SmartNet

Smart TSO-DSO interaction schemes, market architectures and ICT Solutions for the integration of ancillary services from demand side management and distributed generation

Spanish Pilot – Pilot C
Flexibility from Radio Base Stations

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 691405

SmartNet

Vodafone
Base Stations

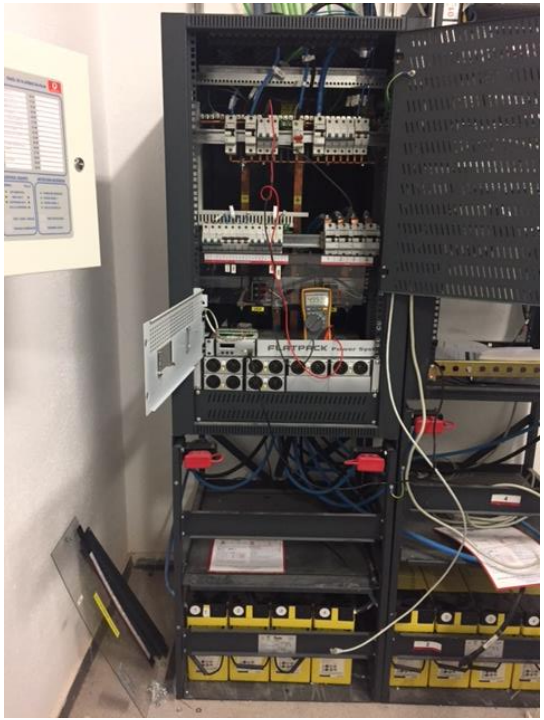
More than 400 units just in
Barcelona

Contracted Power of each one from
5kw to 15kw

Vodafone Base Stations

Flexibility by Storage Capacity

- Back Up Batteries - Base Station of Vodafone



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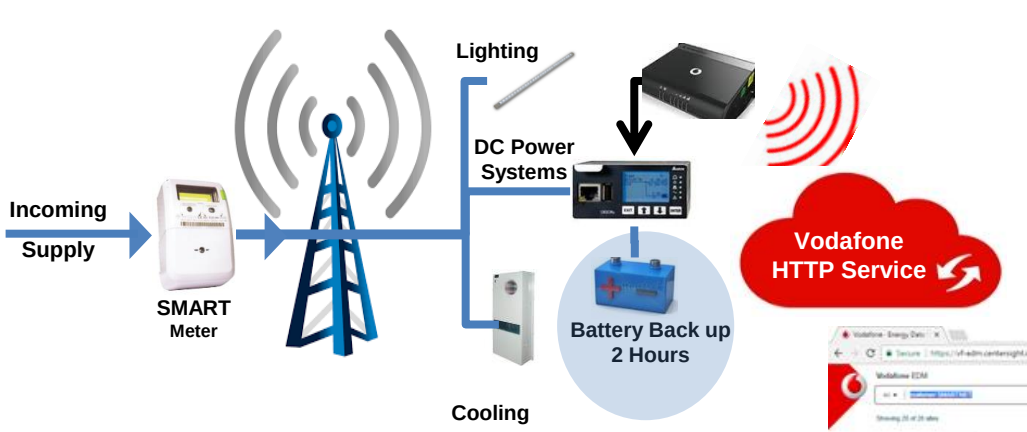
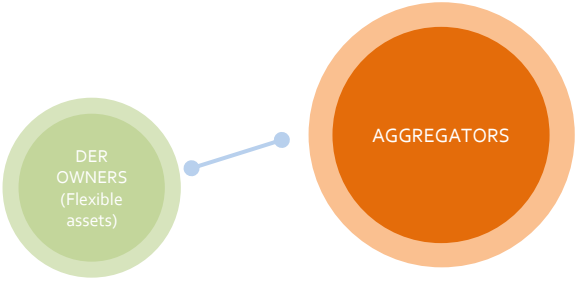
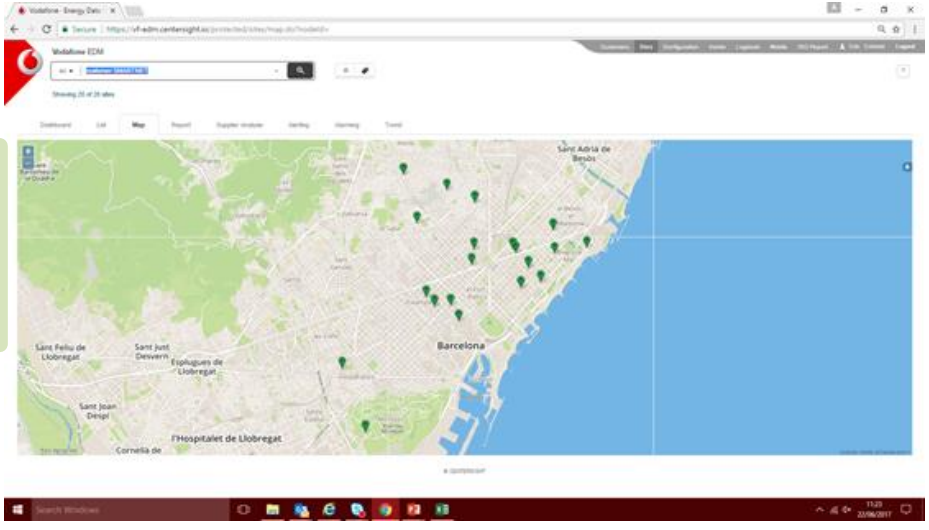
DER Owner side. Demand Response Technology over VF Base Stations





