The Society of Electrical and Electronics Engineers in Israel

Electricity & Energy 2019

The 20th international Annual Convention

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Smart Meter Security

Basis for smart grid security, availability and reliability

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Germany

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Content

- Introduction
- Smart Meter Rollout - Germany
- Smart Meter Rollout - International
- Common security aspects
- Testing requirements and options
- Cooperation NMi – exceeding solutions

Sorry for my bad English!

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Hochschule Merseburg

- 2.500 students
- 3 faculties
- Professorship for computer networks and virtual instrumentation
- Since 2015 first test lab for German smart meter rollout (*“Intelligente Messsysteme 2020”*)

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- Founded in 2013
- Employees (2019)
  - 16 of 20 are engineers/academics
  - 14 of 20 are developers for hard- and software
- Divisions
  - Smart metering (70%)
  - IoT and IT services (20%)
  - Ultrasound and industrial (10%)
- Sales
  - 1,2 Million € in 2018

E-world 2019, Essen

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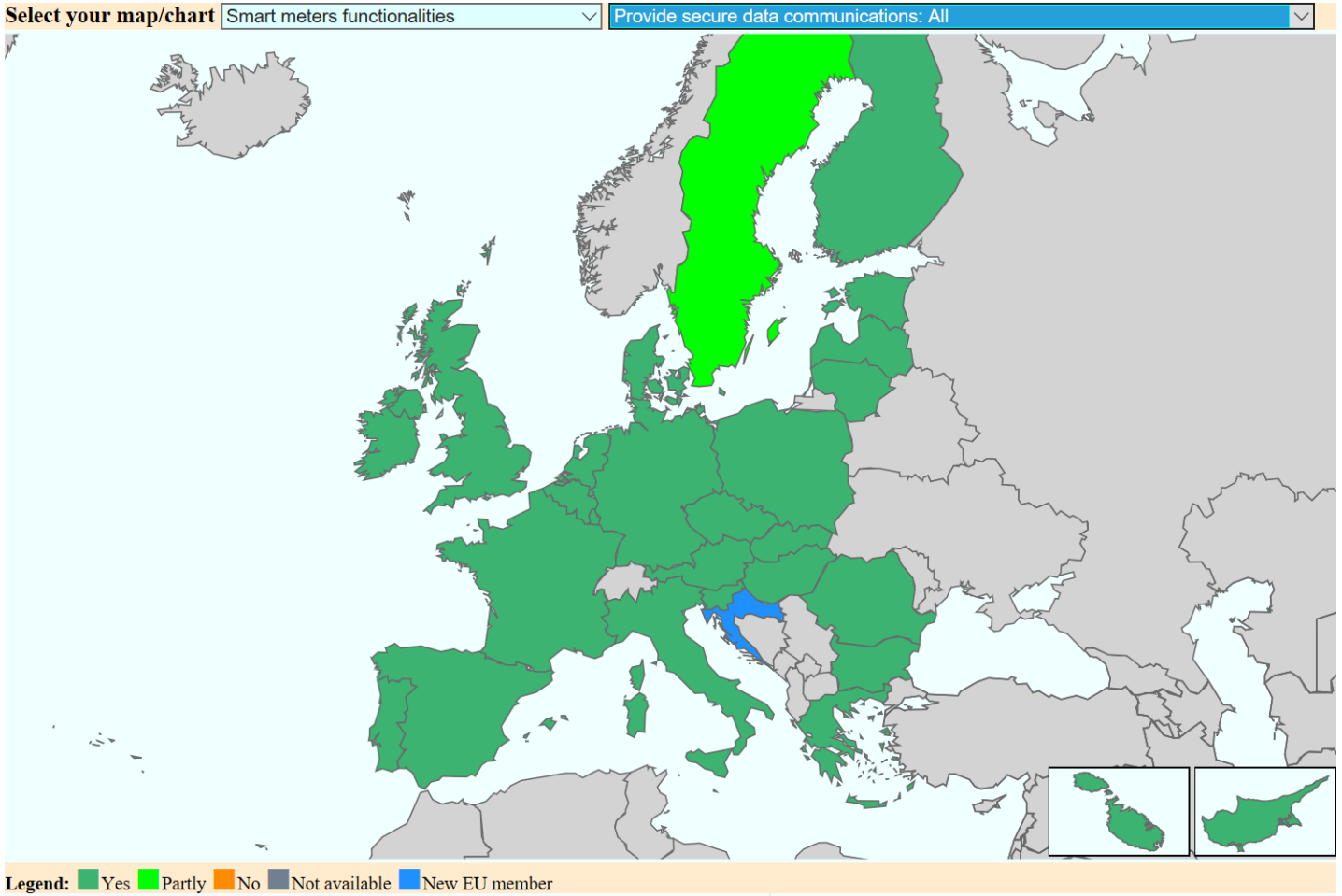
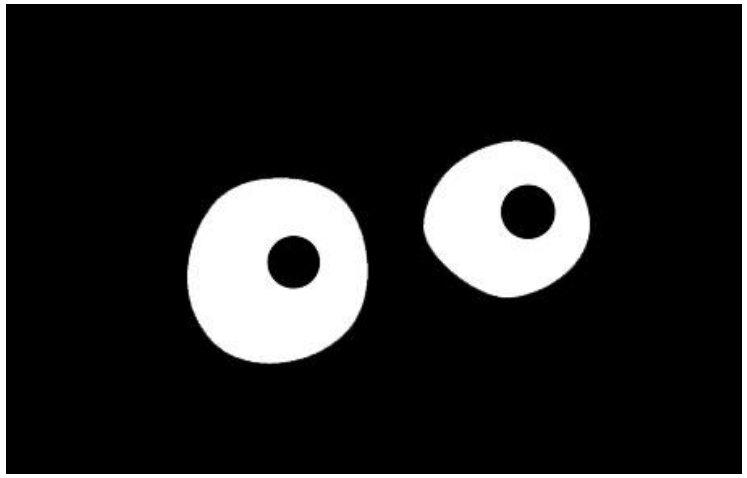
Smart Metering Rollout in EU – Secure communication



