ENEDIS
L'ELECTRICITE EN RESEAU

Linky for the Grid
Solutions Portfolio

Indian Smart Grids Forum - Mumbai

November, 2nd 2018

1 Enedis approach

Enedis, the main French DSO

100% owned by EDF Group (subsidiary since January 2008)

€14 billion turnover

€ 4.0 billion EBITDA

Electricity distribution, a regulated activity, overseen by the French Energy Regulatory Commission (CRE)

Enedis manages the public electricity distribution network for 95% of mainland France

Our public service mission: continuity and quality of service with non-discriminatory access to the network, regardless of the electricity supplier.

1.35 million km Power Lines

36 million Connected Customers

38,500 Employees

11 million Customer Interventions / Year

400 000 generation facilities connected to the distribution grid in France

Benefit from AMI for distribution network applications

Develop **new functions** based on :

1. **Data concentrators** and **smart meters** used as **new sensors**
2. **Communication links** between **meters** and **concentrators**, concentrators and **central system**
3. **Smart meters data** (energy index, load curves, outages records, high and low voltage measurements, connection)

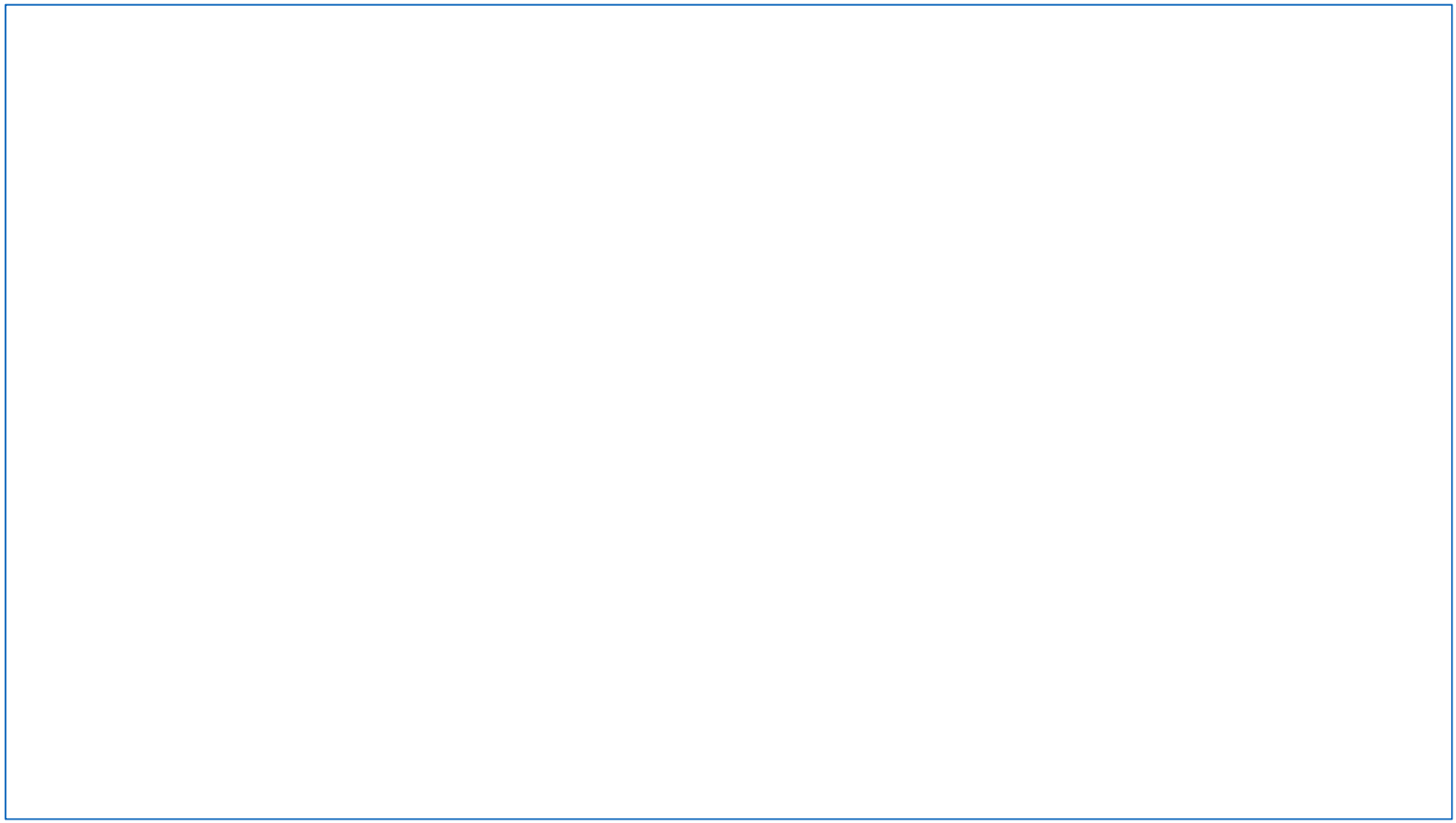
Approach

- First use cases described when the smart meters project was launched in 2007
- In-house developments : proof of concept of the services during the Linky pilot project [2010 - 2014]
- Implementation of the services during the full roll out of Linky

- Implementation of new functions
  - IT Development integrated in the online version, transparent to the users
  - Pilot projects with operational teams
  - If the value has been proven, full deployment

2 Use cases

Linky Grid at a glance



Overvoltage Alarms

- The Overvoltage alarm is sent out by the meter when the **upstream voltage exceeds 270 V** during 5 seconds.
- This situation leads to the breaker opening to **protect the customer installation**, and the transmission of an alarm to the IS to **check the grid situation**.
- 5 minutes after the end of the overvoltage, **the breaker is automatically closed**.

Detect et locate a **phase-to-ground fault**

- The **break of the neutral conductor** leads to **persistent overvoltages** on all meters behind the fault.
