

ETIP-SNET,  
Zagreb, 19-20.09.2018

# The SUCCESS Project

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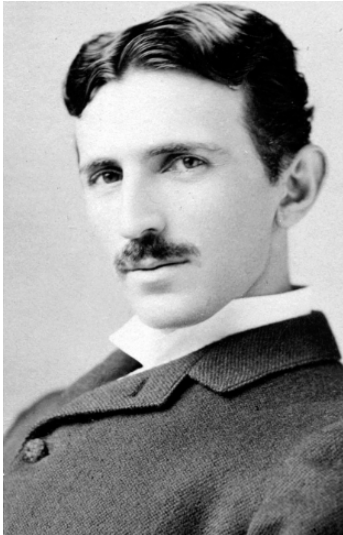
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securing critical  
energy infrastructures

# ETIP-SNET prepares today power systems for the future

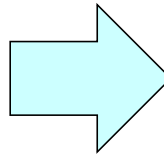
But the invention of power systems is  
related to a man born in this region



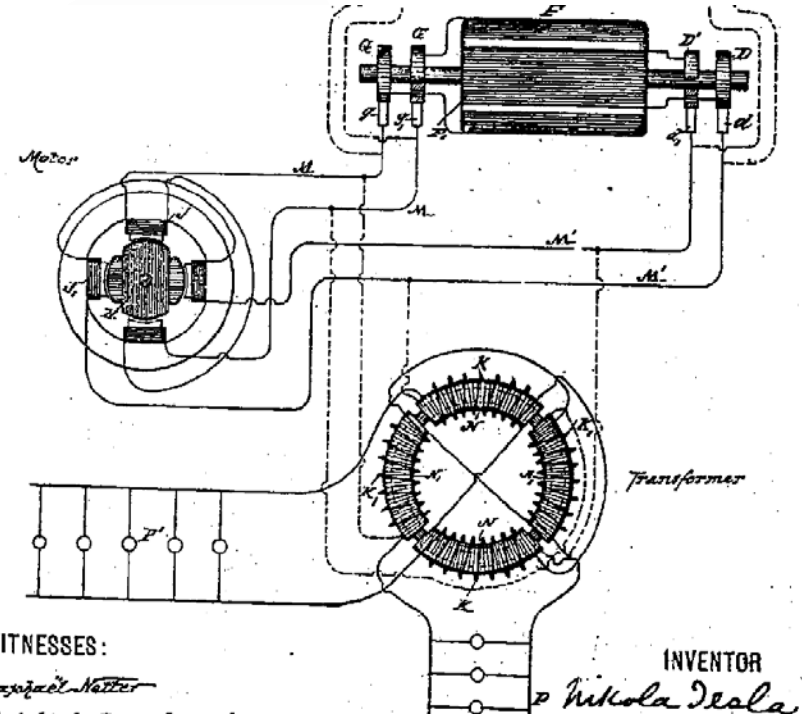
**Smiljan**  
1856



**New York**  
1943



Patent 390 721 / 1888 (Nikola Tesla)  
(one of the important patents shaping 20<sup>th</sup> century)





## The SUCCESS project overarching strategic objectives:

A new approach to the **security of the energy systems**, guaranteeing their security of operation

### SUCCESS Approach:

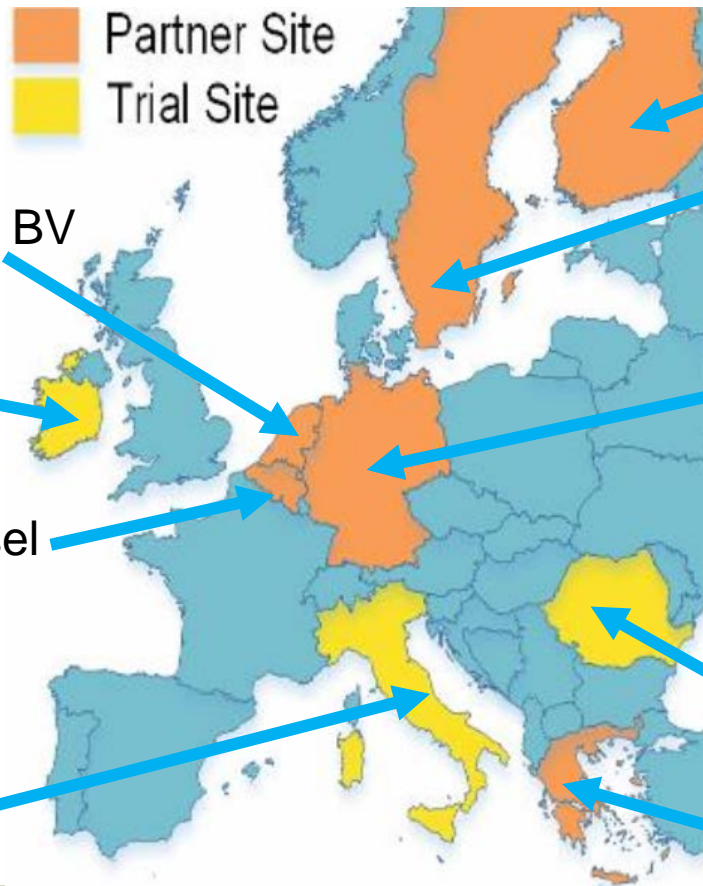
SUCCESS is achieving this objective by **encapsulating the key challenges of Security, Resilience, Survivability and Privacy in 3 use cases**

