



## **G3-Hybrid PLC+RF communication standard - now also supports battery-powered devices for multi-utility metering!**

Information session for Gas/Water/Heat meter  
manufacturers

[www.g3-alliance.com](http://www.g3-alliance.com)

# Agenda

- 11:00 Welcome at Enedis lab in Paris
- 11:30-13:00 Information session (this part can be followed online):

	<b>1</b>	<b>G3-Hybrid and latest developments</b>	<b>Leon Vergeer, G3-Alliance</b>
	2	G3-Hybrid evaluation at Enedis	Abdallah Touil, Enedis
	3	NextGen Dutch Energy Metering System	Martin Idsinga, Dutch DSOs
	4	Battery-powered leaf nodes and G3-Hybrid	Klaus Hueske, Renesas
	5	Q&A	

- 13:00-14:00 Lunch
- 14:00 - 16:00 Tour of the Linky lab and possibility for further discussion

## Today's presenters



**Klaus Hueske**  
Technical WG  
G3-Alliance  
(Renesas)



**Marc DELANDRE**  
Chairman  
(Enedis)



**Abdallah Touil**  
(Enedis)



**Leon Vergeer**  
General Secretary  
G3-Alliance



**Martin Idsinga**  
(Alliander)

# The G3-Alliance evolution: Enabling the smartest grid ... together!



## G3-PLC Alliance

Founding of the Alliance to standardize and promote G3-PLC technology

## Deployment

Start of the Linky roll-out with now 36 million devices in operation in France

## Next Generation

Introduction of G3-Hybrid combining powerline and radio communication

## Battery-powered devices

Incorporate other IOT devices in the same G3 network



2011



2014



2015



2018



2020



2022

2023

## Certification

- Accepted as ITU standard
- Opening of the certification program

## Growth

- Nearly 100 members
- > 500 certified devices
- Protocol enhancements
- >80M devices globally

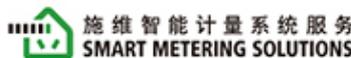
## Hybrid certification

Certification program extended to include G3-Hybrid



G3-Alliance is supported by an international group of nearly 100 utilities and industrial players

**G3-Alliance**  
Enabling the smartest grid...together



# G3-PLC is a mature technology with over 80 million products in operation in more than 30 countries worldwide

## Known pilots and roll-outs of worldwide



## PLC or RF Communication?

### PLC Advantages

- Cost effective as it uses existing infrastructure
- Provides robust communication even under noisy conditions
- No line-of-sight limitation (Underground, through walls)
- Not affected by weather

### RF Advantages

- Immune to noise on the lines
- Able to connect isolated meters
- Can connect meters behind different substation

