

SINAPSE

Near Real-Time Outage Detection With Spatio-Temporal Event Correlation

Jorge Simoes, EDP Inovação

September 28, 2017



ETIP SNET

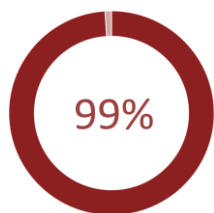
EUROPEAN
TECHNOLOGY AND
INNOVATION
PLATFORM

SMART
NETWORKS FOR
ENERGY
TRANSITION

EDP Distribuição and EDP Inovação – facts and figures



EDP Distribuição is the EDP Group's company operating in the regulated distribution and supply businesses in Portugal. EDP's distribution activity is regulated by ERSE (Entidade Reguladora dos Serviços Energéticos) which defines the tariffs, parameters and prices for electricity and other services in Portugal.



Percent of the electricity distribution network owned in mainland Portugal



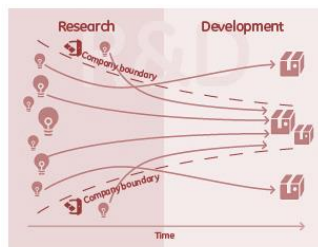
Distribution network approximate length



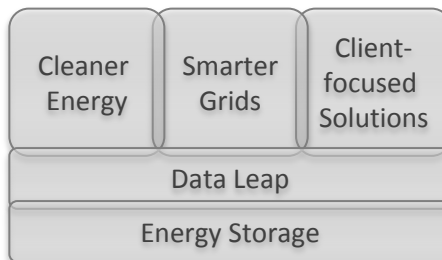
Approximate number of customers served

edp inovação

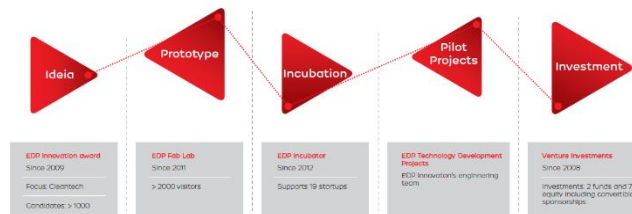
EDP Inovação is the innovation arm of EDP Group, promoting value-adding innovation within the Group by leading the adoption of new technological evolutions and practices.



Open innovation approach



5 strategic innovation areas



Entrepreneurship & Venture Capital ecosystem



The issue at hand: outage time in conventional low-voltage* distribution grids is prolonged by the need for human intervention, resulting in avoidable losses



