![ERDF - L'ÉLECTRICITÉ EN RÉSEAU]

First Feedback on the G3-PLC roll-out in France

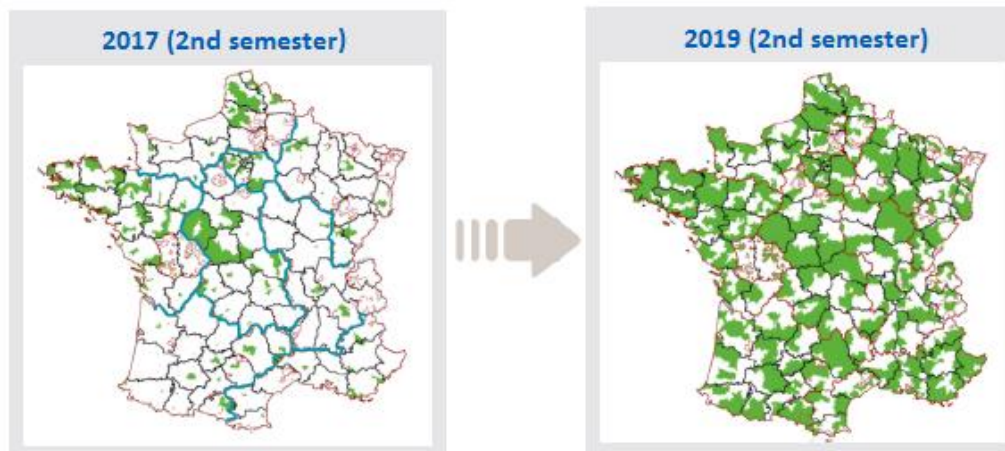## Thierry Lys (ERDF)
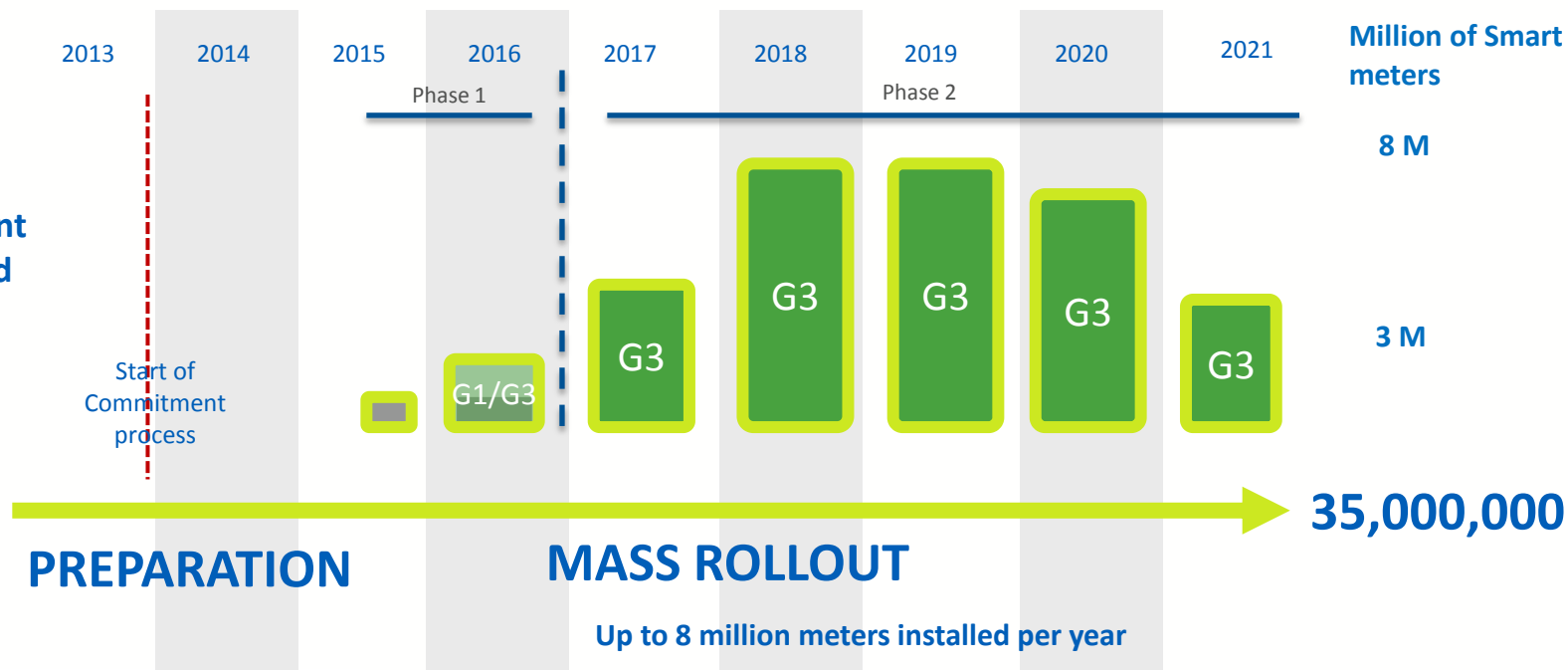
ISPLC
21-23/03/2016

