Welcome to today's Webinar!

G3-PLC communication for smart metering in Africa

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Today's panel

Marc Delandre
Chairman of the G3-PLC Alliance and former Director of the ENEDIS Metering Division.
Worked for over 30 years for Enedis in many functions including R&D, Business Entities and the Network Division.
marc.delandre@enedis.fr

Cédric Lavenu
Expert research engineer at EDF R&D, working in the field of powerline communications and smart grid applications for more than 10 years. Active in various Standard Development Organizations and is the chair of the technical working group in the G3-PLC Alliance.
cedric-2.lavenu@edf.fr

Leon Vergeer
General Secretary of the G3-PLC Alliance. Has been working with the G3-PLC Alliance since 2014 in setting up the certification program. Worked with many utilities in The Netherlands including in the smart metering program of Enexis.
leon.vergeer@g3-plc.com

G3-PLC Alliance

Agenda

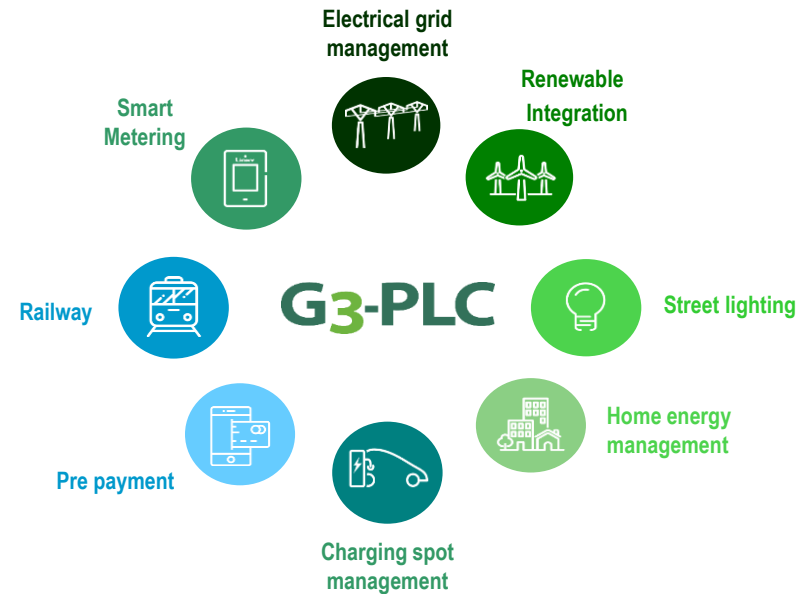**1. About G3-PLC and the G3-PLC Alliance**

2. Enedis roll-out in France

3. Performance, Enhanced Grid Operations and hybrid G3-PLC/RF

Q&A

G3-PLC
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G3-PLC was developed from the start for mass rollout AMI

G3-PLC is a protocol for power line communications providing cost effective, reliable and secure communication

Cost-effective | Long range communi-cation | Real-time communi-cation | ITU standard | Supports IPv6 | Secure | High robustness | High data rate | Future proof | Routing | Plug and play

Smart Metering · Electrical grid management · Renewable Integration · Railway · G3-PLC · Street lighting · Pre payment · Charging spot management · Home energy management

G3-PLC Alliance

About G3-PLC

Over 90 members from more than 30 countries today!

Currently, there are over 50 million G3-PLC products in operation in more then 30 countries worldwide

Known pilots and roll-outs of G3-PLC worldwide

G3-PLC
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What features are built into G3-PLC technology to overcome prevailing conducted EMI in utility power networks?

What is the advantage of G3-PLC over legacy PLC technologies?

- Channel estimation allows adaptive modulation and tone mapping

Noise affecting a group of subcarriers. Transmitters notch these carriers, which are not used for data transmission.

35 kHz   90 kHz   f

- Two-dimensional interleaver allowing to spread redundant information over time and spectrum

G3-PLC Alliance

What should African utilities consider when deciding to deploy G3-PLC in FCC band?

What considerations do utilities need to take when migrating from CENA G3-PLC to FCC G3-PLC?

Is there any evidence of increased radiated EMI from cables carrying G3-PLC FCC?