1 An anomaly occurs in the distribution grid, causing an outage



2 Customers in the geographic area affected by the outage call into EDP's call centers

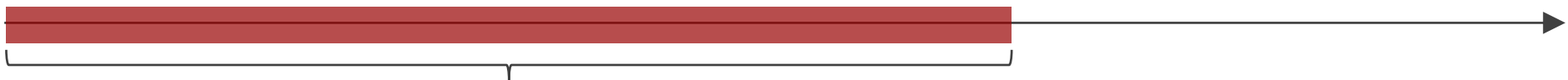


3 Call volume from a delimited geographic area allows for outage management systems to identify and locate the event



4 A ground team is dispatched to inspect and resolve the incident

Time

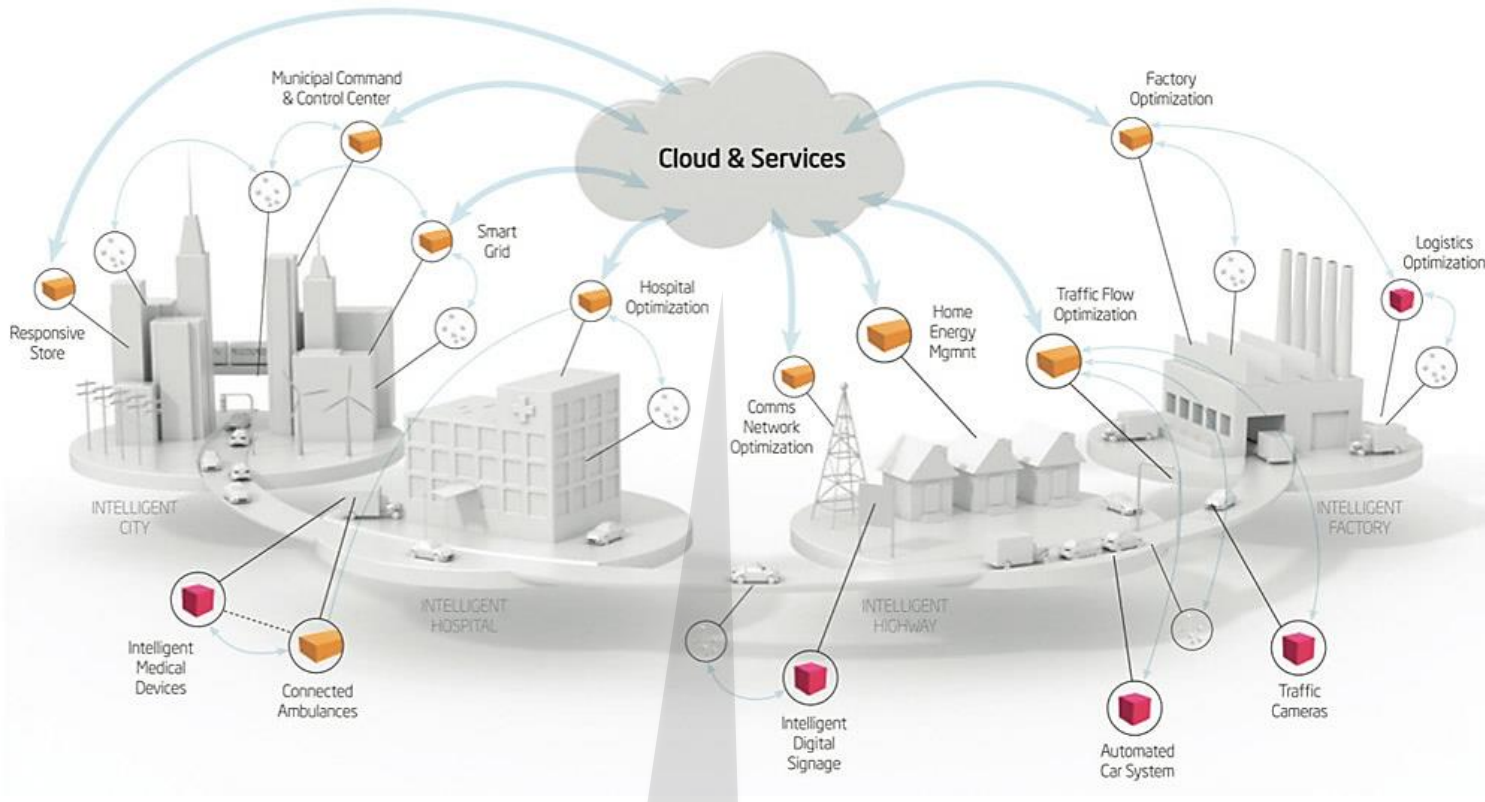


The average time for outage resolution is largely dependent on the time elapsed between moments 1 and 3, and because this relies on human intervention, significant delays may be introduced in the process.

Inefficiencies in the quick detection and consequent resolution of low voltage outages negatively affect reliability indicators (SAIDI, SAIFI...), contributing for potentially avoidable penalties and compensation

* in contrast to smart grids, where outage detection in LV can be automated, and medium/high voltage circuits where SCADA systems detect faults in real time.

The Industrial Internet of Things (IIoT) makes relevant information abundant downstream from the power delivery point, but in most cases it is not being used by the utilities



Project SINAPSE results from the opportunity to transform IIoT data into actionable insights for EDP Distribuição. A cloud service was created to collect outage-related events from customers and provide real-time feedback on known incidents.

Cable operators

Have signal amplifiers and optical nodes fed in LV, and monitor the power status of customers' set-top boxes and internet routers.

Mobile telecoms

Radio stations are mostly fed in LV and monitored in real-time; in urban areas, the density of installation is very high.

Security firms

Provide alarm services with real-time monitoring, including power outage alerts via email/SMS.