### SUCCESS Results:

SUCCESS produces **a comprehensive framework for securing Smart Grids**



# The consortium

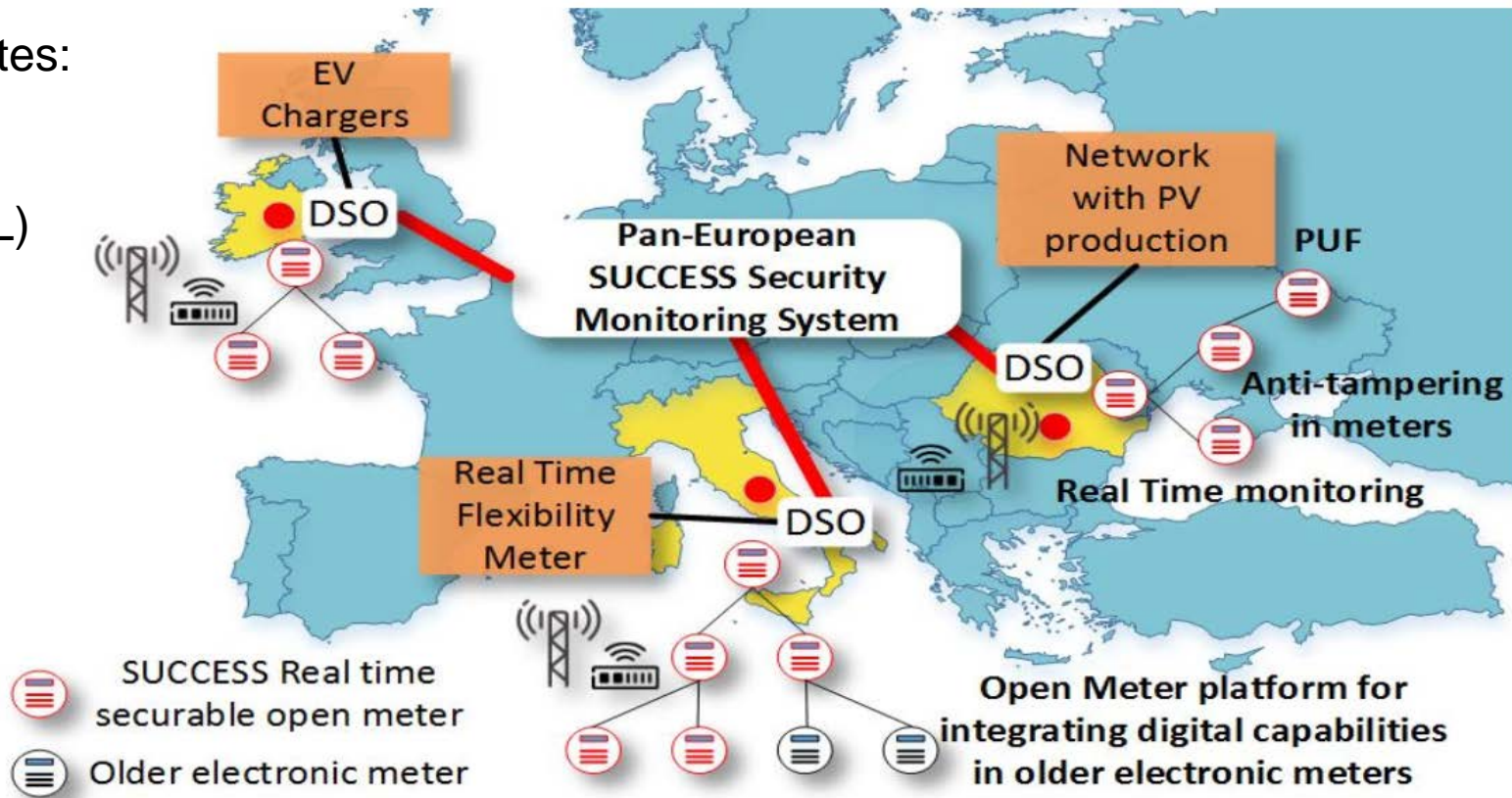


- OY Ericsson
- KTH
- Ericsson GmbH (leader)
- RWTH Aachen
- P3 Communications
- P3 Energy & Storage
- Romanian Energy Center (presenter)
- Electrica SA
- Synelixis
- KEMA Netherland BV
- ESB Networks
- Vrije Universiteit Brussel
- ASM Terni
- Engineering
- Teamware
- ISMB



## The trial sites:

Terni (IT)  
Dublin (IRL)  
Romania



## Unbundled Smart Meter (USM) architecture,

Support for **Smart Grid**

Real-time data

Support for **dynamic energy markets**

Support for **Power Quality**

Including harmonics

Support for **production and storage control**

Support for **Energy services**

Support for **security and privacy**

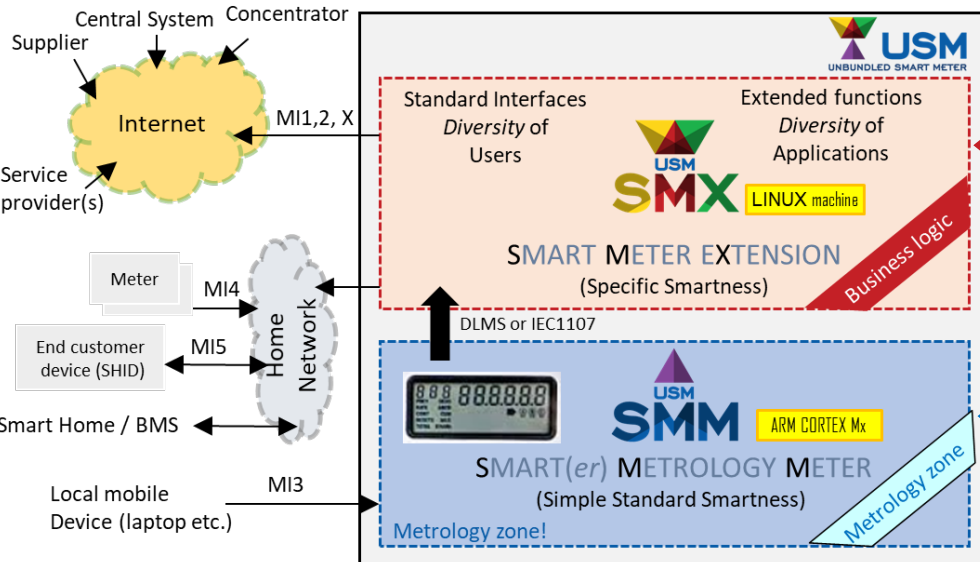
Support for  
**Unknown yet !**

(services of the future)