**What if you can have both in one?!**

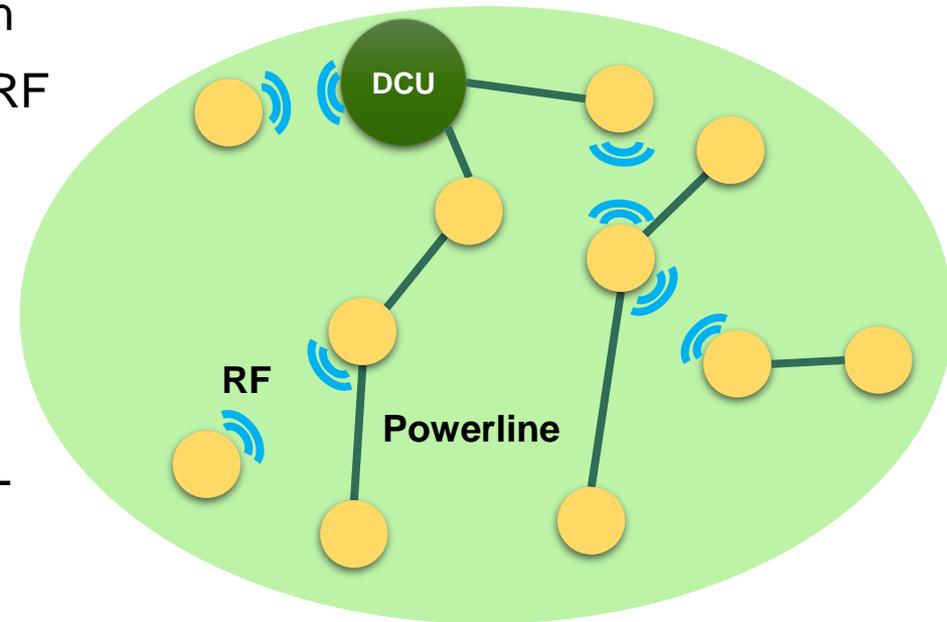
### Hybrid PLC&RF Advantages

- Maximises coverage and connectivity
- Strongly reduces the complexity of the roll-out and with that the cost
- Increases performance

## G3-Hybrid: How it works

- RF mesh and power line communication in one *single* solution
- Each node can use PLC as well as RF for communication
- The route is built with a hop-by-hop selection of the 'best' channel
- Supports all mechanisms to meet global regulatory requirements
- Fully backwards compatible with G3-PLC