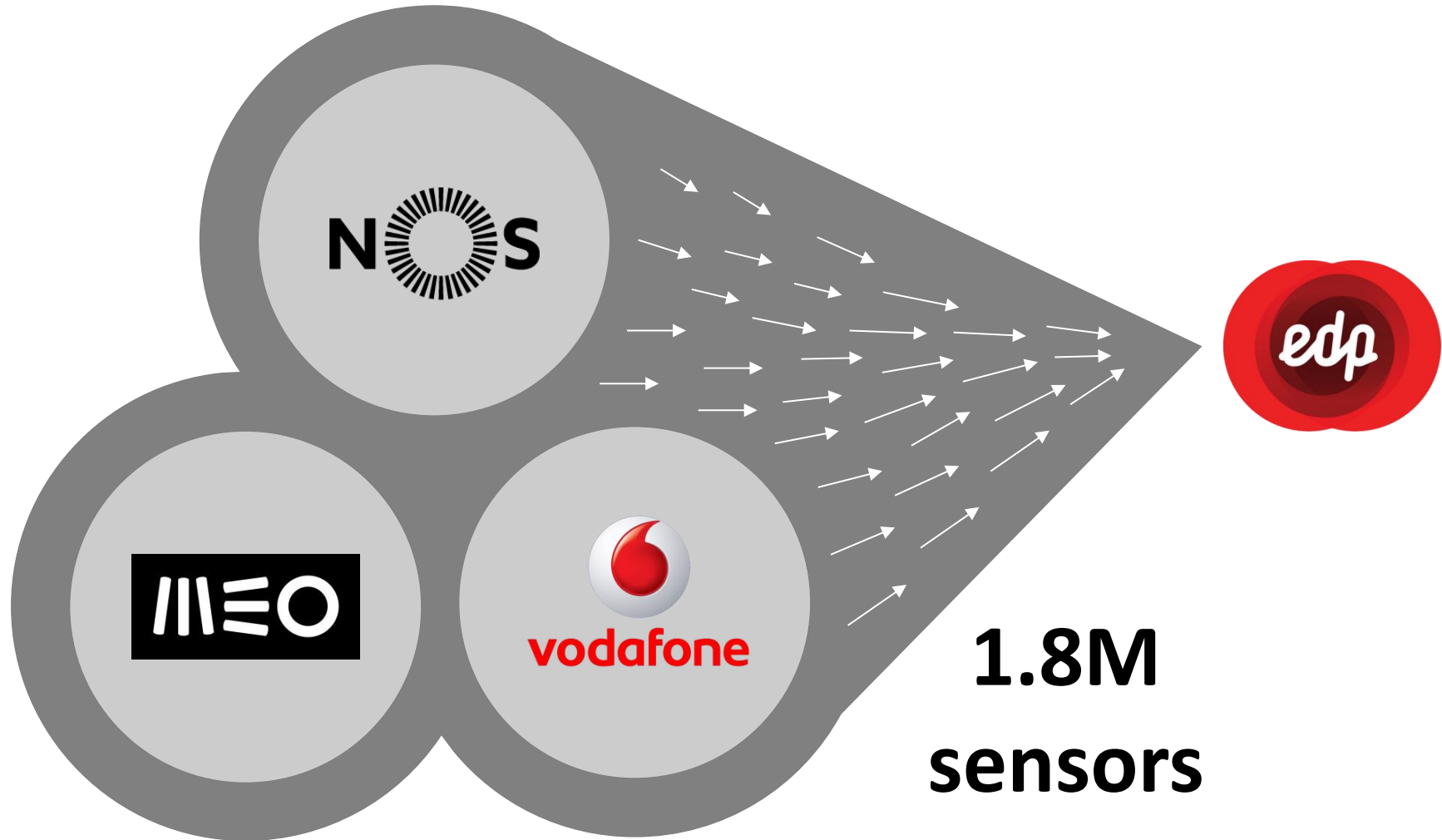
Financial players

Monitor ATM networks and payment terminals fed in LV.