http://ses.jrc.ec.europa.eu/smart-metering-deployment-european-union

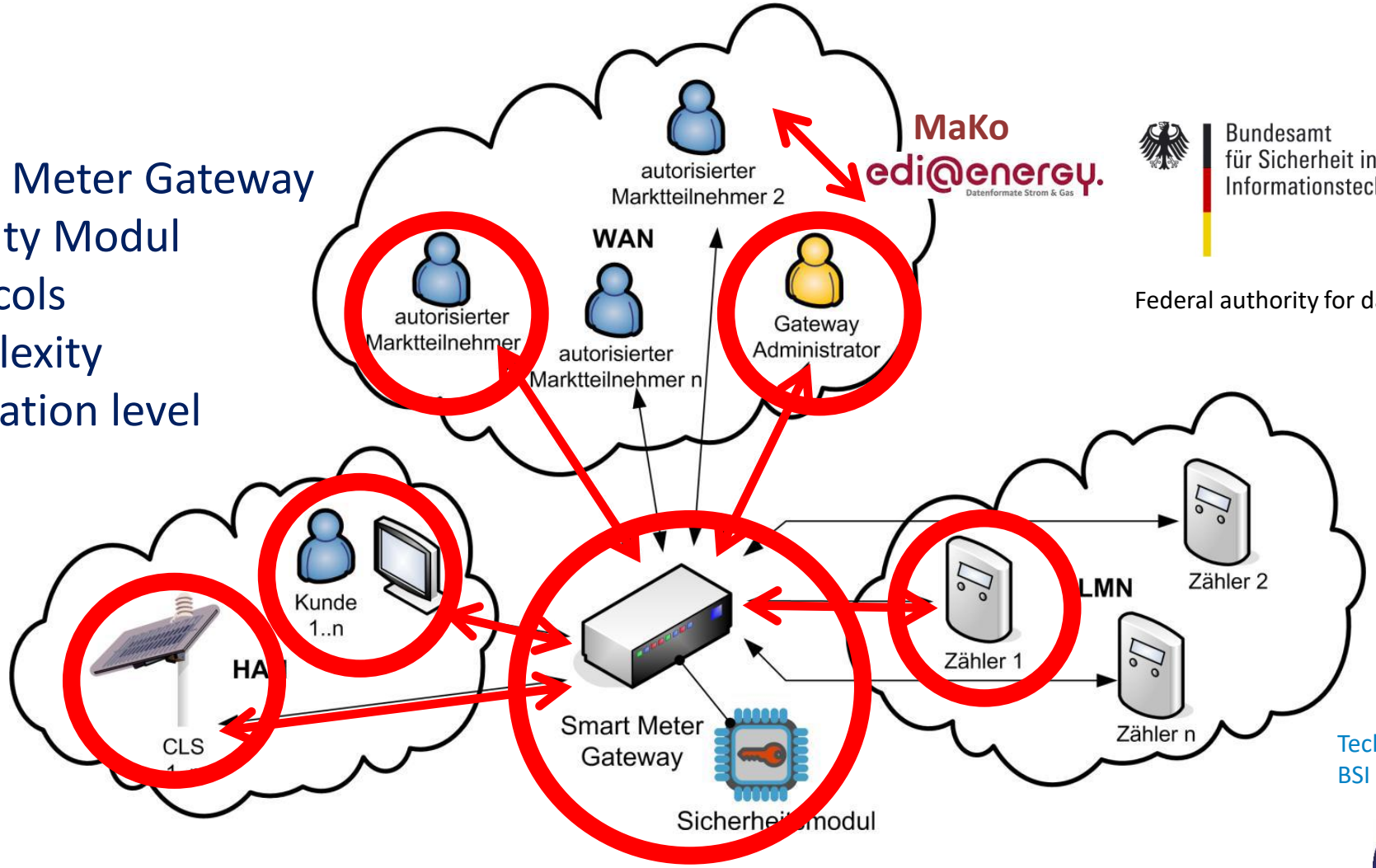
What are the challenges?

- Data protection
- Hacking prevention
- Manipulation prevention
- Grid security
- Blackout prevention
- …



The German approach

- Special:
  - Roles
  - Smart Meter Gateway
  - Security Modul
  - Protocols
  - Complexity
  - Integration level



MaKo edi@energy. Datenformate Strom & Gas

Bundesamt für Sicherheit in der Informationstechnik

Federal authority for data security

Technische Richtlinie
BSI TR-03109

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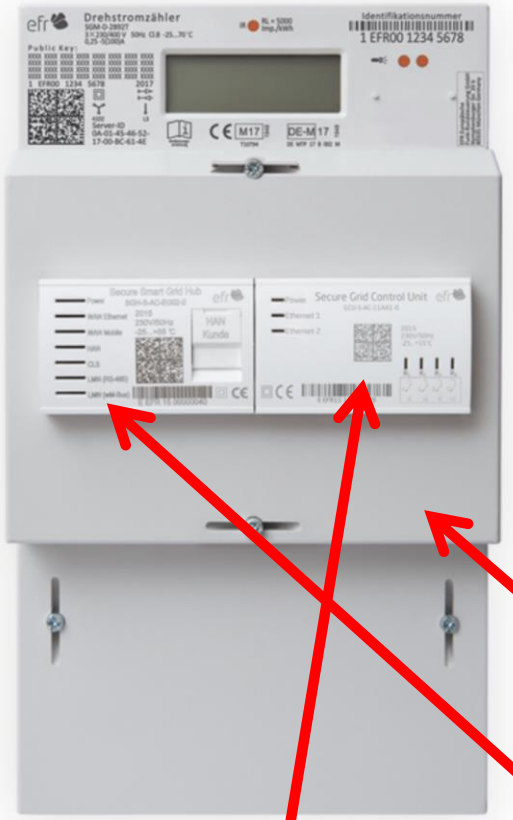
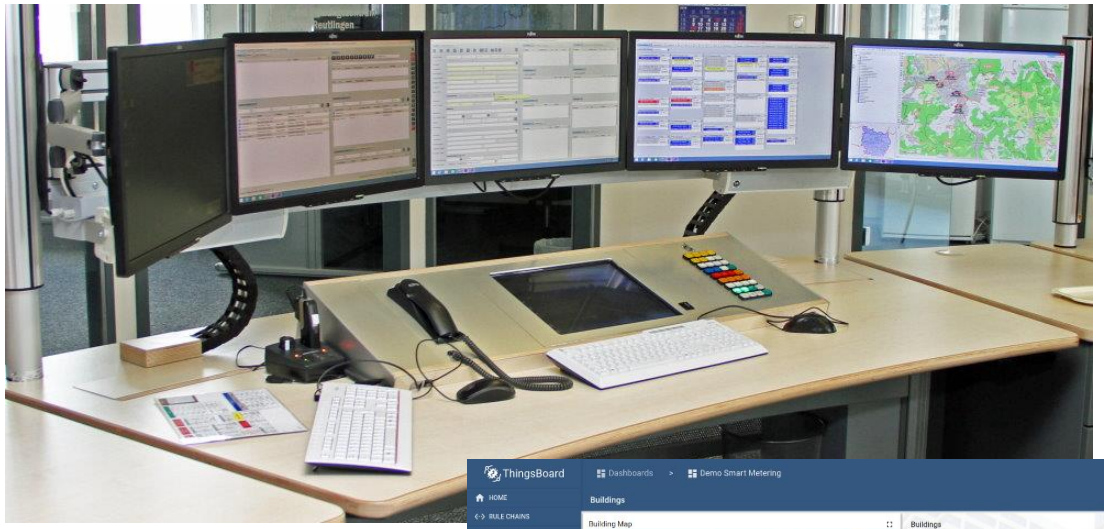
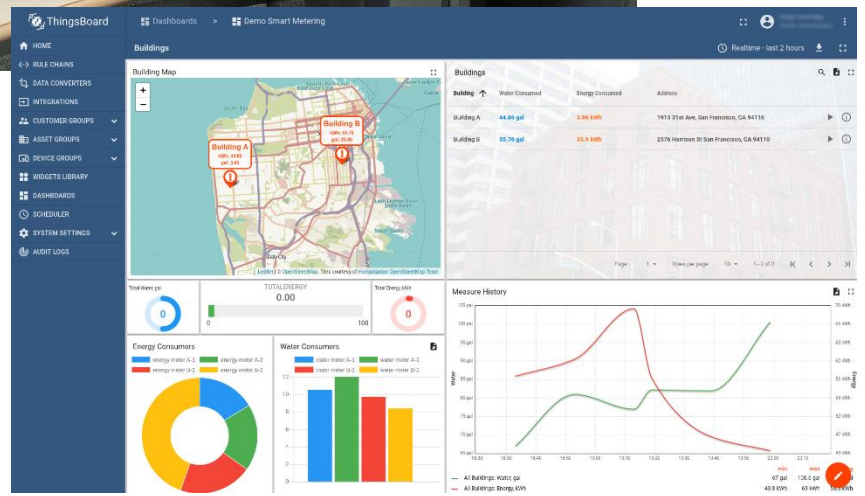
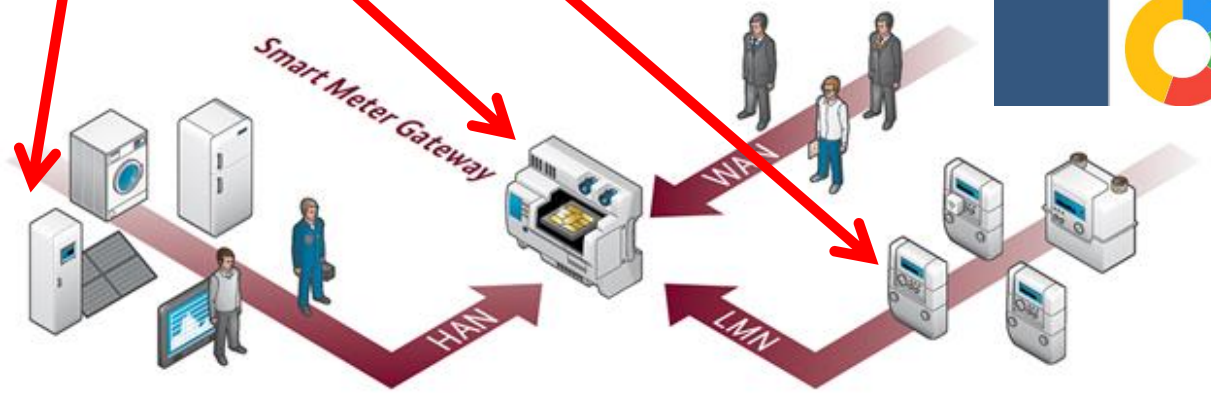




