

SmartGen Project

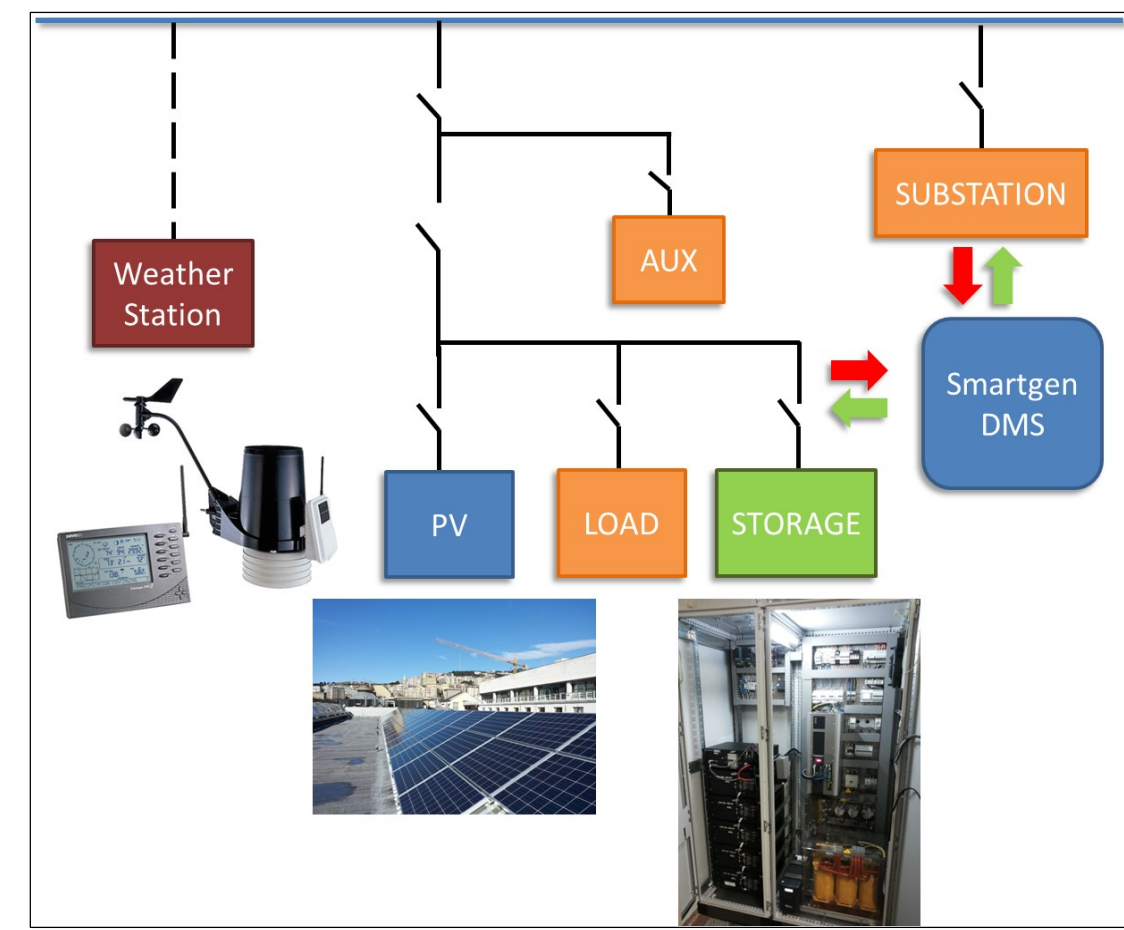
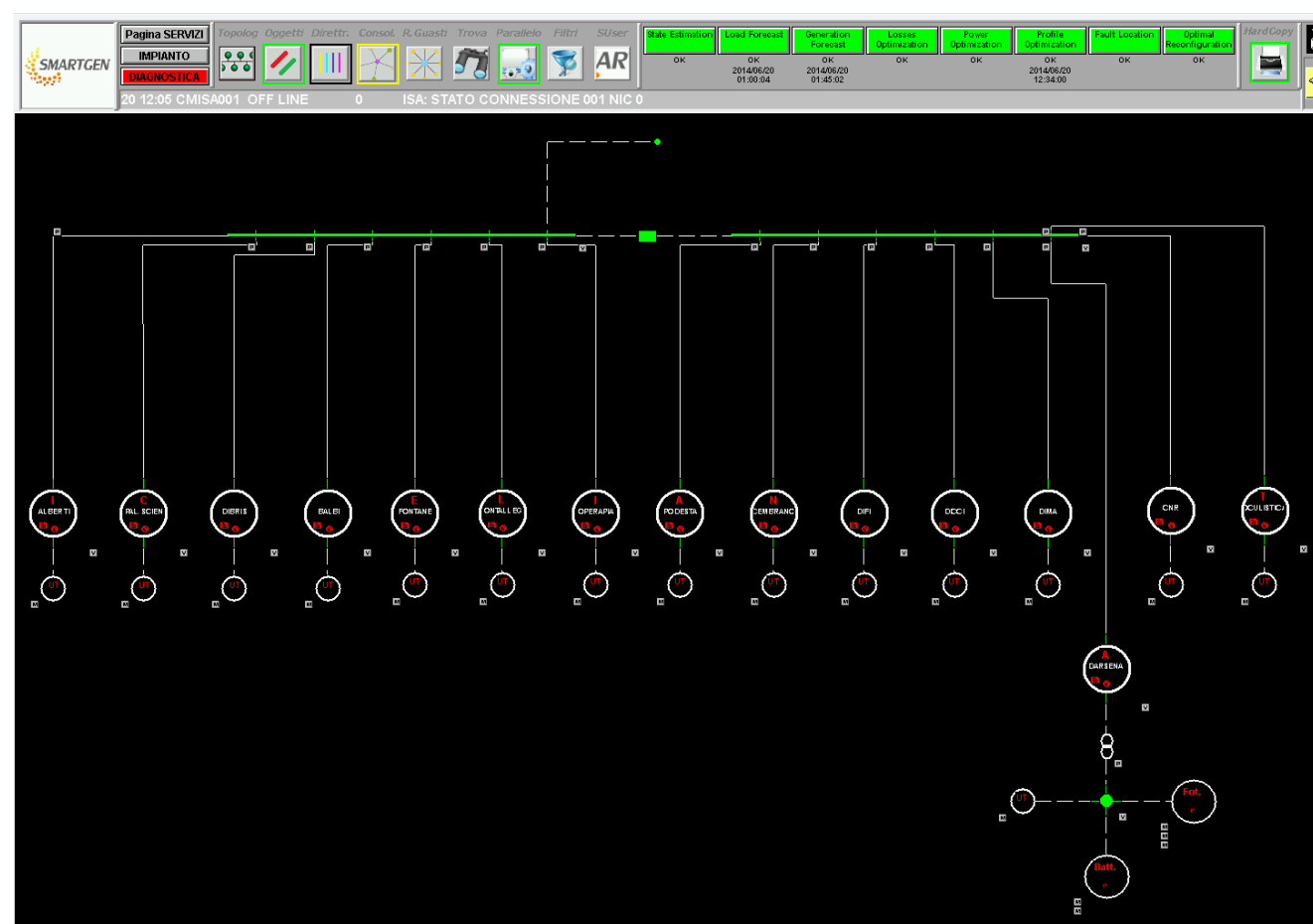
The acronym **SmartGen** describes the project, financed by MISE (the Italian Ministry for Economic Development) and titled “Study, development and validation of innovative methods and tools for the management of active distribution networks with generation from renewables sources”. Within the SmartGen project a centralized **Distribution Management System (DMS)** for portions of electricity distribution networks, able to deal with optimization problems, power flow, voltage control, has been developed and implemented in different test sites.

