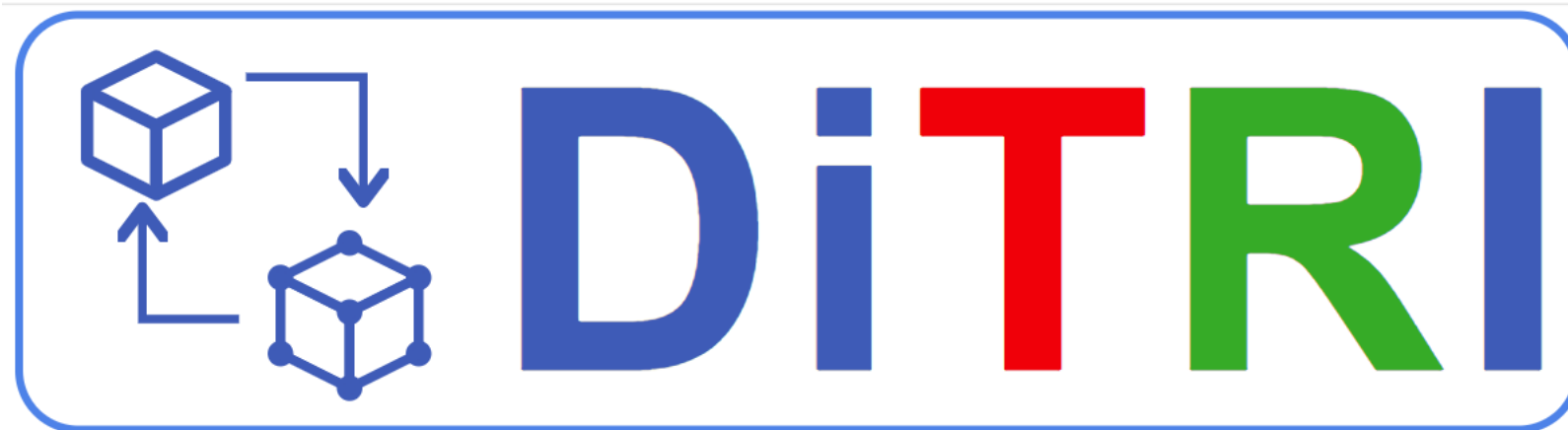




Implementation of a **Digital Twin** to improve the control, flexibility and resilience of a **Hybrid AC/DC** public distribution **Network**

DiTRI project – Overview

- **Title:** Implementazione di un **Digital Twin** per migliorare il controllo, la flessibilità e la resilienza di una **Rete** di distribuzione pubblica **Ibrida AC/DC**
- **Title:** Implementation of a **Digital Twin** to improve the control, flexibility and resilience of a **Hybrid AC/DC** public distribution **Network**
- **Founded** by Italian Ministry of Environment and Energy Security
- **Duration** 28 Months





DiTRI project – Overview

- **ASM Terni S.p.A. (Coordinator)**
- **Sapienza University of Rome**
- **Sistematica S.p.A.**
- **Artel S.r.l.**
- **01Solutions S.r.l.**





DiTRI project – Goals

- DiTRI delivers a **Digital Twin** applied to a real hybrid AC/DC distribution grid.
- It brings **benefits to grid operation**: better observability, lower losses and congestion, higher RES and storage integration, and stronger resilience through cyber deception.
- Its **modular**, open and interoperable design makes it replicable, paving the way for wider adoption by other DSOs and for new flexibility services and business models.