Developed in  
**NOBELGRID**  
project

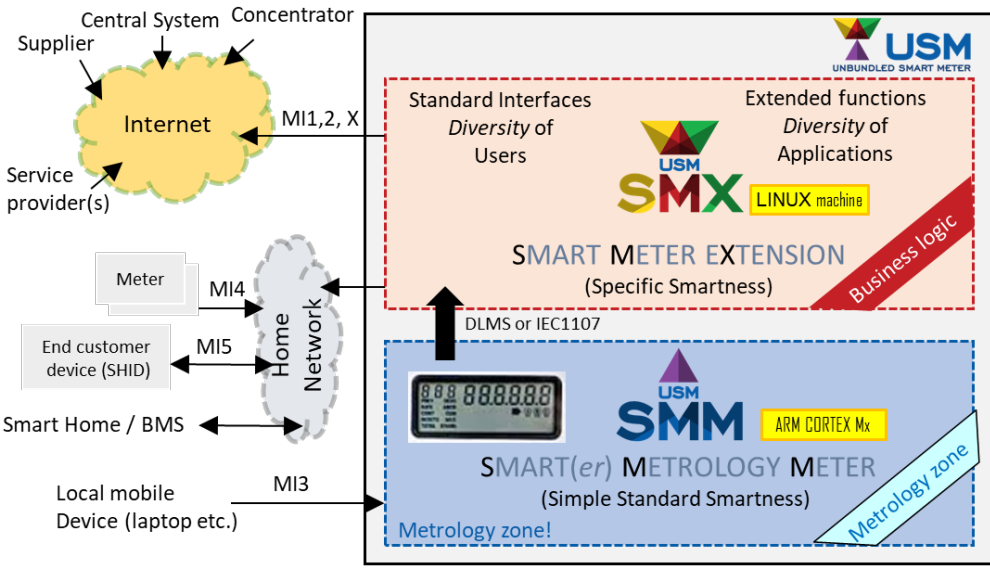


- Competition of Ideas on Smart Grid Functionalities
- Frequent changes, based on Smart Grid evolution
- New business cases easily deployed
- Competition on Standard equipment
- Minimal risk of being technically obsolete during its lifecycle (e.g.15 years)
- Securing investment

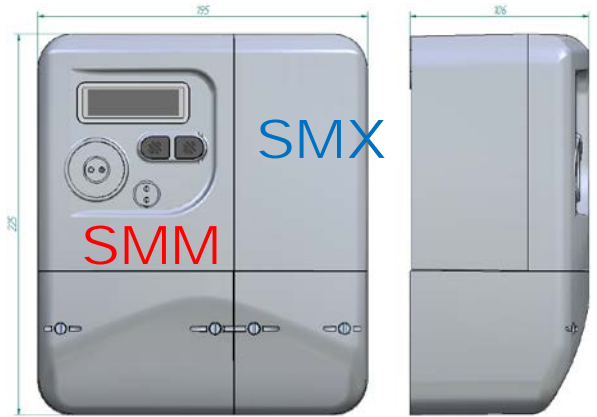
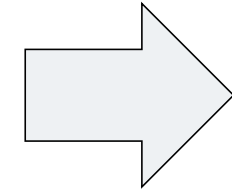
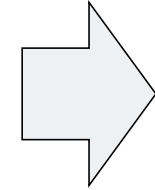
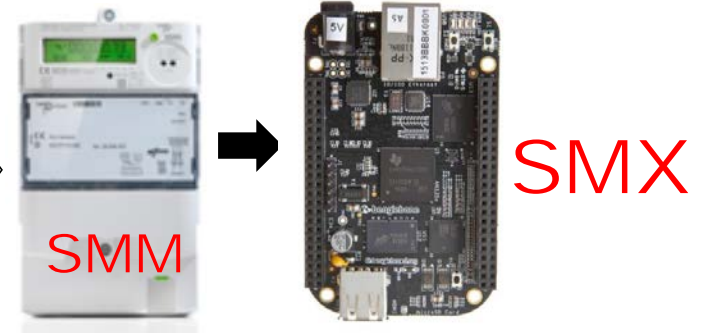