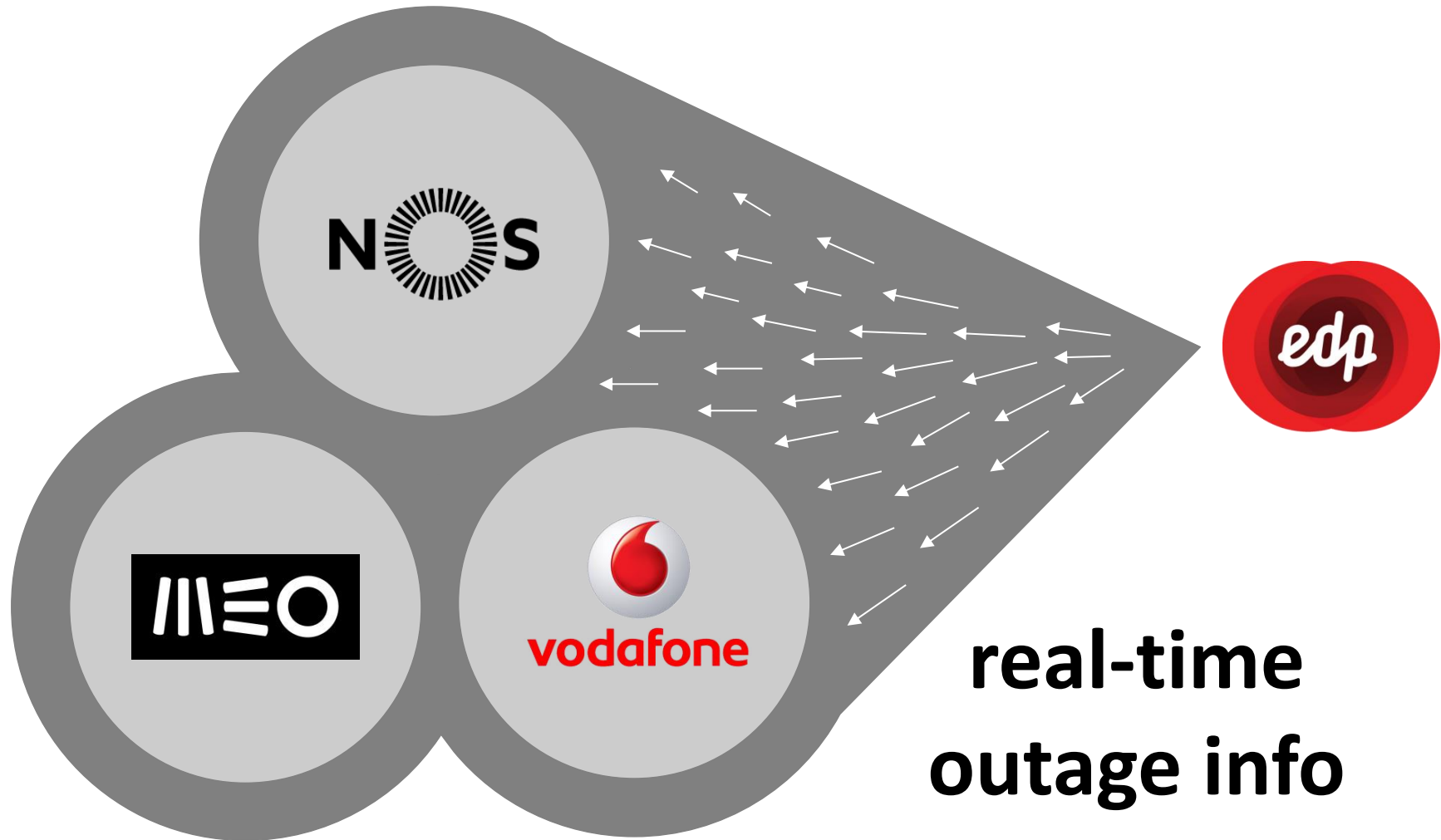
Other utilities

Have assets fed in LV with high granularity, such as water pumps and security valves.

Once the three main portuguese Telecom operators were onboard the project, EDP gained access to over 1.8 million sensors...