- Overvoltage alarms raised by meters enable to diagnostic and **locate the fault**

Detect and locate **a grid weakness**

- Some **grid weakness** can be seen through **transcient overvoltages** that appear recurrently on the grid beyond the damaged element.
- The analysis of recurrent overvoltages alarms on a substation help to locate the default.
- This is a first step toward a **predictive maintencance** on the grid

Grouped Meter Ping

- The grouped meter Ping enables the grid supervisor **to probe all the meters in a given location** on the grid.
- Meters, if powered, send back the state of their breaker and **their voltage.**

Check the persistency of **an overvoltage**

- To **evaluate the incidents** created after overvoltages alarms, the grid supervisor can **verify if the overvoltage is still active** and if the breakers of the concerned meters are still opened.

→ The grouped meter ping enables to **check the overvoltages persistency**, to **better evaluate the need to act on the grid.**

→In situations where overvoltages were fugitive, the grouped meter ping enables to confirm that the incident is over and can be closed in the dashboard of the grid operator.

Determine the location of a LV outage

- During the detection of a LV outage, the grouped meter ping help to determine the portion of the grid that is affected, by checking meters that can be reach through a Ping, meaning that they are powered.

Meter Ping

- The meter Ping enables to **probe a meter in real time.**
- The order and the reply of the meter goes along the whole communication chain with the **highest priority level**
- The meter transmit in the reply the main information about its current behaviour : **his breaker state**, the opening reason if so, an overvoltage detection…

Help to the diagnostic during a customer call

Compte rendu du Ping Linky

Titre du ping	
Résultat disponible : Anomalie détectée	

Informations générales	
Point de Livraison (PDL)	22438350162967
Organe de coupure	Ouvert : surtension amont, tel dépannage
Temps de réponse	18 sec
Date d'émission de la demande	Vendredi 13 Juillet 2018, 16:01:05
Date d'exécution réelle	Vendredi 13 Juillet 2018, 16:00:56
Palier technique du compteur	P1
Heure et date ouverture/fermeture du breaker	Vendredi 13 Juillet 2018, 15:22:25

