SUCCESS CASE 5.2024

DDP

DISTRIBUTED PROCESSING PLATFORM

THE CHALLENGE

The **Distributed Processing Platform (DPP)** is a system concept aimed at decoupling hardware from software applications, identifying and separating platform components, and using open solutions and interfaces. Today, intelligent equipment installed in substations (SS-IED) addresses one specific application each, resulting in the need for one piece of equipment per application. Besides this, for specific use cases, there might be an opportunity to process part of the data locally. The DPP will foster an open multi-source model where an application runtime environment (a) in one general purpose hardware (b) hosts multiple, specialized applications (c), each of which addresses a specific function in the substation. A central systems installed at the core of the management platform administers and manages all three aspects of this model (a, b, and c) to enable remote management of thousands of such installations in substations on the field.
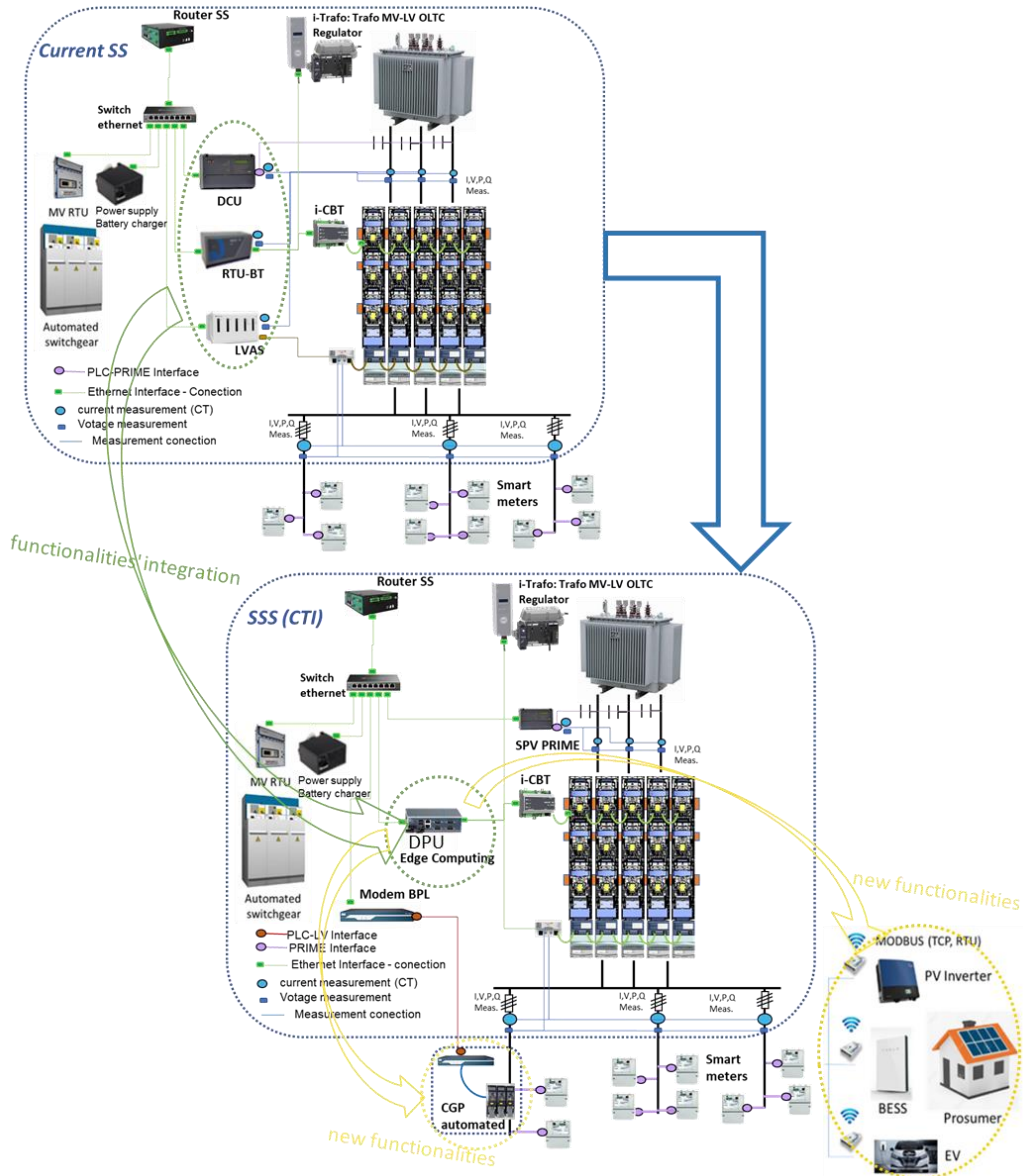
Current Secondary Substation (SS)

- Digitized secondary substation: supervision, control and remote management.
- Centralized processing.
- One device per functionality (hardware remunerated assets): monolithic solution, installation of new equipment required for new functionalities
- No possibility of real time control (high latency).
- Limited processing capacity: no evolutionary capacity.