Grid operator





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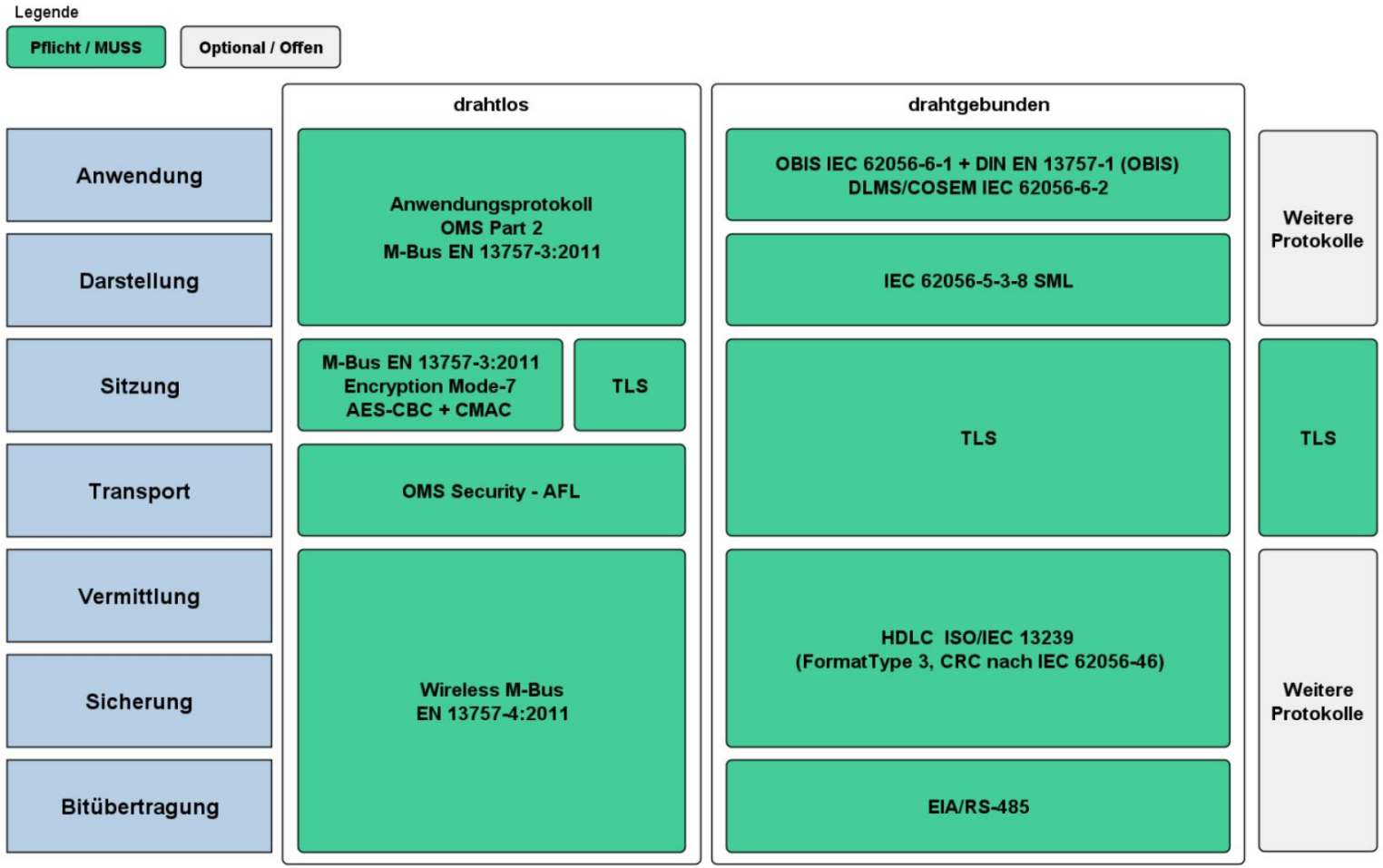
LMN protocol stack

- Meter/SMGW interface:
  - Wired
  - Wireless
  - „Proprietary“ protocols (SML)
  - Combined with standards (TLS, wM-Bus, AES-CBC-CMAC)