...and our partners gained access to real-time outage information, including estimated time to repair



Information exchange between the Distribution System Operator and its customers is a win-win scenario

Project SINAPSE : value creation...

...for EDP

Reduction of outage times and consequent minimization of losses associated to regulatory penalties and complaint compensation.

Creation of an information baseline regarding LV outages, aimed at reducing compensation fraud and accelerating resolution of legitimate complaints.

Call center optimization, through integration of the information automatically collected from external sources.

Improvement in workforce management by near real-time mapping of outage areas based on geo-referenced data.

Improvement in the overall quality of service.



...for project partners

Reduction in downtime for services depending on electricity.

Free up resources by automating processes currently dependent on human intervention, such as monitoring and communication of power outages.

Call center optimization, through integration of the resolution status of known outages provided by EDP in response to event notifications.

Operational improvements enabled by increased visibility over the root-cause of service disruptions.

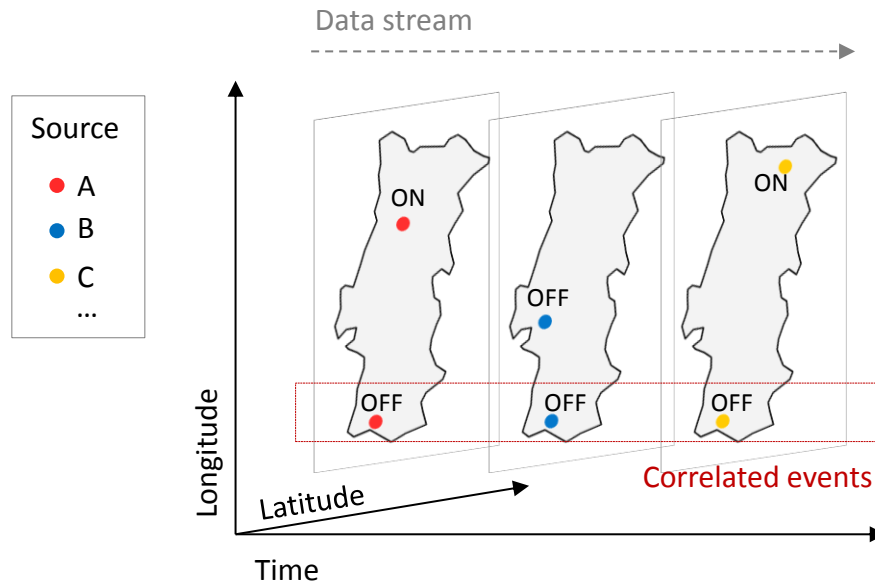
Improvement in the overall quality of service.

The bidirectional machine-to-machine communication channel created with SINAPSE enables EDP and the project partners to interexchange information that creates value for all parties

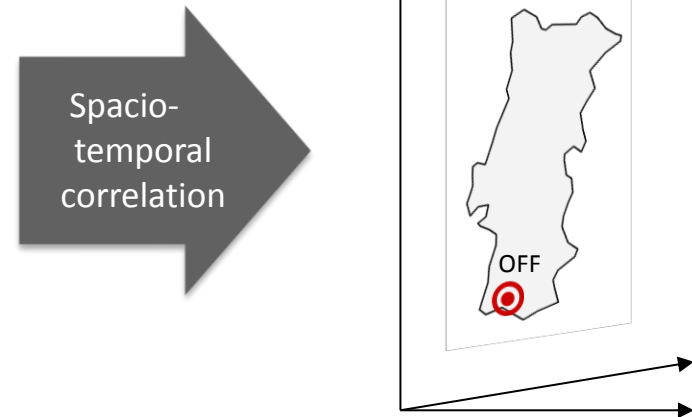


The challenge is to transform streaming data into insights in real-time with spatio-temporal correlation

