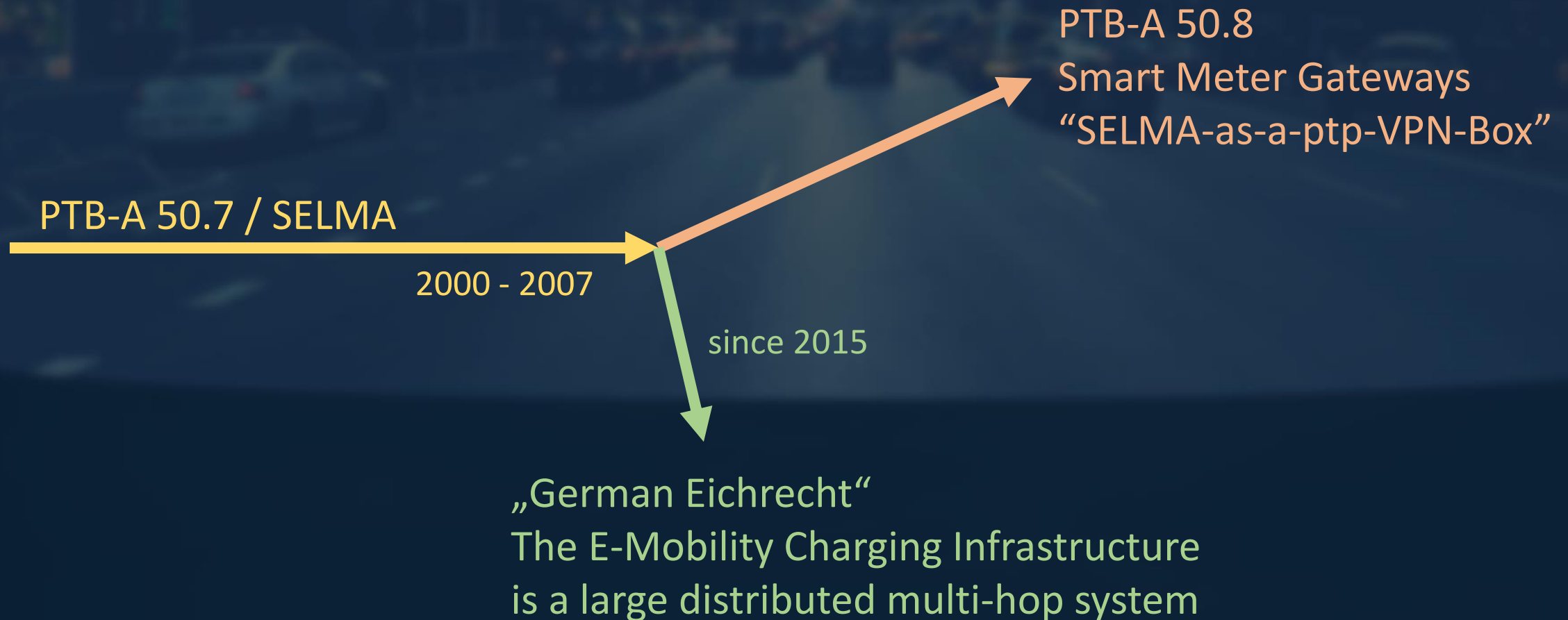
Smart Meter Gateways

“SELMA-as-a-ptp-VPN-Box”



<http://www.selma-project.de>

No... very different use cases in both worlds





Measurement Data Transmission

- Measurements travel **many hops** through different operator networks
 - Smart Energy Meter
 - Charging Station (e.g. ABL)
 - Local Charging Station Management System
 - Cloud Charging Station Management System (e.g. IONITY)
 - EV Roaming Platform (e.g. Hsubject)
 - E-Mobility Service Provider Platform (e.g. VW)
 - Invoicing Platform
 - EV Driver *with a Transparency Software*
- The **entire value chain** must be **certified** for reliability & conformity
- Solution: E2E Digital Signatures



Good Regulations & Bad Legacies

- **Entire charging station** is the measuring device
→ Even **simple firmware updates** are **regulated!**
- **Common work-around: “measuring capsule”**
→ Regulated parts are encapsulated within a smart energy meter
→ EV Driver must be able to look onto the display of the smart energy meter through a “**viewing window**” to read **kWh & public key** (an old MID bug)



“Viewing Window” & Usability Reality



Charging station design becomes difficult... and ugly...
and lights are required during the night ;)