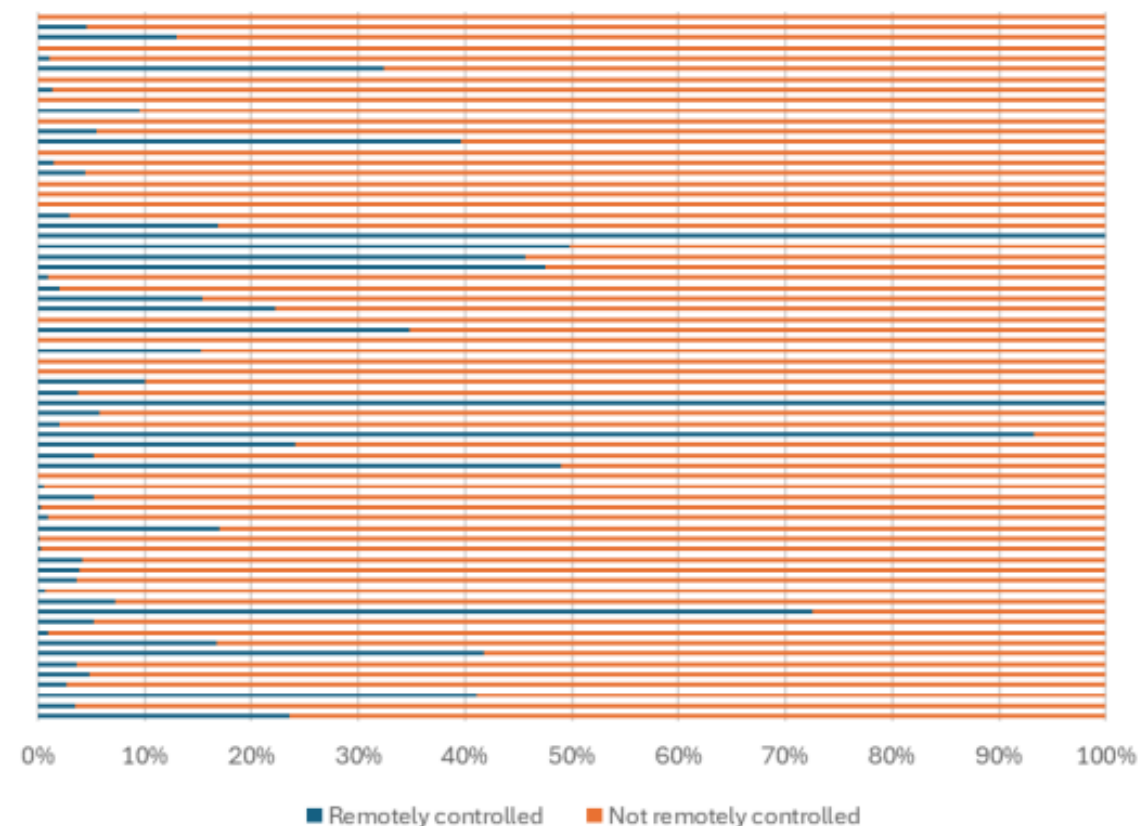


DiTRI approach

- A digital twin approach for addressing 2 main goals
 - Exploiting the grid digitalization (**short term**)
 - Hybrid grid integration in the distribution network (**long term**)



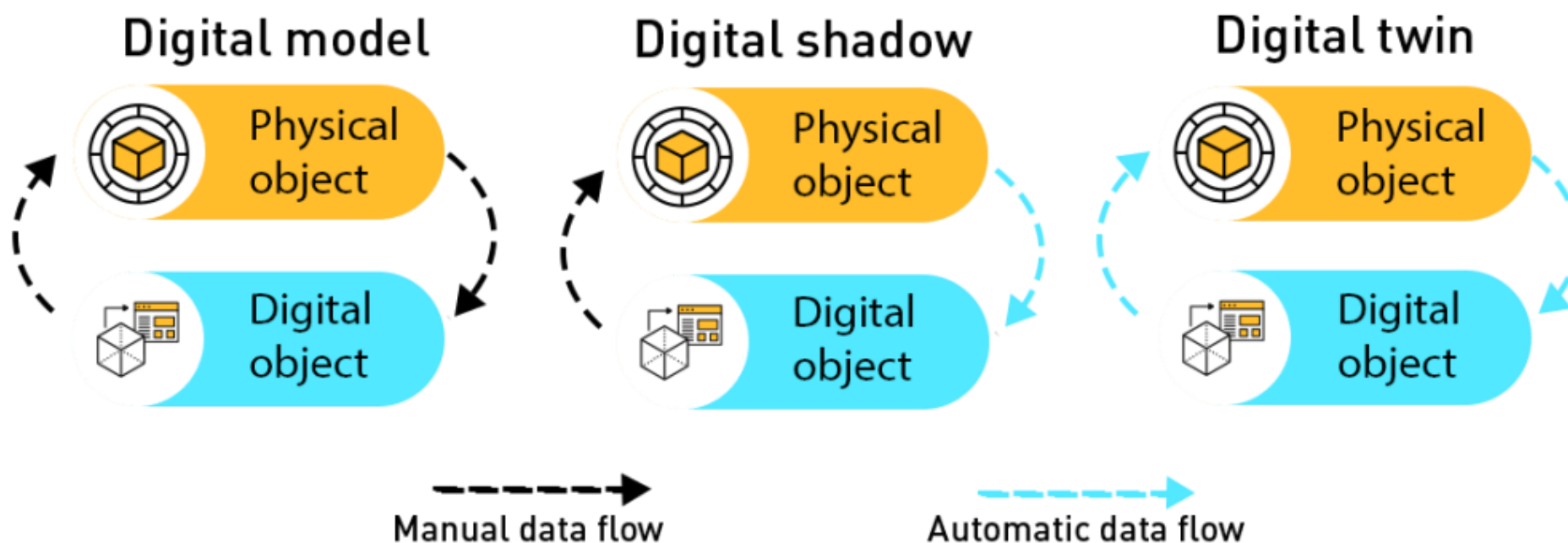
Figure 24. Percentage of remotely controlled MV/LV substations