- In Europe deploying FCC is purely a regulatory issue. This should not be a problem in African countries unless there are local rules not to use the FCC band

- Migrating from one CEN-A to FCC is not always possible when meters are already installed. To avoid replacing all equipment, it is recommended to check this matter with equipment manufacturers to evaluate "FCC-ready" options associated with a migration plan

- Regarding FCC, no EMI cases have been reported up to now. But G3-PLC also supports tone masking which allows interfering carriers to be turned off if needed

G3-PLC
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In South Africa customers will have a smart meter as well as a customer interface unit (CIU or in-home display).

For good performance, the CIU and the smart meter should have peer-to-peer communication (i.e. without communicating through a DC/PAN-Coordinator).

Is it possible to let the meter act as a PAN coordinator for the CIU and a PAN device in relation to data concentrator, simultaneously?

- G3-PLC implementations only operate as PAN-device or PAN-coordinator: a single stack cannot run both*

- Therefore it is recommended that the meters integrate two G3-PLC protocol stacks (= two chips); the first communicating with CIU and the second with DC

- It is strongly recommended to separate frequency bands for both links. Communication with CIU could for example be performed in CEN-A or CEN-B and communication with DC in FCC

* Technically it is possible to cumulate PAN coordinator and PAN device roles and some vendors have implemented that but this goes into too much detail for today's webinar

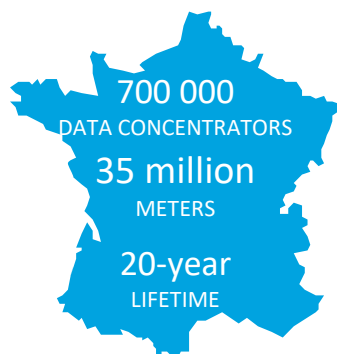**G3-PLC** Alliance

Agenda

1. About G3-PLC and the G3-PLC Alliance

2. **Enedis roll-out in France**

3. Performance, Enhanced Grid Operations and hybrid G3-PLC/RF

G3-PLC
Alliance

Linky Roll Out in a nutshell: Main targets

6 **years**

2015→ 2021
MASS ROLL OUT

700 000
DATA CONCENTRATORS
35 million
METERS
20-year
LIFETIME

€5 **billion**

CAPEX BY 2021

10 000 **JOBS**
CREATED
(5 000 OPERATORS IN
THE FIELD)

6 **PARTNERS** →

Sagemcom
• Single phase meters G1 / G3
• Three phase metersG3
• Data Concentrators G3

alfanar
• Three phase meters G1 / G3

Landis Gyr+
• Single phase meters G1 / G3
• Three phase meters G1 / G3
• Data Concentrators G1

CAHORS
• Data concentrators G1 / G3

Honeywell
• Single phase meters G3

Itron
• Single-phase meters G1 / G3
• Three phase meters G1 / G3

>3 **billion**

DATASETS COLLECTED /
TRANSFERRED / STORED
PER DAY

Linky Deployment: Key figures

24 million METERS INSTALLED
30 000 METERS INSTALLED PER DAY

100 % Power Line Communication

- G1-PLC : 15 %
- G3- PLC : 85 %
- GPRS : 0 %

750 000 METERS PRODUCED PER MONTH

99% SUCCESS RATE OF REMOTE OPERATION

>98% DAILY COLLECTION RATE (23h59)

What steps should a utility follow for successful rollout of G3-PLC networks composed of thousands of meters?

For example, is it necessary to conduct noise measurements on utility power grids before roll out to optimise G3-PLC noise robustness?

