GIS for Outage Management

edp distribuição

SMART GRID FORUMS | GIS4SmartGrid 2019
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Rui Almeida, EDP Distribuição

Analyzing Real-Time and Historic GIS and OMS Data to Pinpoint Network Faults, Reduce Downtime and Predict Further Incidents

AGENDA

- EDP and EDP Distribuição in brief
- Today's Objectives
  1. GIS Integration with SCADA/DMS
  2. Operational Systems
  3. Control Rooms
  4. Situational Awareness
  5. Next Steps

EDP in a Glance

We operate in 14 countries and 4 continents

We are:

- the largest generator, distributor and supplier of electricity in Portugal
- the third largest electricity generation company in the Iberian Peninsula
- the fifth largest private operator in electricity generation in Brazil

EDP in a Glance

We provide electricity to almost 11 million electricity customers

We have about 12 thousand employees around the world

Almost 81% of our energy is produced from renewable sources

EDP Distribuição is the regulated Portuguese Distribution System Operator

We are **EDP Distribuição**, the company of EDP Group which keeps connected more than **six million** customers

226 thousand km of distribution grid, about 8 laps around the world

143k LV lines (km)

73k MV lines (km)

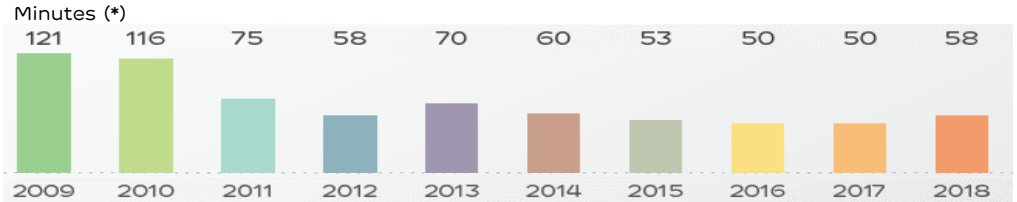
10k HV lines (km)

46 TWh of distributed energy

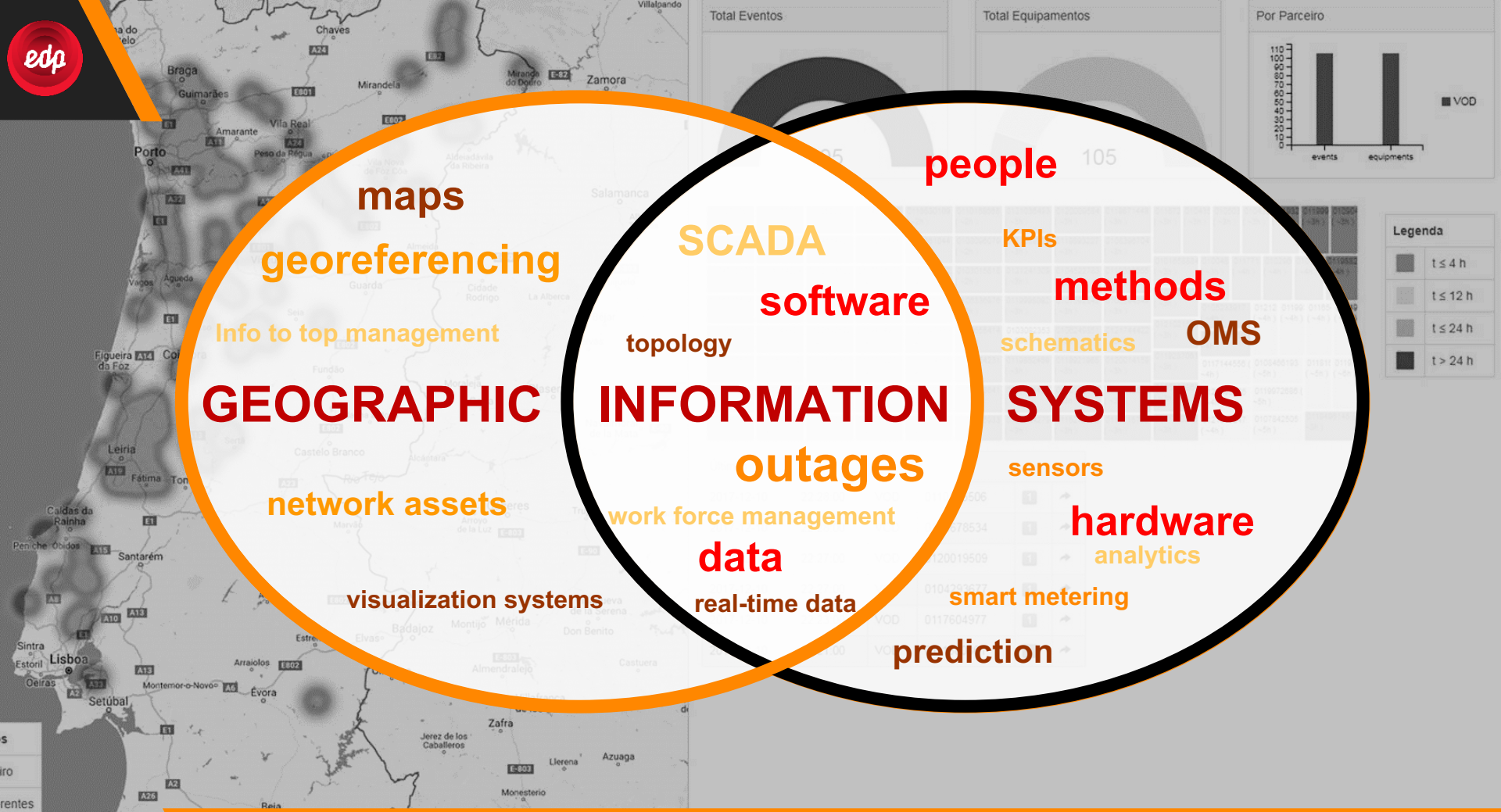
400 Substations

67k Secondary Substations

Increased Technical Service Quality



(*) Equivalent interruption time of installed power (Extra events not included)


maps
georeferencing
Info to top management
GEOGRAPHIC
network assets
visualization systems
SCADA
software
topology
INFORMATION
outages
work force management
data
real-time data
people
KPIs
methods
OMS
schematics
SYSTEMS
sensors
hardware
analytics
smart metering
prediction
Total Eventos
Total Equipamentos
Por Parceiro
VOD
events
equipments
Legenda
t ≤ 4 h
t ≤ 12 h
t ≤ 24 h
t > 24 h

Today's Objectives
Sharing EDP Distribuição GIS Challenges and Vision

Main challenges to cope with...

GIS integration with SCADA/DMS

Overlaying outage information onto GIS data to create a comprehensive picture of the network in real time

Reports Generation

Automatically generating reports and creating visual tools to monitor and convey likely outage duration, impact, and cost to the organization

Faults Response Improvement

Emphasizing the power of GIS data to support reductions in network failure and improve responses to remaining incidents

Control Rooms

Equipping control room teams with live maps displaying crucial outage data to improve response times and provide earlier warnings of faults

Other Sources Integration

Accessing multiple internal and external data streams and contextualizing them with topology and geospatial information

Situational Awareness

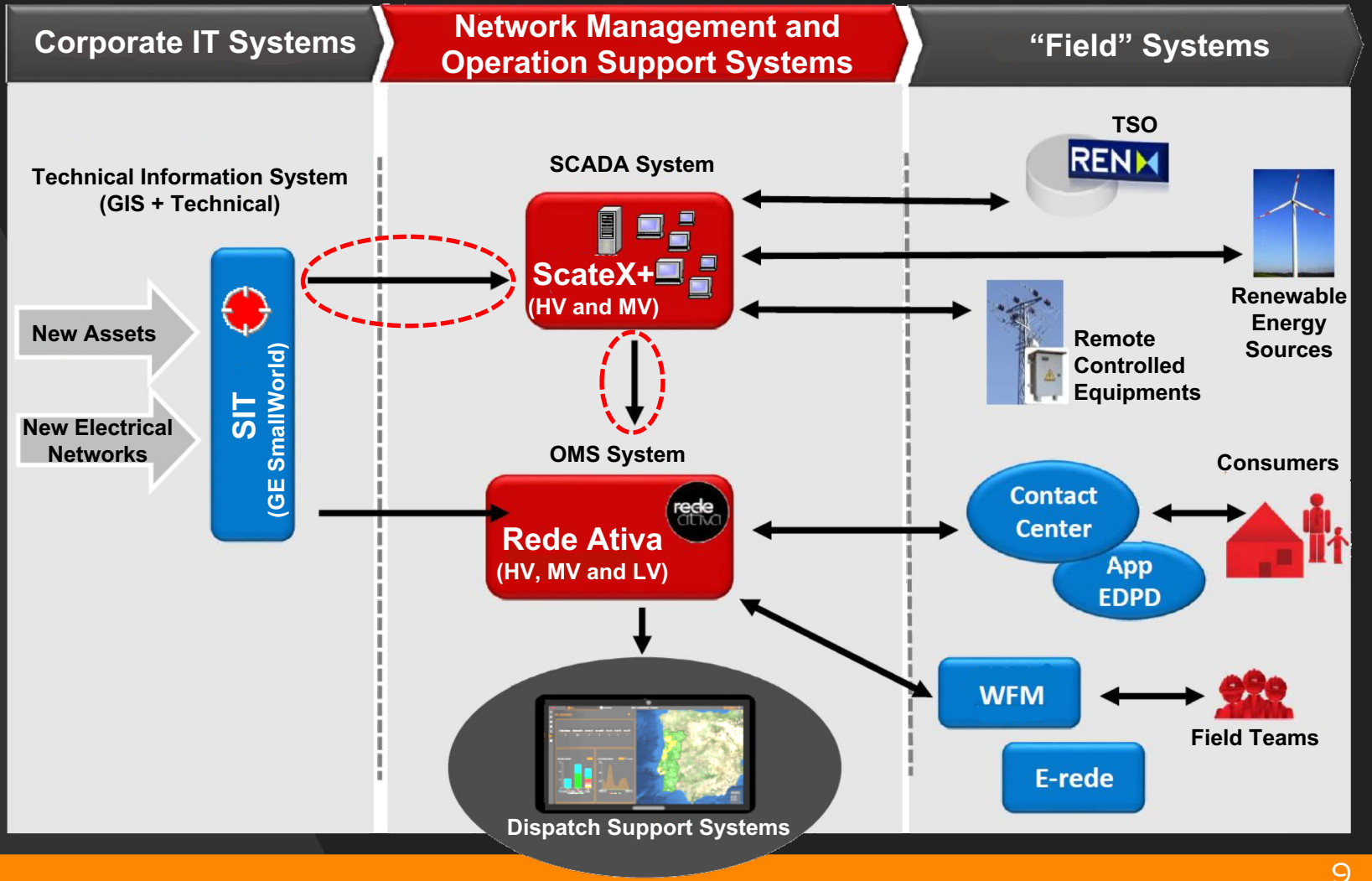
Using GIS asset information alongside outage data to identify failure-prone assets to be addressed before failure occurs