University of Genova - Microgrid

The **University of Genova (UNIGE)** test site includes 16 Points of Delivery (PoD) at MV level, deployed on the urban district in correspondence to the Faculties. Moreover, the site includes the **LV Microgrid located** at the Faculty of Economics and composed by:

- 20 kWp of PV panels connected through two 10 kW inverters
- 10 kW-12 kWh ion-lithium storage system
- local load (building global consumption)
- weather station

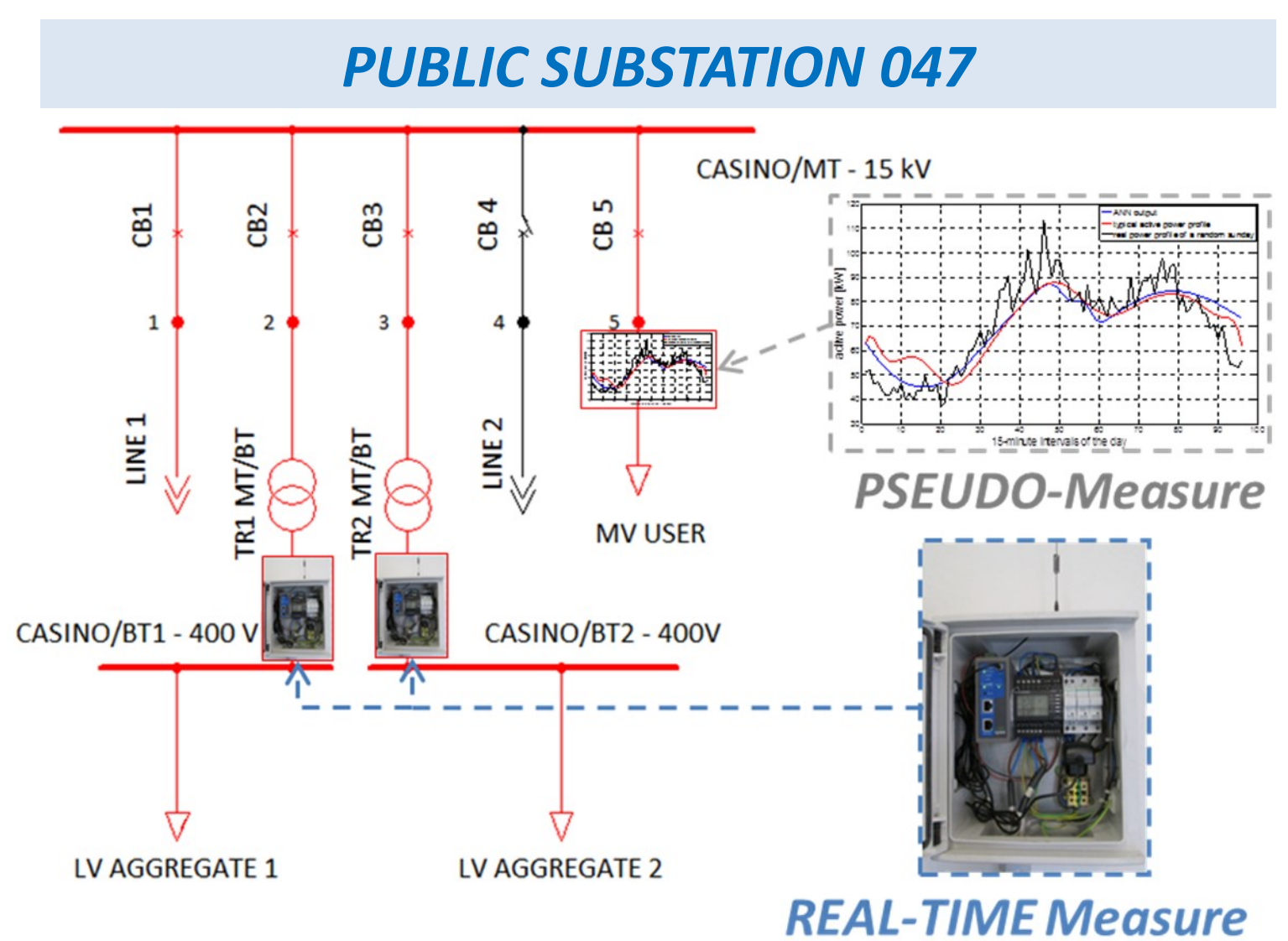
The acquisition rate is 1 minute for the PoD and 1 second for the Microgrid devices.