# Background:

## Unbundled Smart Meter (USM) architecture



Developed in Nobel Grid project

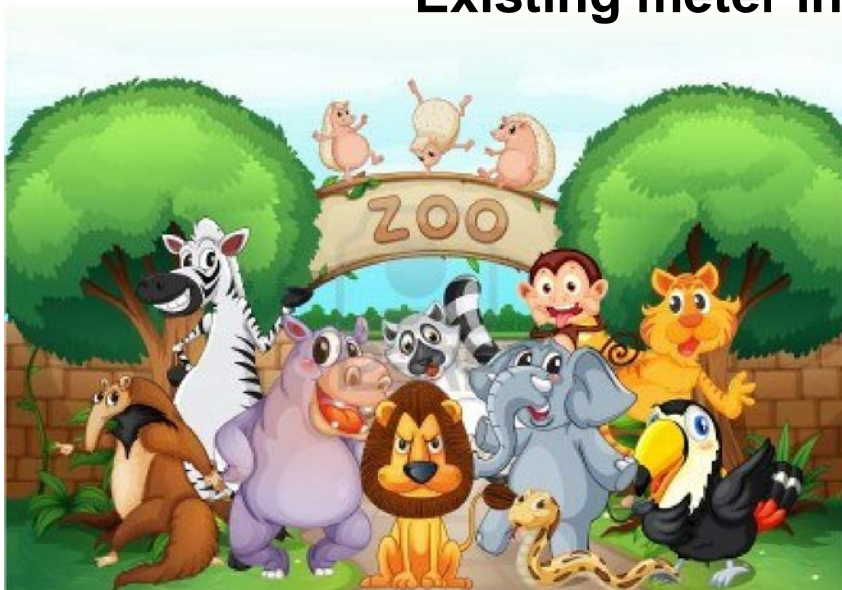


TRL9

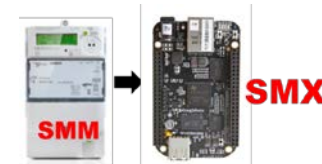


## Unbundled Smart Meter (USM) – Lesson learned:

### Existing meter integration is a nightmare !



- Multitude of protocols
- Non-standards protocols
- Custom (secret) protocols
- Standard protocols but wrong implemented
- Standard protocols are not enough standard (e.g. DLMS/COSEM)
- Data security issues in some situations
- Lack of documentation
- No communication interfaces (except IR port)

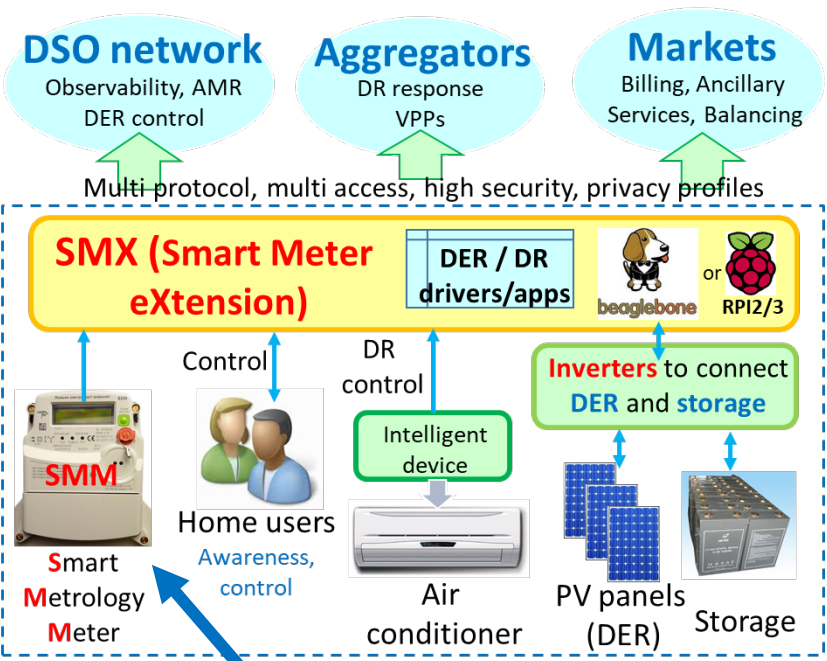


**CEN-CENELEC standardization and real meters life: Improvements are definitively needed**





# Unbundled Smart Meter (USM): Support for **Known** and **Unknown yet**



Using meters which proved working (and using SLAMs)

**WiseGRID**



RES, storage, EVs and enhanced smart grids

**NRG5**



Blockchain technology in SMX / SLAM

**Storage4Grid**



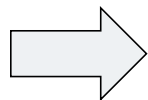
Using USM for valuing prosumers with storage/EVs

And in **SUCCESS** .. to be presented





# SUCCESS



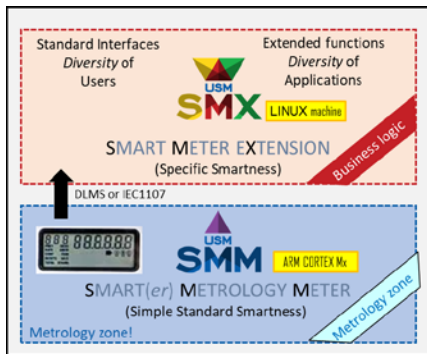
## Next generation Open real-time Smart Meter

# NORM

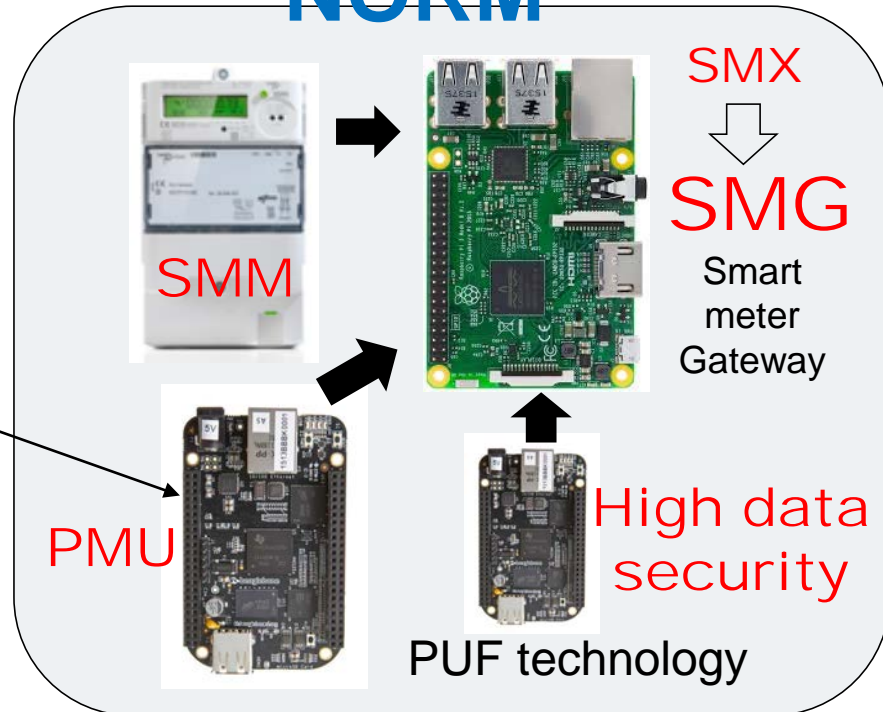
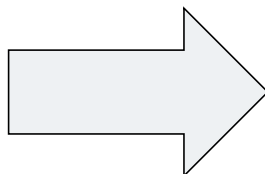
### Key exploitable results:

- Serving Active distribution networks, microgrids, high RES
- Implementing SUCCESS Security Solutions, facing cyber attacks

Open source part



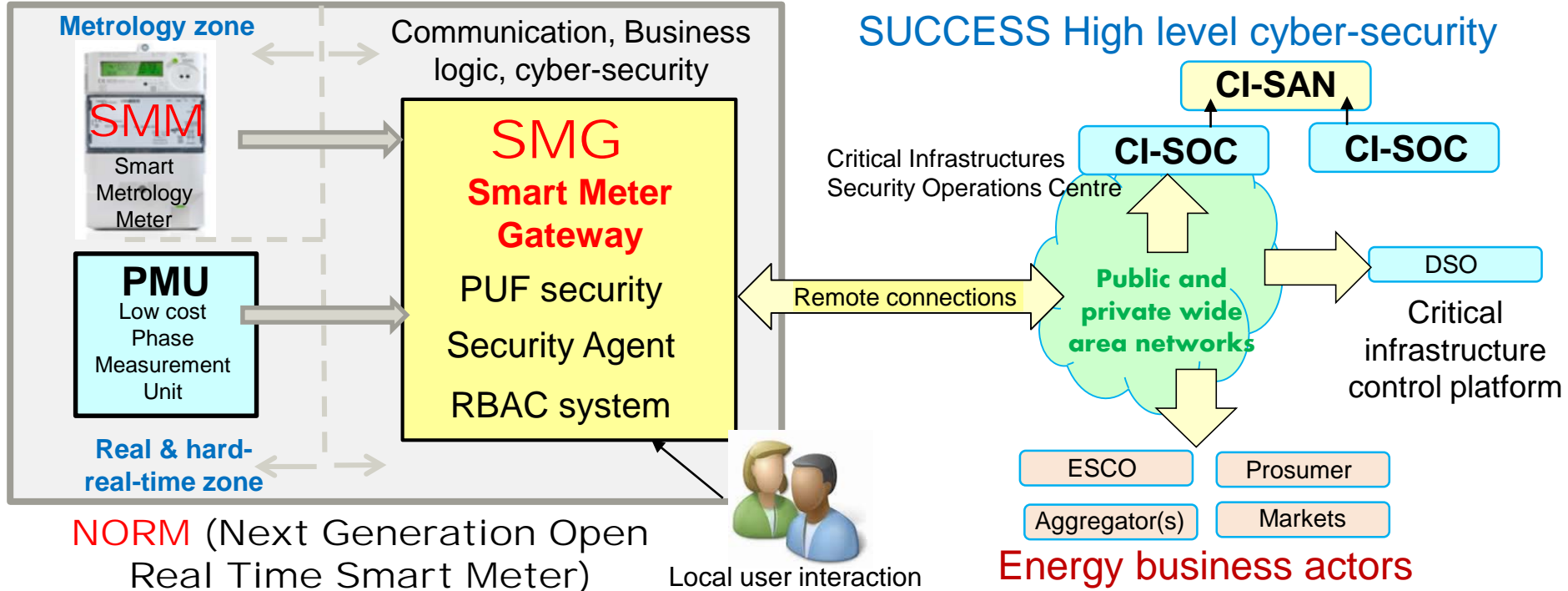
Synchro





# Benefits: Increase Smart Grid cyber-security ← killing factors →

## Multi-actor, ease renewables penetration, keep privacy





# Key exploitable result: deployment of CI-SOC solutions

## CI-SOC OVERVIEW

*CI-SOC = Critical Infrastructures  
Security Operations Centre*

- CI-SOC is a real-time decision support system for the utility
- It **can help utility on detect threats** and apply tailored countermeasures to protect the field devices infrastructure from cyber-threats
- It **processes real time and historical data of smart meters and PMU devices** across the local area of distributor operator
- It **supports a pan-European strategy for the detection of threats across Europe** providing to the CI-SAN component information from DSOs

*CI-SOC = Critical Infrastructures Security Operations Centre*  
*CI-SAN = Critical Infrastructure Security Analytics Network*



## Challenge:

- How to assess data inconsistencies at each levels: local, regional, national, EU level
- What kind of monitored data does not break citizen privacy (GDPR), while still achieving security assessment at each Smart Meter across Europe ?