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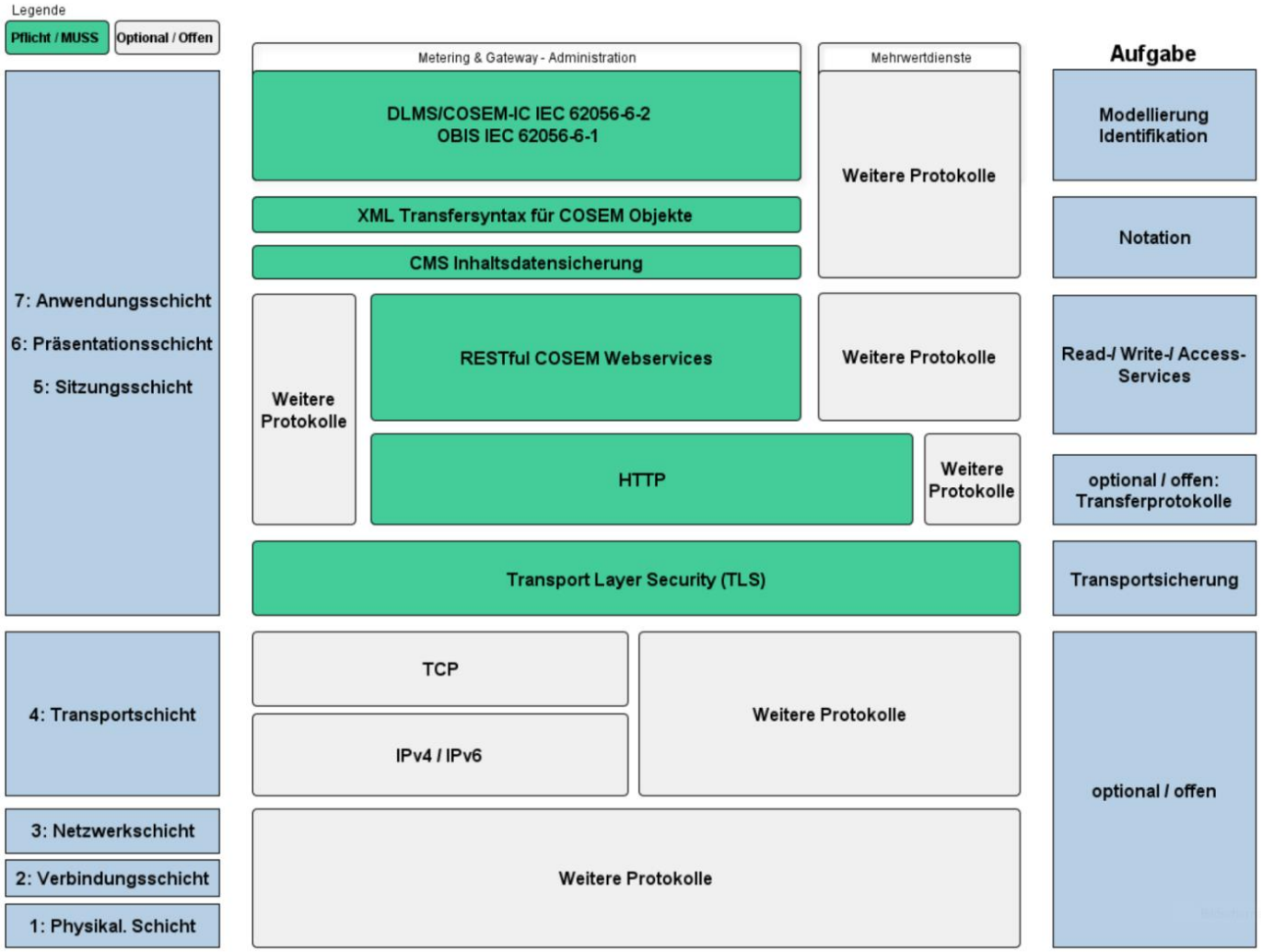
WAN protocol stack

- SMGW-to-GWA/EMT interface:
  - On top of TCP/IP
  - GPRS, LTE, ETH, PLC, …
  - „Proprietary“ protocols (COSEM/XML)
  - Combined with standards (TLS, HTTP, RESTful WS)



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What is cryptography?

- Big number computation
- Public algorithms
- Private/secret key data
- Symmetric, asymmetric and message digest algorithms and their combinations
- Data structures, data encoding, protocols
- International standards
- National/proprietary standards

BSI selected cryptography

- Premium quality
- Similar to other eGovernment security project (e.g. identity card)
- Elliptic curve cryptography (ECC … no RSA or others)
- Special curves (brainpool)
- AES-CBC-CMAC (authenticated encryption)
- TLS 1.2 (with strong restrictions and always client authentication)
- Additional end-to-end data security with CmsSignedData and CmsAuthEnvelopedData (similar to signed and encrypted email)
- All ECC operations (plus RNG) in hardware (security module, HSM)
- SM-PKI-DE
- Certification of SMGW (BSI PP/CC, PTB), meters (PTB, FNN) and backend IT (ISO 27001)

very difficult

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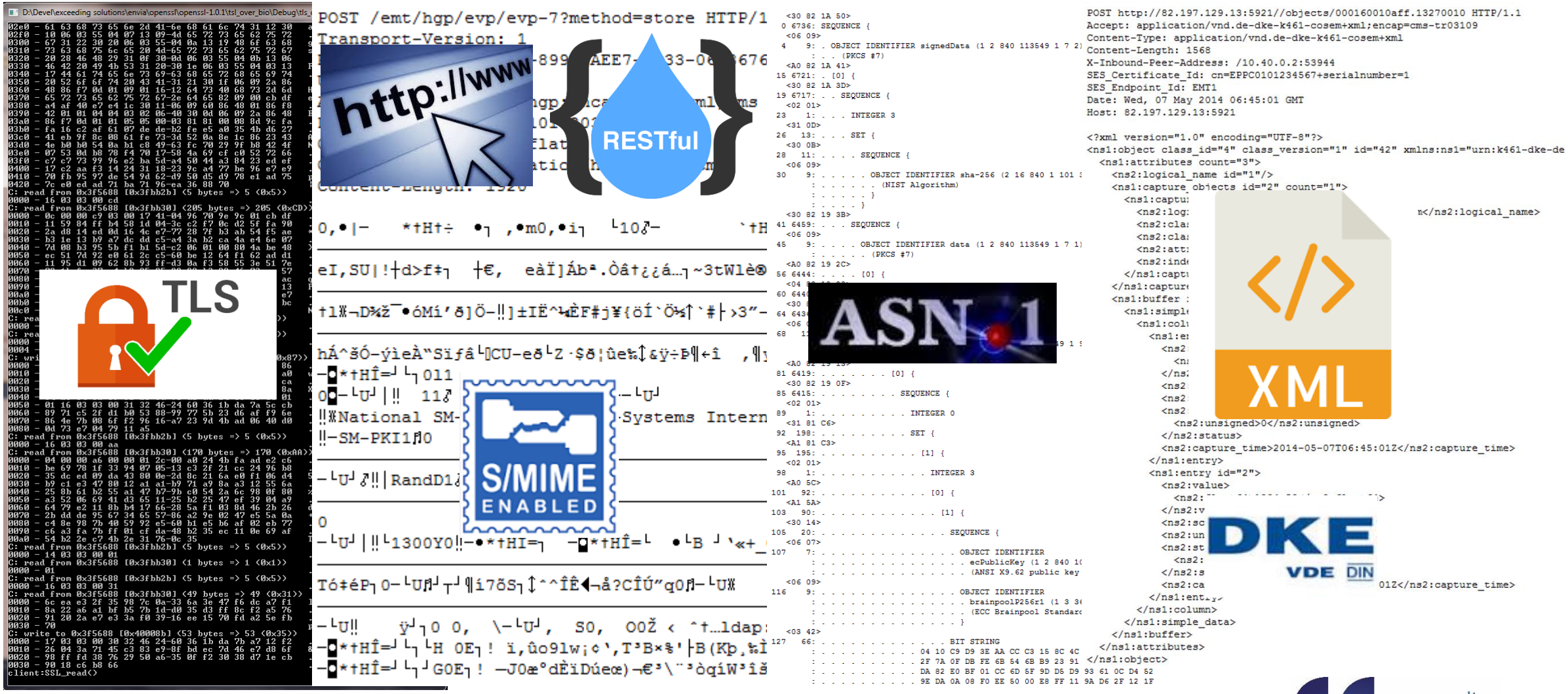
How the communication looks like?