- **Target 1: Installation**
  - Installation complete @ 17/20 sites
- **Target 2: Commissioning**
  - Monitoring complete & live @ 12 sites
- **Target 3: Control**
  - Complex meter configuration for real-time communications

Pilot flexible aggregation capacity: around 100 kW



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Pilot realisation

Italian Pilot (A)

Danish Pilot (B)

Spanish Pilot (C)

Motivation

To proof in real field the feasibility of the *Shared balancing responsibility model* of SmartNet project

Market layer

Physical network layer

ICT layer

Goal achievements

- Validation of TSO-DSO interactions
- Balancing (TSO level)
- Congestion management (DSO level)

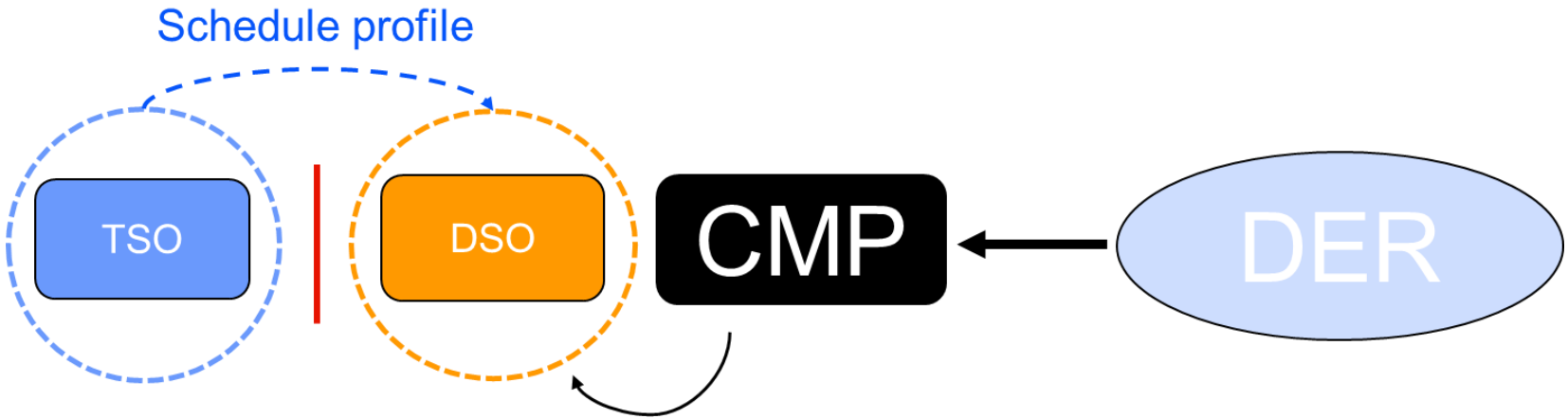
✓ Flexibility Aggregation

✓ Demand Response (Base stations)