Linky Program

Main features & rollout

Roll out strategy (2015-2021)

Leopard pattern rollout

2017 (2nd semester) → 2019 (2nd semester)

2013	2014	2015	2016	2017	2018	2019	2020	2021
			Phase 1			Phase 2		

Million of Smart meters

8 M

3 M

Past phases
Pilot deployment (2009-2011) and evaluation

Start of Commitment process

G1/G3   G3   G3   G3   G3   G3

PREPARATION   **MASS ROLLOUT**

35,000,000

Up to 8 million meters installed per year

Perimeter of the Linky smart metering program
Linky : key figures

AN INDUSTRIAL ROLLOUT

6 YEARS

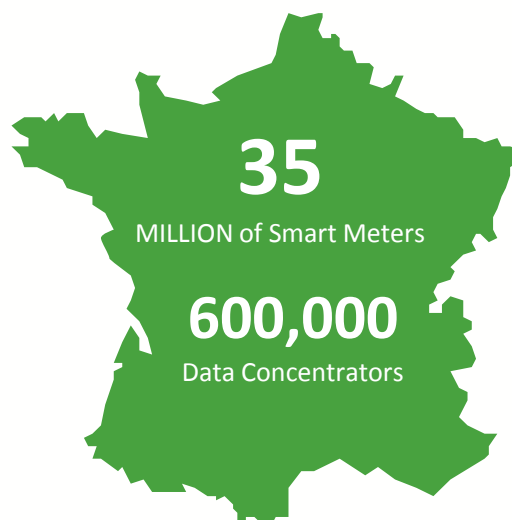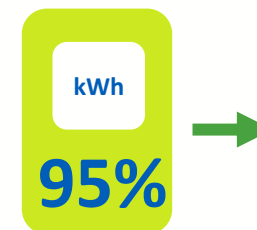**2015 → 2021**