Source: JRC, 2024

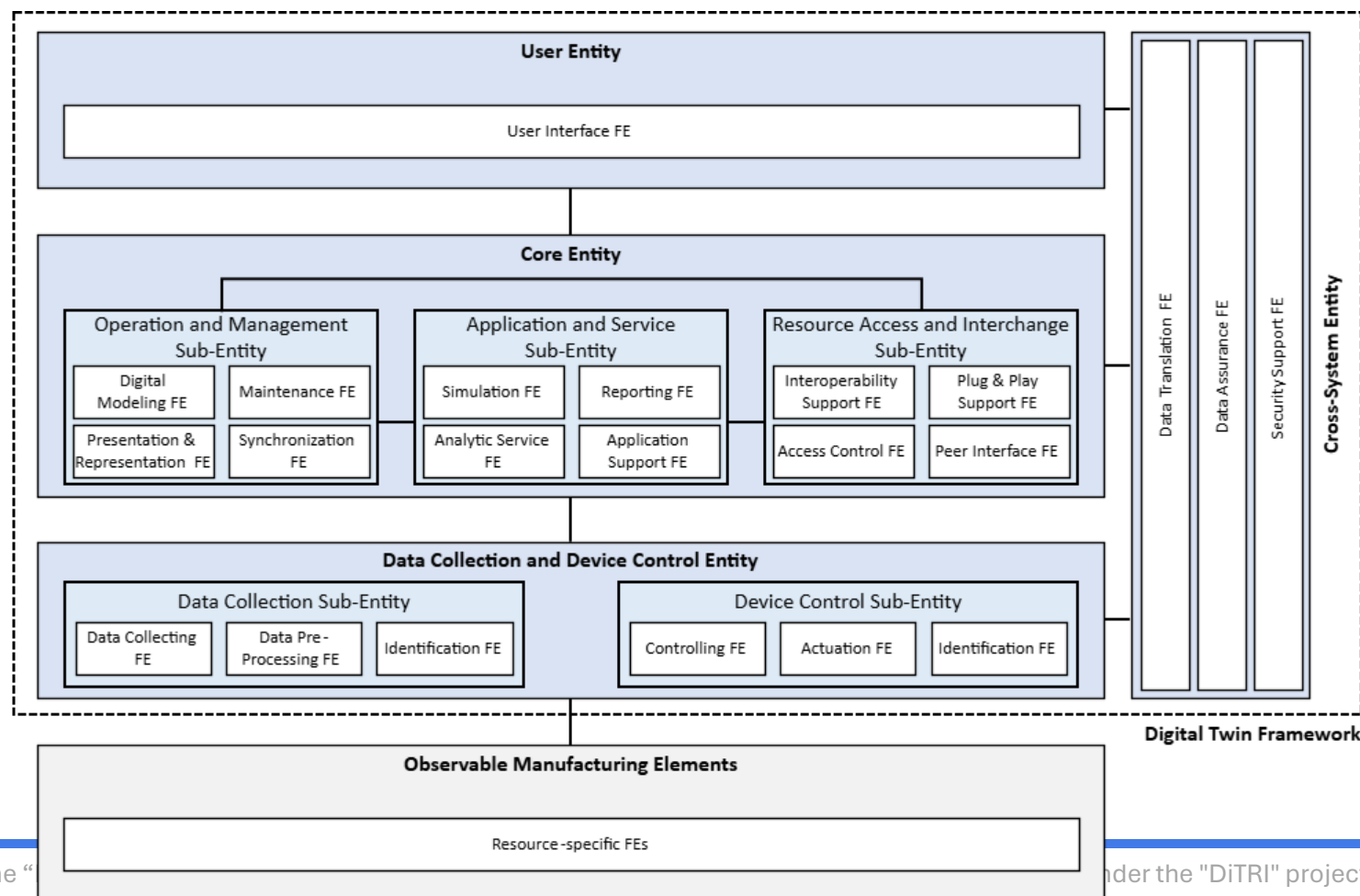
DiTRI approach

- An approach for digital twin



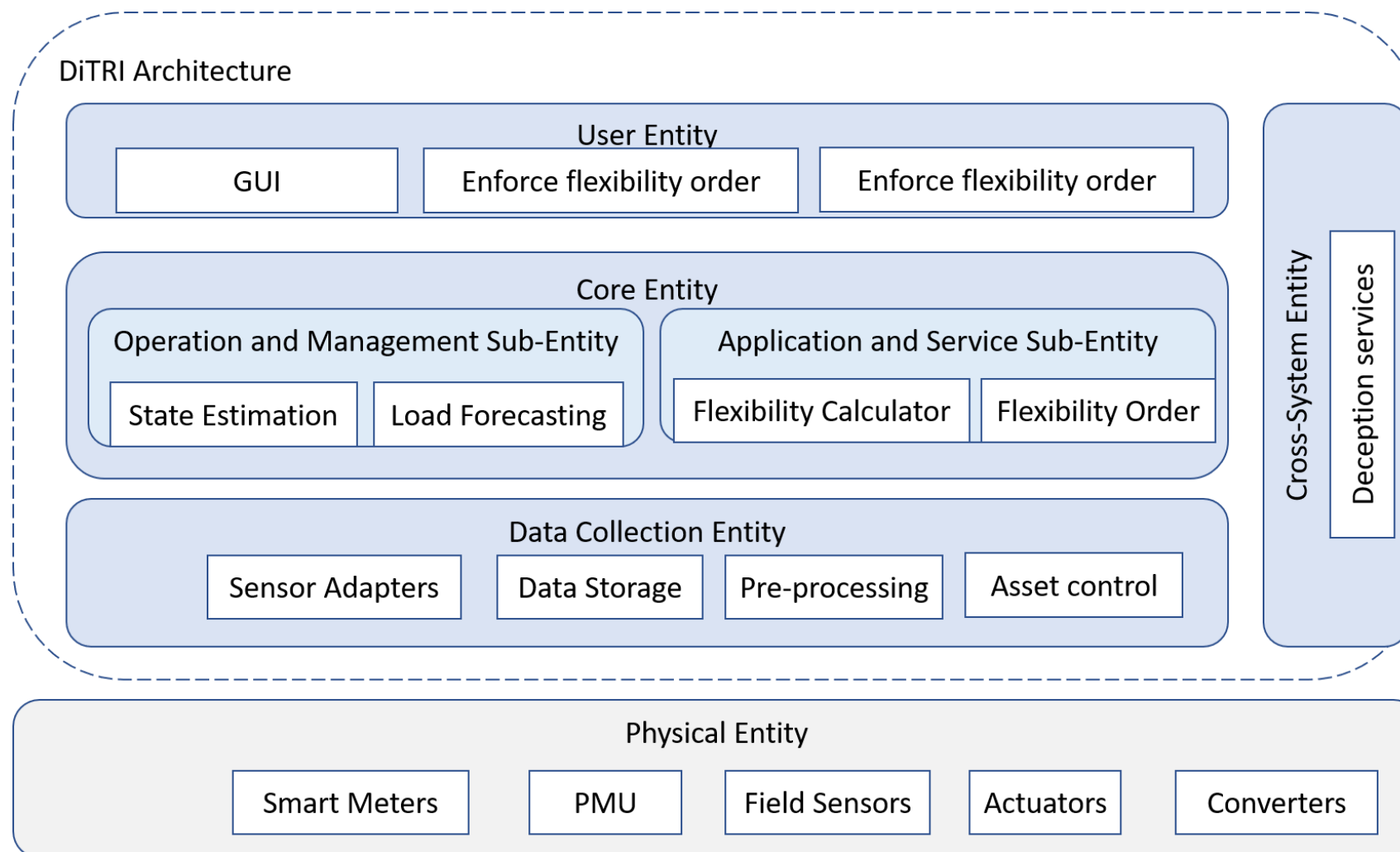
DiTRI approach

- Exploiting existing experiences from other fields: **ISO 23247 Digital Twin Framework for Manufacturing**