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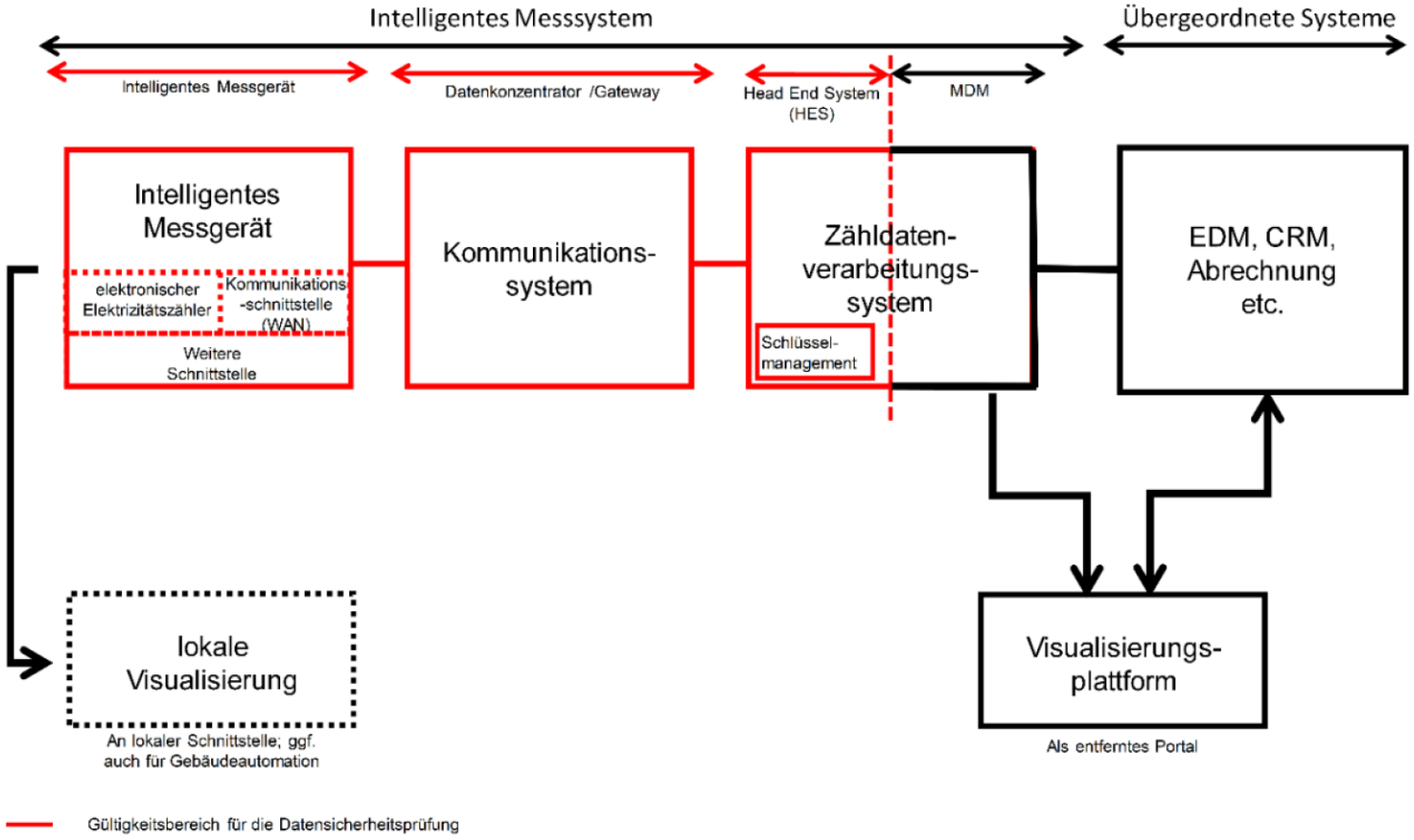
Smart Meter Rollout Swiss

- Different wording
- Different technologies
- Different certification
- Similar architecture



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International

- DLMS
  - „DLMS -The true international metering standard“

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Comparision - cryptography

Category	German approach	International
Symmetric cryptography	Wired LMN pairing phase 1 (SYM) [FNN] wM-BUS (security mode 7) [OMS] AES-CBC-CMAC-128	DLMS/COSEM security suite 0 [DLMS] wM-BUS (security mode 5, 7) [OMS] AES-GCM-128
Transport layer security	TLS 1.2 (SM-PKI-DE) [RFC + BSI] >= TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLS 1.0 – 1.2 [RFC] VPN
Application layer security (asymmetric/hybrid cryptography)	SML signature [FNN] CmsSignedData (SM-PKI-DE) [RFC + BSI] CmsEnvelopedData (SM-PKI-DE) [RFC + BSI] ECC BRAINPOOL (& NIST)	DLMS/COSEM security suite 1 [DLMS] DLMS/COSEM security suite 2 [DLMS] ECC NIST ECDH_ECDSA_WITH_AES_GCM_128_SHA256

not so different

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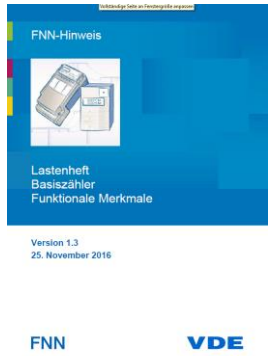
Standardization/Certification

- International
  - MID
  - DLMS
  - OMS
  - ESMIG
- Germany
  - MID
  - FNN
  - OMS
  - DKE
  - PTB
  - BSI

mostly different



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Challenges

- Complex technologies
- Special and proprietary protocols
- „invisible“ data
- Huge number of transactions and amount of data
- Limited humans
- Infinitely sources of error
- Many threats

Testing, testing, testing, …

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es:Testsystem

advertising block

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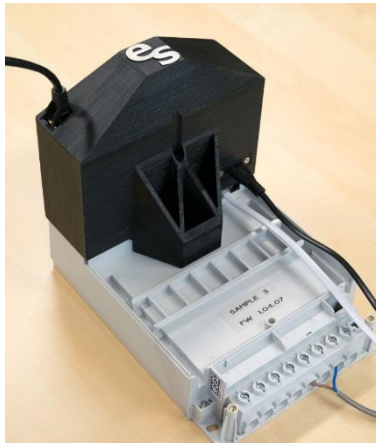
ToE - FNN base meter