TECHNICAL ASPECTS

PLC
FROM THE SMART METERS TO THE DATA CONCENTRATOR

2G/3G
FROM THE DATA CONCENTRAROR TO THE CENTRAL I.T SYSTEM

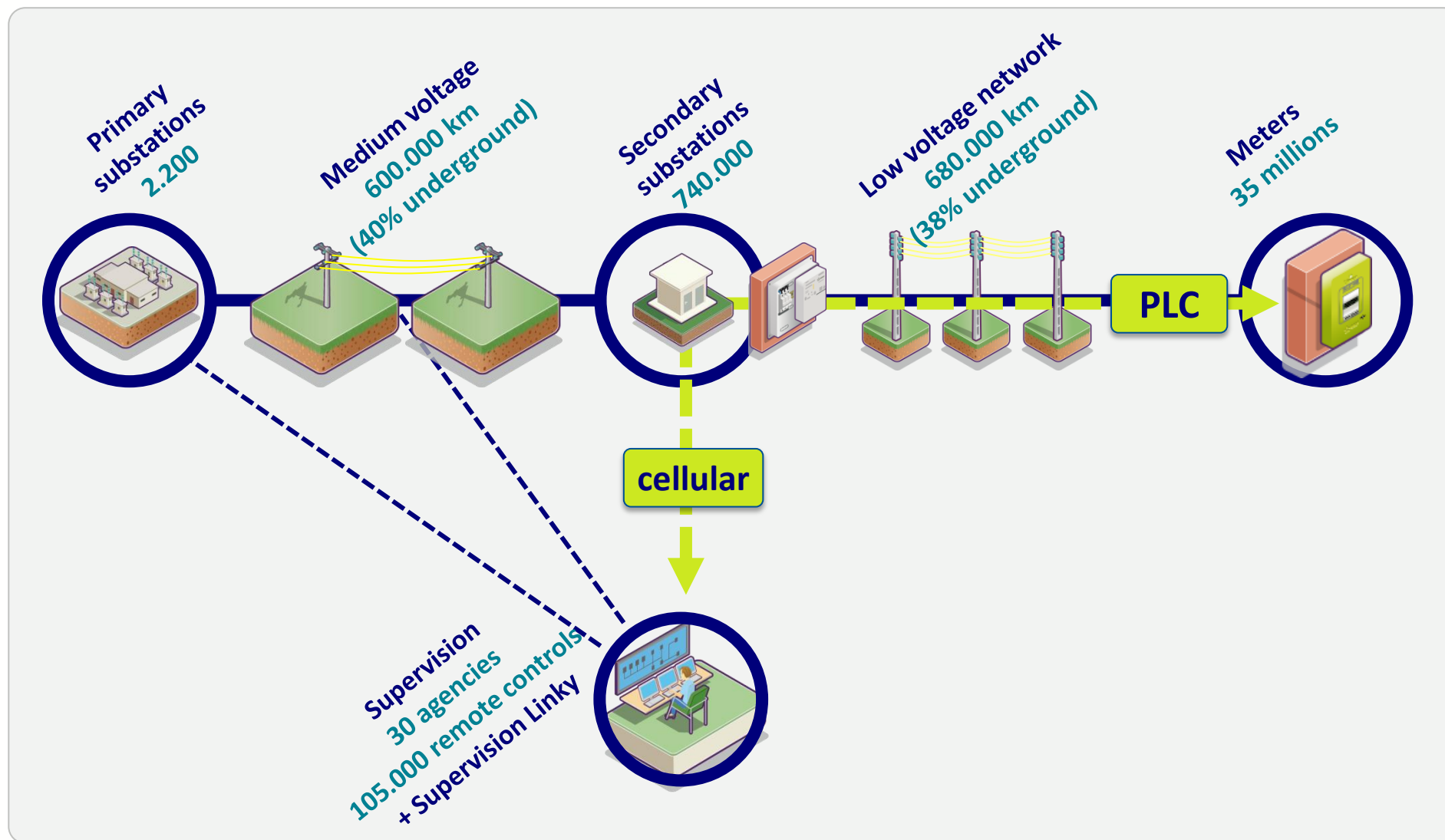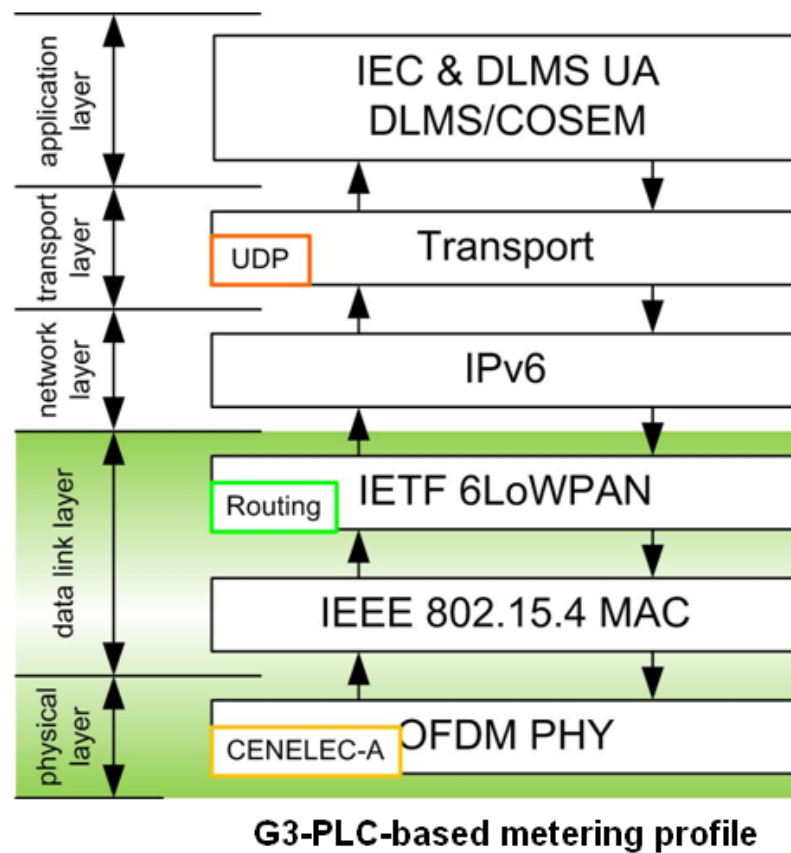**DAILY COLLECTION RATE TARGET REQUIRED BY FRENCH ENERGY REGULATOR (CRE)**

kWh

95%

10 ,000 jobs created in France
(direct or indirect)
(5,000 jobs for mass rollout)

35
MILLION of Smart Meters

600,000
Data Concentrators

€ 5 B

Billion of current Euros of investment by 2021

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Network topology and technology to be deployed
More than a meter, Linky is a complete system

Primary substations
2.200

Medium voltage
600.000 km
(40% underground)

Secondary substations
740.000

Low voltage network
680.000 km
(38% underground)

Meters
35 millions

PLC

cellular

Supervision
30 agencies
105.000 remote controls
+ Supervision Linky

Linky Metering Profile

G3-PLC-based metering profile

G3-PLC

Capabilities & performances

G3-PLC Bootstrapping Time

▶ At start, a G3 node knows nothing. It has to find an already bootstrapped neighbour (aka LBA) to help it convey information with the DC:

• **Pre-Shared Key** (PSK) to ensure device authentication,

• **Group Master Key** (GMK) to ensure secured transactions in the cluster

• **Short Address** to reduce the size of each address

In a second step, **DC can send IPv6 Prefix** and context (optional) to compress IPv6 Global Addresses