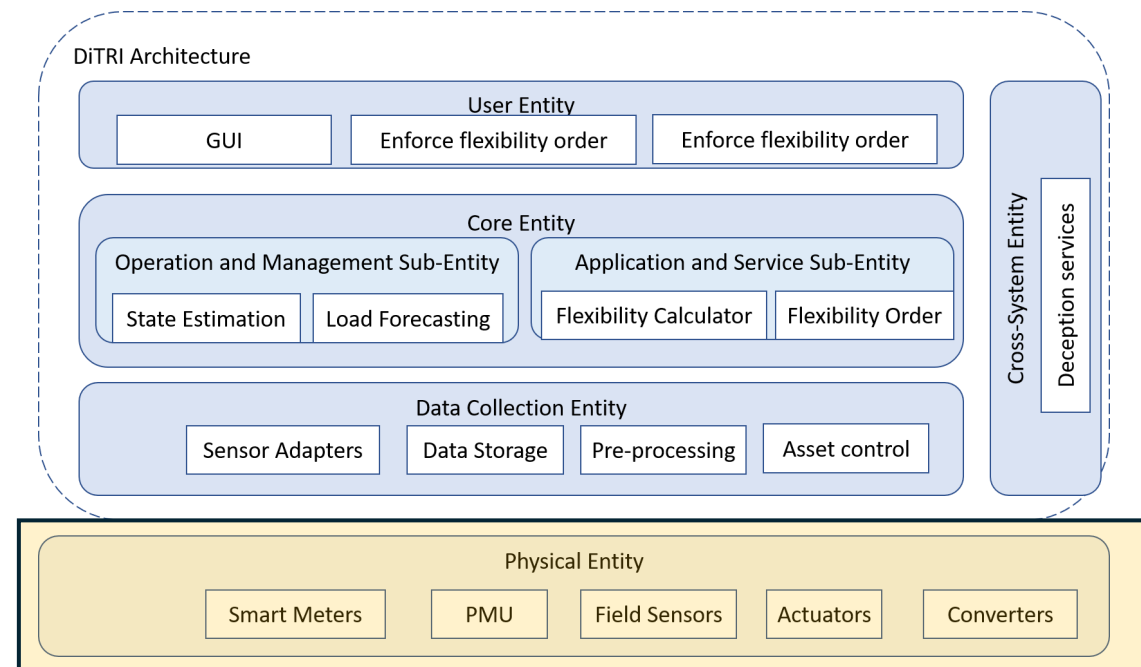


DiTRI approach



DiTRI approach

- Developing HW and SW interface for measuring and controlling the networks:
 - energy harvesting sensors for current measurements
 - SW interface for converter control