Mass roll-out in general:
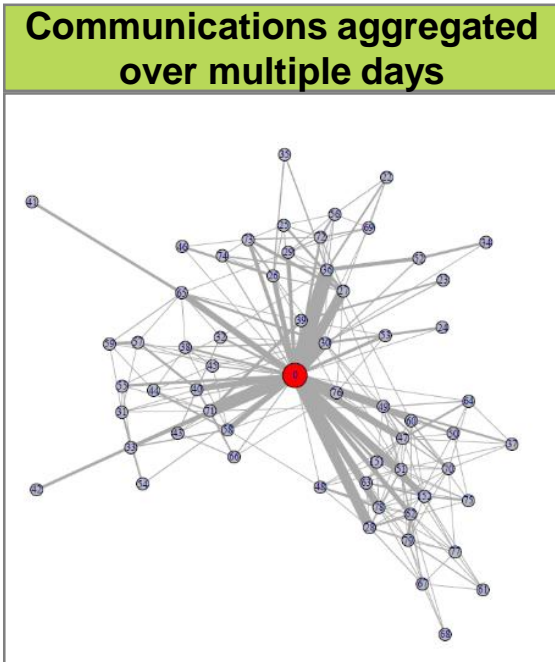- Prepare logistics
- Customer acceptance

Mass roll-out G3-PLC:
- First install the DC's
- Finish one area quickly ('leopard pattern')
- Noise is not an issue: noise measurements are not necessary
- FCC should be used whenever possible to maximize available data rate

G3-PLC Alliance

Agenda

1. About G3-PLC and the G3-PLC Alliance

2. Enedis roll-out in France

3. **Performance, Enhanced Grid Operations and hybrid G3-PLC/RF**

G3-PLC Alliance

Performance of the G3-PLC network depends on the configuration of the network: is there a maximum of smart meters per DC?

Communications aggregated over multiple days

- G3-PLC was designed to handle several hundreds of meters per DC

- Largest substation managed in Enedis grid has 1200 smart meters

- Alliance is working to further improve bandwidth in dense networks (>300 meters)

- Recommendation regarding G3-PLC stack configuration:
  - extend routing table entry time to live to avoid route construction every time a query is sent towards a particular node
  - set long application layer time to lives for the current association to the G3-PLC PAN

- Optimize application processes and traffic patterns

- Guidance is available in user guidelines 'Upper layer integration with G3-PLC'

G3-PLC Alliance

How do you optimize registration of Intelligent Electronic Devices and Appliance Control Devices on the network?

- First of all, avoid too many concurrent registration at the same time:
    - G3-PLC allows randomized transmission of beacons over a certain time
    - distribute bootstrap attempts over time in a randomized fashion (for PAN device application layers)
    - Last is similar to the back off principle of CSMA channel access mechanisms but here we are talking about randomization over minutes or even hours

- Once bootstrapping is done, it is crucial to maintain registration / association over time and avoid losing it during a power outage
    - for example by keeping the same communication parameters when the device is powered back on (design rule for meter manufacturers and is related to the application process)

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The DLMS/COSEM G3-PLC interface classes expose several G3-PLC attributes and settings.

Which of these can be used/changed by utility engineers to improve network performance or to overcome certain noise problems?

For example, how can you optimise G3-PLC routing based on the number of devices connected through or the architecture of their distribution network?

- Indeed a significant number of settings may be changed by the user. The Alliance develops user guidelines suggesting optimized setting of those.
- The use of default values is recommended as they reflect the current understanding of parties involved in G3-PLC since a long time

- Some attributes may further optimize G3-PLC operation but this could also lead to unexpected behaviours. In any case, tweaking should be done together with G3-PLC equipment manufacturers and/or after gaining significant experience in lab and/or field

- G3-PLC routing is influenced by the routing metric which depends on some key attributes

G3-PLC Alliance

Are all "G3-PLC certified" implementations equal in performance, robustness, etc.?

If not, what parameters can be used to compare different G3-PLC implementations?

- G3-PLC certification guarantees confor-mance to the standard, interoperability and that specified performance levels are met

- All certified products have passed the same performance tests requiring a minimum performance level

- Manufacturers can specify higher performance levels and certification verifies whether the product meets these specified performance levels

- ETSI TS 103 909 provides guidance to test products. Test results may be requested from manufacturers in RFP's

- Other important aspects outside the scope of G3-PLC certification include meter lifetime and upper layer integration

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Can G3-PLC cover a distance of 200-300 meters between the home display and the electricity meter?

In which frequency bands does G3-PLC work?