Input



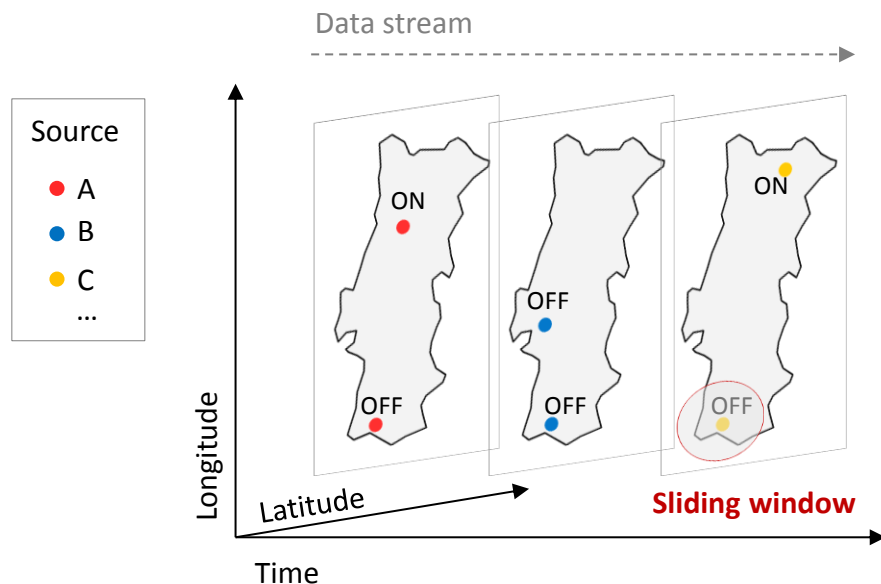
Expected output



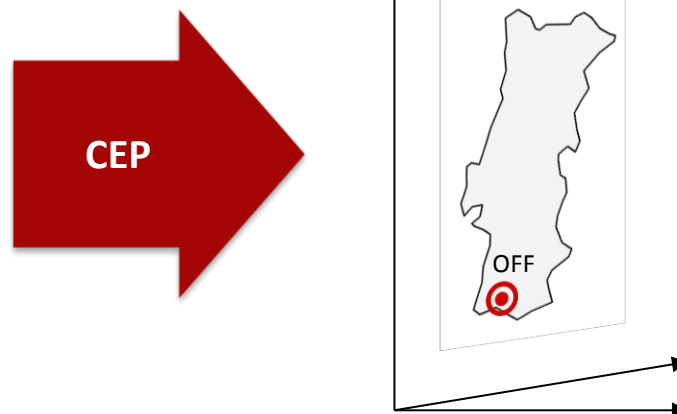
Several strategies are documented for spacio-temporal correlation of data^[6], commonly resorting to reducing the dimensionality of the data and then applying clustering algorithms. These techniques are suited for batch processing scenarios, however our use case requires processing streaming data.

A suitable solution to process data streams in real-time is to use a Complex Event Processing (CEP) engine, implementing a sliding window to look at recent events and perform correlation