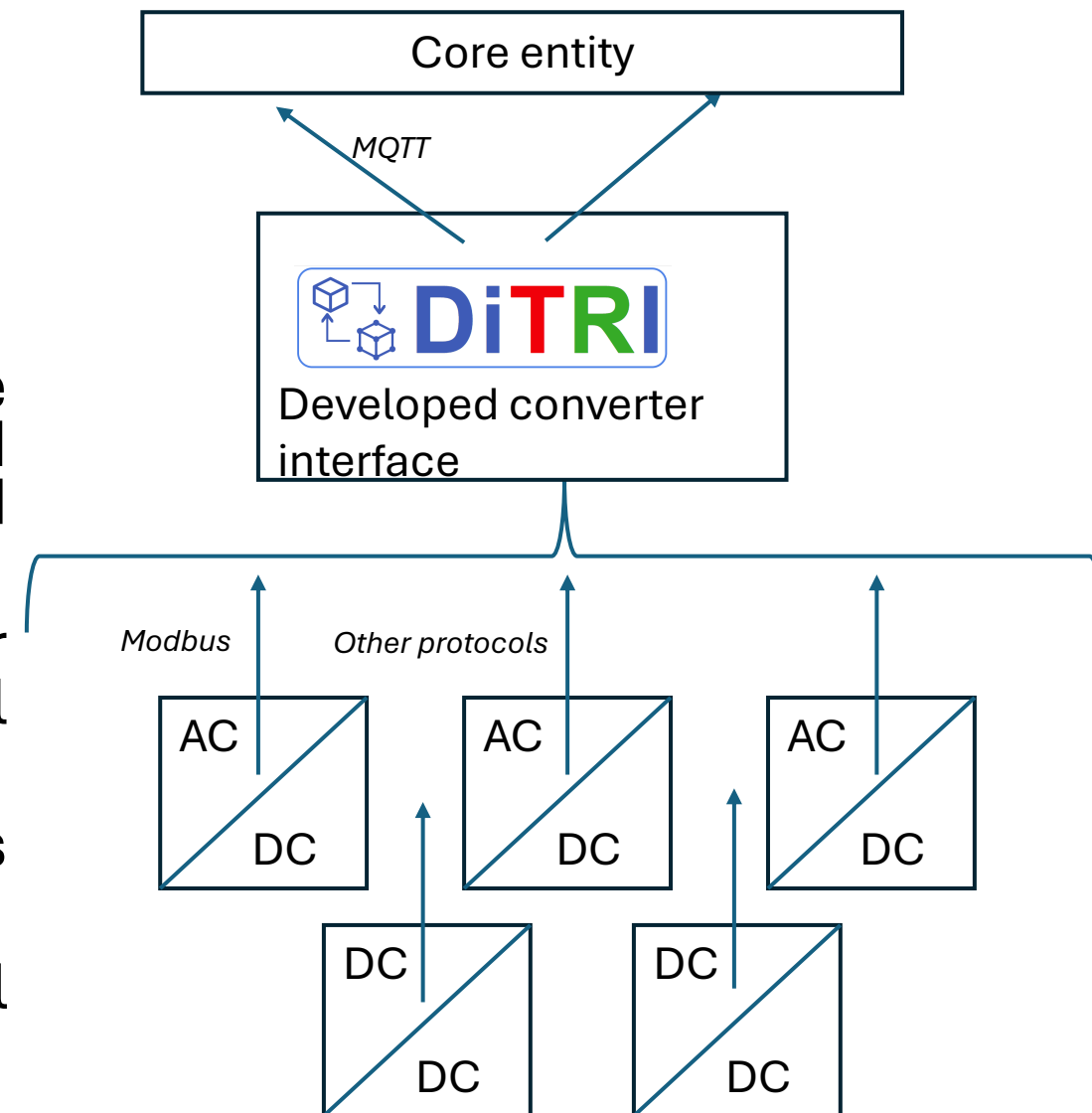


DiTRI approach

- **Low-cost sensors**
- iSensor is a wireless monitoring infrastructure for monitoring current in Low Voltage AC lines
- The developed sensor integrates:
 - Hall sensors with 400 kHz bandwidth
 - Li-ion battery
 - Energy harvesting supply system
 - Microprocessor that manages device supply, data package
 - Bluetooth antenna
- A concentrator manages several sensors (1 device per phase)
- iSensor allows to monitor LV lines with reduced cost and without service interruption
- Applicability range: 5 – 500 A