Vision, roadmap and next steps towards a full systems integration (commonly referred to as ADMS, in which GIS plays a key role)

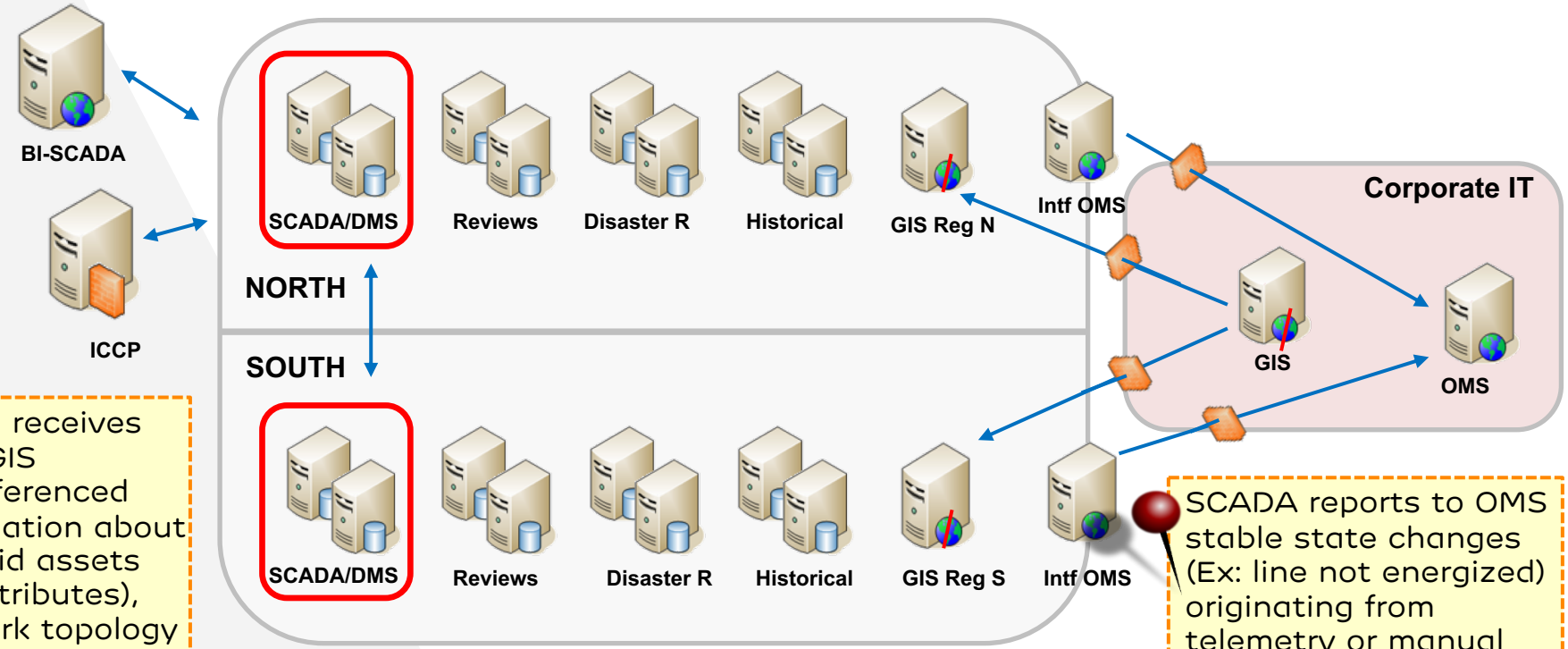
1.
GIS Integration with SCADA/DMS

Overlaying outage information onto GIS data to create a comprehensive picture of the network in real time

EDPD Systems Landscape



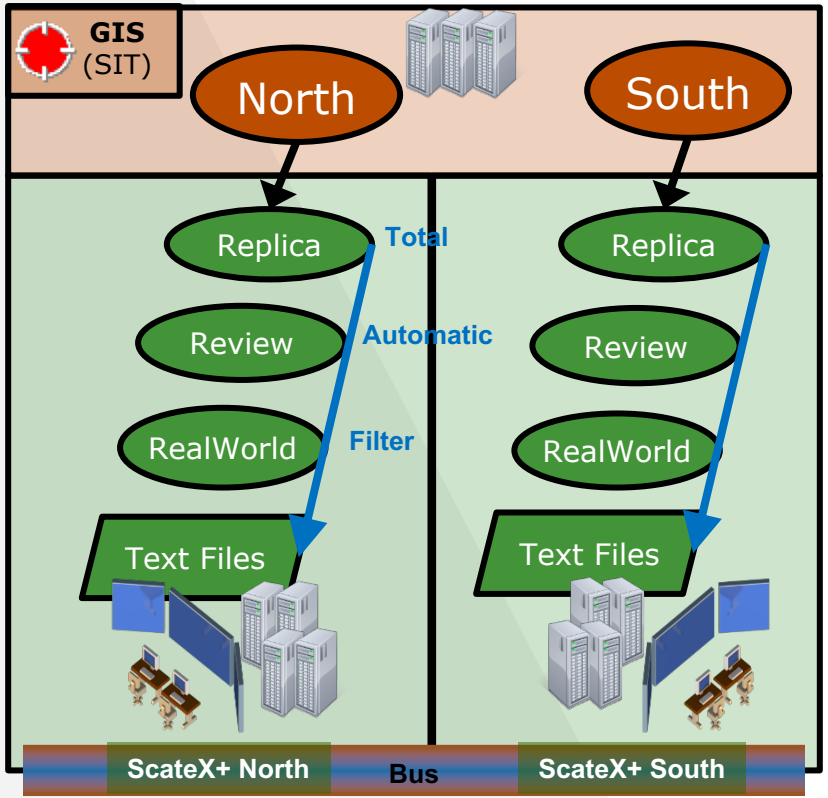
Systems Interconection

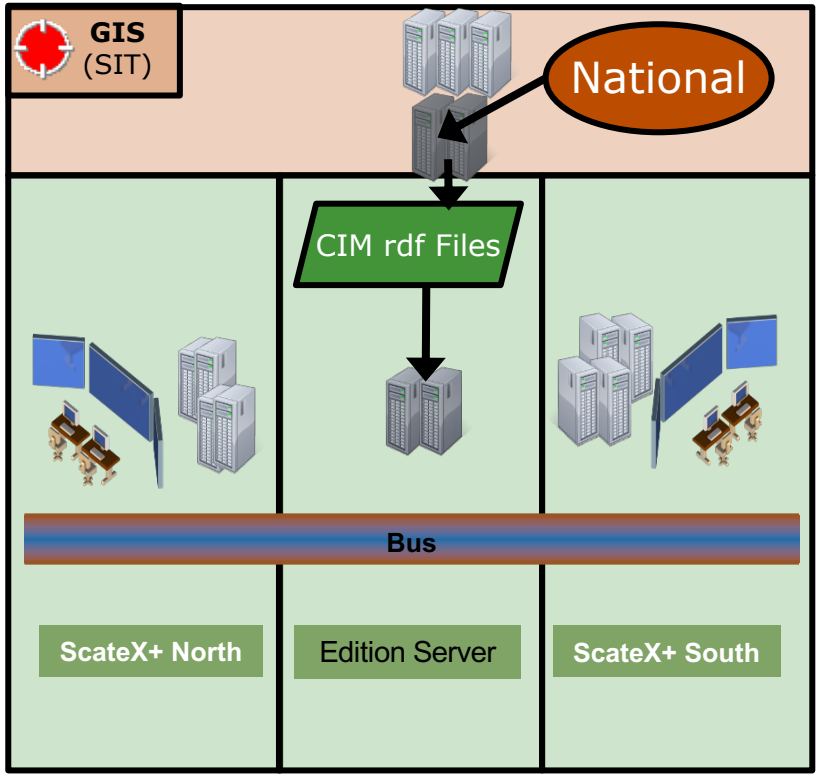


Scada receives from GIS georeferenced information about the grid assets (its attributes), network topology and schematics.