Number of meters in the cluster	**133**
Max number of hops	**5**
Environment	**Lab**
Interoperability	**4 different meter & 3 different G3 chips**
Specs	**G3 Specs (apr-15)**

G3-PLC Boostrapping time

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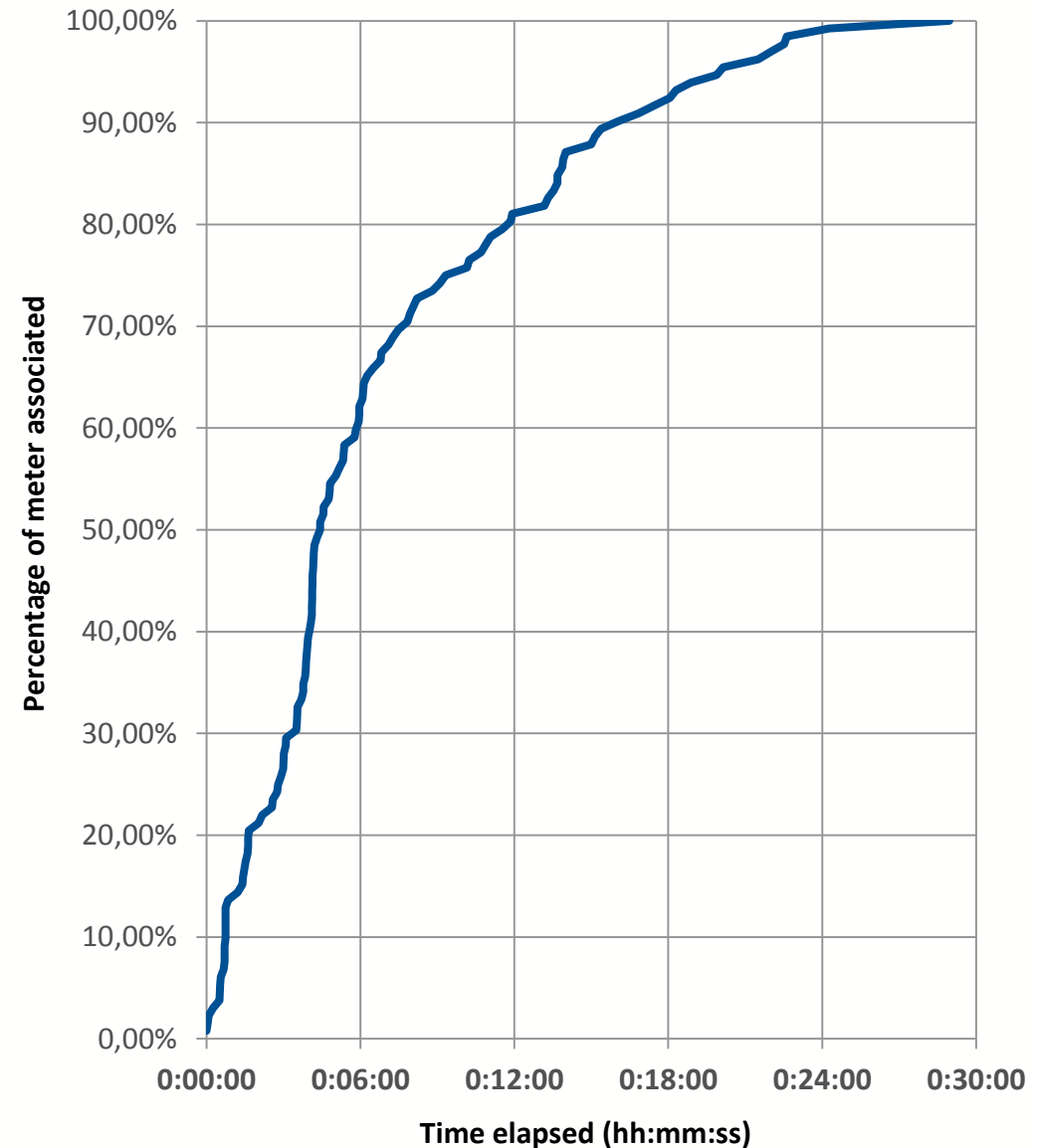
Performance in the field : Choice of the cluster

ERDF has more than 30 000 G3-PLC meters installed now in various environments (rural, urban, deep urban).

▶ We could have chosen a cluster which works well but results would have been biased.

▶ We could have shown the average performance figures, but that would been of limited interest since the environment and cluster size varies greatly.

We choose to focus on the **toughest cluster** we have as of today:

- the one equipped with the largest number of meters,
- in a deep urban environment.