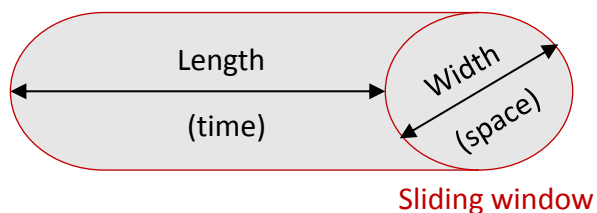
Input



Output



Key impacting variables



Solution selected and implementation status

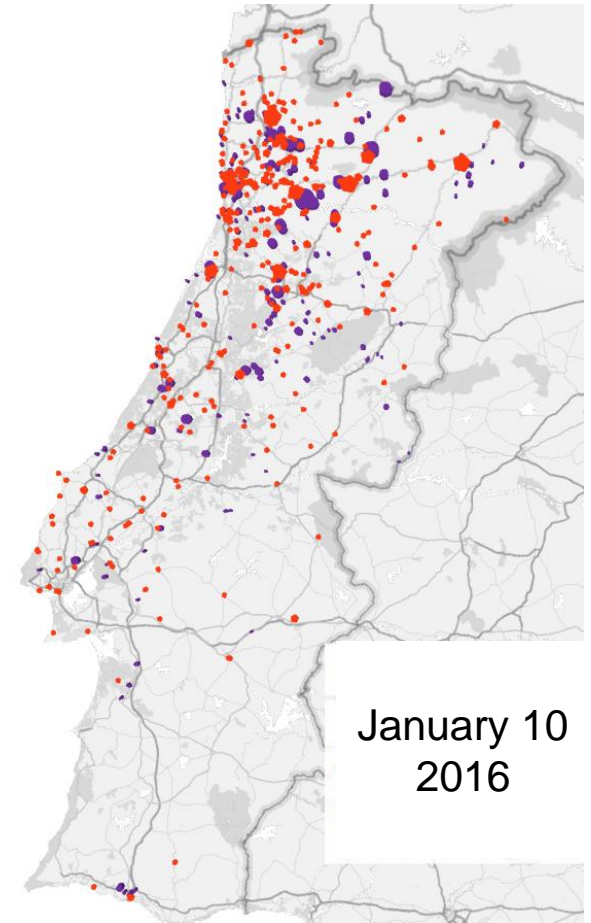
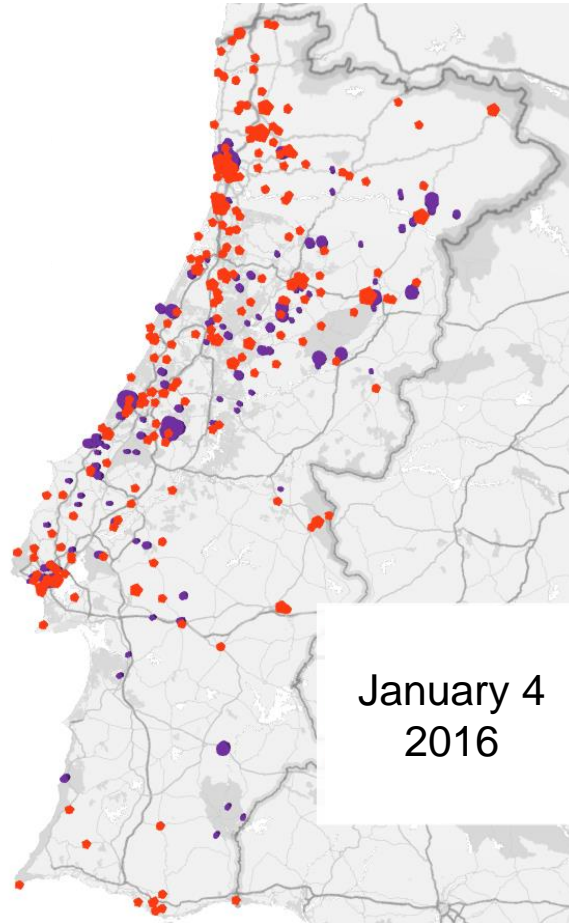
- The open-source ESPER CEP engine was selected for SINAPSE, for cost-effectiveness and suitability
- The CEP engine is in integration process, with rules definition and testing scheduled for August
- Data analysis is ongoing to determine optimal length and width parameters for the sliding window.