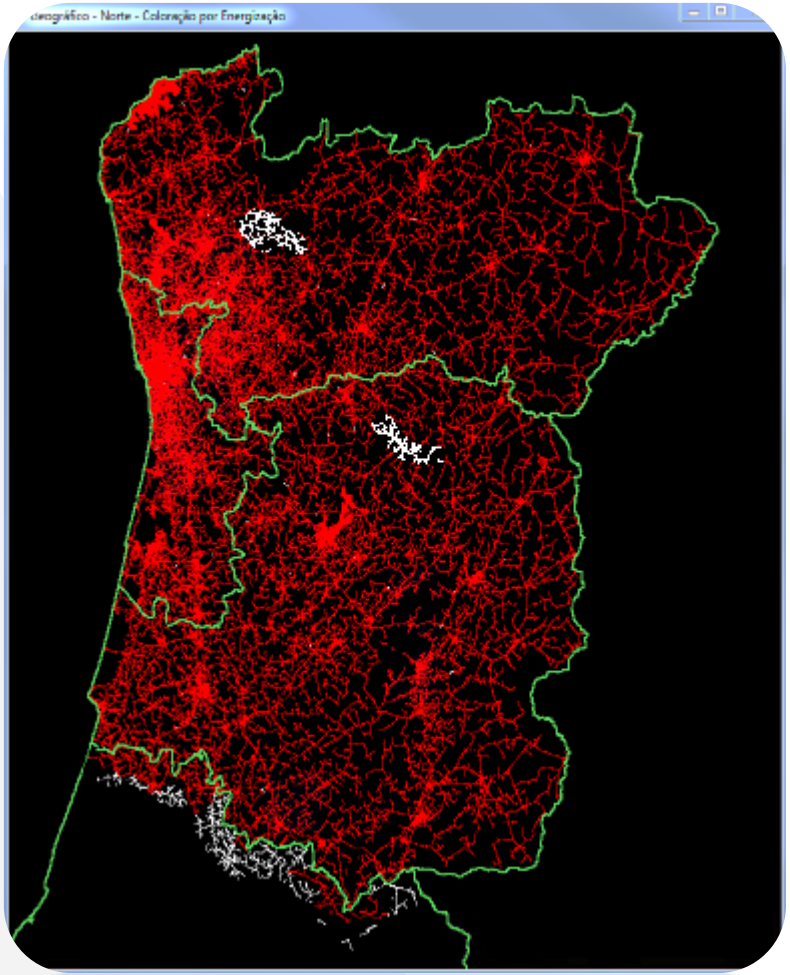
SCADA reports to OMS stable state changes (Ex: line not energized) originating from telemetry or manual actions.

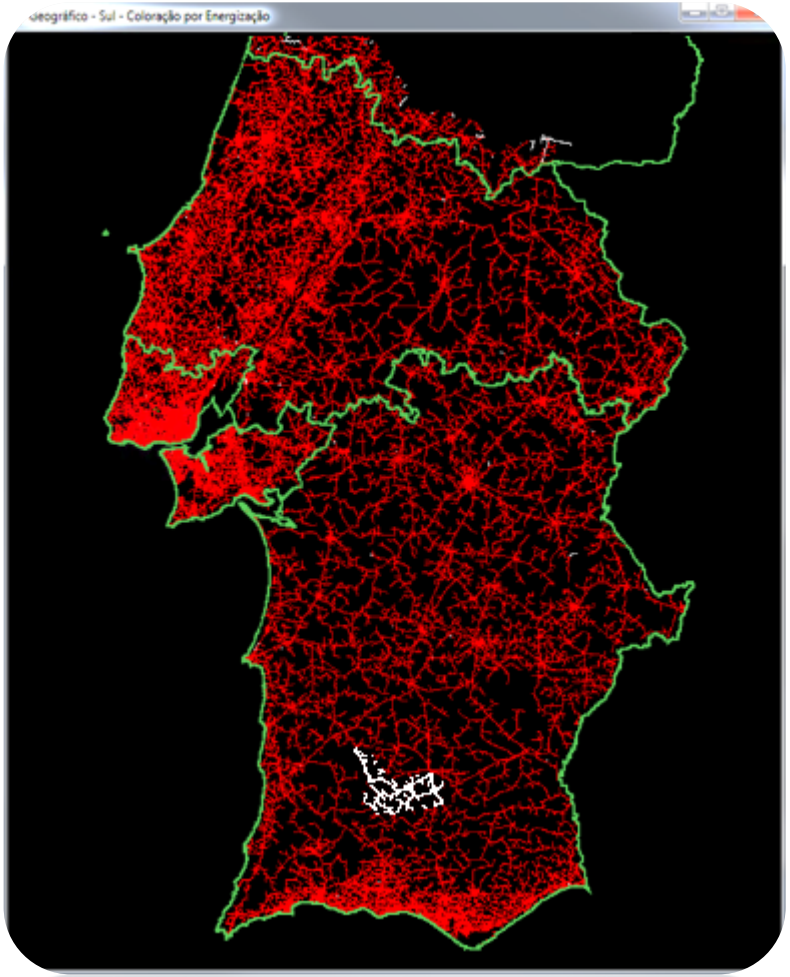
GIS/SCADA Interface Process (Present and Future)





GIS / SCADA Outage Diagrams

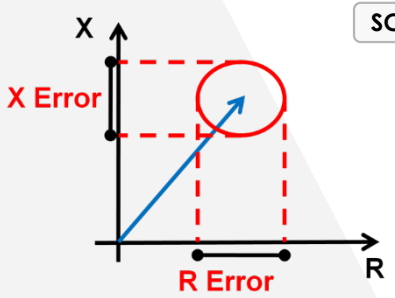


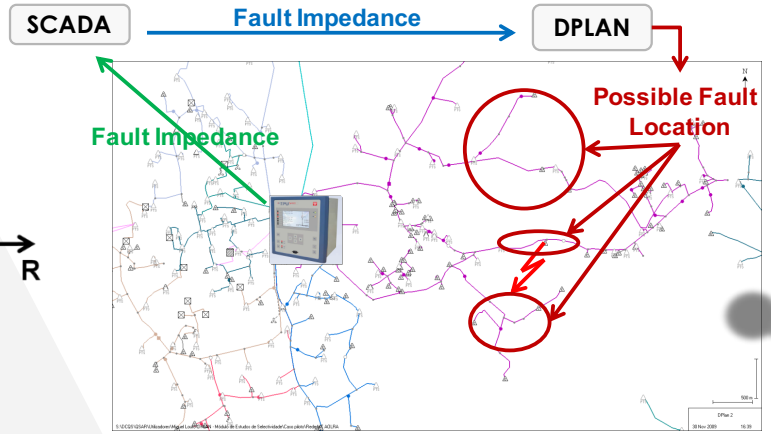


2.
Operational Systems

Emphasizing the power of GIS data to support reductions in network failure and improve incident responses, by accessing multiple data streams and contextualizing them with topology and geospatial information.

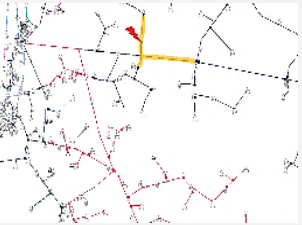
SCADA Fault Location in MV Networks
Topological Approach (Standard fault location methods based on R, X)

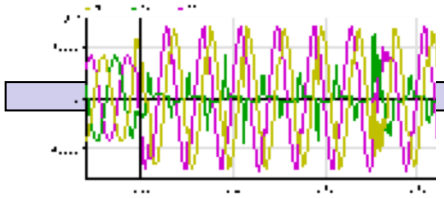


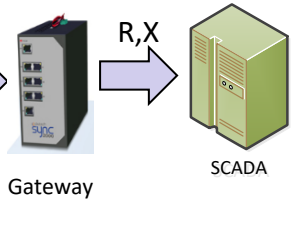


- Estimate fault locations provided by the digital protections
- Digital protections saves the fault impedance and these signals can be compared with the network impedance which may lead to a likely area for the fault location

GIS as a Key Factor
Accurate Network topology and characteristics of the lines



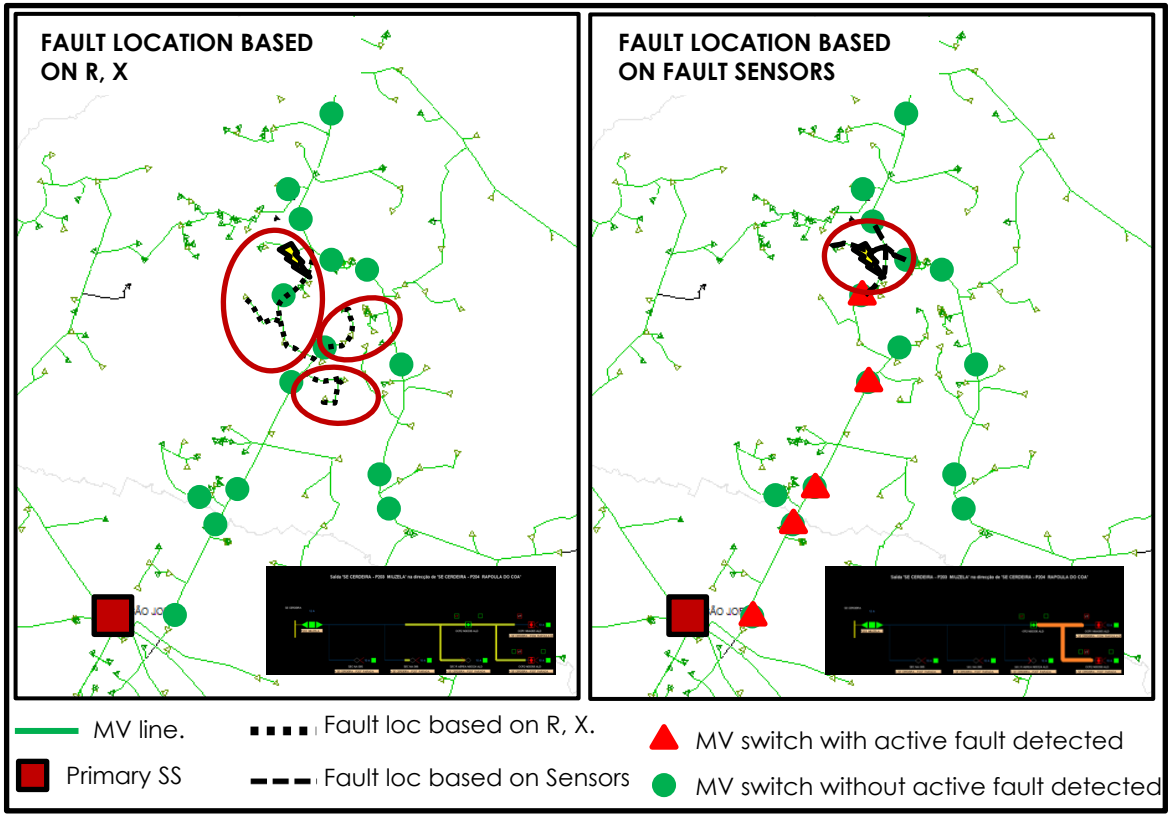




Fault location algorithm

SCADA Fault Location in MV Networks Sensor Based Approach

- The solution of MV grid fault detection can be optimized considering also the status of the fault locator sensors (located on network switchs and secondary substations).
- That way proved to be more precise than standard fault location methods based on R,X
- Operator performs the manual fault detection process or possible Integration with Self-Healing system