Frequency Band...CENELEC-A

Location.....Ile de Nantes, city of Nantes, West of France

Number of meters : ....463 meters installed in high rise buildings up to 16 stories (social housing)

Data Concentrator 1

Transformer ....9 feeders

Security...activated

Environment ....extremely challenging with a very large number of neighbours (meters in the same hearing collision domain) that share the same media.
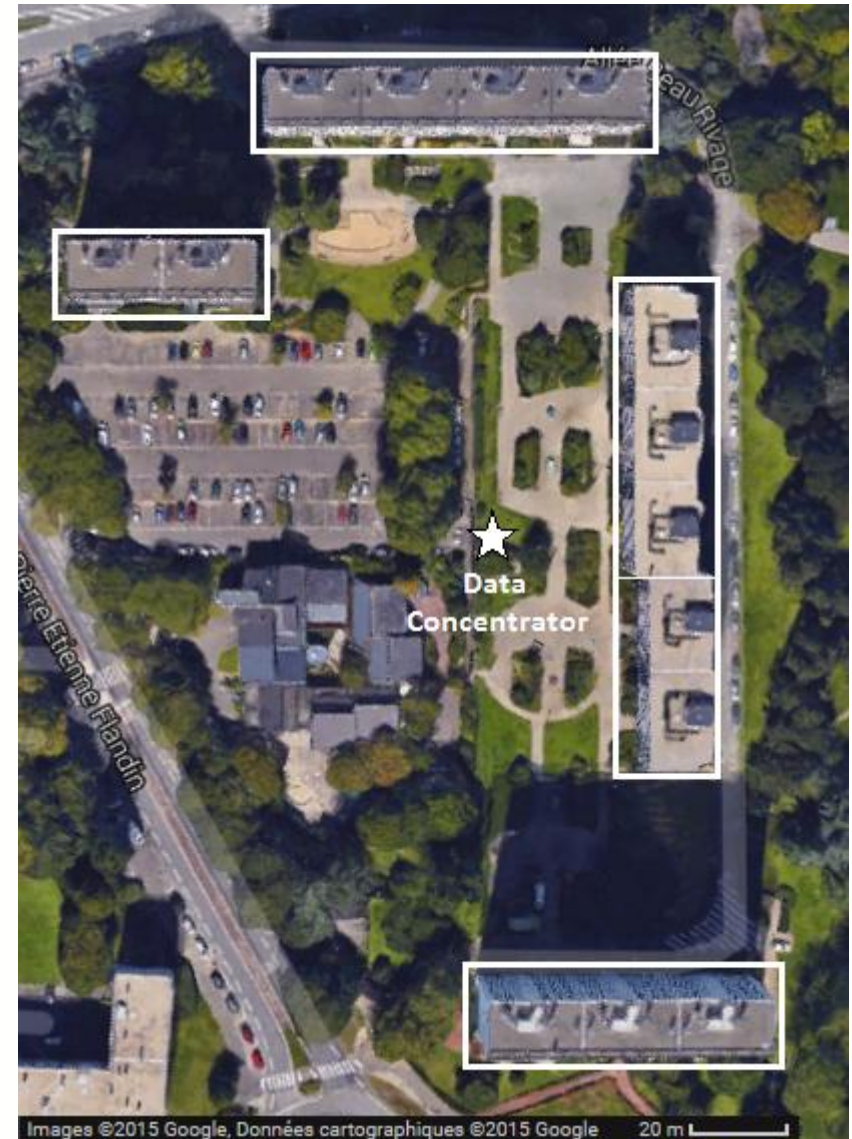
Characteristics - Neighbour distribution

Each G3 node stores information on PHY characteristics to communicate with this neighbour :

- Modulation and tone map (carriers) to use when sending packet to the neighbour,