Compatibility with GDPR (General Data Protection Regulation):

Choosing to monitor only grid-related data: **frequency**, **voltage**, **phase angles**, **ROCOF**

**Frequency is the heartbeat** of the synchronous power system

It is a common feature across the grid, at each level

It can be measured by both Smart Meter and by the PMU

***NORM*** implements for the first time such measurement, each 1 second

It has “nearly” the same value across grid, due to small deviations or to meas. errors

Monitoring inconsistencies can be elaborated at each grid level





## Data security assessment on each level, using frequency as real-time “marker”

Checking consistency at each grid level (using redundancies):

Redundancy at NORM level: {  
Frequency from meter (each 1 second)  
Frequency from PMU (each 1 second)

Redundancy at local grid level: {  
Grid frequency from NORM\_1  
.....  
Grid frequency from NORM\_n

Redundancy at national and Pan-European level: {  
Frequencies from regional/national grid 1  
.....  
Frequencies from regional/national grid n



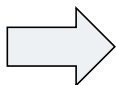


# Details:

Redundancy at NORM level:

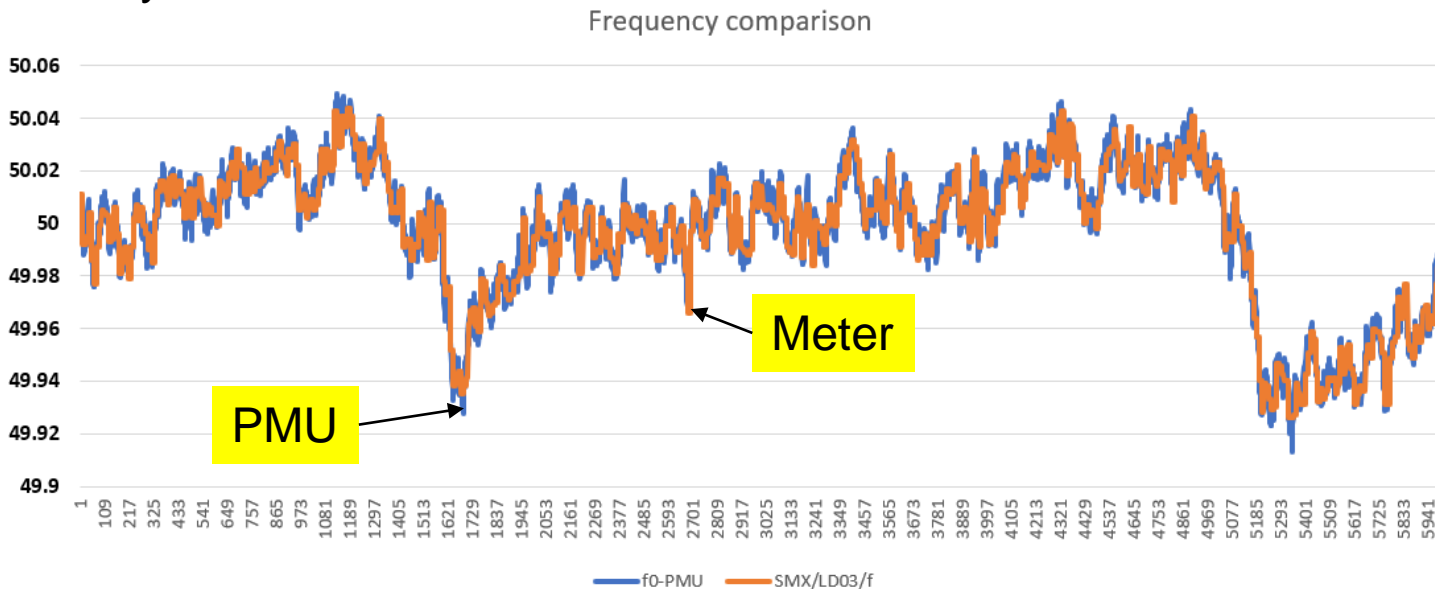


Frequency from meter (second based)  
Frequency from PMU (second based)



Data consistency

It is the first time that **Smart Meter** measurements are paired with **PMU**, in real-time – each 1 second, based on NORM architecture



## Real measurements in Romanian trial

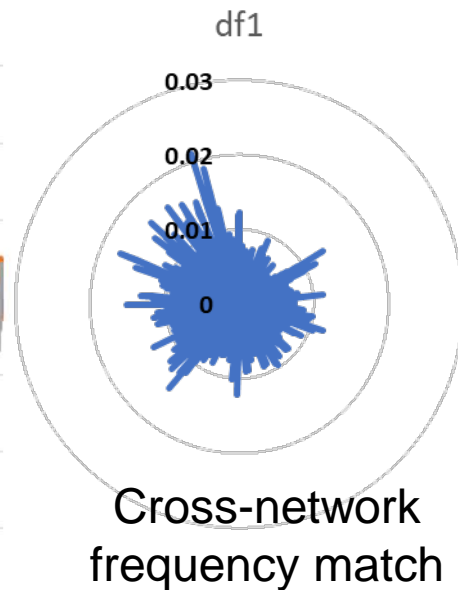
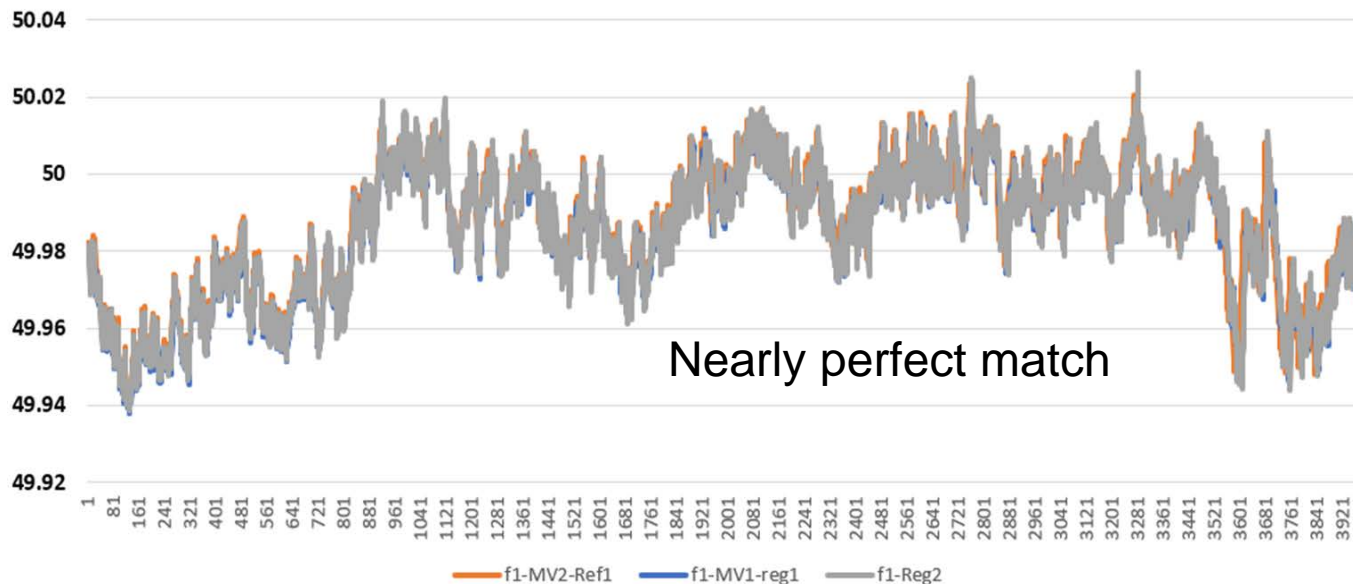