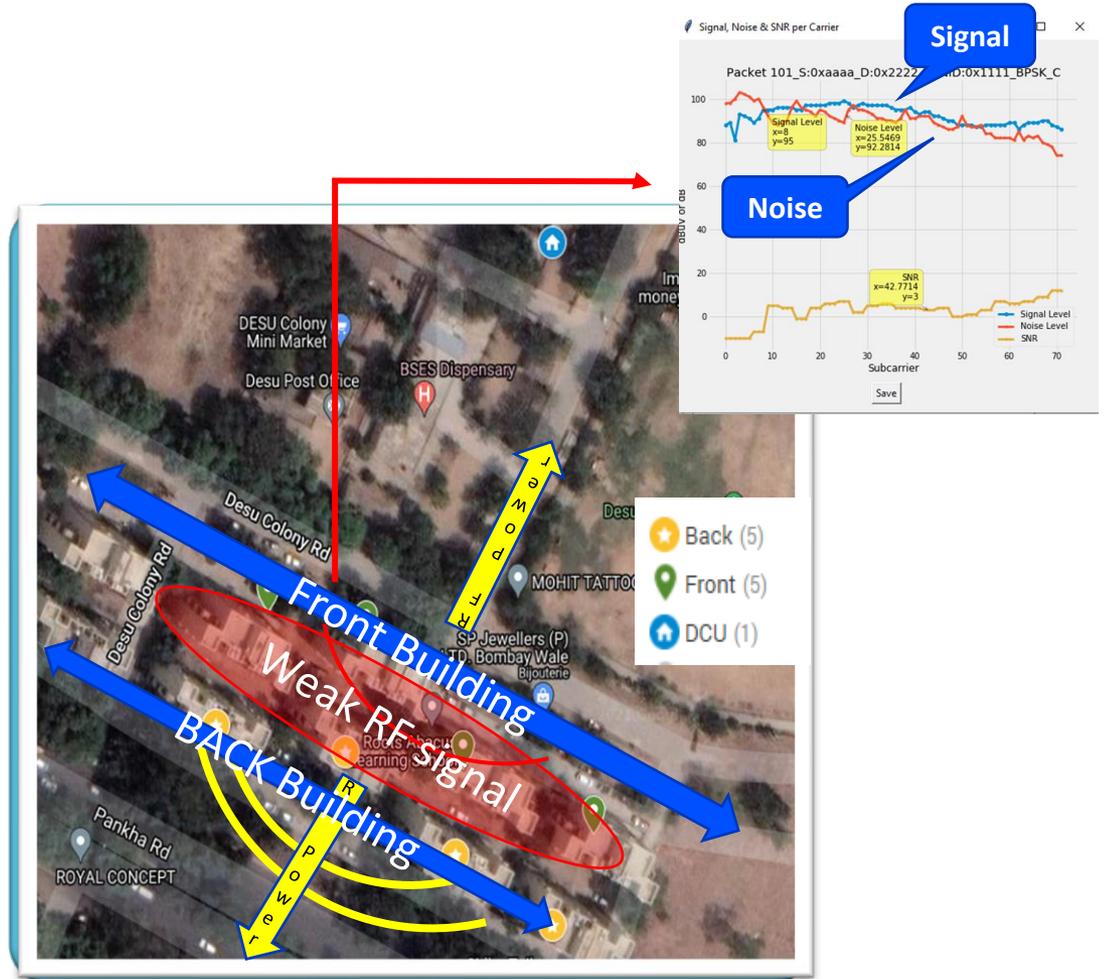
# G3-Hybrid



# Trials for example in India by Sagemcom show G3-Hybrid is performing well under very harsh conditions

- Location represents a challenging environment for both RF & PLC communications:
  - Very high level of PLC noise
  - Obstacles create a very harsh environment for back meters to communicate in RF with the front Meters

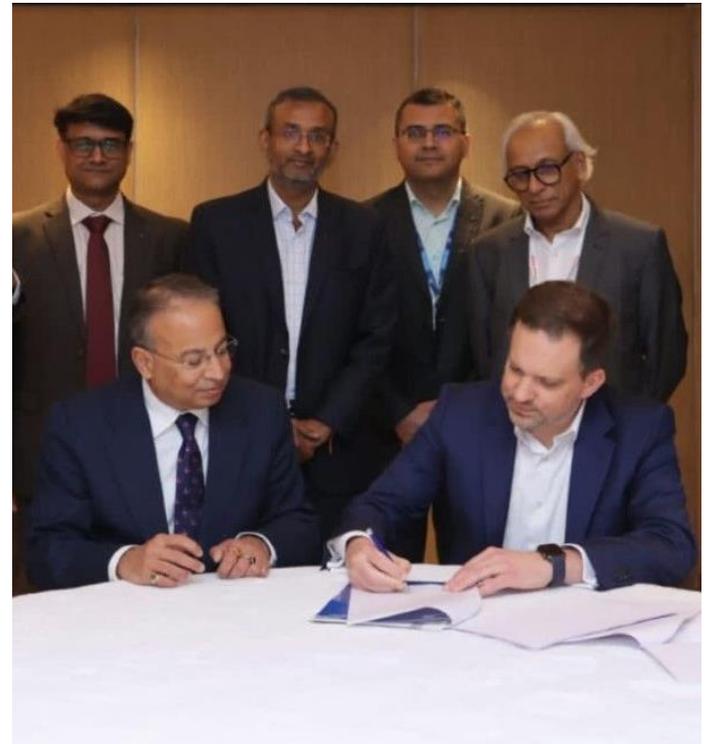
Sagemcom



## Gridspertise announced to start a smart meter pilot in India with G3-Hybrid

- Gridspertise signed an MoU with Tata Power
- Tata Power Delhi Distribution Ltd. (TPDDL), serves 1.9 million customers in North Delhi
- Objective is to deploy smart metering and automation technologies in India's distribution network
- The smart meter pilot project will use G3-Hybrid technology

<https://www.smart-energy.com/industry-sectors/smart-meters/tata-power-and-enel-group-to-deploy-smart-meter-and-automation-tech-in-india/>



## Gridspertise started deployment of G3-Hybrid technology in Latin America in June this year



### G3 Hybrid technology deployment Colombia

A new fully modular and interoperable Smart Meter that:

- allows different communication protocols (G3 Hybrid – PLC + RF Mesh, Cellular LTE and NBloT)
- is flexible allowing the distributors to change the communication technology over the time
- maximizes the reachability and availability of field devices in urban and rural areas thanks to G3 Hybrid technology



## **G3-Hybrid provides a powerful solution for the smart grid, now including Gas/Water/Heat metering in the same network**

- ✓ Based on open standards and natively supports IPv6
- ✓ G3-Hybrid is a *full* RF solution *plus* the capability of PLC
- ✓ Can include other IoT devices in the G3 network as it now supports battery-powered leaf-nodes
- ✓ Member driven Alliance with nearly 100 members including many utilities
- ✓ Thorough certification program to enable multi-vendor implementations