✓ ICT communications

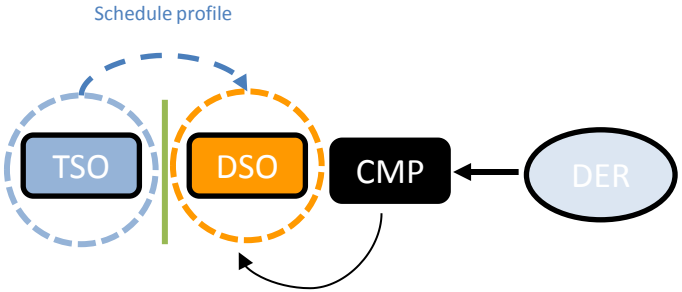
Coordination scheme

Shared balancing responsibility model



Coordination scheme

Shared balancing responsibility model



TSO Transmission system operator

DSO Distribution system operator

CMP Commercial market parties

DER Distributed energy resources

Local market operator

AS market operator

Schedule profile

Balancing responsibility transfer

Two different markets

- Ancillary Service market for resources connected at TSO-grid
- Local Market for resources connected at DSO-grid

Ancillary services

- **Balancing** in the interconnection point by respecting schedule profile (on behalf of TSO)
- **Congestion management** in the distribution grid

How? →

By using flexibility from DER owners through Commercial market parties

Roles in the project

endesa	Transmission System Operator	Balancing at interconnection level Developing the TSO-DSO interaction
	Distribution System Operator	By doing congestion management services for itself at local network
	Commercial Market Party	Virtual nodes emulating other CMP's (Smarthouses, PV's, BSs)
	Market operator	Local market operation
	Commercial Market Party	Managing the portfolio of Vodafone radio base stations
Vodafone	DER owner	Owner of the base stations (flexible resource) Provider of connectivity services to CMP's DR providers
tecnalia Inspiring Business	Consulant	

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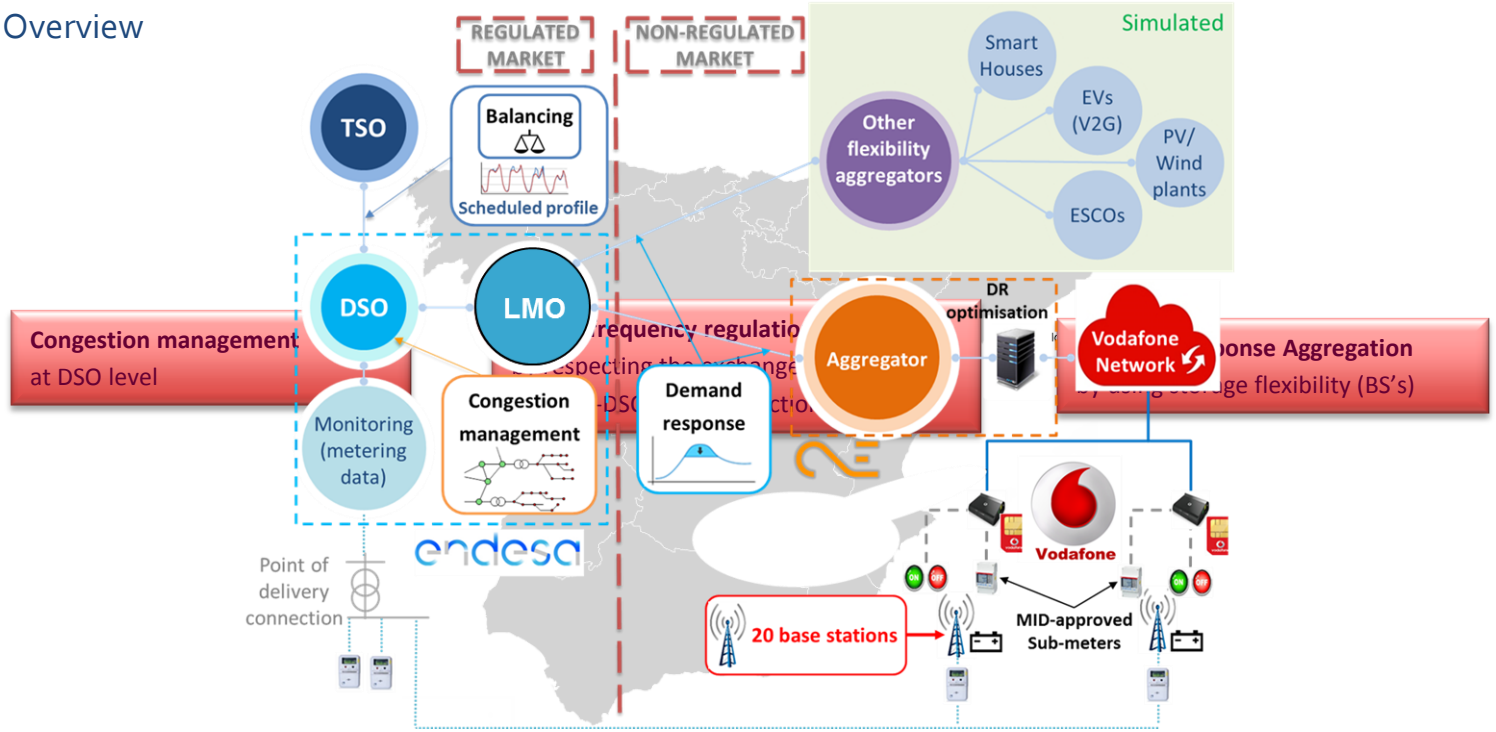
- Overview