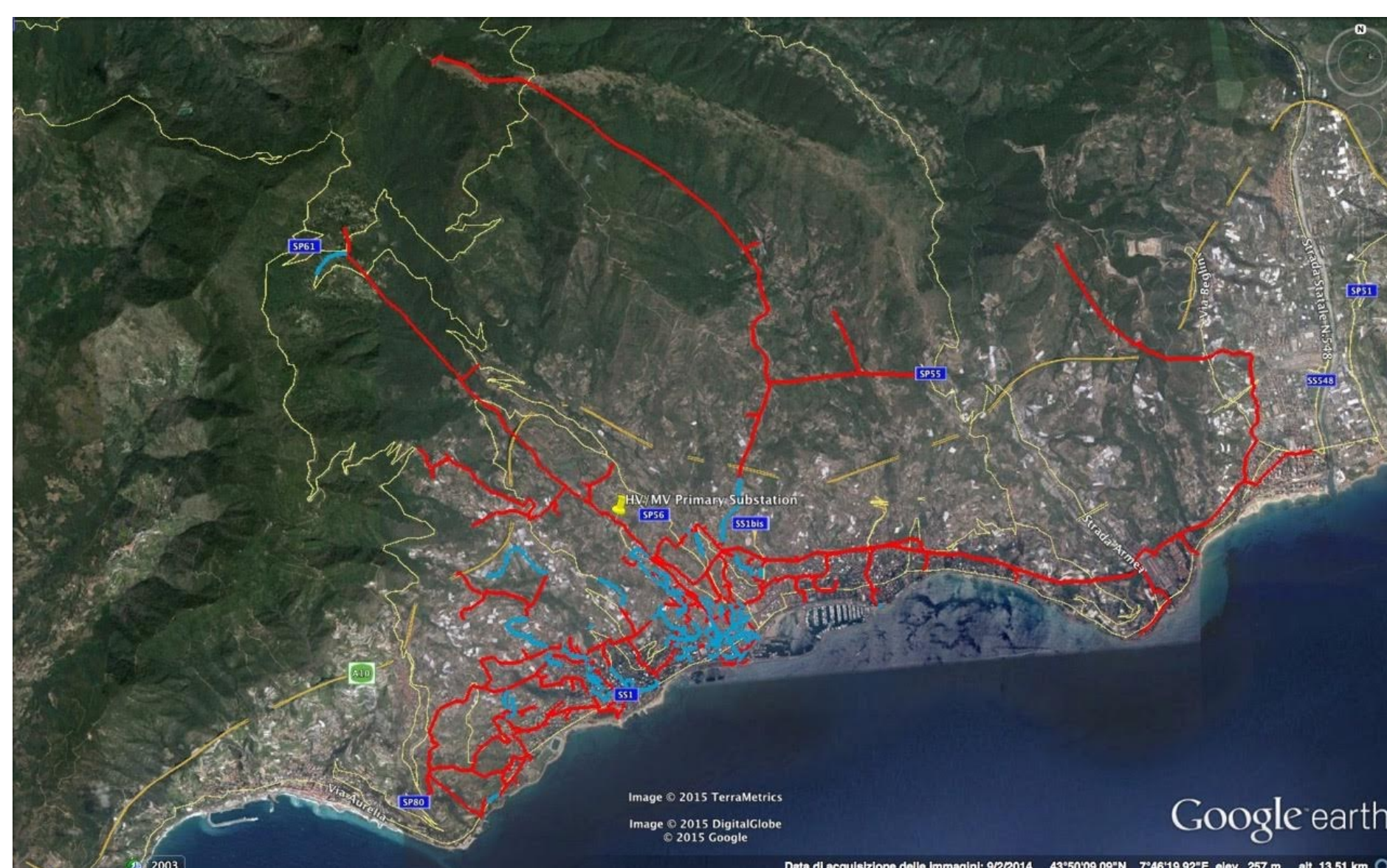
DSO Medium Voltage network

The **MV network of AMAIE**, DSO in Sanremo North-West of Italy, has been adopted as test site. The power system is composed of 1 HV/MV substation, 10 MV feeders for 186 MV/LV substations and 17 MV users, a 470 kW PV plant and several others of smaller size connected at LV level. The whole network has been modeled in the simulation environment (**DigSILENT**) while only three feeders (equipped with measurement devices) have been modeled into the Smartgen DMS.

Globally, the SCADA acquires: the 3-phase values of V/I/P/Q and frequency from 24 substations (a whole urban feeder with the possible reclosing paths) and the 470 kW PV plant; 3-phase voltage waveforms from 2 Phasor Measurement Units (**PMUs**) installed at the HV/MV substation and in one LV/MV substation at the end of the feeder; total P/Q and 2-phase V/I from the transformers and feeders protections in the primary substation.