WFM/GME
Work Force Management

Corporate Systems

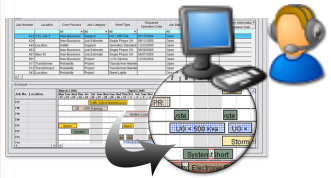
- **OMS** — Rede Ativa, PowerOn
- **SAP/IS-U** — SGCC-SEP
- **SAP R/3 PM** — JUMP
- **GIS** — SIT RD, SmallWorld
- **SCADA** — SCATEX+

Sending Work Orders →

← Returning Information for Closing Work Orders

WFM/GME: "Sistema de Gestão da Mobilidade de Equipas"

Schedule and Dispatch



Field Team Reception

Itineration

Return

Execution

WFM / GME enables job optimization, support to field execution and real-time capture of services status.

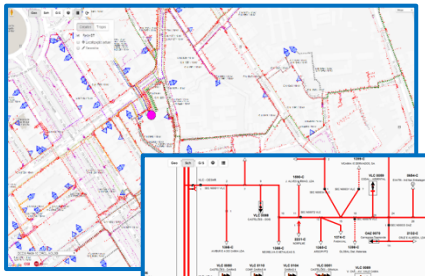
GIS as a Key Factor

Accurate Geo-referencing is crucial to reduce outage resolution times

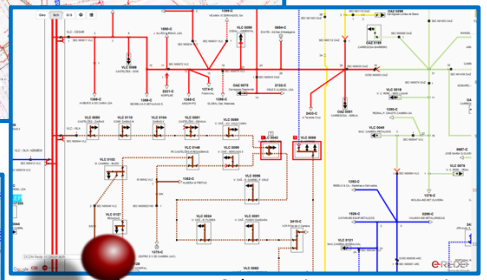
E-REDE
Online Network Information to Support Field Operation

- Providing Field Teams with easy and fast online access to schematics concerning the network grid updates and additional and useful information
- Access to equipment information and installation's internal scheme.
- Access to the current operational configuration of the network (switching operations), directly obtained from the OMS system.

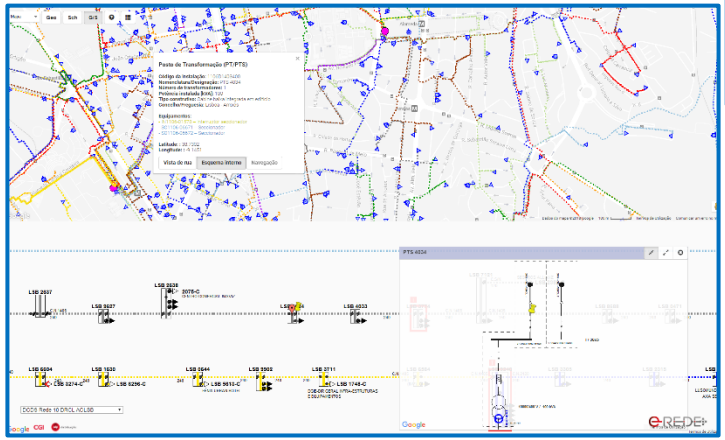
Running on Multiple Devices



LV Network



Schematic Representation



Geographical Representation

GIS as a Key Factor
Accurate Asset information crucial to reduce outage analysis times

GRID CONTROL
LV Network Supervision (Integrated Interaction DMS/OMS/AMI)

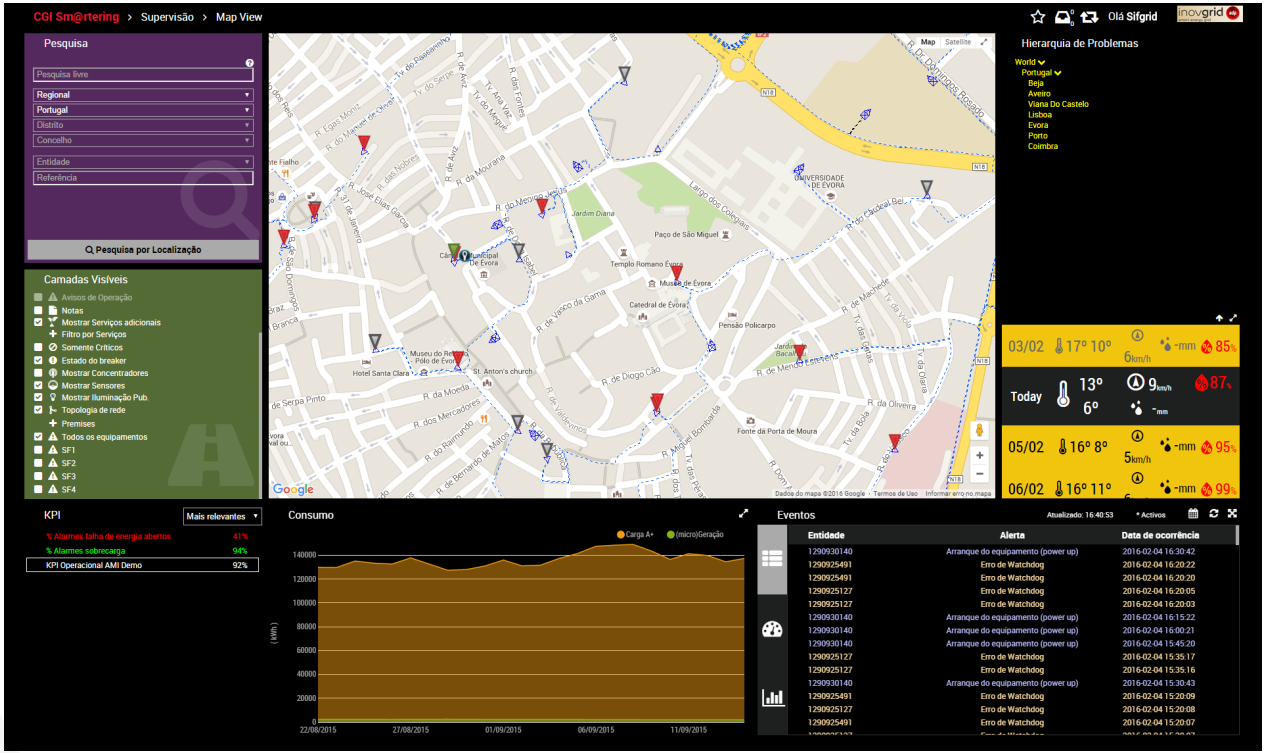
- Improve troubleshooting and response time to LV Outages.

Symbology

- DTC
- EB
- Group of EBs
- Public Light

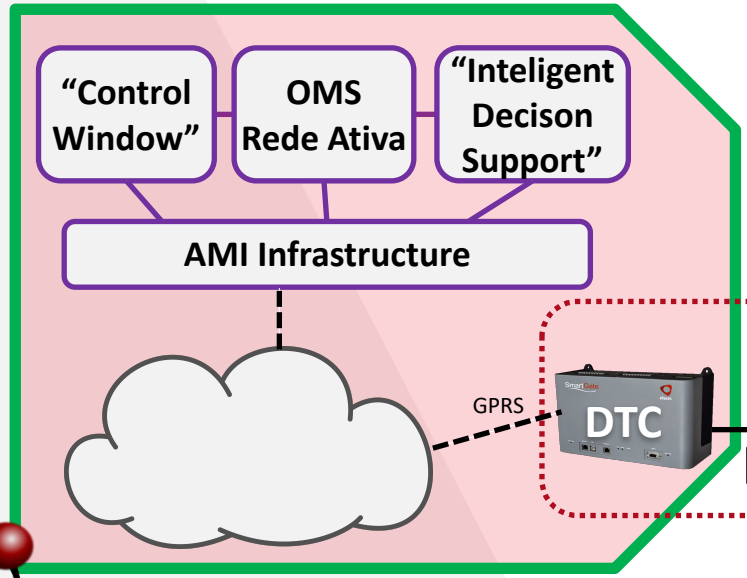
Coloring

- Not Visible to the System
- Don't Communicate
- Communications disturbance
- OK



Map View

GRID CONTROL
LV Network Supervision (Integrated Interaction DMS/OMS/AMI)