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- Local Market Operator

Endesa Distribución will play the **market operator** role at the local (distribution) level by means of the **market clearing algorithm**, which at the end is an OPF (Optimal Power Flow).

The OPF solves in the same optimization model both technical and market-related aspects of the balancing and congestion management services.

In other words, **technical constraints and bid prices are combined in the same optimisation problem**, which provides an optimal economical outcome.

Local Market Operator

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TSO

DSO

Balancing

Congestion management

Main LMO Functionalities

- DSO transfers their needs to solve congestion issues from the d-grid
- Comercial market participants send their bids and Baselines to the LMO

Local congestion management

Facilitates flexibility to solve **congestion issues from the DSO**

Performs market clearing

Market clearing

Facilitates flexibility for **balancing at the TSO-DSO interconnection**

Acquires information from participants and **broadcasts market results**

- DSO transfers the TSO needs for balancing

Balancing at TSO-DSO level

AGGREGATORS

DER OWNERS (Flexible assets)

Software Flexible Tool for the DSO

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Loged

Balancing & Congestion

Market

CMP

User guide

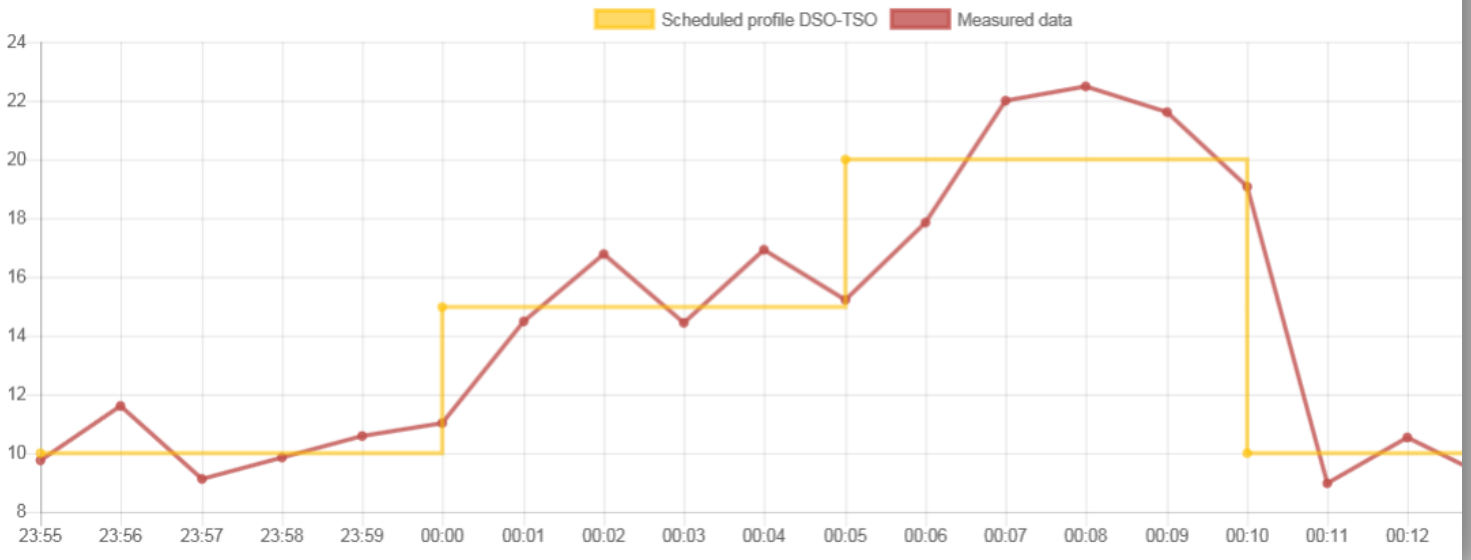
Balancing & Congestion Management Interconnection 01