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# Hybrid dual band electricity meters

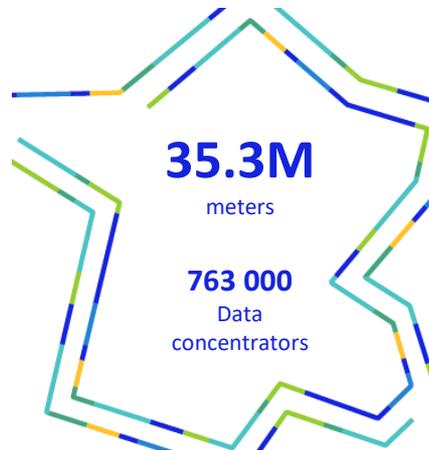
Hybrid PLC+RF technology evaluation



03/07/2023



# Linky program, a success for the energy sector



 **LAN PLC communication**



**3,3 M**  
meters

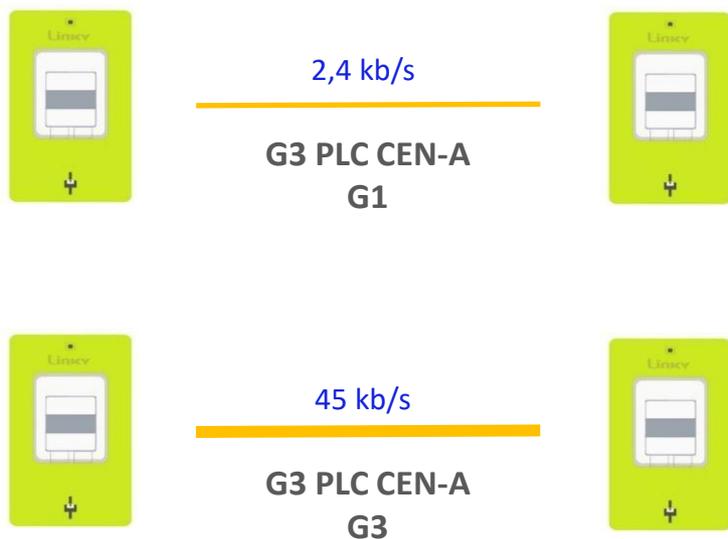
**2** PLC meters generation



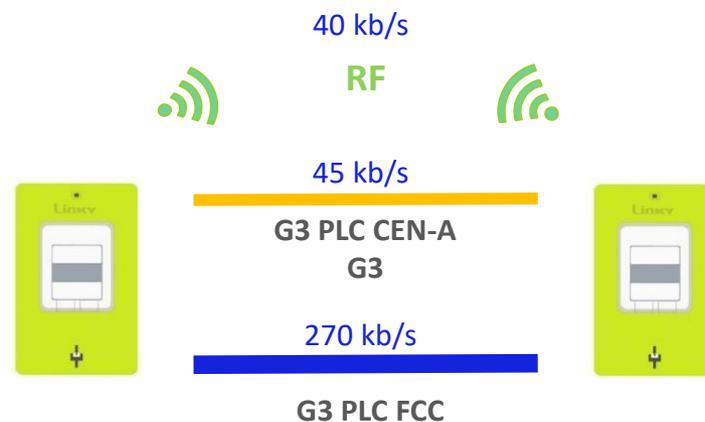
**32 M**  
meters

# Overview of PLC and RF technologies

## Current Linky meters



## Hybrid Meter



# Enedis requirements

The hybrid dual-band meter is a relevant way to meet two requirements of Enedis in the short and medium term:

## 1 Improvement of the collect rate



- Contribute to the increase of the mass market collection rate:
- Overcome remaining network disruptions
  - Anticipate the problems linked to the electrical cars charging.

## 2 Anticipation of the end of life of the G1 PLC meters



- Anticipate and solve problems posed by the G1 PLC:
- Equipment availability,
  - Level of performance that can be improved,
  - Increased sensitivity to PLC noise.