GIS as a Key Factor

Accurate LV Network Topology crucial for the correctness of operator decisions

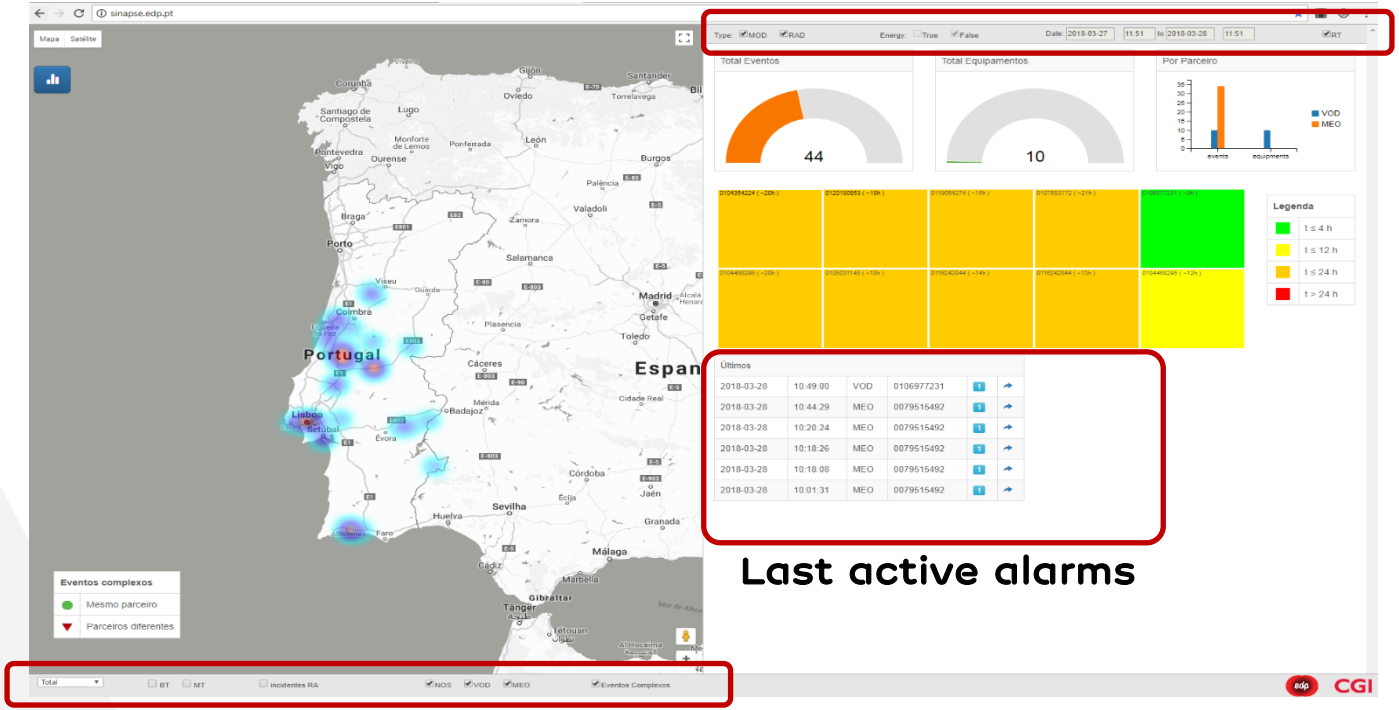
5 Scenarios:

- SS voltage failure
- Correlation and aggregation of SS voltage failure events
- LV Network Power troubleshooting
- Unbalanced Phases
- Power Transformer Overload

SINAPSE
Sharing Low Voltage Incidents with Telecom Operators

- Receive information about problems in the communications network of Telecommunications partners (Vodafone, NOS, MEO)
- Provide information on the expected recovery time of the power grid failures to the Telecommunications partners

Settings / Filter *Dashboard*

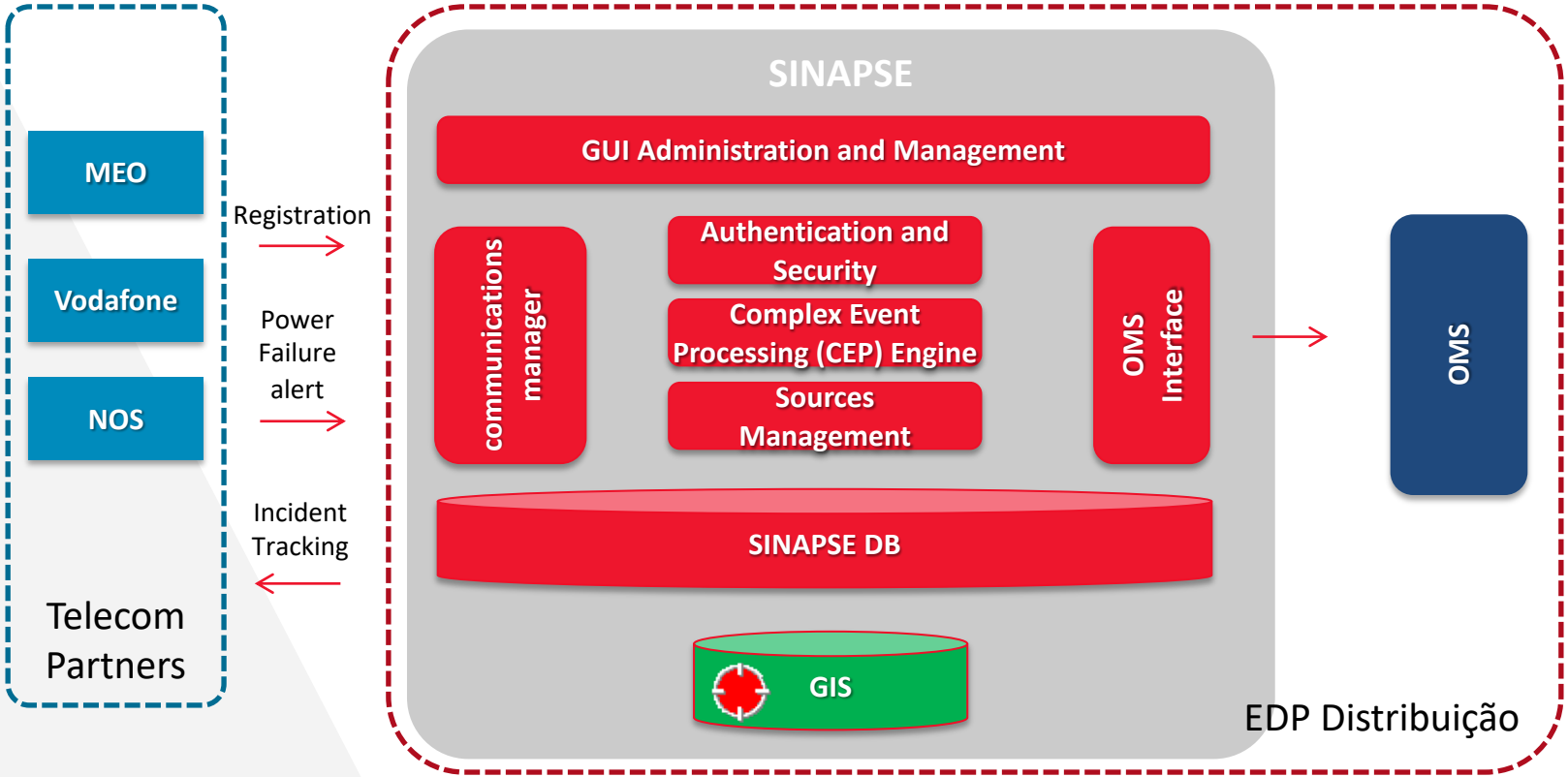


Last active alarms

Settings / Geographical Filter

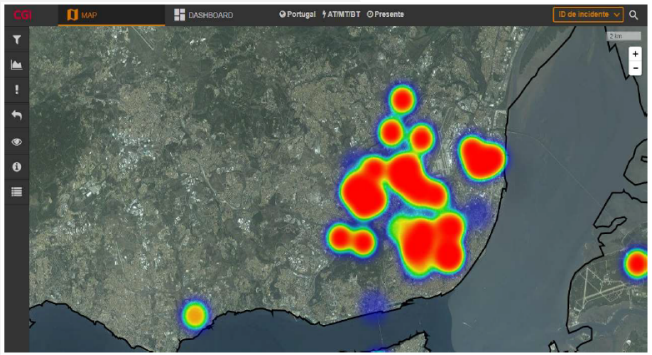
SINAPSE
Sharing Low Voltage Incidents with Telecom Operators

Integrated Systems Architecture



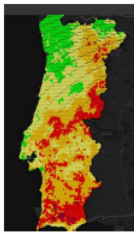
GRID EYE
Grid Status (Metrics and Indicators in Real time and Historical Operational Data)

- Ensure information about impact of the outages on the distribution network, in order to support the various levels of management, either in monitoring, control or decision making.