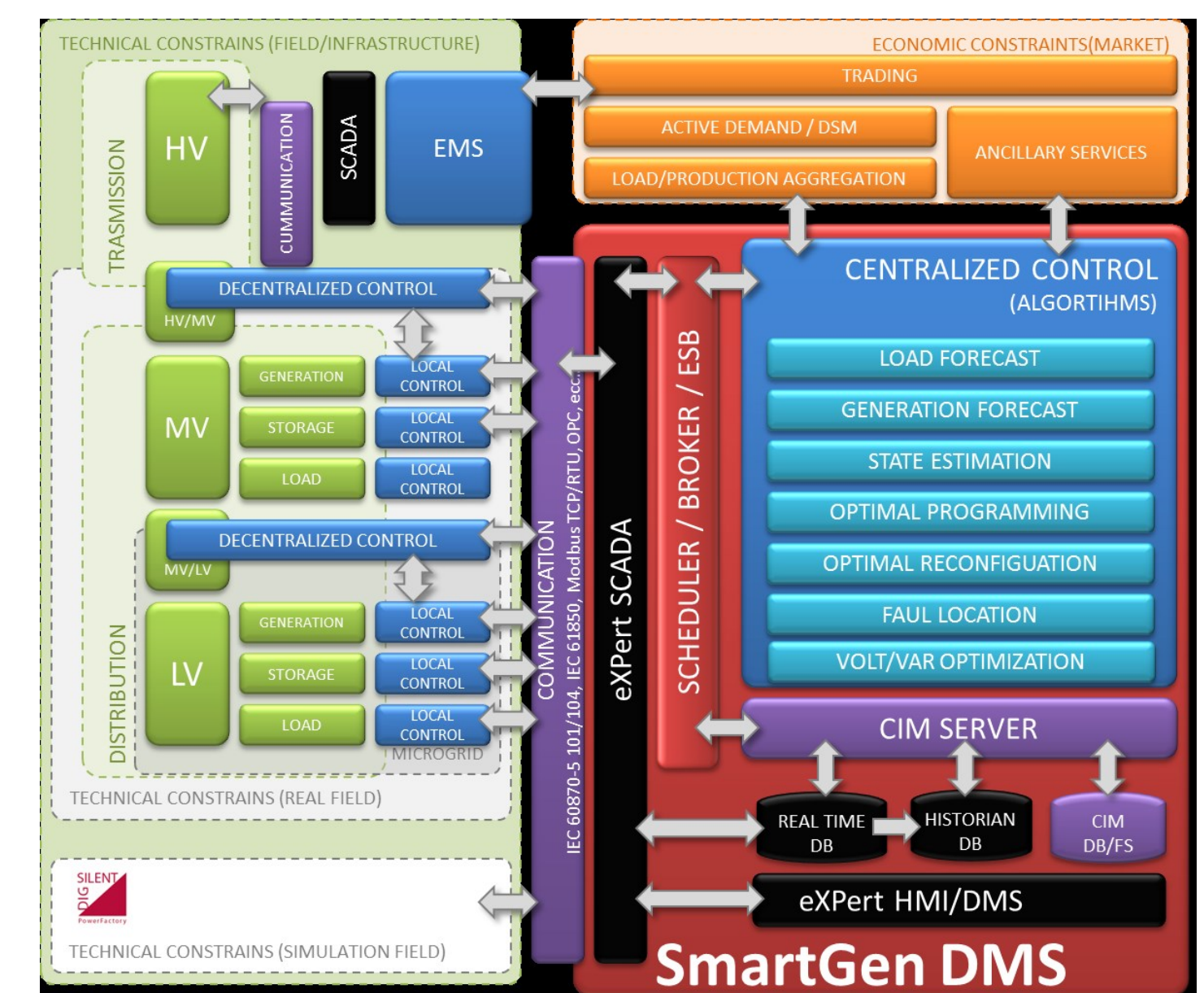
DMS architecture and functionalities



DMS ARCHITECTURE

1. **eXPert SCADA and DMS** (in each test site, control room): field monitoring, collecting and storing of measures, modelling of the power system (**CIM standard**).
2. **CIM server** (Genova): CIM to hdc conversion, delivering the requests of algorithms to the algorithm server, collecting the results, hdc->CIM conversion, delivering to DMS.
3. **Centralized Algorithm server** (Genova): running the algorithms in MATLAB environment.

DMS ALGORITHMS



Load Forecast (ALF) → 36h profile of consumption, based on ANN method. **Generation Forecast (AGF)** → 36h profile of PV plants production, based on weather forecast. **State Estimation (ASE)** → distribution state estimation using pseudo-measures derived by load modelling. **Optimal Programming (APO)** → 24h set points for dispatchable devices as storage systems and generators. **Optimal Reconfiguration (AOR)** → optimal switches status to reduce active losses. **Reactive Loss Optimization (AWR)** → tap changers and compensators status to optimize reactive losses. **Fault Location (ALF)** → from PMUs analysis.

Results and Conclusions

- The SmartGen DMS has been successfully implemented in three different test sites, by the deadline of the project, September 2014. Nonetheless the **SmartGen DMS is still running** and provides valuable additional information, useful for the local operators.
- The challenges faced during the project, as the adoption of the **international standard CIM** to model the electrical system or the issues of communication and security by interfacing with a primary substation of an **operating distribution network**, have been fully achieved.
- The functionalities proposed have been tested on the real field and have provided significant scientific results that are published in technical literature.
- Further developments of the project are now under evaluation.

UNIGE

LOAD FORECASTING ERRORS

	MAPE	DAILY PEAK MAPE
Max	13.32%	22.46%
Min	6.59%	2.48%
Mean	9.82%	10.23%

AMAIE

LOAD FORECASTING ERRORS

	MAPE	DAILY PEAK MAPE
Max	16.87%	13.85%
Min	3.38%	1.96%
Mean	8.05%	8.30%