- G3-PLC can easily cover larger distances then 200-300 meter! We know about G3-PLC communications achieved without repeaters:
  - over a single LV line of 800 meters without branches (CENELEC A)
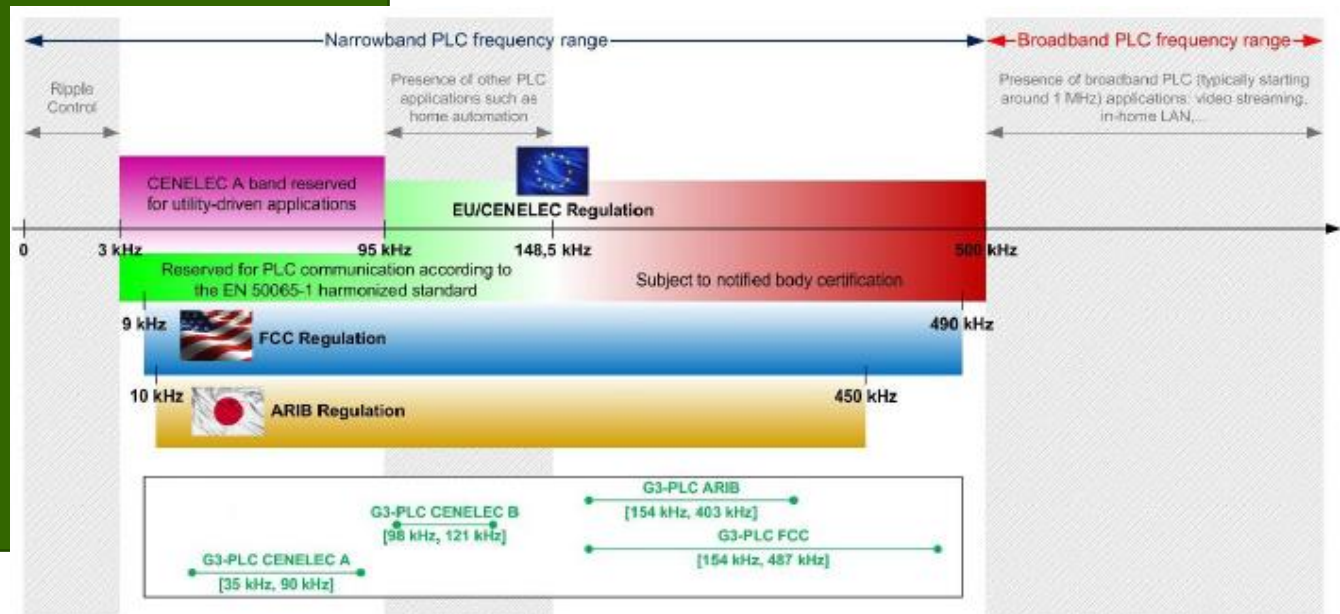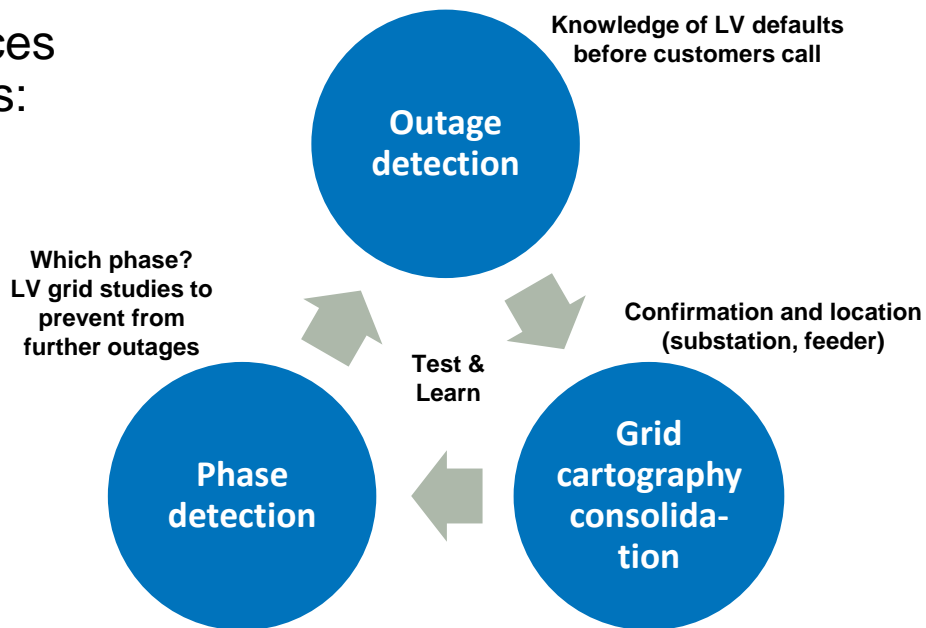 - over a single MV line of 2,4 km without branches (FCC).