Registre d'erreurs	
Défaut contact sec	Non
Inversion branchement phase-neutre	Non
Ouverture cache-bornes	Non
Tension anormale en aval	Non

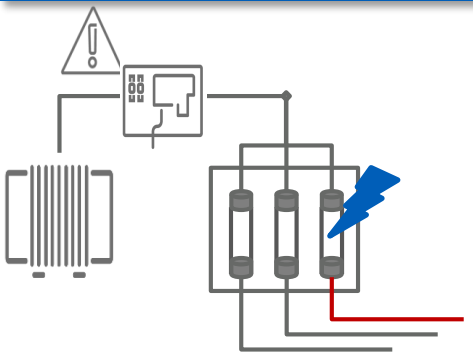
Registre des statuts	
Contact sec	Ouvert
Etat du cache-bornes client	Fermé
Surtension sur une des phases	Surtension en cours
Valeur de tension phase 1	243 v
Valeur de tension phase 2	269 v
Valeur de tension phase 3	242 v

- During a customer call because of an outage, the operator can Ping the meter
- If the meter is powered, it replies **in a few seconds.**
- The meter then report its breaker state, and the reason of its opening if so, enabling **a real time diagnostic to the customer.**
- In case the meter does not reply, we suspect a LV default upstream and the troubleshooting process is triggered.

Power Outage Detection through PLC

- As PLC is by nature connected to the grid, the loss of communication between DC and some meters could mean that **a power outage may occur on these meters**
- Two events may leads to such a situation :

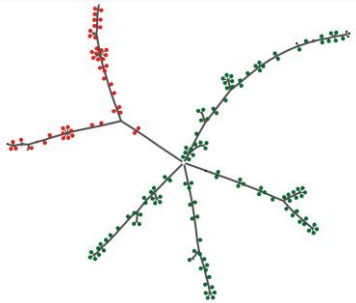
Detect a **LV fuse fusion**



- In the standard configuration, the concentrator is connected between the transformer and the LV switchboard

→The **fuse fusion of a feeder** leads to a loss of communication of all the meters connected to it.
→ If a MV Incident occurs, the DC sends out a Last Gasp to the IS
→ Additional sensors in the substation can be connected to the DC

Detect and locate a **LV conductor breaking**



- Cover various situations of incidents with a **LV conductor breaking** (cable lifting, tree falls…)
- If the fault does not triggers grid protections, the cartographic projection of the unpowered meters enable to deduce its localization

Phase detection service

Principle

- G3 PLC provides relative phase detection between neighbours, and communications are not tight to the network frequency.
- It is located in the « PhaseDifferential» attributes of the neighbour table.
- Each meter and DC has a neighbour table.