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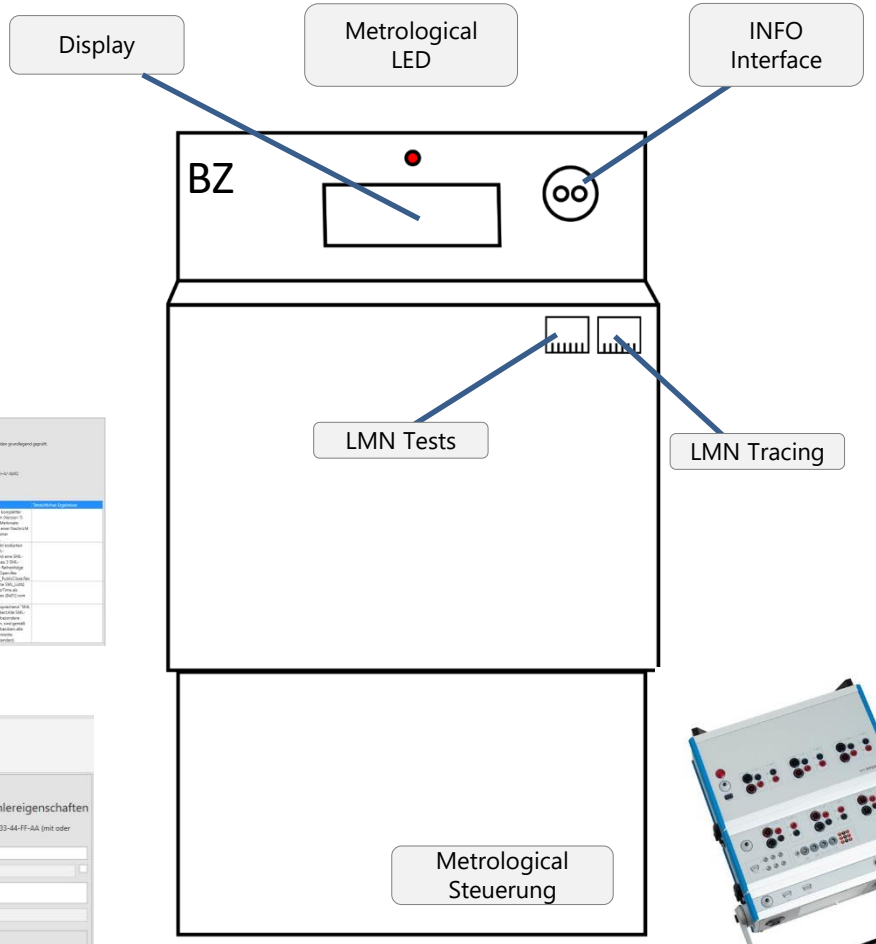
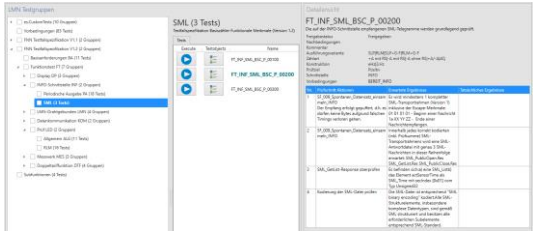
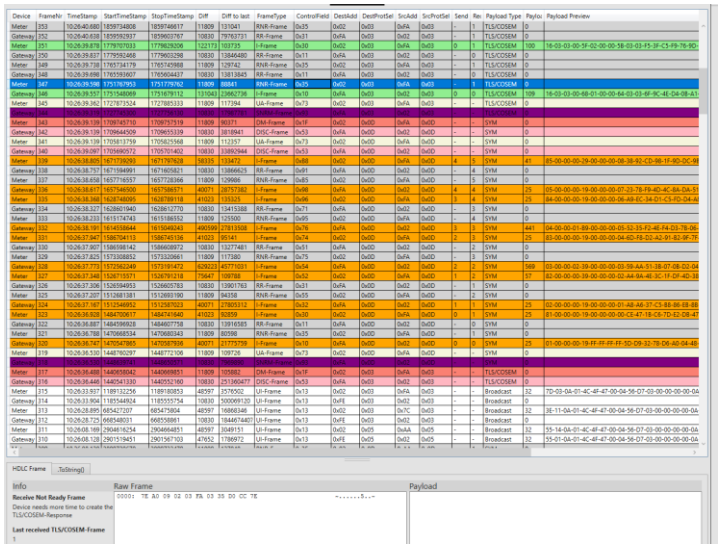
SMOCS
Smart Metering Optical Capture System







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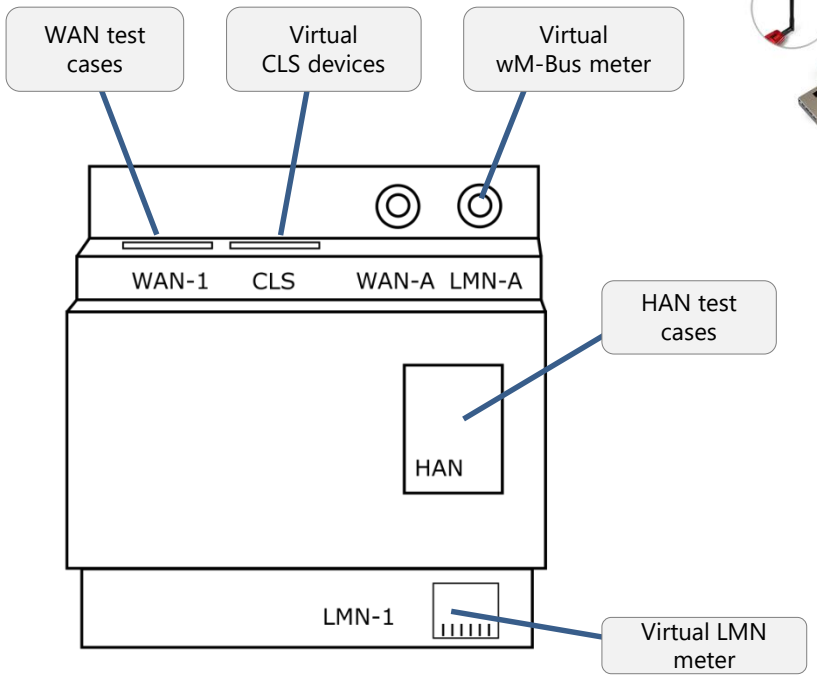
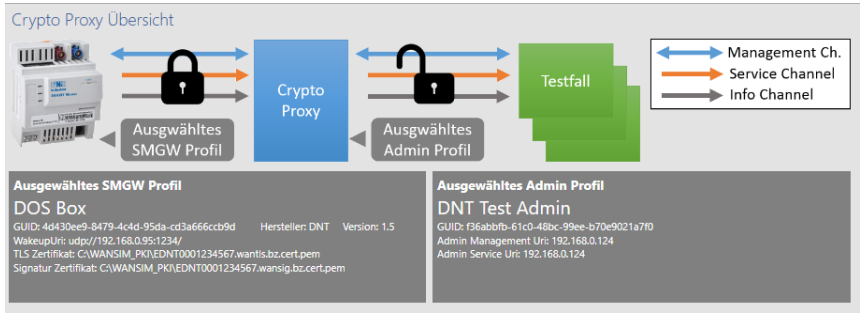
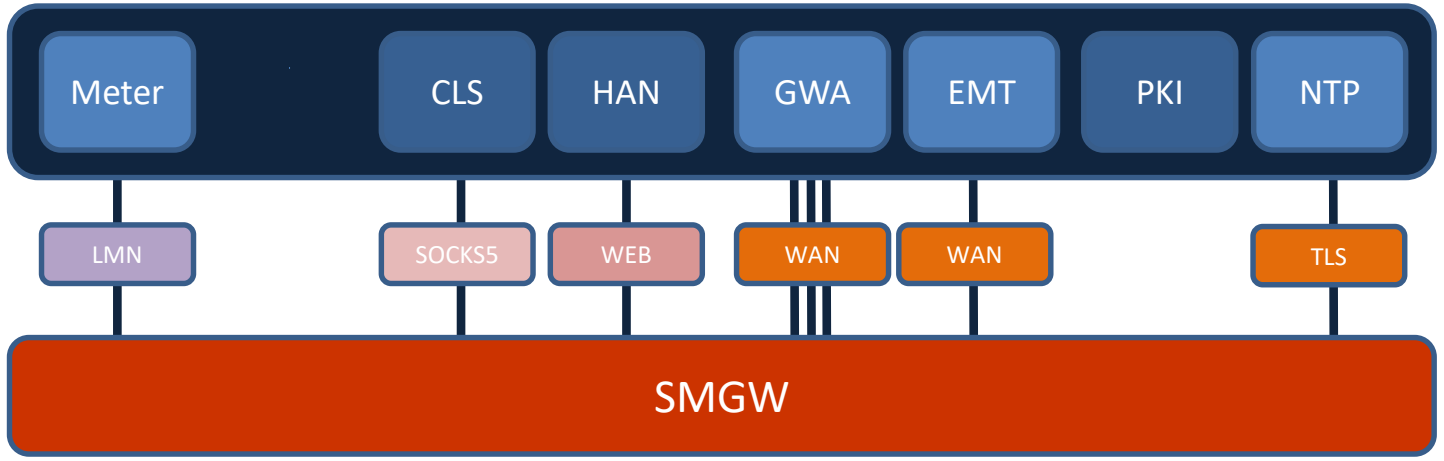
ToE - BSI SMGW