Figure 1: Different bandplans to address different needs and match regional regulation

Enhanced Grid Operation is an additional benefit of G3-PLC technology

Enedis runs 3 major grid-oriented services on top of the 20+ million G3-PLC meters:

1. Power outage detection

2. Phase detection
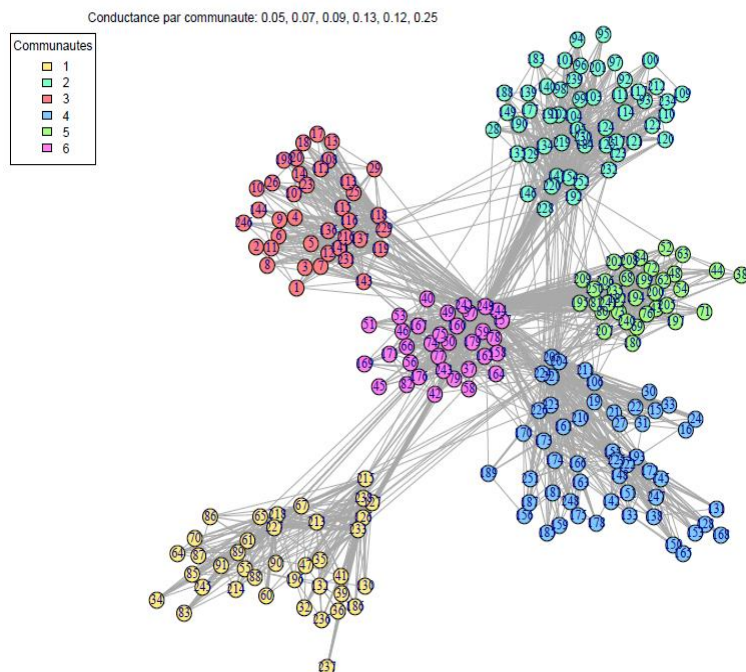
3. Grid cartography consolidation

Knowledge of LV defaults before customers call

Outage detection

Which phase? LV grid studies to prevent from further outages

Test & Learn

Confirmation and location (substation, feeder)

Phase detection

Grid cartography consolida-tion

> It is pure software based: no additional devices than meters and DC using G3-PLC are needed

> G3-PLC is by nature connected to the grid, so the protocol actually gathers key information from the grid state

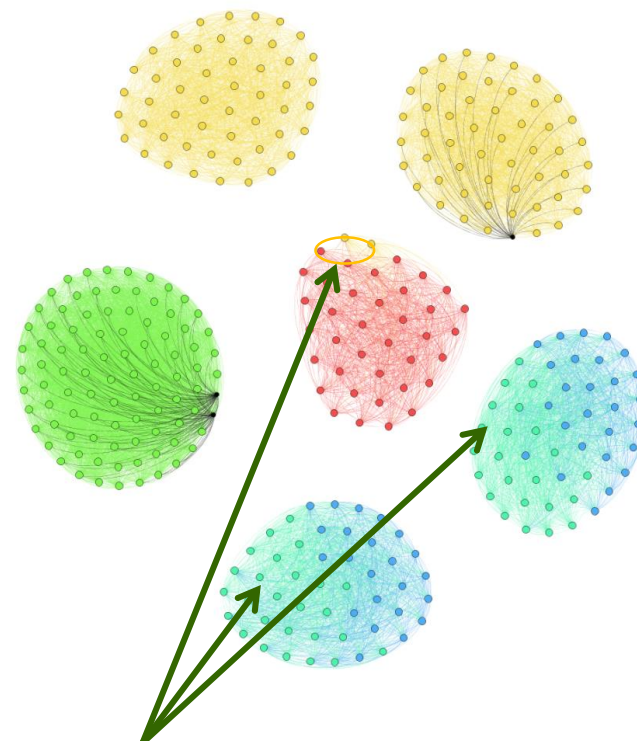> G3-PLC offers a smarter approach based on neighbour tables