3 phase network

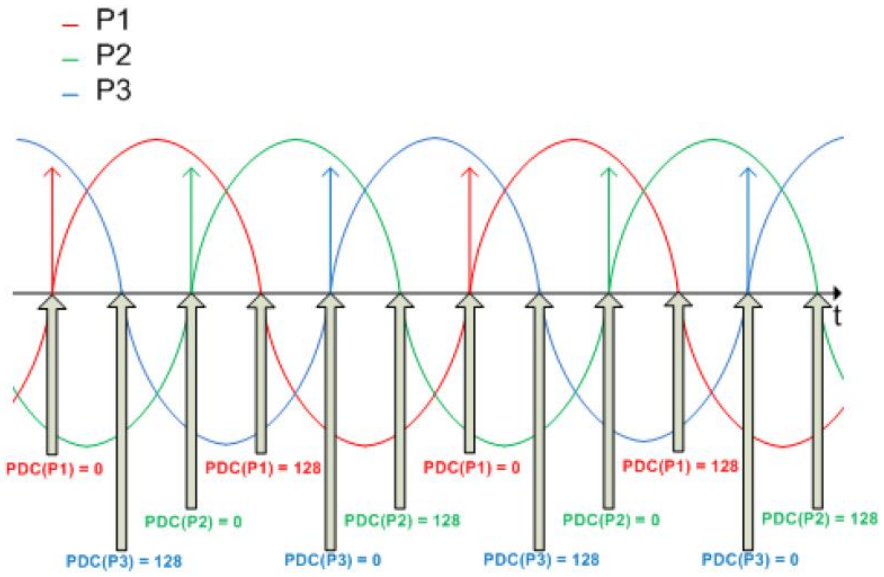
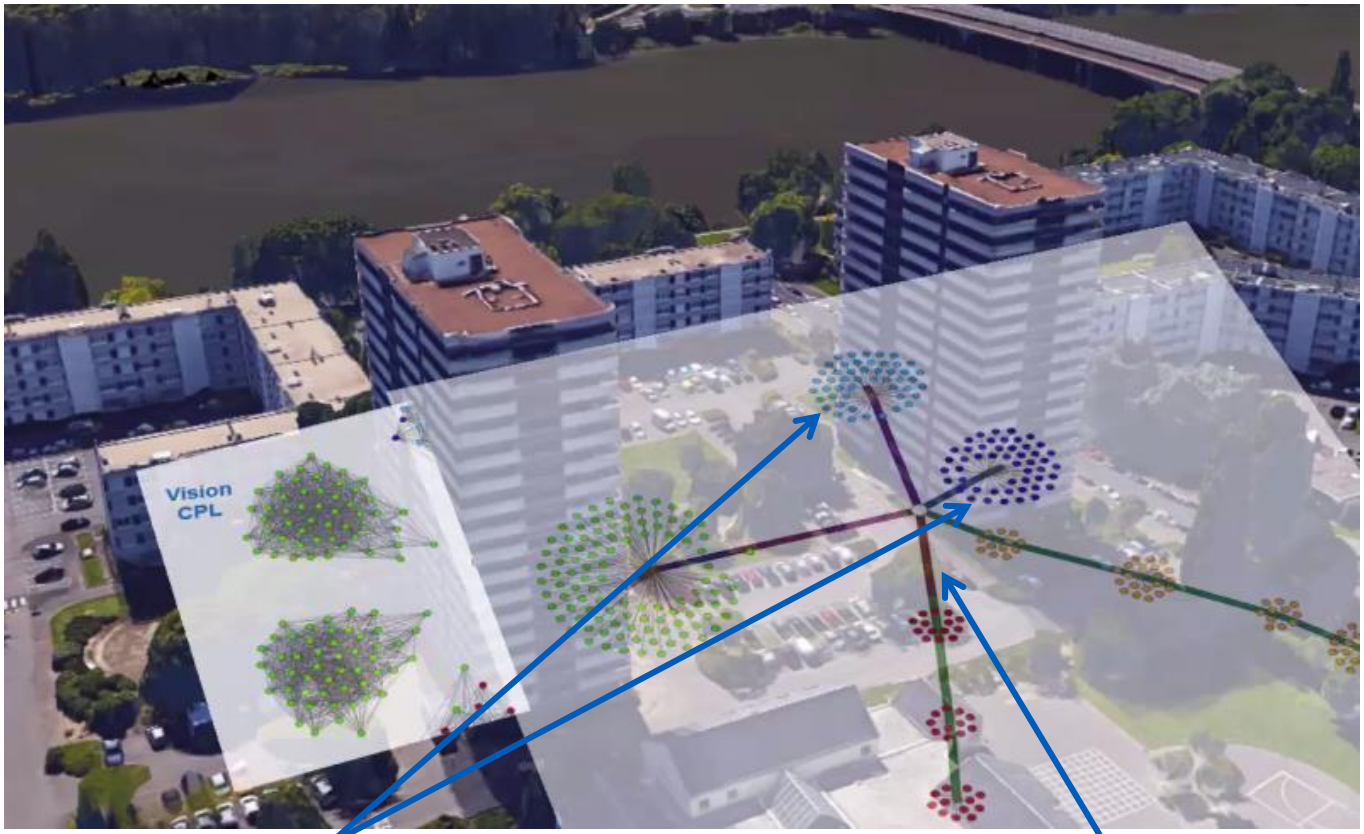