“Viewing Window” & Usability Reality

Ein SELMA-schädlicher Webfehler der MID

PTB



**MID, Anhang 1, 10.5
lässt leider
Interpretation zu:**

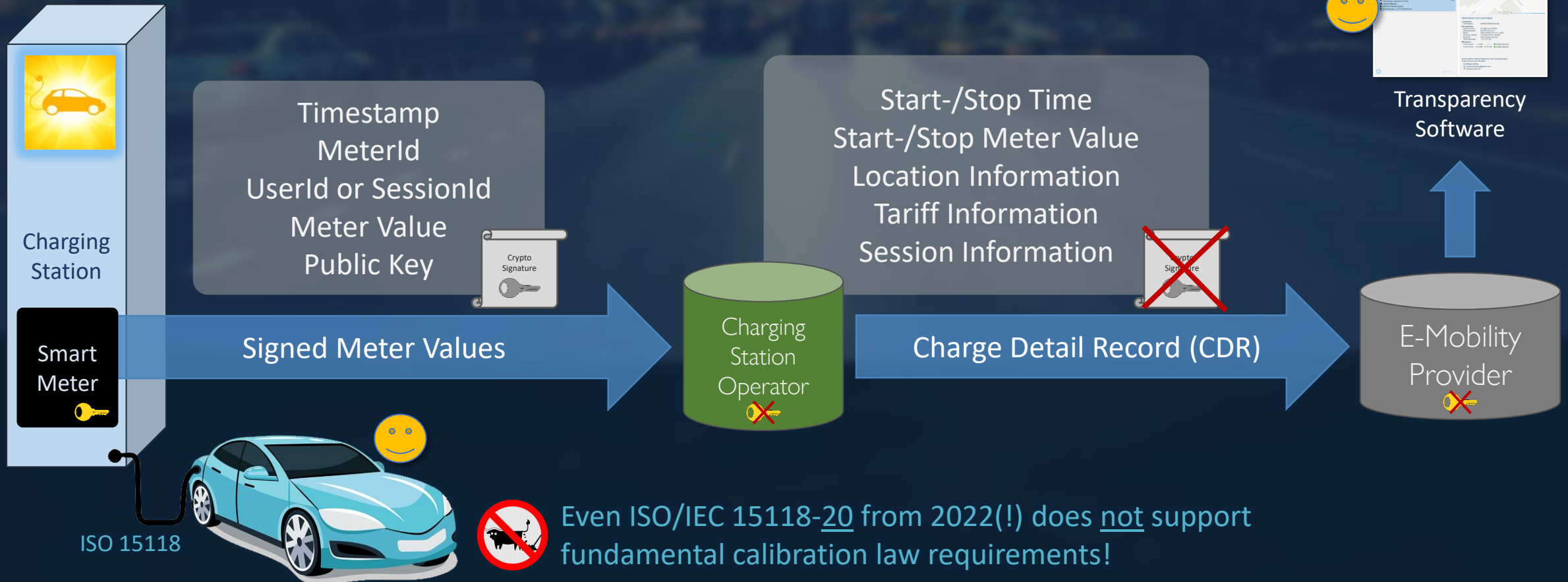
**Zähler muss immer
integrierte Anzeige
aufweisen**



...just because a stupid sentence
within an EU regulation nobody
wants to fix since >18 years m(

PTB's "Favorable Solution"

PTBs "Günstige Lösung"



ISO 15118



Even ISO/IEC 15118-20 from 2022(!) does not support fundamental calibration law requirements!

Chargy - Transparenzsoftware für die Elektromobilität

Eneco
eMobility

Chargy - Transparenzsoftware für die Elektromobilität

Alle Ladevorgänge
von Freitag, 8. Juli 2022
bis Freitag, 8. Juli 2022

Freitag, 8. Juli 2022 10:00:28 Uhr - 10:05:52 Uhr ✔ Gültig

- Ladedauer 5 Minuten 24 Sekunden
Real Energy Imported 0.15 kWh
- 12345678abcdef
- DE*BDO*E8025334492*2
- Breitenbergstr. 2, 87719 Mindelheim

Informationen zum Ladevorgang

Ladestation
Identifikation DE*BDO*E8025334492

Energiezähler
 Seriennummer 001BZR1521070006
 Zählerhersteller BAUER Electronic
 Modell BSM-WS36A-H01-1311-0000
 Firmware Version 1.9:32CA:AFF4, f1d3d06
 Messung Real Energy Imported
 OBIS-Kennzahl 1-0:1.8.0*198

Messwerte

10:00:28 Uhr	0 kWh	0	✔ Gültige Signatur
10:05:52 Uhr	0.15 kWh	+0.15 Wh	✔ Gültige Signatur

Falsche Daten, falsche Signaturen oder sonstige Fragen?
 Treten Sie mit uns in Kontakt:

- Mängel melden
- support-business@eneco.com
- +49 9321 9319 101

- The Transparency Software is a virtual display, thus legal part of the charging station for validating the digital signatures of measurements

- EV drivers and the PTB can use this regulated software in case of a dispute

- Regulated means: It's a Linux Live ISO image ;)
But Windows "toy" versions are also available