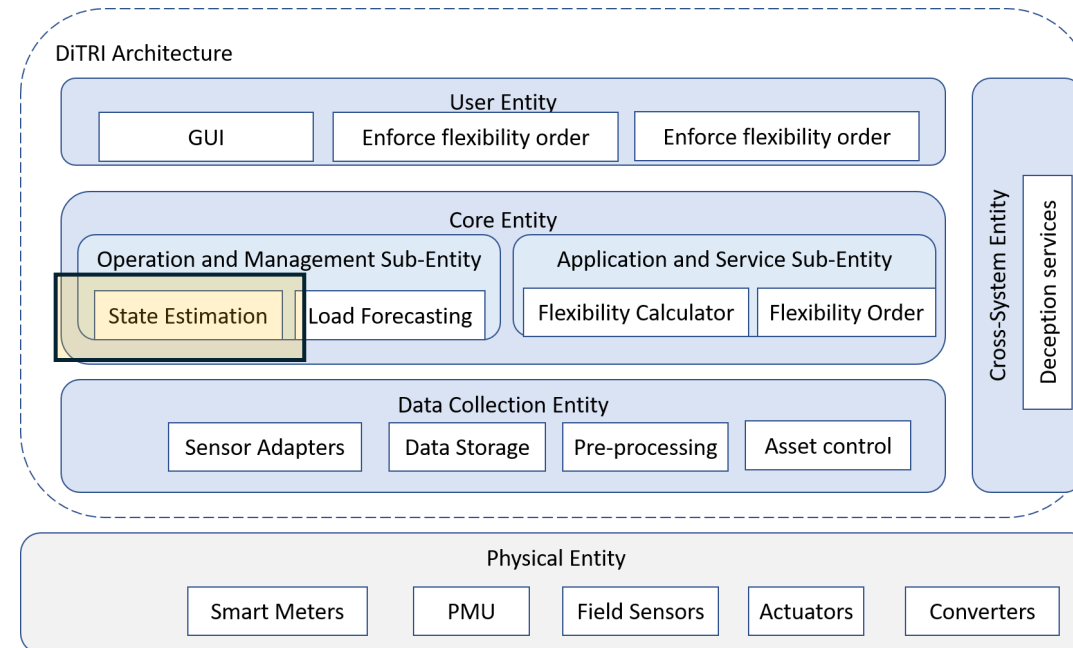
DiTRI approach

- **Converter interfaces**
- Developing a scalable and replicable framework for interfacing AC/DC and DC/DC converters in hybrid distribution grids
- Try to overcoming multivendor compatibility control for high-level energy services
- Developed interfaces manages Modbus registers of the converters
- They enable the monitor and control of the devices



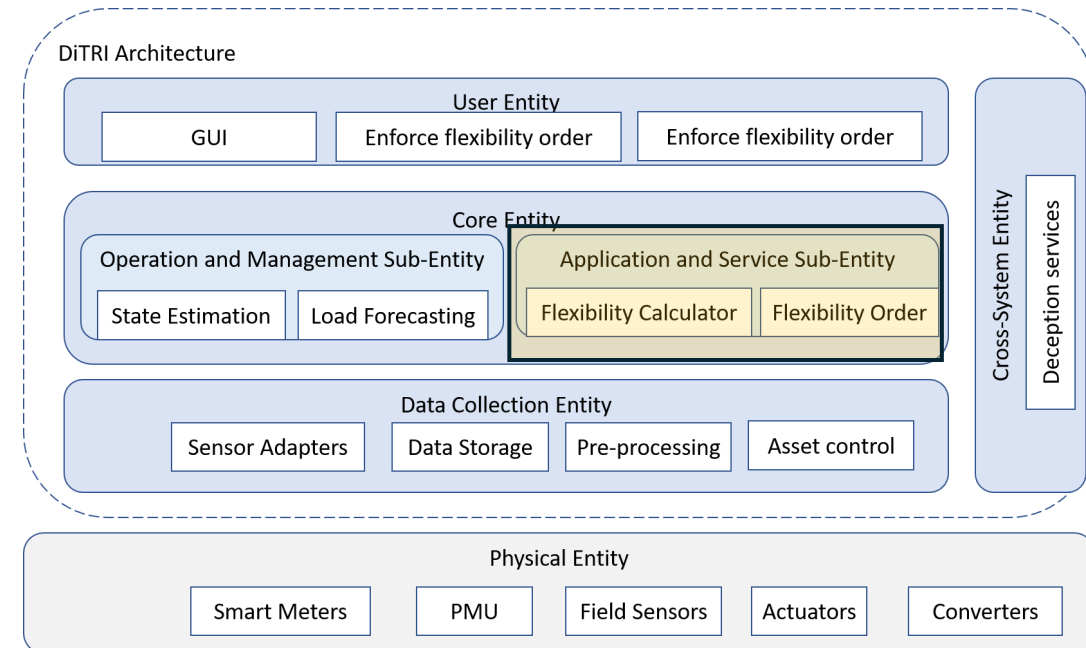
DiTRI approach

- **State estimation**
- State estimation enables DSO awareness about network status
- It is a counter measurement against partial and missing measurements
- Allows to exploit the available measurements from a partially observed system



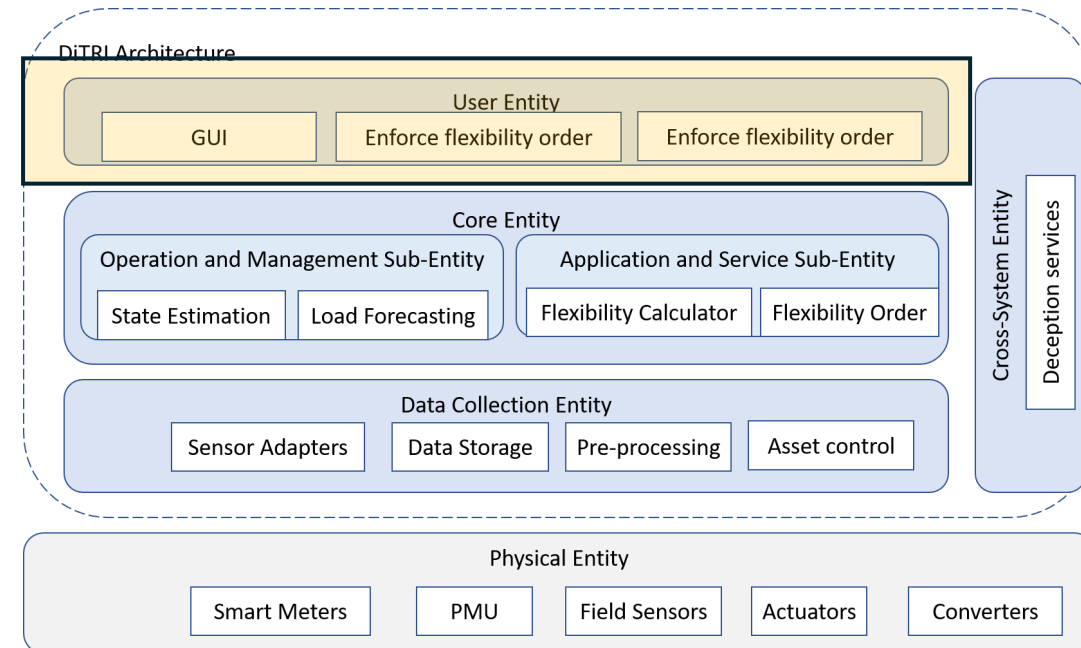
DiTRI approach

- **Flexibility calculator and execution orders**
- Forecasting orders need specific KPIs to be addressed
- Converters will be used as main levers since they are flexible by design