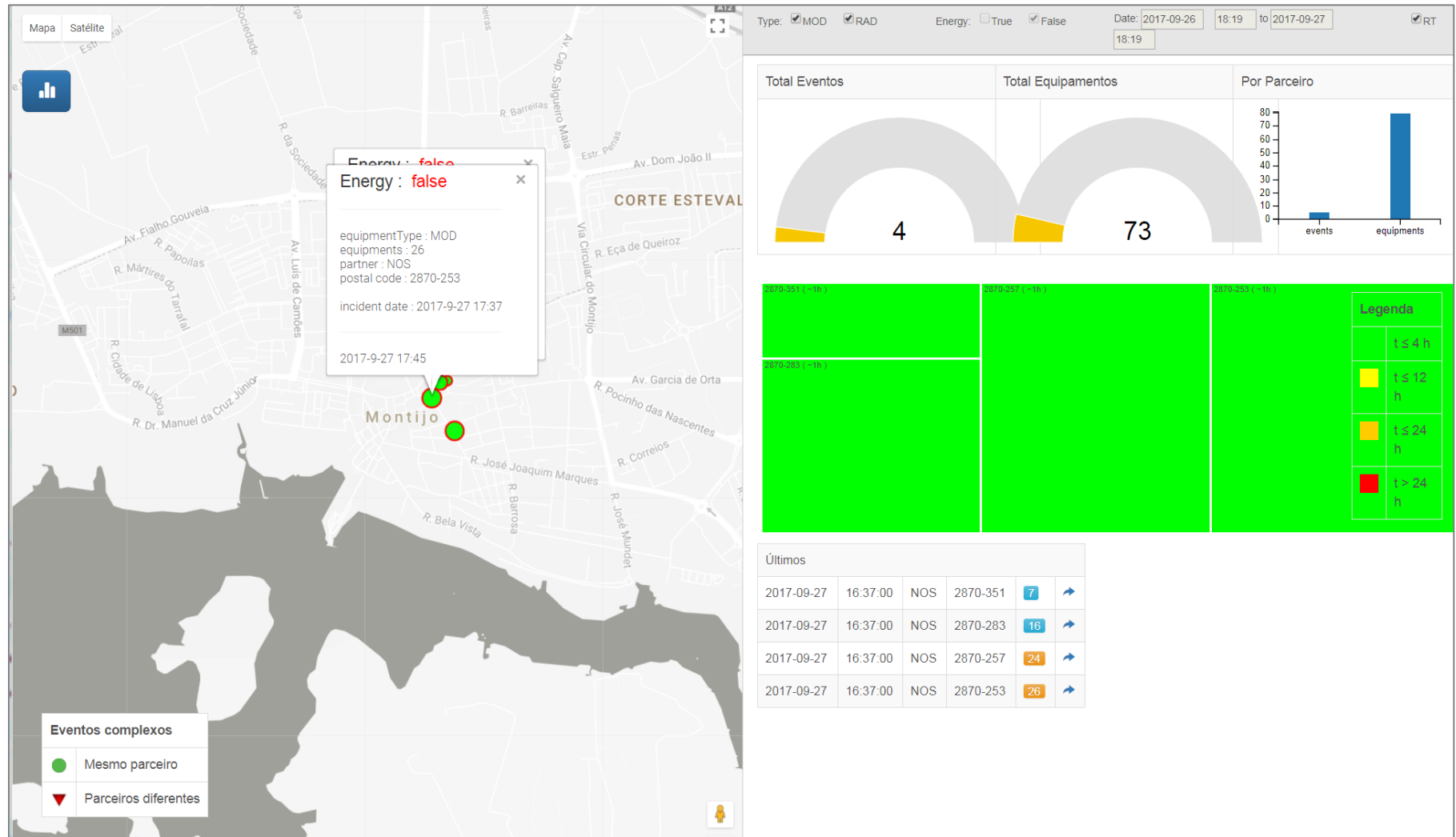
Visualizing both event streams over time, the intensity of events in the area affected by the storm (northwest) is common to both systems...

Sinapse vs. RA outage management system (location of events), severe weather days in January 2016

- RA
- Sinapse



Events are visible in a web-based interface with mapping and search features, aiming at ease and flexibility of use for operational teams



Key learnings, challenges and next steps

3 key learnings

- Correlation of diverse data sources can create value for all stakeholders; collaboration pays out!
- Low investment (open source software, low dev effort) can provide significant returns
- Communication channel is more valuable than outage insights

3 major challenges

- Data quality and consistency (trash in = trash out)
- Stakeholder engagement and alignment as partner network grows
- Integration between existing systems and proof-of-concept

3 next steps

- Improve input data quality
- Engage more partners (other utilities, financial system)
- Refresh analytics engine technology



Acknowledgments



CGI is EDP's technological development partner in the Sinapse project, with full responsibility for software development and third-party solution integration.

EDP relies on CGI's deep expertise in the utilities business, OSS and IT innovation. Our long-lasting relationship and common vision greatly accelerated this joint endeavor.



Nos, Meo and Vodafone are the three largest telecom operators in Portugal. Their partnership in the project has been instrumental in the design of the information streams that feed Sinapse, its implementation, testing and fine-tuning.



We are very thankful for the enthusiasm these partners have shown since day one and for their continued support.