- Substations (SS) with reduced space, difficulty to deploy new devices (i.e., functionalities).
- High failure rate of electronic devices: high OPEX.
- Little agility to incorporate new functionalities: high HW dependency and need to re-certify complete functionality for each change.

Smart Secondary Substation (SSS)

Secondary substation local processing, control and supervision in operations, providing:
- **General hardware (HW) platform** with processing capacity (**edge computing**), low cost industrial Hardware (PC).
- **Service oriented software (SW) architecture (containers):** complete Internet of Things (IoT) architecture that allows, with minimum resource consumption, to deploy and manage a complete Container as a Service (CaaS) architecture, based on Dockers containers.
- **Agility to implement new services**: monitor and manage all applications and the deployment of new ones.
- Centralized monitoring (closer to **local resources**): Ability to monitor and react in real time to changes in the network and protection of users, by bringing real time management closer to the client.

- Cost efficiency in LV digitalisation: Reduction of equipment and maintenance costs in the SSs.
- Efficiency in investment costs: low CAPEX.
- Efficiency in digital maintenance: low OPEX.
- Agile application deployment and updates: Efficient and scalable capacity to adapt to new needs and services, "time to market" for the implementation of new functionalities and services reduced by 80%.
- Improved quality indices, through local and automatic control of parameters for network operation, avoiding overvoltages and locating and resolving breakdowns faster.

Example of the evolution of the physical architecture of a current SS towards a distributed processing architecture (SSS).

THE SOLUTION

i-DE has been involved in the evaluation and analysis of the DPP technology for secondary substations since 2018, participating in different working groups for joint specification (e.g., **Futured Smart Secondary Substation, E4S Alliance,** etc.) as well as in the piloting and validation of developed solutions (e.g., **MiDE4S project** in conjunction with Minsait 2020). In 2023, a Request For Information (RFI) was launched to multiple suppliers who presented to i-DE different proposals for a semi-proprietary architecture based on the following components (❶ to ❹ in the figure on the next page):

1. Distributed Processing Unit - Platform Software (DPU-PS).
2. DPU – Application Runtime Environment (DPU-ARE).
3. ARE Agent and Operation, Administration & Management System – ARE (OAM-ARE). This software will be owned by i-DE and the development of these modules would be implemented according to i-DE requirements.
4. OAM Platform Software (SW). This would be the traditional Element Management System that controls various aspects of the DPU-PS using the SNMPv3 protocol and other means.
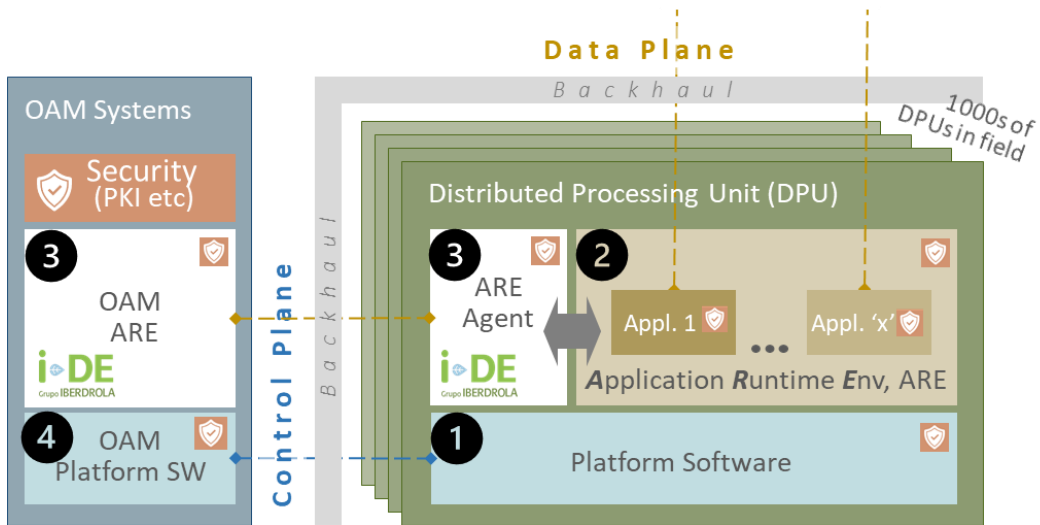
DPP concept mapped to the concept-trial plan.

The figure shows thousands or tens of thousands of DPUs installed in substations. DPUs are managed by two categories of software at the backend. One category of backend software, designated as OAM systems, manage the DPU devices and the various applications running on each of them, enabling the Control Plane. The second category of software consists of application software that communicate with their respective peer applications running on DPUs, forming the Data Plane.

The conclusion obtained from this work is that there is no clear environment to progress in this area of multi-suppliers, proposing very different solutions. A new market review will be proposed in the last quarter of 2024 when an **Edge Computing laboratory** is going to be developed at the facilities of the GSGIH (Global Smart Grid Innovation Hub) of i-DE in Bilbao with the technical support of the company Barbara IoT. In this laboratory, i-DE expects to be able to **develop and test new business use cases** that can be integrated into the presented architecture.