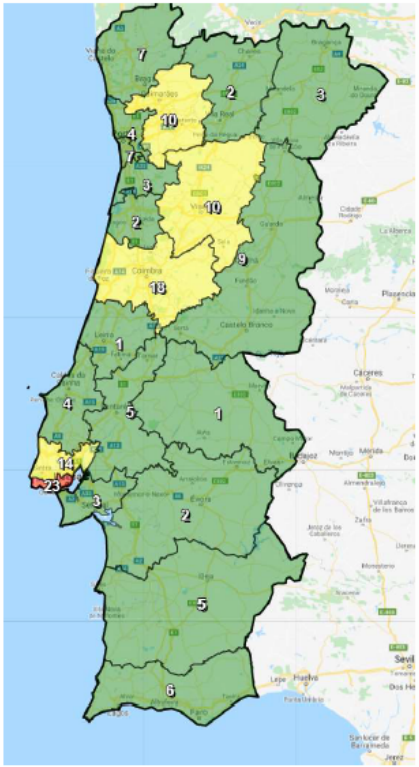
Electricity Incident Representation
through heat map determined by the number of affected customers…

Status visualization and monitoring of
the active incidents on the Grid and its affected network



Active fires and fire risk prediction (coming soon)

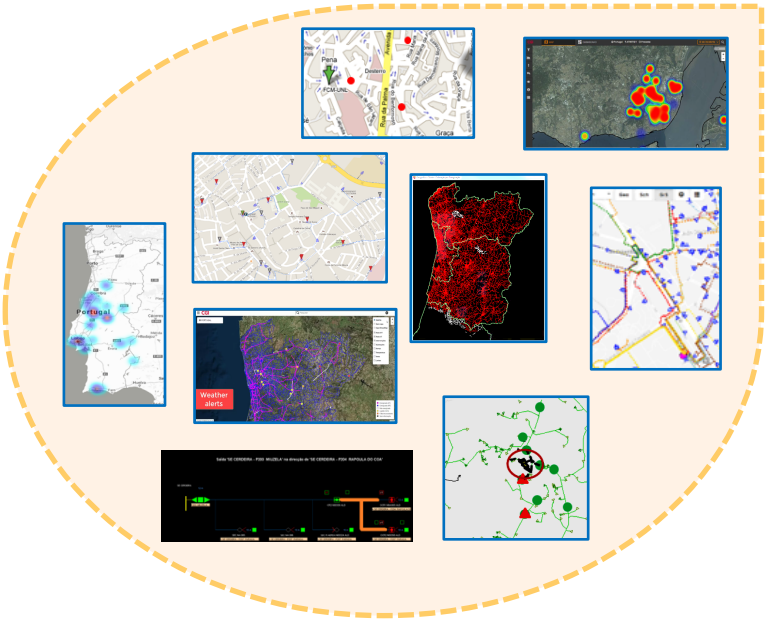
Representation of Operational Indicators: number of incidents, affected customers, affected sites by region...



GIS Criticality

Large Set of Support Applications:

- Delivering Visual Tools and Reports
- Relying On GIS data completeness degree, of the network equipment's and topology
- Accurate Geo-referencing and asset information is crucial to reduce outage resolution times



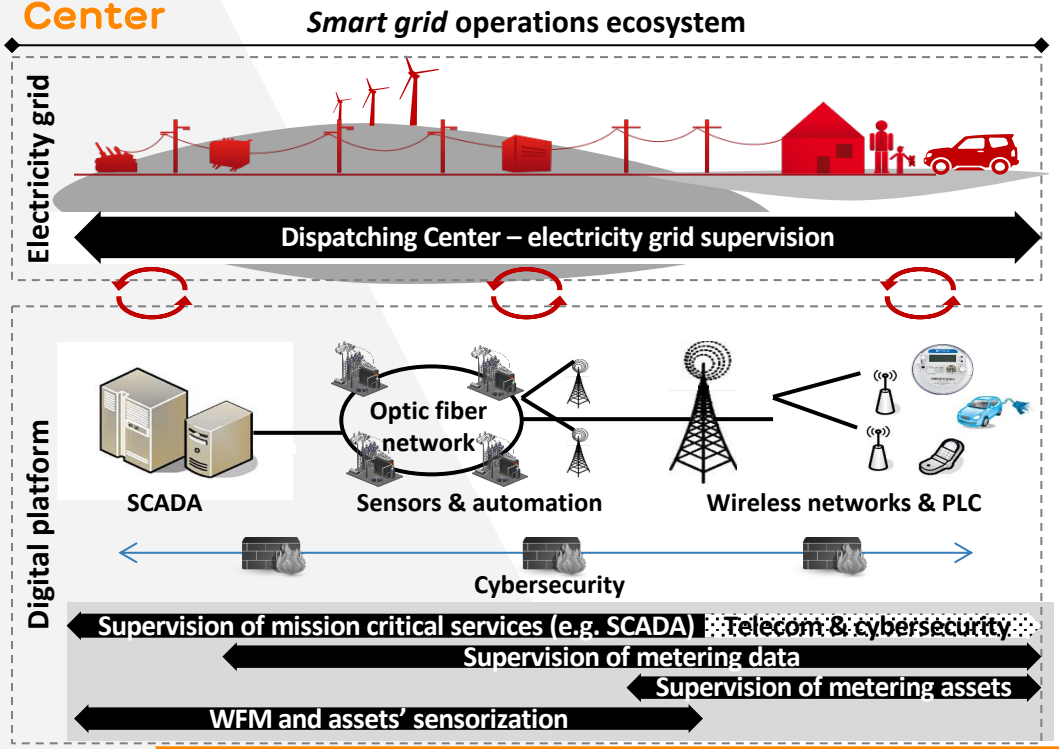
INTEGRATION !!!

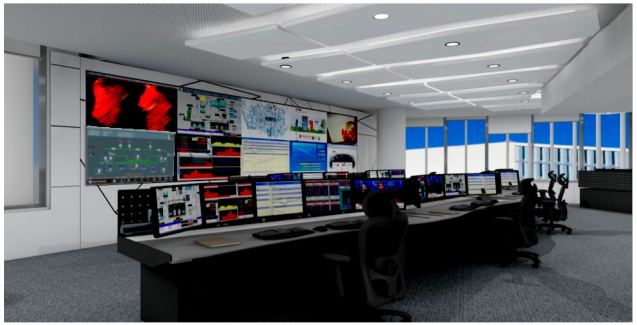
3.
Control Rooms

Equipping control room teams with live maps displaying crucial outage data to improve response times and provide earlier warnings of faults

Supervision and control of the electrical infrastructure is done through **2 Dispatch Centers** and the monitorization and operation of the digital service is done in the **Integrated Supervision Center**

Dispatch Center + Integrated Supervision Center



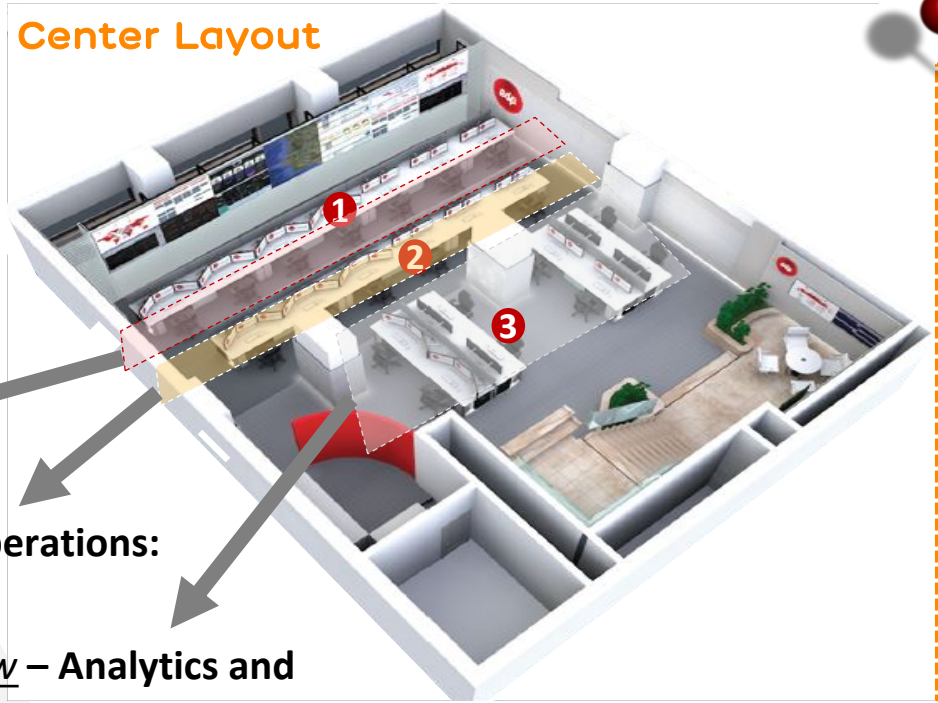


Dispatch Center – High Voltage Dispatch Room (@Porto)

Integrated Supervision Center (@Lisboa)

Integrated Supervision Center is located on EDP Distribuição headquarters and its layout is in line with the best practices

Integrated Supervision Center Layout



Forefront Row - **Control: Detection and Reaction**

Second Row – **Technical Operations: Support to Forefront Line**

Third Row – **Analytics and Performance Management**

Smart grid Evolution Imperative

Merging the **network services operations** and the **supporting operations of the technological platforms** in the same locations is a key factor for the smart grid of the future

4.
Situational Awareness

Using GIS asset information alongside outage data to identify failure-prone assets to be addressed before failure occurs

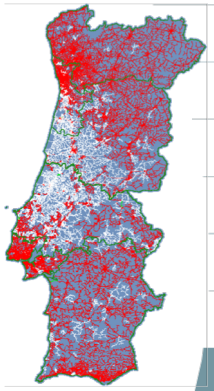
The Problem...

1,5M events

Adverse Weather Conditions

Definitive trips on the grid

Gong Storm



Four Levels of Analytics

Prescriptive Analytics
Provide better decision options according to forecasts

Prescription
Depending on the severity expected for each region, it will recommended the activation of suitable Alert Levels

Predictive Analytics
Learning from the past to find out: Trends; Standards; Correlations.

Forecast adverse conditions
Prepare and make faster and more efficient execution of first maneuvers and cancellation of some programmed maintenance actions.