# Details:

**Redundancy at local grid level:**

- Grid frequency from NORM\_1
- .....
- Grid frequency from NORM\_n

NORM-PMU frequencies in different national locatios

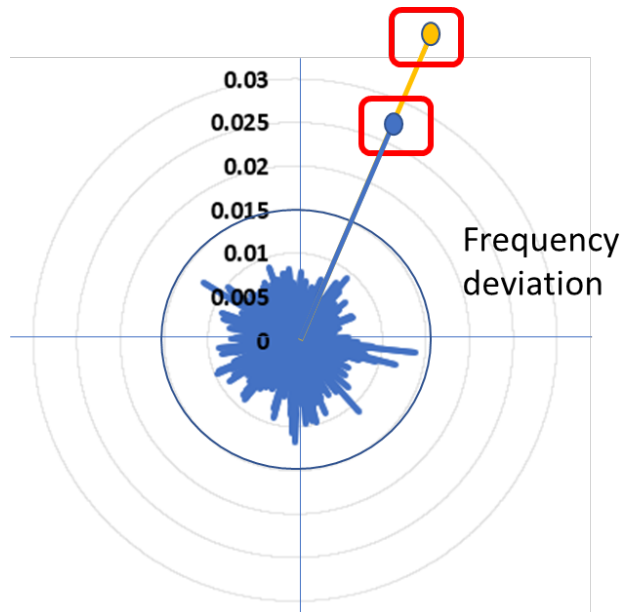




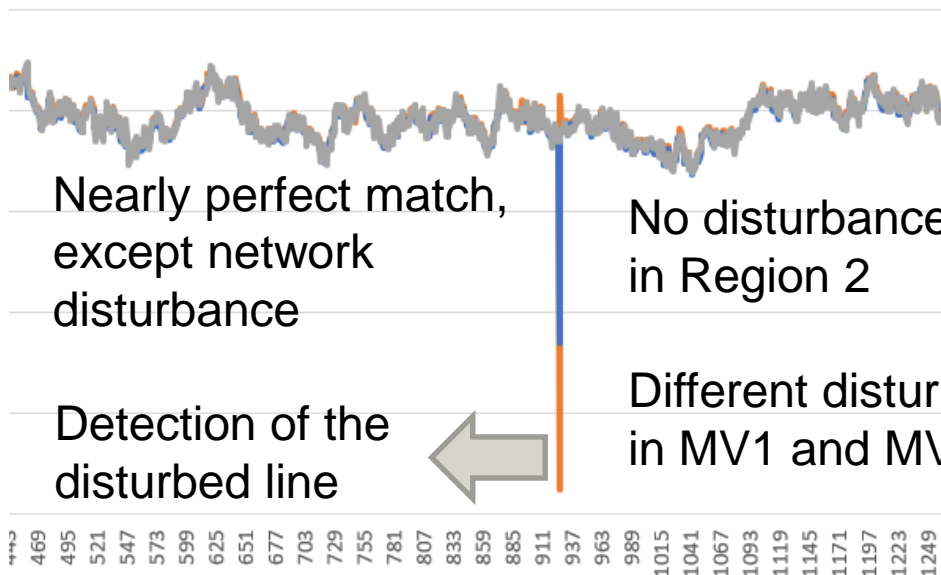


### Redundancy at local grid level:

Grid frequency from NORM\_1 - PMU  
 .....  
 Grid frequency from NORM\_n - PMU



Frequency conformity check at CI-SOC



Nearly perfect match, except network disturbance

No disturbance seen in Region 2

Detection of the disturbed line

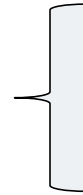
Different disturbance in MV1 and MV2





# Details:

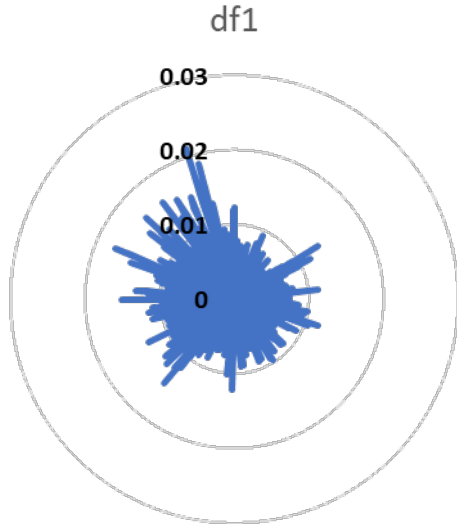
## Redundancy at grid level:



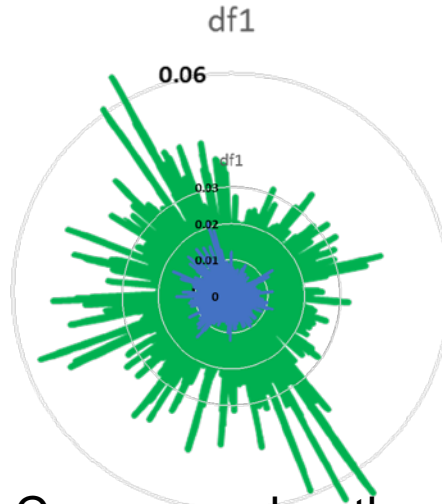
Grid frequency from NORM\_1 - PMU

.....