- Link quality of the last received packet from the neighbour,
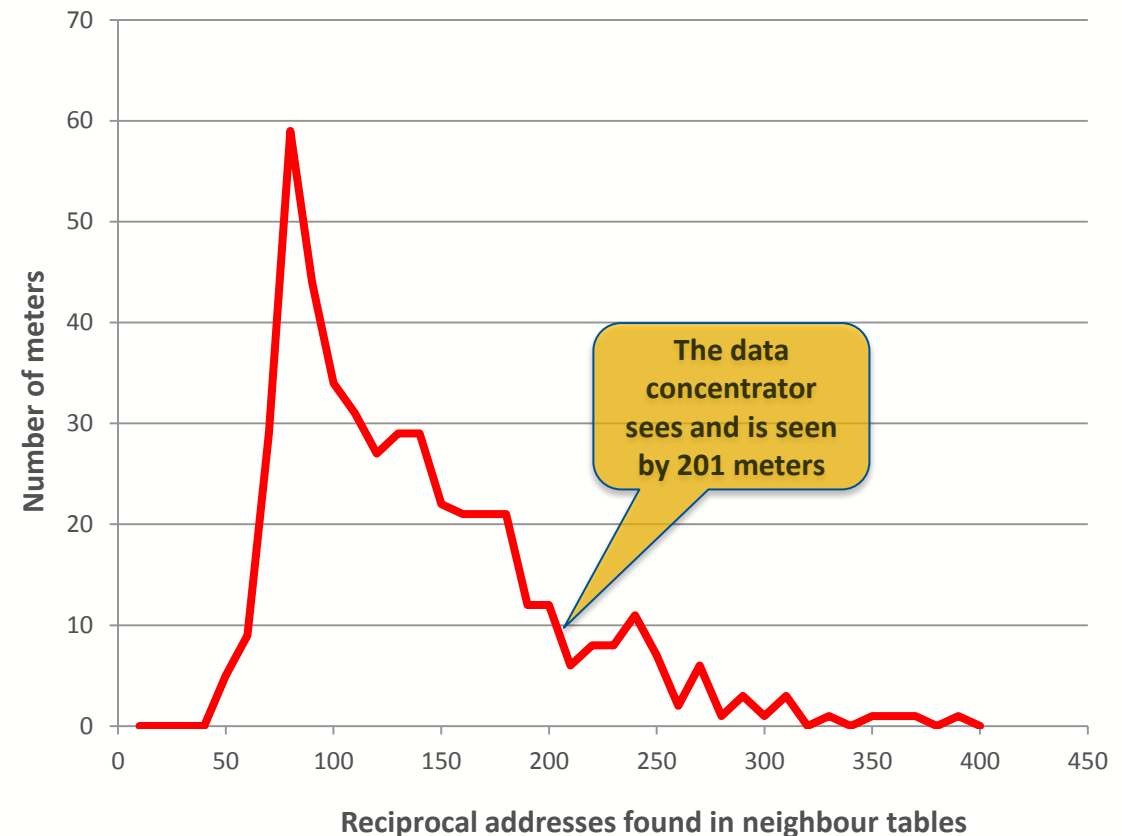
- Phase difference with the neighbour.

Number of meters in the cluster	463
Max number of hops	5
Environment	Ile de Nantes – deep urban
Specs	G3 Specs (apr-15)

Distribution of reciprocal addresses found in neighbour tables

The data concentrator sees and is seen by 201 meters

Reciprocal addresses found in neighbour tables

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Routes topology / Number of hops

The number of hops varies with the metric used.

The results shown here is done with the default metric provided with the G3-PLC specifications
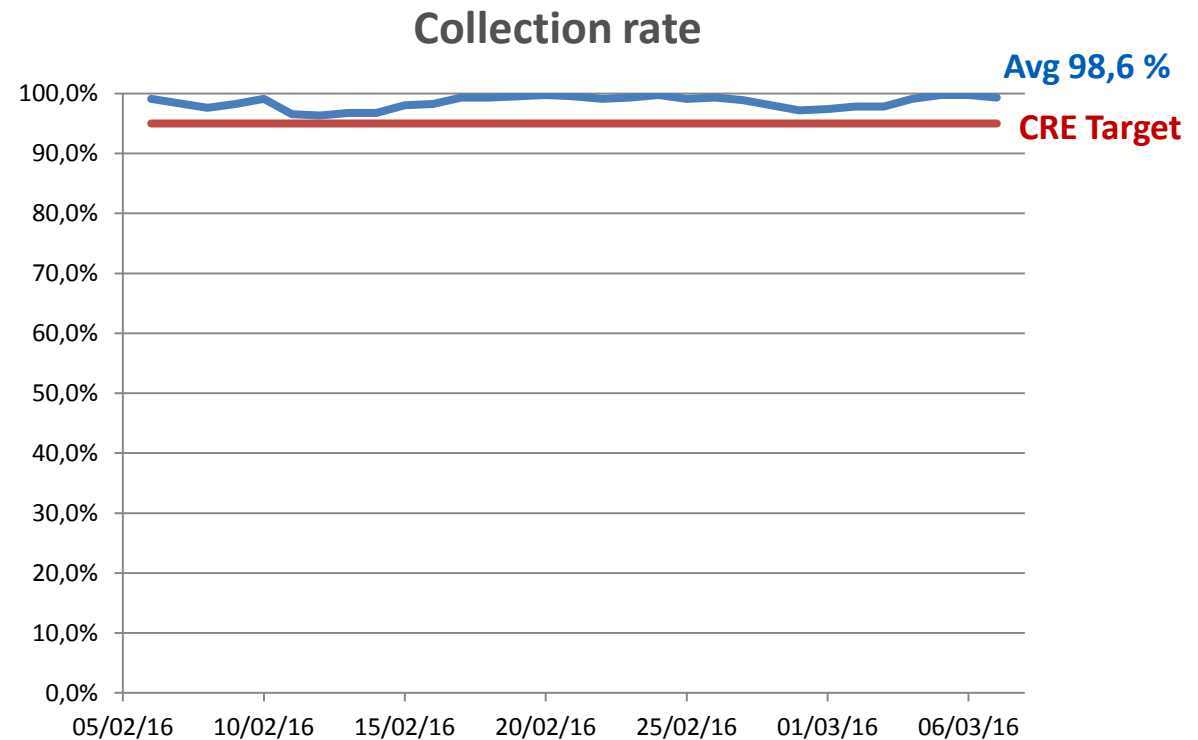