Example Grid Services: Grid Cartography Consolidation

Meter communities based on PLC communication analysis

Meter communities according to the electrical cartography in the database (1 color = 1 LV feeder)
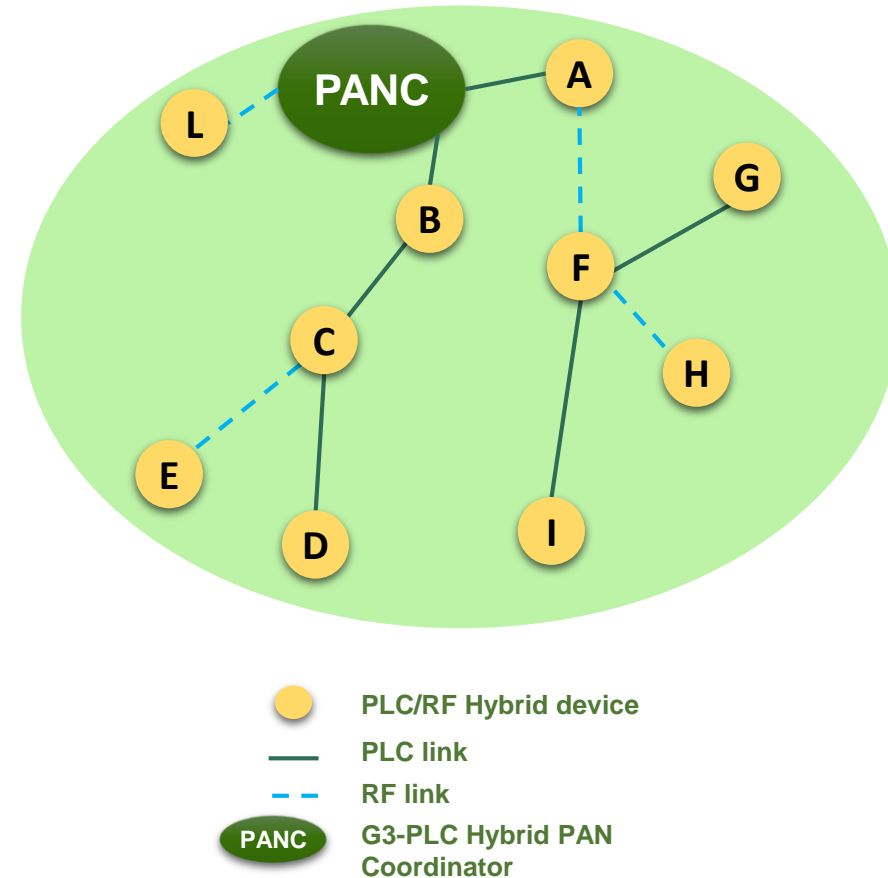
Match ?