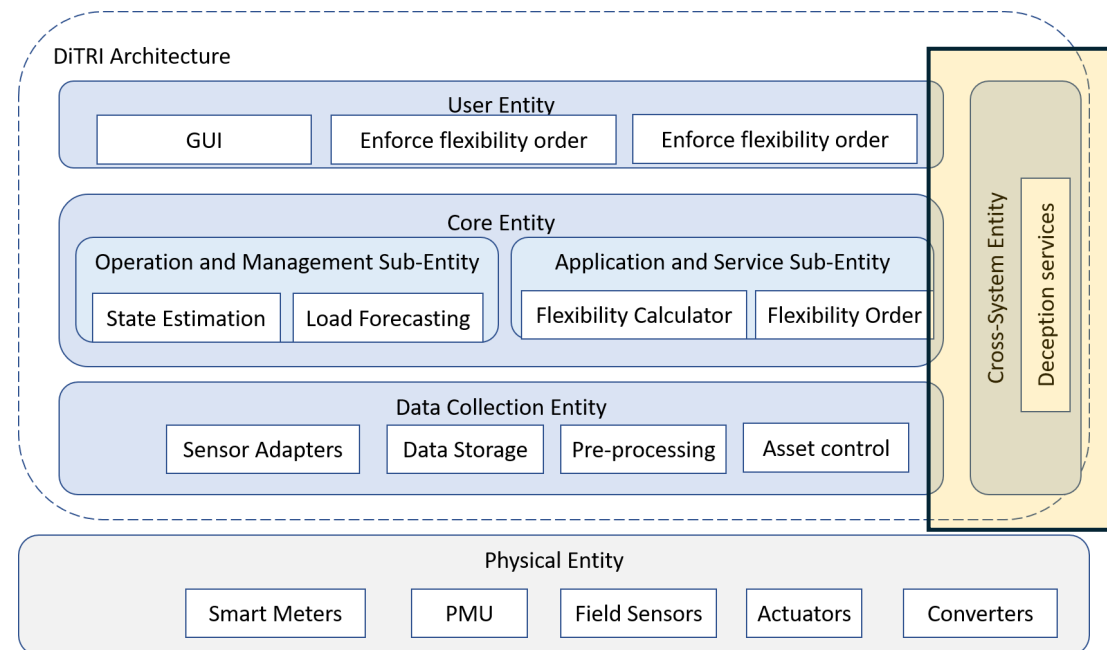
DiTRI approach

- **GUI**
- Operator awareness
- What-if scenarios
- Directly interfaced with network models and datasets



DiTRI approach

- Cybersecurity based on deception





DiTRI approach

Deception services

Deliberate actions that induce the adversary to perceive a false reality and to decide in favor of the deceiver: not only to hide the truth (dissimulation), but to show the false (simulation). Born as a military art, today it is used to attack and, increasingly, to defend.

War

Ukraine: Inflatable lures and fake HIMARS attract expensive missiles. Op. Spiderweb (2025): Drones concealed in civilian trucks.

B. Whaley, Stratagem (1969)

Info-ops

"Doppelganger" campaign: clones of European newspapers to spread false narratives. False flags and misleading attributions.

*EU DisinfoLab (2022);
VIGINUM (2023)*

AI and deepfake

Fideuram, 2026: fake WhatsApp of the CEO of Intesa and cloned voice of a lawyer, about €95 million transferred abroad.