Figure 2 : Synchronisation des compteurs *PDC* sur chacune des trois phases du réseau.

Grid cartography consolidation

Beauty of PLC : Telecom Links = Electrical Links ! → Grid info for free



1 grid connection BUT PLC enables to look beyond the current knowledge of grid cartography
(floors 1-8 + floors 9-16)

2 meters were uncorrectly referrenced

3 Conclusion and perspectives

Values for Enedis (1/2)

	Technical Solution	Outage time	Grid Observability	Supply quality	CAPEX savings	Safety
Operation	**Overvoltage Alarms**	✓		✓		✓
	Remote interrogation of a meter group (**Grouped Meter Ping**)		✓			✓
	Power Outage detection	✓	✓			
	Analysis of the **loss of power supply on the DC**	✓	✓			
	Loss of phases alarms on triphased meters	✓	✓			
MV Control	**Remote transmissions of fault detectors** connected to the DC	✓	✓			✓
	Remote control of the DC		✓			
	Reverse voltage detection alarm on the DC	✓				✓

Values for Enedis (2/2)

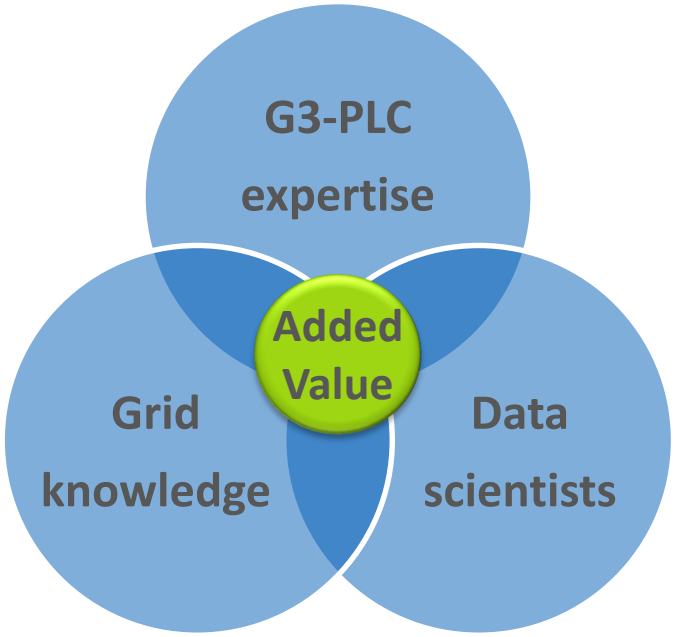
	Technical Solution	Outage time	Grid Observability	Supply quality	CAPEX savings	Safety
Trouble Shooting	Meter Ping		✓			
	Remote Diagnostic	✓	✓			
Cartography and studies	Analysis of **PLC connection** between meters and their DC		✓			✓
	Consolidation of the **cartography**		✓			✓
	Phase Detection using PLC	✓	✓	✓	✓	
Supply quality	Recording and remote transmission of supply quality data		✓	✓	✓	

Conclusion and perspectives

G3-PLC generates by nature grid-oriented data

Data are **the next golden raw material** for DSOs

Gather telecom experts, data scientists and grid experts and make them work together



- ✓ Algorithms fully developed by Enedis thanks to the combination of these 3 expertise
- ✓ Very well received by operational teams
- ✓ Disruption of the customer relationship : building trust with our customers

Thank you for your attention

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