Sate: Running Stop

03/05/2017 - 10:32:16 UTC

Time Filter

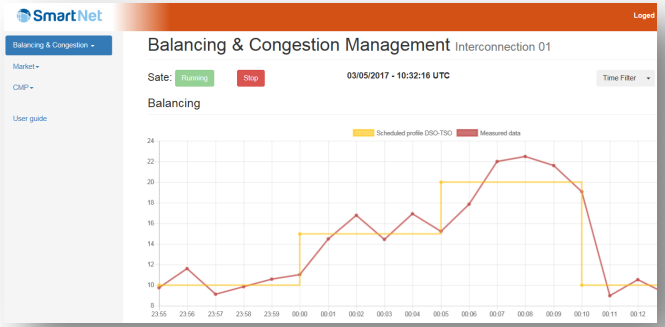
Balancing



SW Flexible Tool

LMO
DSO
Virtual CMP

- Control of the pilot



Balancing. Time plot of active power exchanged at TSO-DSO interconnection points

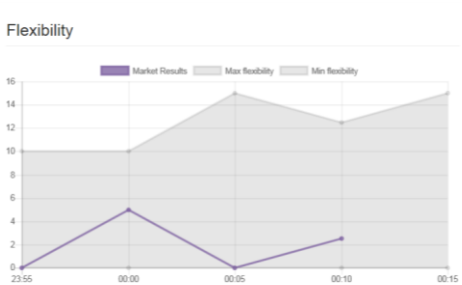
Flexibility. Time plot of total flexibility volumes per market session at each TSO-DSO interconnection point (kW)

CMPs. Time plot of aggregated load of customers' portfolio of each CMP.

Market prices. Time plot of the clearing price per market session at each TSO-DSO interconnection point

Market results. Table of dispatched flexibility volumes per CMP per market session and node at each TSO-DSO interconnection point (kW)

Network Status. Diagram of the distribution network downstream each TSO-DSO interconnection point:



Market results

Market time	Node	CMP	ΔP (kW)
2017-02-14T00:10:00Z	6	ONE	2.5
2017-02-14T00:00:00Z	6	ONE	2.5
2017-02-14T00:00:00Z	10	TWO	2.5

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- Progress so far

Functional specification

- Definition of roles
- Definition of architecture
- Definition of Vodafone's constraints
- Definition of services to be tested
- Definition of DSO market
- Definition of Endesa's constraints

Technical specification

- Specification of SW for simulating other aggregators
- Specification of SW for simulating DSO needs
- Specification of SW for simulating DSO market
- Specification of ONE-Endesa communications
- Specification of SW for aggregation
- Specification of Vodafone-ONE communications
- Specification of SW for controllers at base stations

Software development

- Development of SW for simulating other aggregators
- Development of SW for simulating DSO needs
- Development of SW for simulating DSO market
- Development of SW for aggregation
- Development of SW for controllers at base stations

Testing

- Definition of test protocol
- Test of DSO market
- Test of ONE-Endesa communications
- Test of aggregation algorithm
- Test of Vodafone-ONE communications
- Test of controllers at base stations

Experimentation in field during 1 year

January 2018 to November 2018

- Identification of primary substations
- List of base stations
- HW installation. DR kits
- HW installation plan

Site selection & installation

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- Following

Testing

- Definition of test protocol
- Test of DSO market
- Test of ONE-Endesa communications
- Test of aggregation algorithm
- Test of Vodafone-ONE communications
- Test of controllers at base stations

Experimentation in field during 1 year

January 2018 to November 2018

Reporting of the Pilot

And after Smartnet?

If the outcomes are positive, one of the following steps could be to simulate this project considering a higher number of border points (TSO/DSO), which could cover large urban areas.

Regulatory framework **analysis** and Propose **policy recommendations**

SmartNet-Project.eu

Thank You

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