WAN-A
LMN-A
theben
PWR
TLS
LMC
wMT
DE-M
CX
CONEXA 3.0
WAN-1
CLS
LMN-1

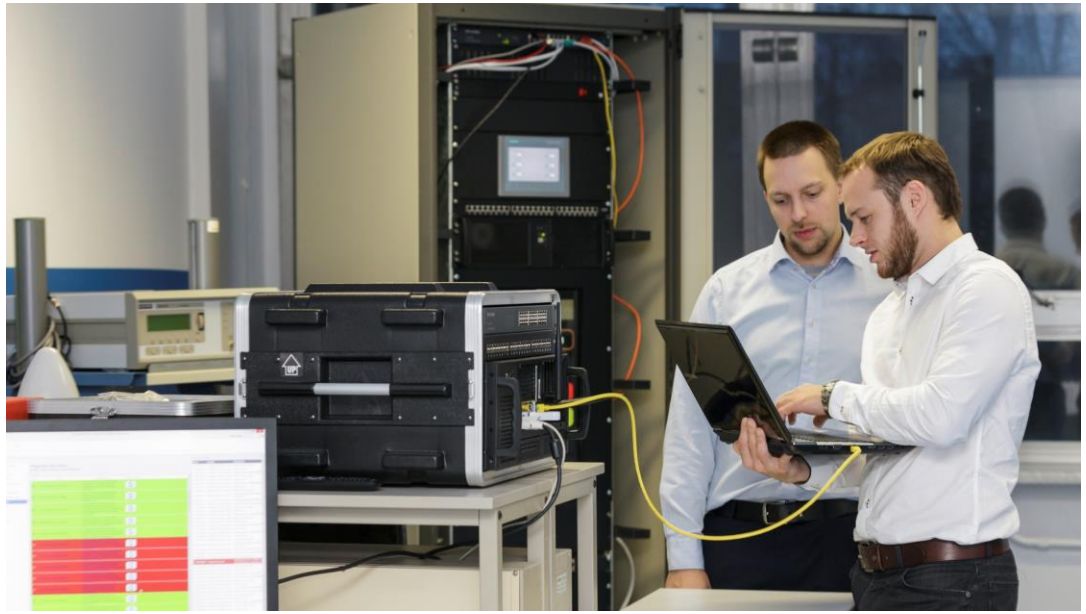

WAN test cases
Virtual CLS devices
Virtual wM-Bus meter
WAN-1
CLS
WAN-A
LMN-A
HAN test cases
HAN
LMN-1
Virtual LMN meter

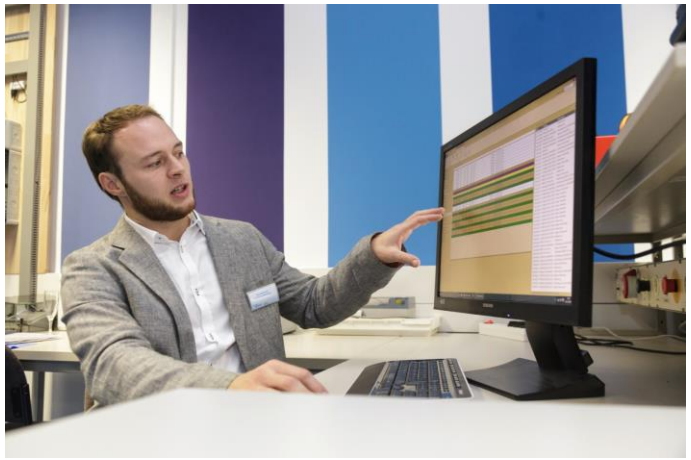

Crypto Proxy Übersicht
Ausgewähltes SMGW Profil
Crypto Proxy
Ausgewähltes Admin Profil
Testfall
Management Ch.
Service Channel
Info Channel
Ausgewähltes SMGW Profil
DOS Box
GUID: 4d430ee9-8479-4c4d-95da-cd3a666ccb9d
Hersteller: DNT
Version: 1.5
WakeupUri: udp://192.168.0.95:1234/
TLS Zertifikat: C:\WANSIM_PKI\EDNT0001234567.wantls.bz.cert.pem
Signatur Zertifikat: C:\WANSIM_PKI\EDNT0001234567.wansig.bz.cert.pem
Ausgewähltes Admin Profil
DNT Test Admin
GUID: f36abbfb-61c0-48bc-99ee-b70e9021a7f0
Admin Management Uri: 192.168.0.124
Admin Service Uri: 192.168.0.124


Meter
CLS
HAN
GWA
EMT
PKI
NTP
LMN
SOCKS5
WEB
WAN
WAN
TLS
SMGW

Testing services

- Meter
- SMGW
- Backend IT
- Conformance
- Vulnerability
- Interoperability
- Performance
- …





Activities with NMi Certin B.V.