Chargy Transparency Software

- **First Open Source Transparency Software for E-Mobility**
- **Data formats of many different vendors are supported**
- **Based on the Electron Framework**
 - **Cross-Platform: Windows, Mac OS X, Linux**
 - **TypeScript, SCSS, HTML**
 - **Source Code: <https://github.com/OpenChargingCloud/ChargyDesktopApp>**
 - **Smart Phone apps would be possible, but the PTB does not certify them**



♥ Sponsor on GitHub

Freistaat
Thüringen



Thuringian Ministry
for Economic Affairs, Science
and Digital Society



Chargy - Transparenzsoftware für die Elektromobilität

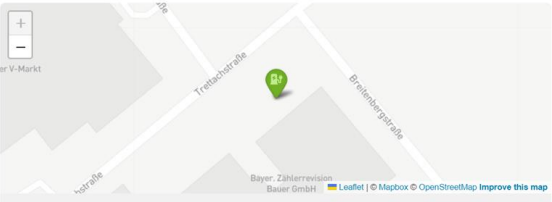
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Messwerte

10 kWh	0 kWh	0 kWh	✔ Gültige Signatur
10 kWh	15 kWh	15 kWh	✔ Gültige Signatur

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Demo Time

Commodore 1084B
VIDEO MONITOR

Chargy - Transparenzsoftware für die Elektromobilität

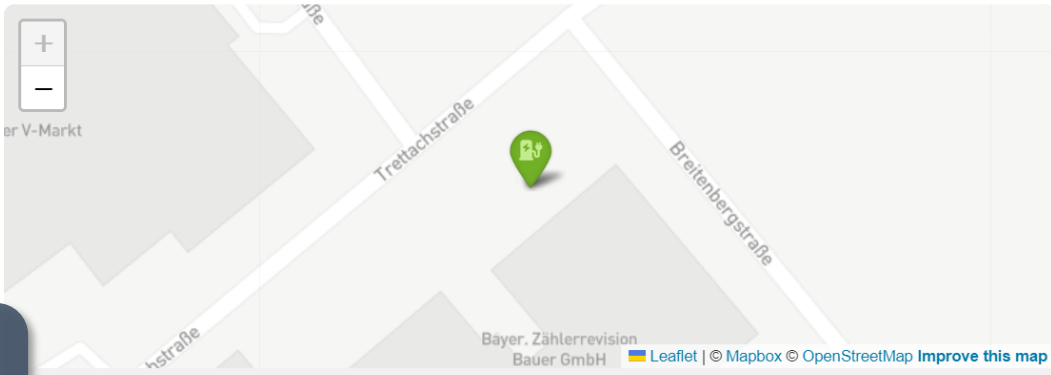
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Nice idea, but...

- ...which transparency software?
- ...which version of the software?
- ...which meter public key?
- ...how good or bad is UI & UX?
- ...what about **billing**?



not really helpful



Billing?

- EV drivers want to **verify invoices**, not metering measurements
- So where to get authentic & timestamped charging tariff information from?
- In Germany
Preisangabenverordnung (PAngV)
- In the Netherlands
Real-time tariff information before, during and after charging

Missing overall architecture

- „Eichrecht“ as a digital process is reasonable but fails in daily operations
- Nothing in e-mobility really fits together
- Security requirements are not understood
- Security goals can not be realized



Surprise! Some new EU Regulations

EU NIS 2 Cyber Security (2022/11)

Charging Stations and Charging Operator Backends are now part of “sectors of high criticality”.



EU RCE (2022/12)

Resilience of critical entities



...till October 2024

Member states must define national laws.

e.g. using metering data for grid load management
without real security? Really?!

Surprise! Some new EU Regulations

EU NIS 2 Cyber Security
Charging Stations and
part of "sectors of high




Let's reboot E-Mobility ICT





Open vs. Closed World

- **E-Mobility must become a true “Internet of Energy”**
Today it is more a union of loosely coupled electric kingdoms 
- **All higher-level protocols need a solid & secure E2E infrastructure like TLS/TCP/IP**
- **Common definition of entities, semantics, errors**
Some protocols still have no concept of charging stations(!)
- **Defined (protocol) extensibility everywhere**

Chargy TS 1.5+

Uses even more crypto...

- Energy Meters to sign energy meter values
- Station Operators to sign B2B/B2C tariffs & invoices, location and real-time data
- E-Mobility Providers to sign B2C tariffs & invoices, anonymous EV driver identities
- EV Drivers to verify their temporary E2E identity
- Energy Managers to sign charge plans





Chargy Transparency SaaS

SaaS services for charging infrastructure related data, security and transparency just like the **EU Medical Device Regulation (MDR) & EUDAMED database**

- Vendors, device models, PTB certificates, ...
- Operators, devices, daily self tests, ...
- Real-time full async server-to-server protocol suite to enable scalability and real e-mobility business models