Diagnostic Analytics
Determine cause of successes and failures

Knowledge
Data correlation: Ex. wind > 70 km/h and Lightning = circuit breaker failure

Descriptive Analytics
Work the historical data to understand what happened and when

Retrospective
Use SCADA historical data to analyze fault in power grid

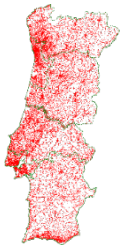
Situational Awareness Concept

External Sources

- Websites
- **Weather data**
- Mails
- Social media
- others

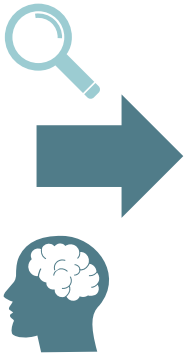
Internal sources

- GIS
- **SCADA**
- SAP
- **Alert Plans**
- others



PGPI

Key-Idea:
Gather the data, internal and external, structured and unstructured, to extract valuable information for the company



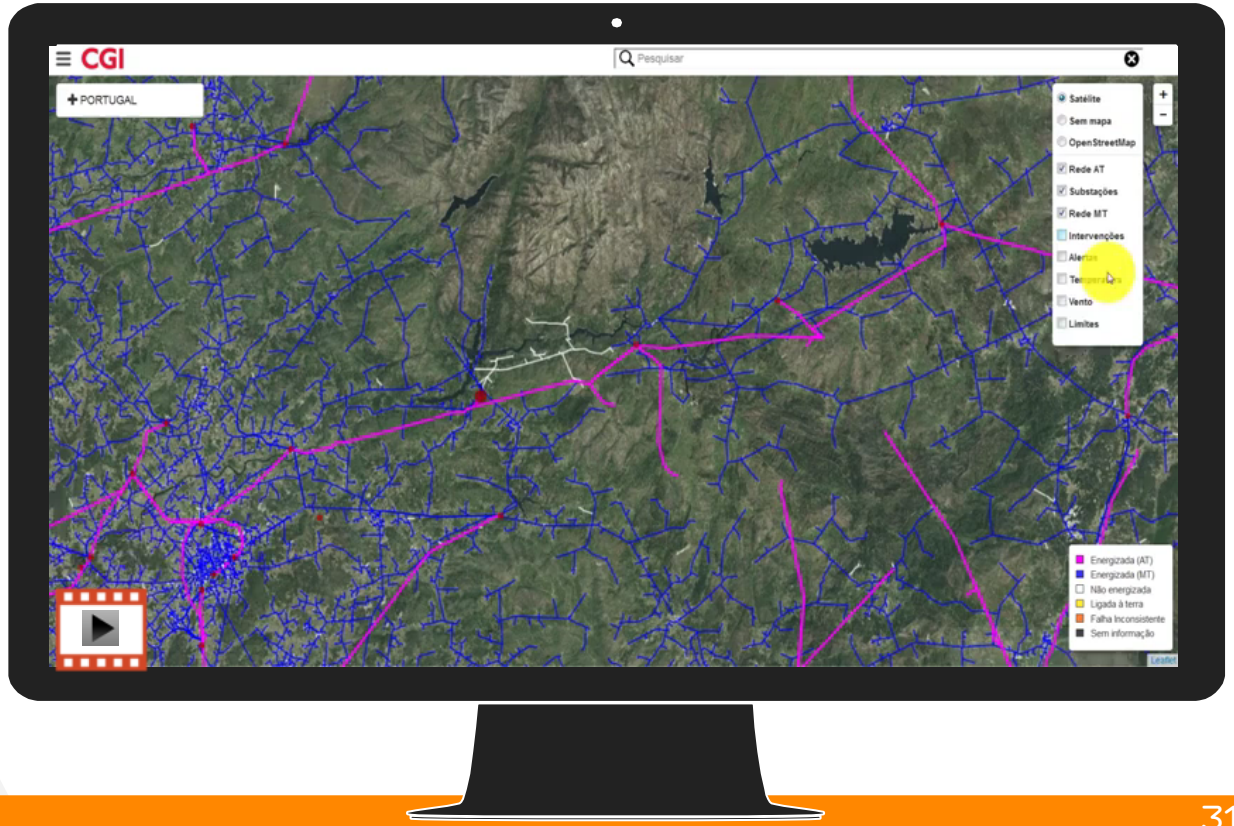
Valuable information

Situational Awareness Pilot at EDPD

Network + KPIs

Current State Grid

- [Km] afected grid (HV, LV, underground and aerial)
- [#] triggers
- [#] affected installations
- (PS, SSs, Switchs)



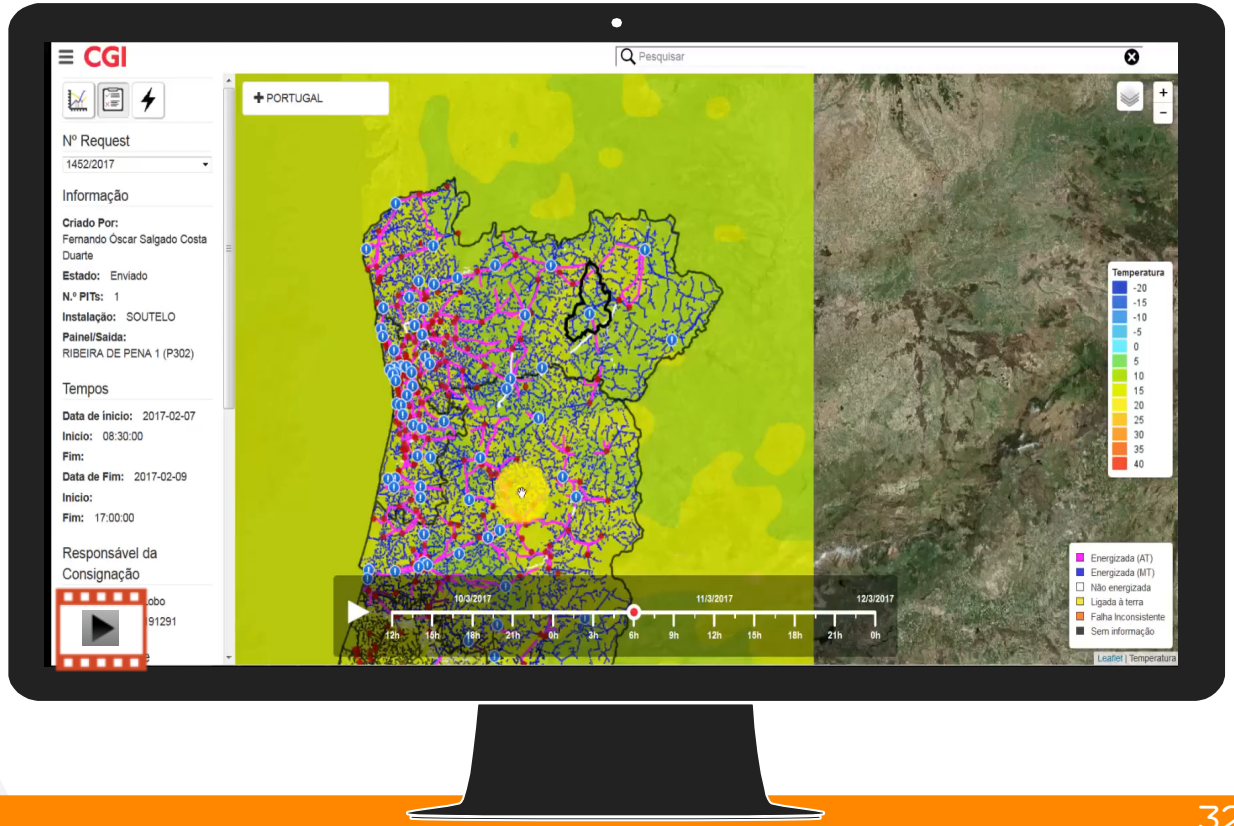
Situational Awareness Pilot at EDPD

Weather Info

- Temperature
- Wind

To be incorporated:

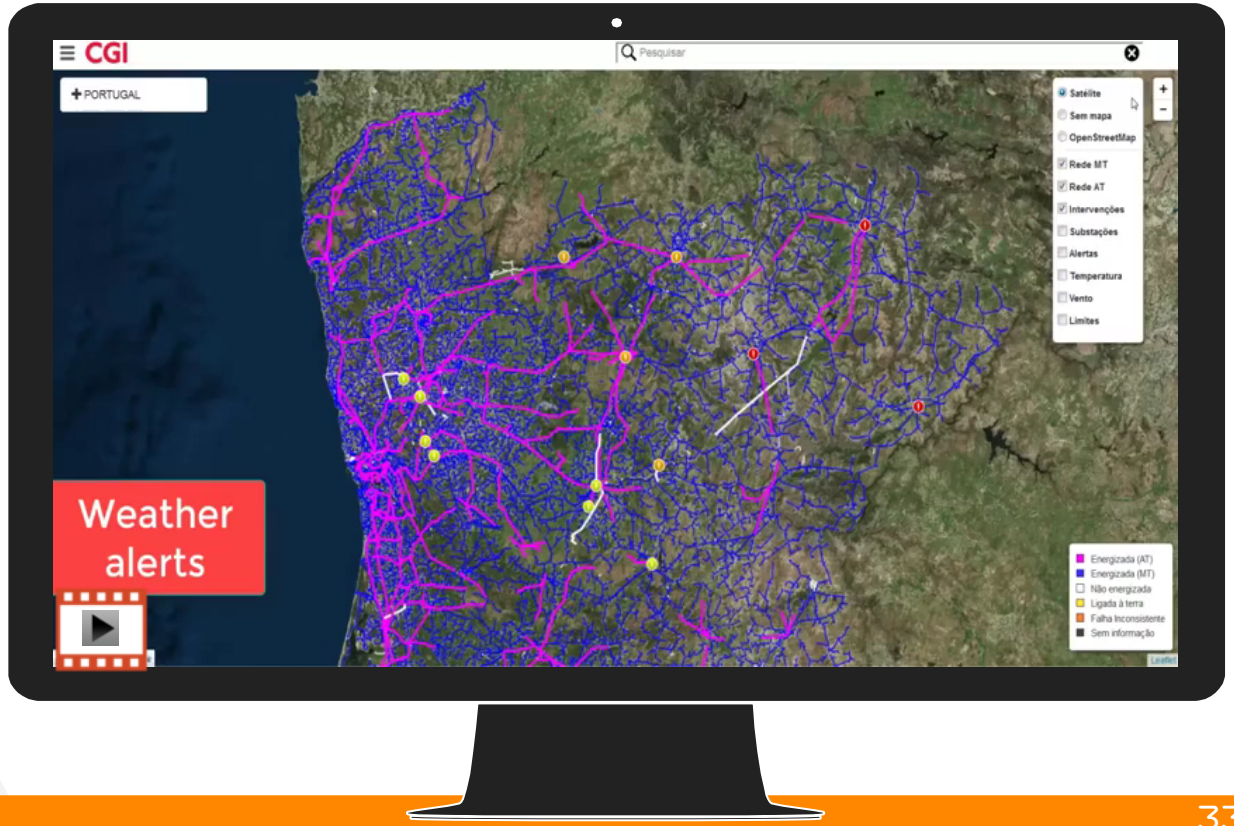
- Lightning
- Precipitation
- Humidity



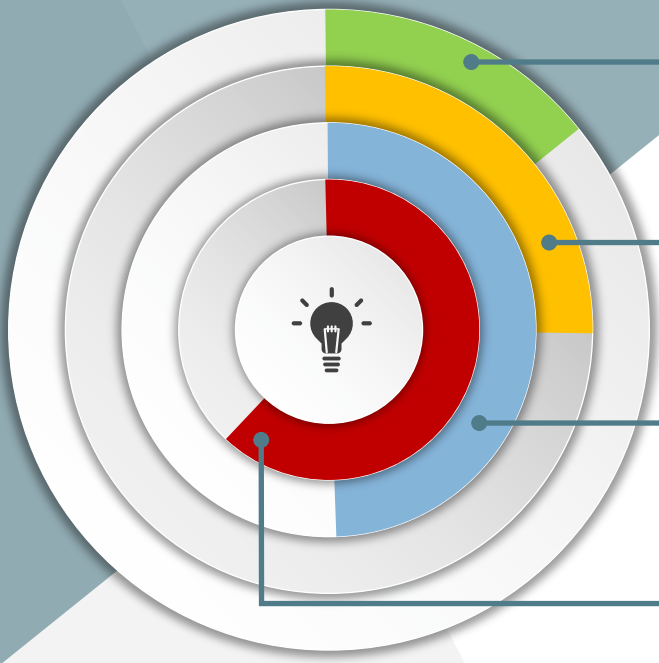
Situational Awareness Pilot at EDPD

Alert Plans

- [local] Programmed works
- [Time] works
- Alert level - Plan activation
- Suggestion for postponing maintenance actions



Future Work - New Layers of Information

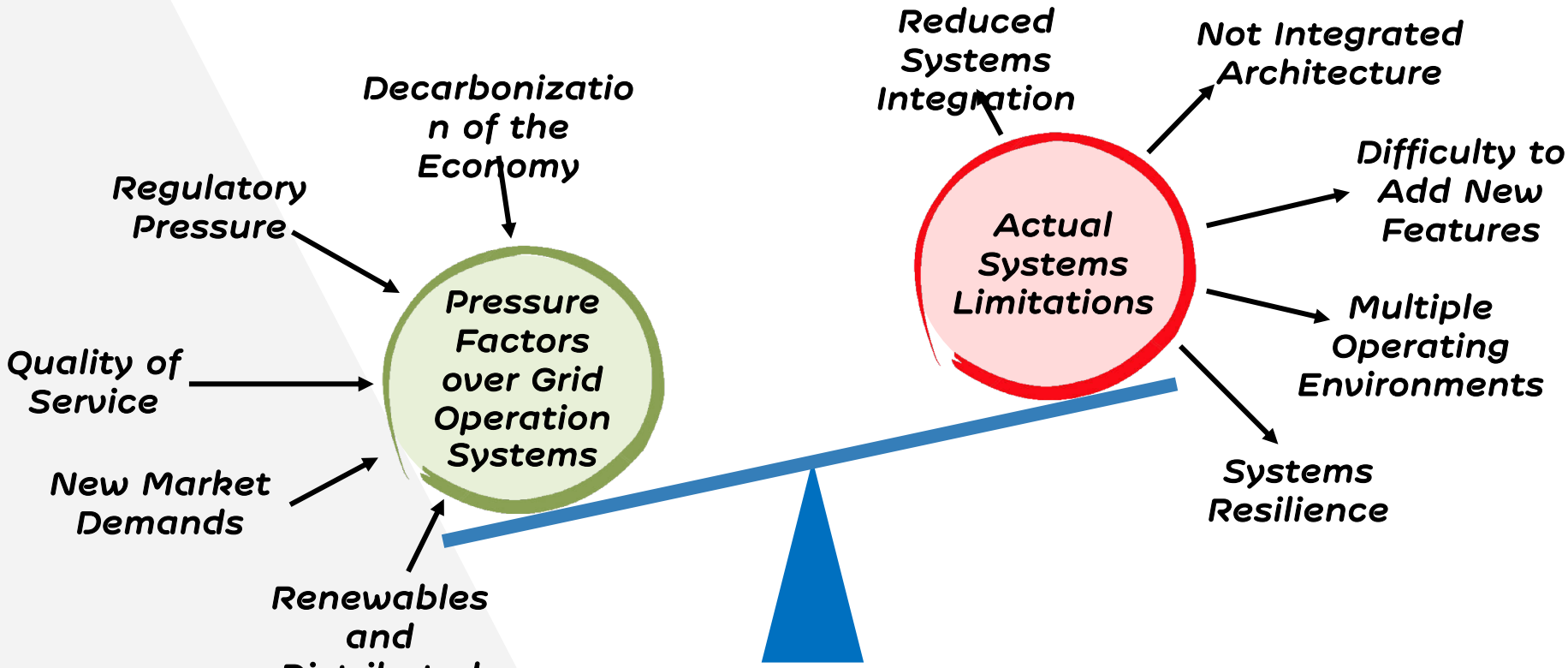


- Vegetation Management + Wildfires
- Anomalous Behaviors in the Grid
- Telecomunication
- GIS & OMS

5.Next Steps

Vision and next steps towards a full systems integration (ADMS), in which GIS plays a key role

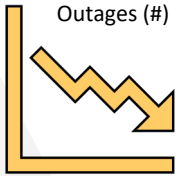
Future Pressure Factors vs **Present** Limitations

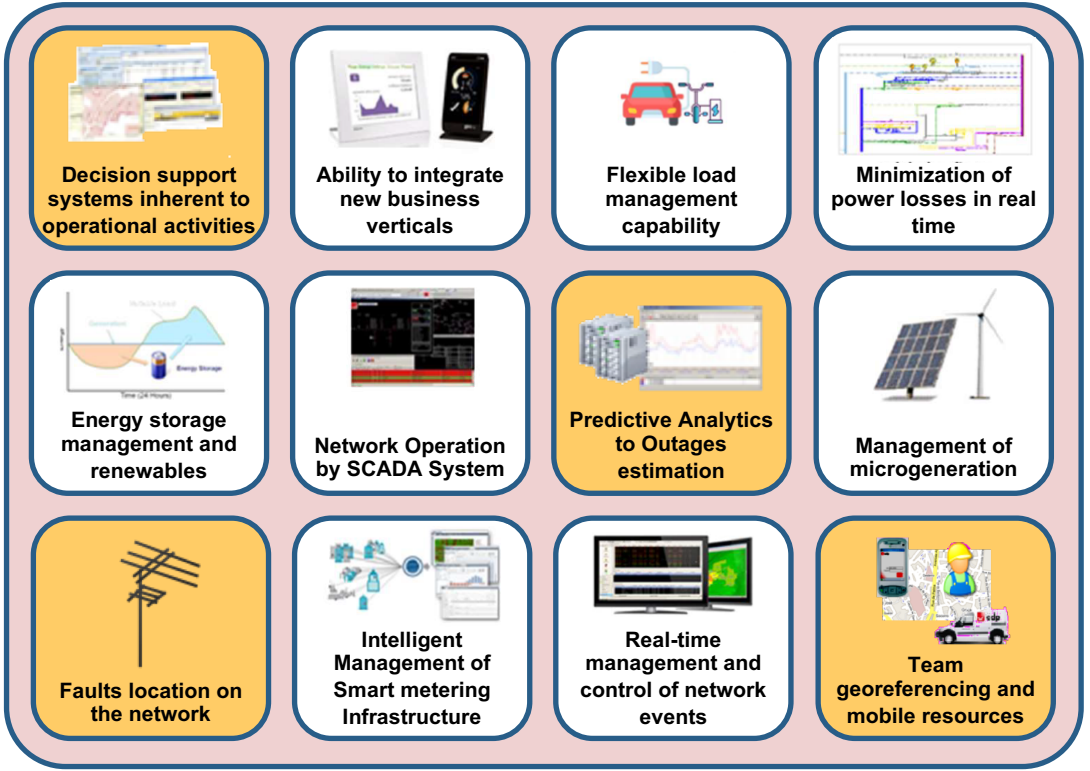


ADMS – Support & Dispatch Systems Evolution

Diagnosis Is Done:

- It is necessary and urgent to evolve EDPD's network operating systems, towards a full integrated **ADMS** System.
- ADMS should address the DSO future needs, delivering a wide set of functionalities, in a consistent and integrated way.





The application of GIS is limited only by the imagination of those who use it !

Jack Dangermond, ESRI

THANKS!

Any questions?

You can find me at rui.almeida@edp.com