- First projects (started in 2017)
- Mutual education and certification (01/2019)
- Smart Meter Test Lab Merseburg, Germany (06/2019)
- Strong Cooperation in several fields (ESMIG, penetration testing, …)

https://www.nmi.nl/data-security-of-smart-meters/

https://www.nmi.nl/markets/cyber-security-and-safety/

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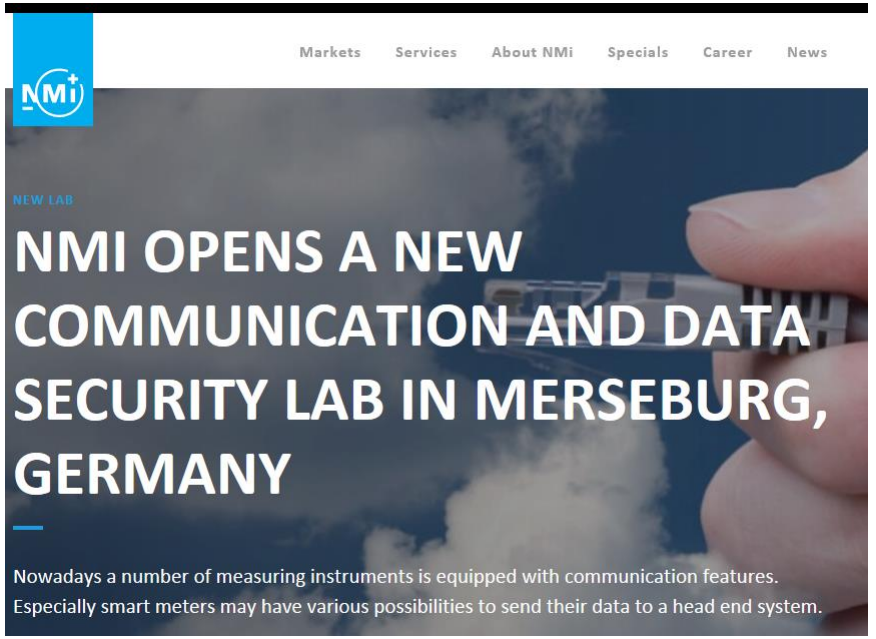
NMi Smart Meter Test Lab Merseburg, Germany



https://www.nmi.nl/nmi-opens-a-new-communication-and-data-security-lab-in-merseburg-germany/

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ESMIG security requirements

Smart Meter Co-ordination Group
Privacy and Security Approach – Part IV

Minimum security requirements for AMI components

European level requirements for Smart Metering

Version: 1.1
Date: 17th July 2016
Authors: SM-CG Task Force on Privacy and Security / ESMIG

- A: All AMI components SHALL provide a log of security events
- B: All data exchanges SHALL take place in a (end-to-end) secure manner
- C: Availability of the system (AMI components and communication network) SHALL be sufficient
- D: Crypto mechanism and key management SHALL be documented and be compliant with recognized/proven and approved open standards
- E: Every AMI component SHALL check the authorization
- F: Data at rest SHALL be protected in all system components
- G: AMI components SHALL be upgradable for new (security) functionalities
- H: Functionalities in AMI components SHOULD be limited to the intended operational Use Cases
- I: AMI components and the communications network SHALL be adequately protected against external disturbances and/or attacks

AMI … advanced metering infrastructure

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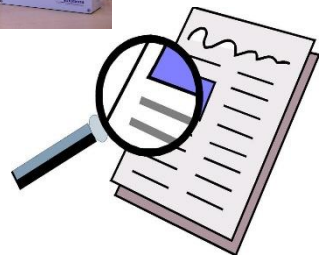
ESMIG … certificate

ESMIG

Test specification

Test implementation

Test report



Certificate

First pilot projects are running!

Any questions …

- Why the smart meter rollout projects are late (so late)?
- Complexity means security?
- What about process security?
- … communication stability?
- … business cases?
- … customer acceptance?
- Where we find the technical experts?

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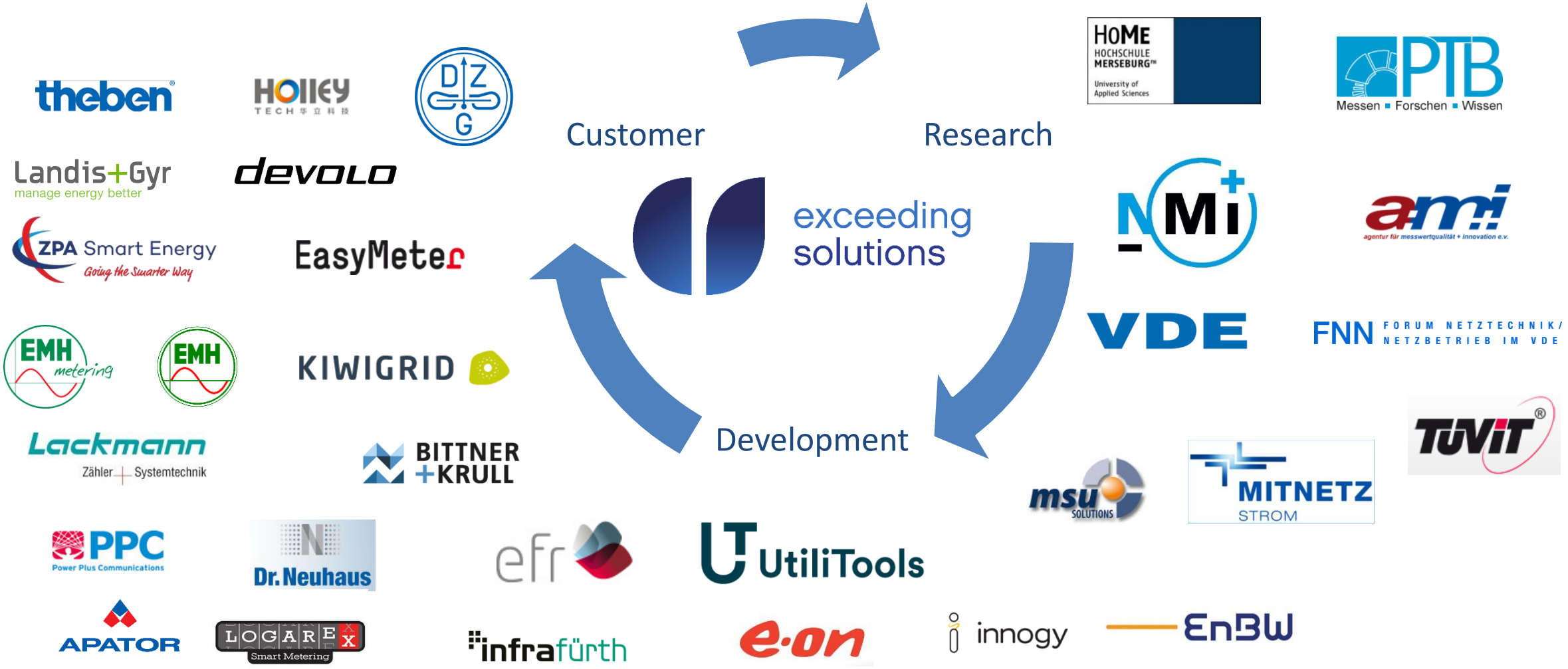
Cooperation – Smart Metering



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