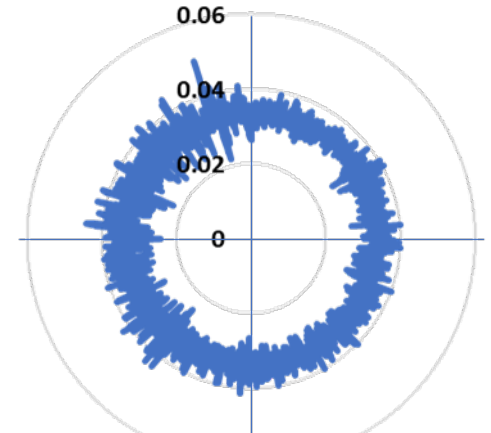
Grid frequency from NORM\_n - PMU



Normal pattern



Concern: cyber threat ?



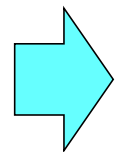
De-calibration,  
Microgrid,  
Cyberthreat?

## Frequency conformity check at CI-SOC



# Redundancy at national and Pan-European level:

Frequencies from regional/national grid 1  
.....  
Frequencies from regional/national grid n

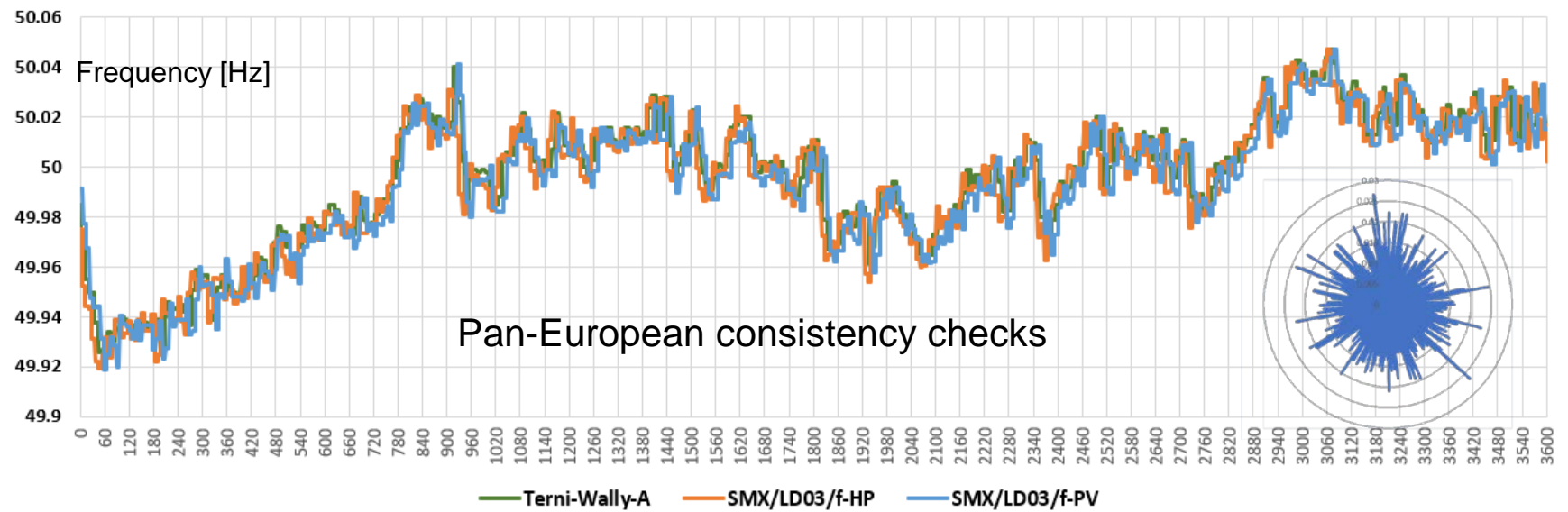


## Measurements:

- PV in Romania
- Hydroplant in Romania
- MV distribution grid in Terni / Italy



Frequency measurements





## **Different security related measures are applied:**

Data integrity check: Performed by SMM, PMU, SMG

Detecting tampering at device level

Communications spoofing / data altering

Security Agent and CI-SOC recognizing bad traffic

High level encryption: PUF technologies



## Lessons learned and barriers to innovation / exploitation of the results

- NORM as a DSO-only related equipment is a barrier, as DSO is not fully interested in multi-functionality: need multi-actor, societal approach; A joint multi-actor investment for stacked services might be a solution
- Internet remains a need: ubiquitous internet is needed anywhere (progressing towards implemented a full digital agenda infrastructure)
- The proof of concept ask for a low price NORM: till then it is a barrier for exploitation (another step towards mass production is needed)



## Needs for future R&I activities coming out of the project :

- Increase the number of NORM devices with bigger demonstrators
- Integrate functionalities in new SBCs, to address price issues (Meter + PMU + Energy Gateway + Communication 4/5G, all in one)
- Enhancing TRL from 6 to 9

It is **by design** a local + **inter-regional cooperation** solution

# Questions ?



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