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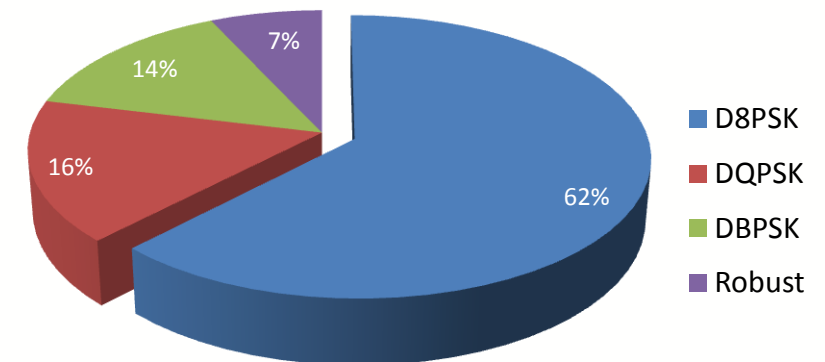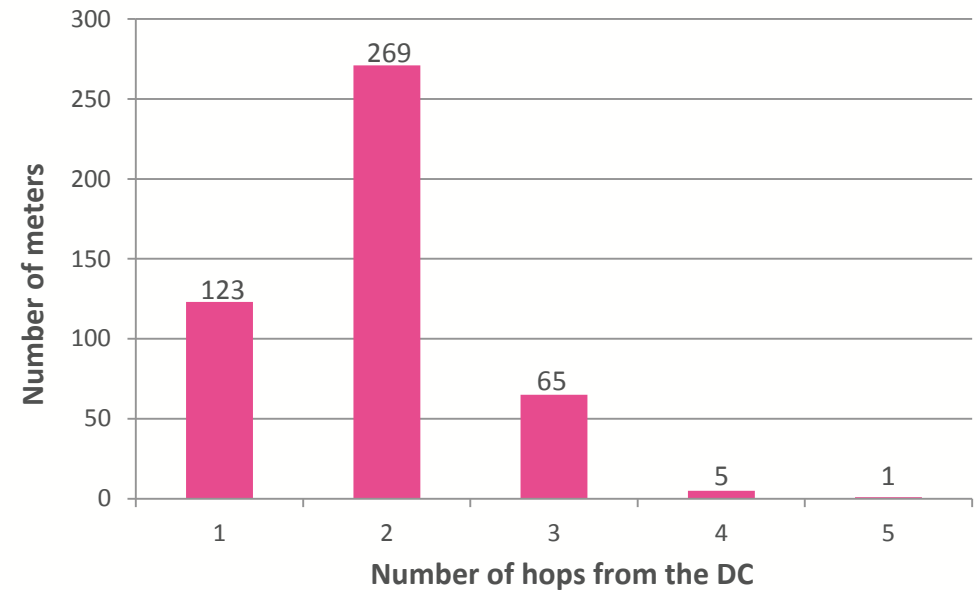
Modulations chosen by data packets

PLC performance : Collection rate

Everyday the DC collects the meters.

Data includes power registers and error status.

Collection rate

Avg 98,6 %

CRE Target

Number of meters in the cluster	463
Max number of hops	5
Environment	Ile de Nantes – deep urban
Specs	G3 Specs (apr-15)

Ping Round Trip Time with a node one-hop away from the DC

Due to Tone Map Request/ Response first exchange

min	average	max
180 ms	190 ms	500 ms

Size : 64 bytes
calculated over 100 Ping

Conclusion

Performance

Very satisfactory

- ▶ **collect rate target reached**
- ▶ Meters reached in **4 hops or less**
- ▶ **Highest modulation scheme** (D8PSK) represents +60% of the modulation used
- ▶ Less than **an hour to collect**

Environment

harsh

- ▶ 6 buildings with 16 stories
- ▶ **463 meters**
- ▶ 1 single DC for **9 feeders**