Procura di Milano; ANSA, set. 2026

Cyber

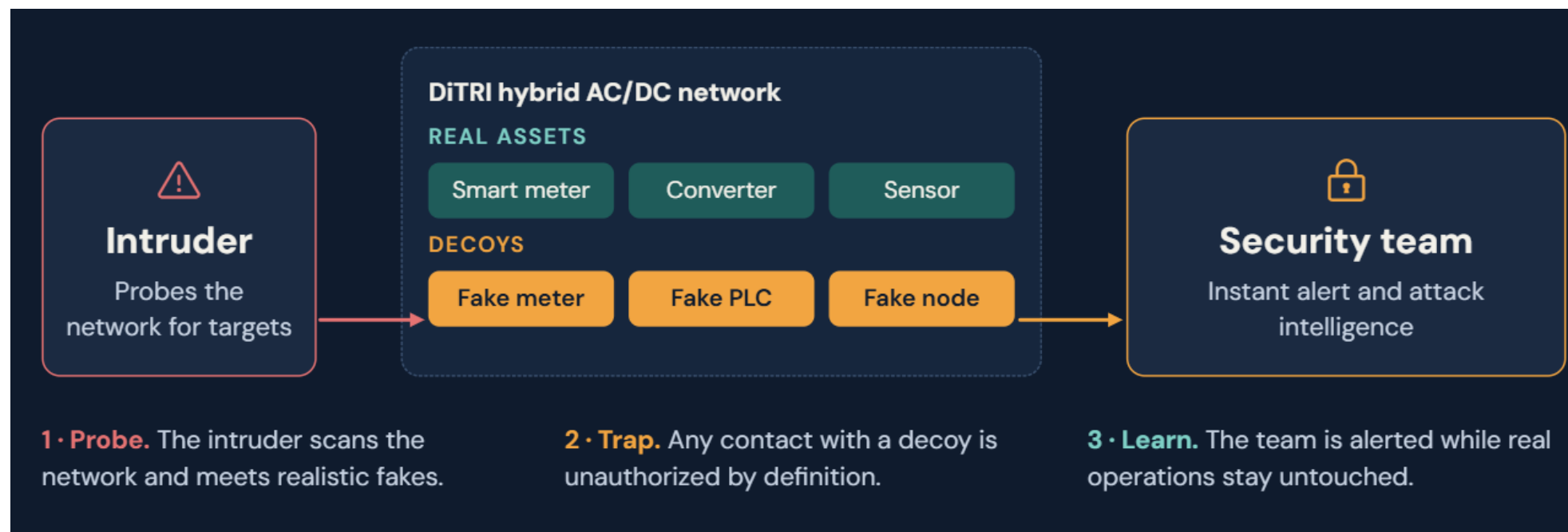
Honeypots, honeytokens, and bait nets: the defender uses deception against the attacker.

C. Stoll, The Cuckoo's Egg (1989)



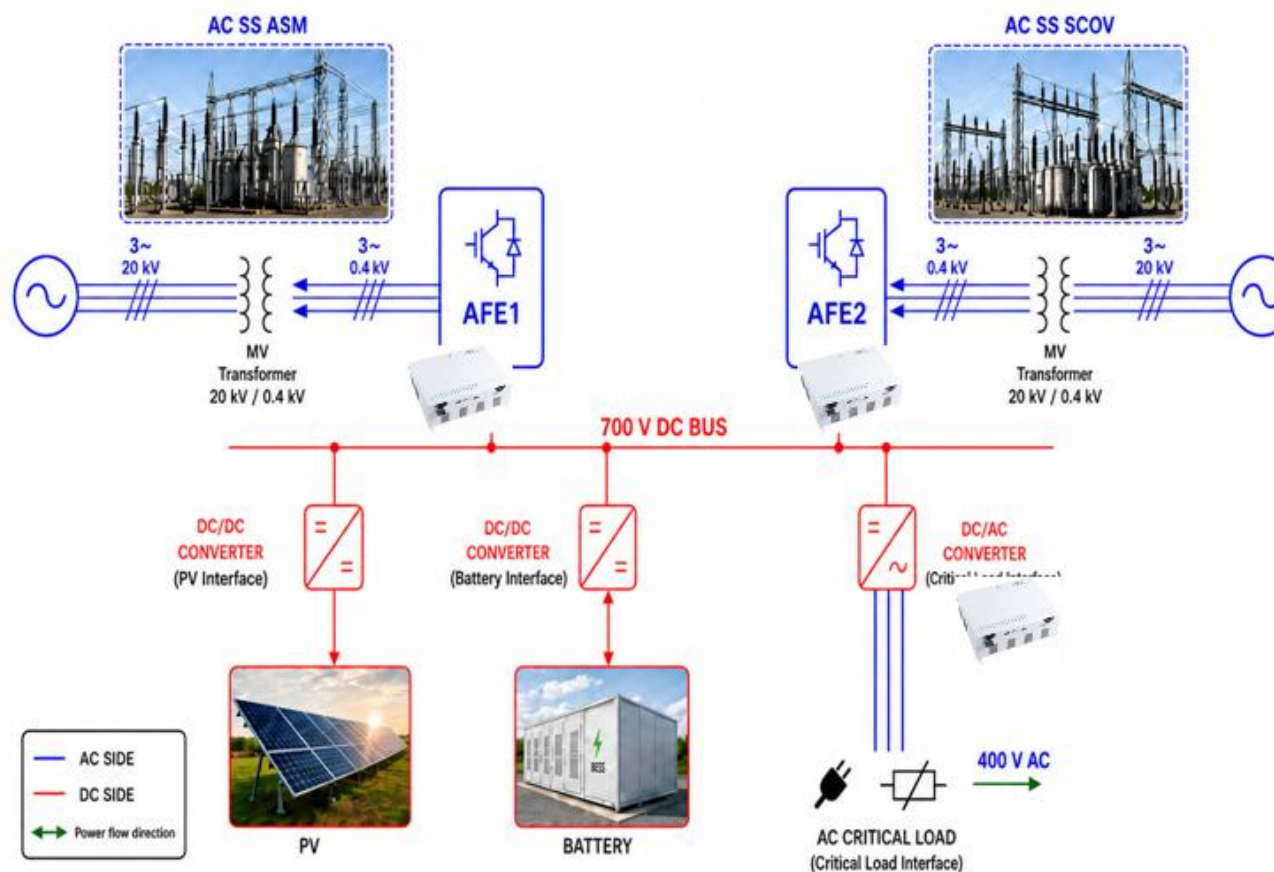
DiTRI approach

Deception services



DiTRI case study

- ASM Terni hybrid distribution network





Thanks for your attention

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