PLC communication and grid database do not match, who's right?
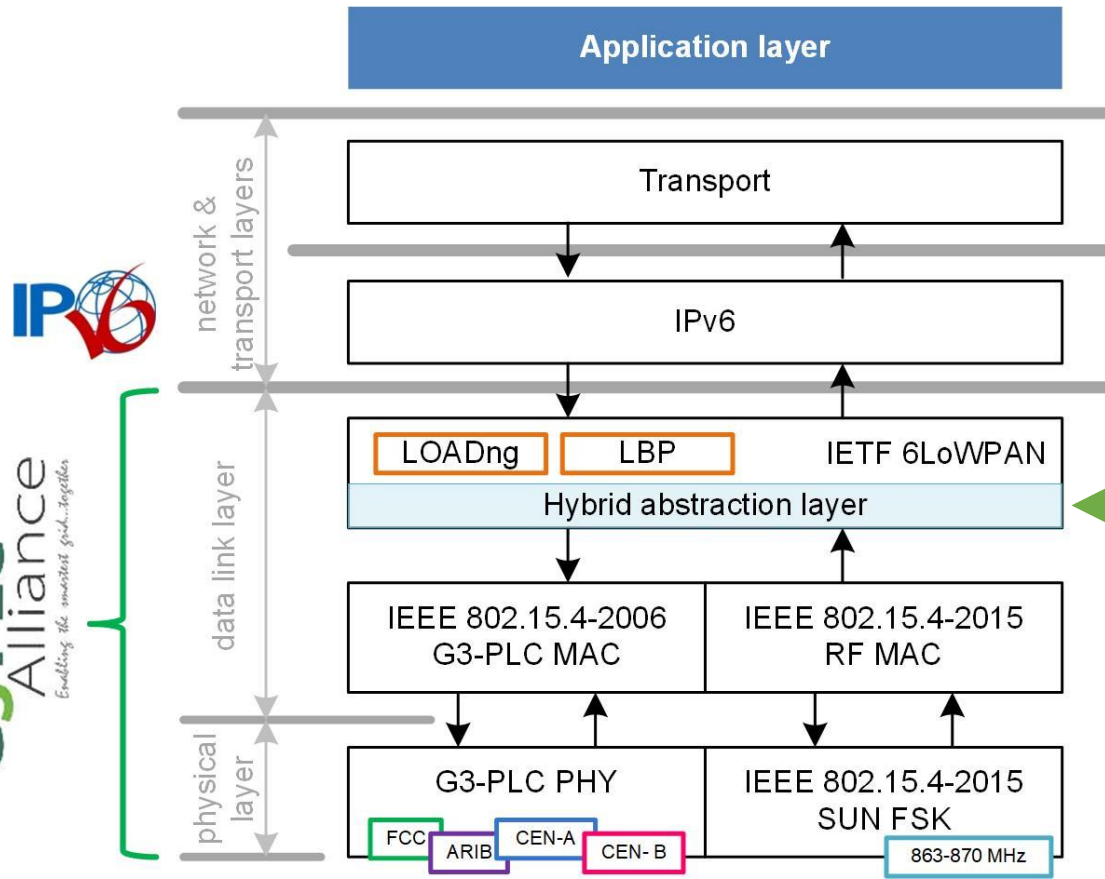G3-PLC turned out to be right!

We are developing the first PLC/RF hybrid standard which provides a more efficient solution for smart grid and smart city use cases

- By using both G3-PLC an RF media, the resulting hybrid G3-PLC/RF meshed topology maximizes coverage and resilience

- Hybrid G3-PLC/RF technology provides a more efficient solution for smart grid and smart city use cases enhancing the relevance of the G3-PLC technology

- Hybrid G3-PLC/RF technology favours new use cases beyond smart metering such as smart grid, smart city, lighting control, building automation, demand response, railway applications.

🟡 PLC/RF Hybrid device
─── PLC link
- - - RF link
PANC G3-PLC Hybrid PAN Coordinator

G3-PLC Alliance

The G3-PLC Alliance Hybrid PLC/RF solution: Target protocol stack

- Fully backwards compatible with any G3-PLC network

- RF is complimentary techno-logy in case of bad channel conditions for PLC links

- Automatic channel selection during network setup and dynamically adjusted

- Switching between PLC and RF is decided above the hybrid abstraction layer which provides appropriate services to the 6LoWPAN-based adaptation layer

G3-PLC is a powerful communication backbone for the African Smart Grid!

- G3-PLC has proven its robustness in the 50+ million devices already deployed worldwide

- G3-PLC is designed for harsh network conditions thanks to its automatic adaptive modulation, mesh routing and by using different frequency bands (Cenelec A/B/C, FCC, ARIB…)

- G3-PLC by nature enables enhanced grid operations through sophisticated software analysis to address DSO's critical processes:
    - Outage management, Phase detection, Network wiring mapping, etc.

- Its robust routing mechanism enables hybrid communication (PLC, RF) maximizing coverage and opening up new use cases

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