Additional hints for improving performance

- ▶ Fine-tuning the parameters (we use default values in all of our environments up to now),
- ▶ Activate the coherent modulation (coherent modulation performs better when the channel is affected with impulsive noise),
- ▶ Increasing Data Concentrator Requests Rate,
- ▶ Minor nits on standard interpretation have been cleared.
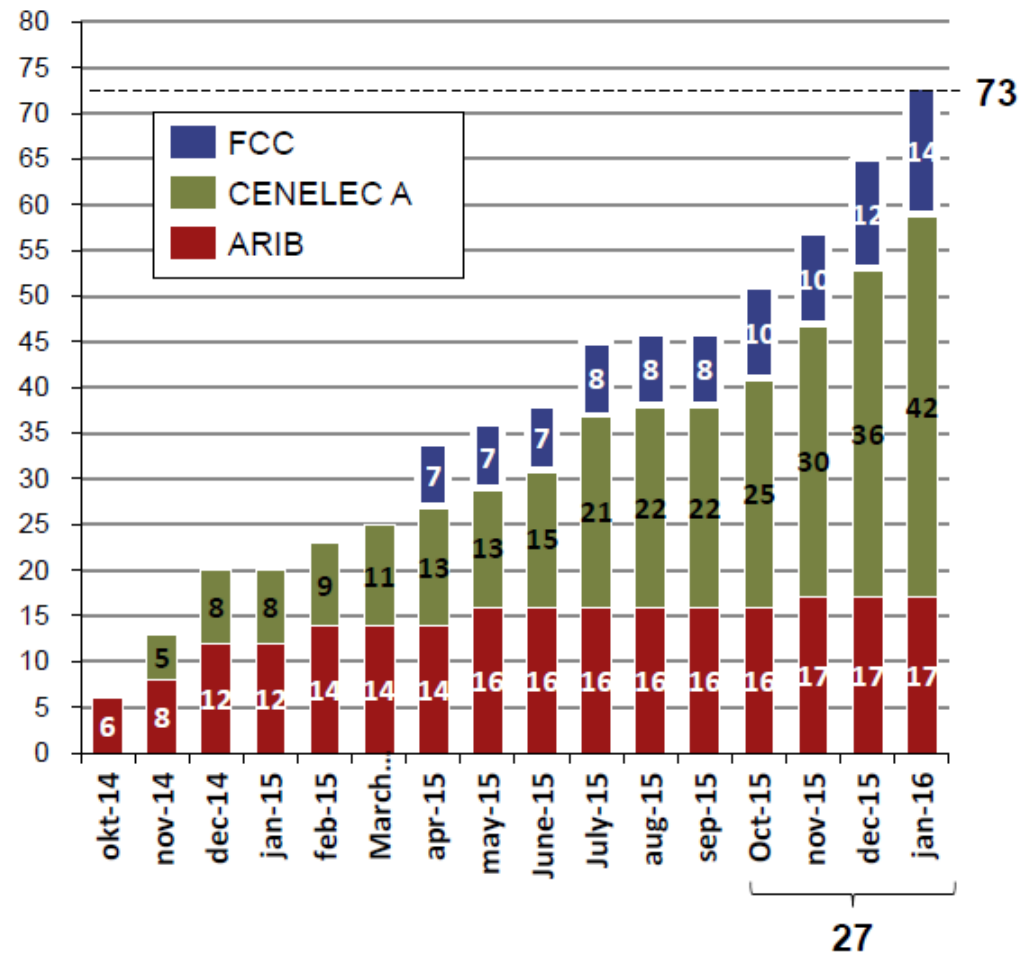
New areas that ERDF is exploring

- ▶ load balancing (with the help of the phase detection feature),
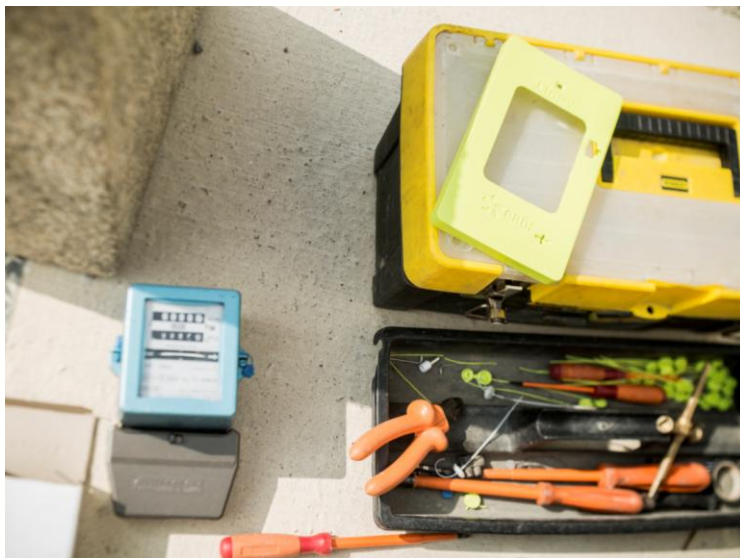- ▶ grid topology control,
- ▶ overvoltage alarms.

G3-PLC certified devices

availability

► 73 different devices certified in G3-PLC Alliance

► 54 platforms

► 19 products

► 15 different vendors

Number of certified devices (cumulative)

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Thank you !