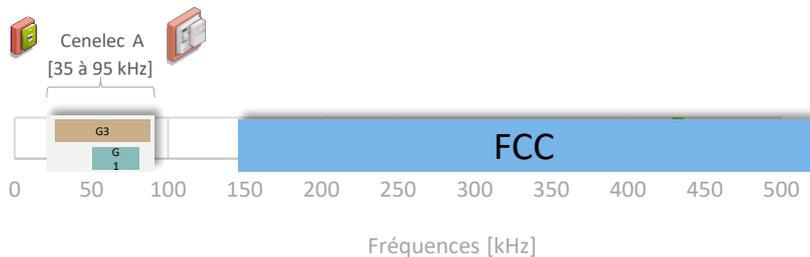
# Review of PLC and RF technologies

1. **Hybrid** : ability to use two communication medium: **PLC** or **RF**
2. **Dual band** : ability to communicate in two PLC frequency bands, **CENELEC A** or **FCC**

## PLC

Wireline technology with major distinctions:

- **Technologies** : PLC G1 - PLC G3
- **Frequency bands**: Cenelec A + FCC

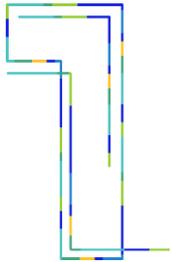


## RF

Wireless technology with the following characteristics:

- **Radio frequency**: 860MHz - 930MHz
- **Communication** : from meter to meter, and from meter to data concentrator

# Tests on hybrid meters planned for 2023



## Labo CPL tests

- PLC/RF Switching test
- Duality test
- Interoperability Test 1
- Interoperability Test 2



## Labo Dense tests

- G3 / FCC Collection Test
- Performance test G3 / FCC
- Performance test G1 / FCC

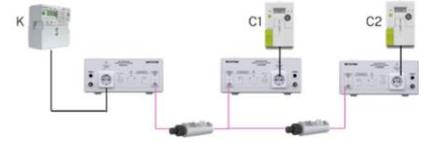
# Tests Labo PLC

1. PLC/RF Switching test
2. Duality test
3. Interoperability Test 1
4. Interoperability Test 2

# 1.1. Labo CPL Tests – CPL/RF switching

## Objective

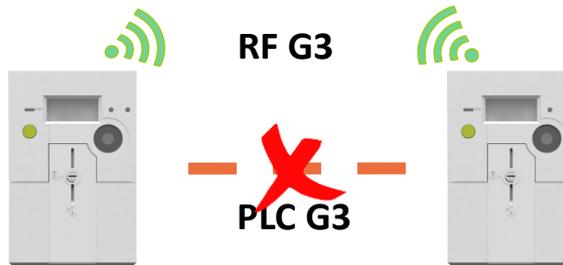
Check that the meters switch from PLC to RF when the PLC link quality reaches a critical threshold. And vice versa.



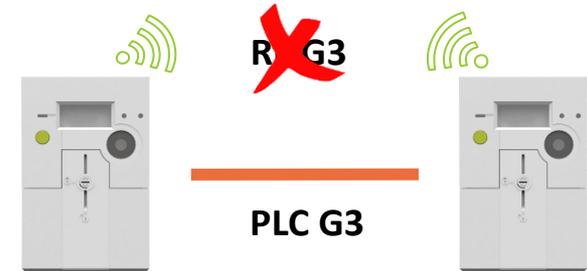
- 1 The meters communicate with **PLC** by default (at start-up)



- 2 Meters switch to **RF** if **PLC** communication is lost



- 3 Meters switch back to **PLC** in case of loss of **RF** communication



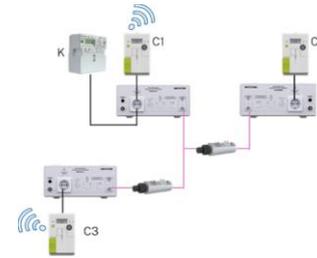
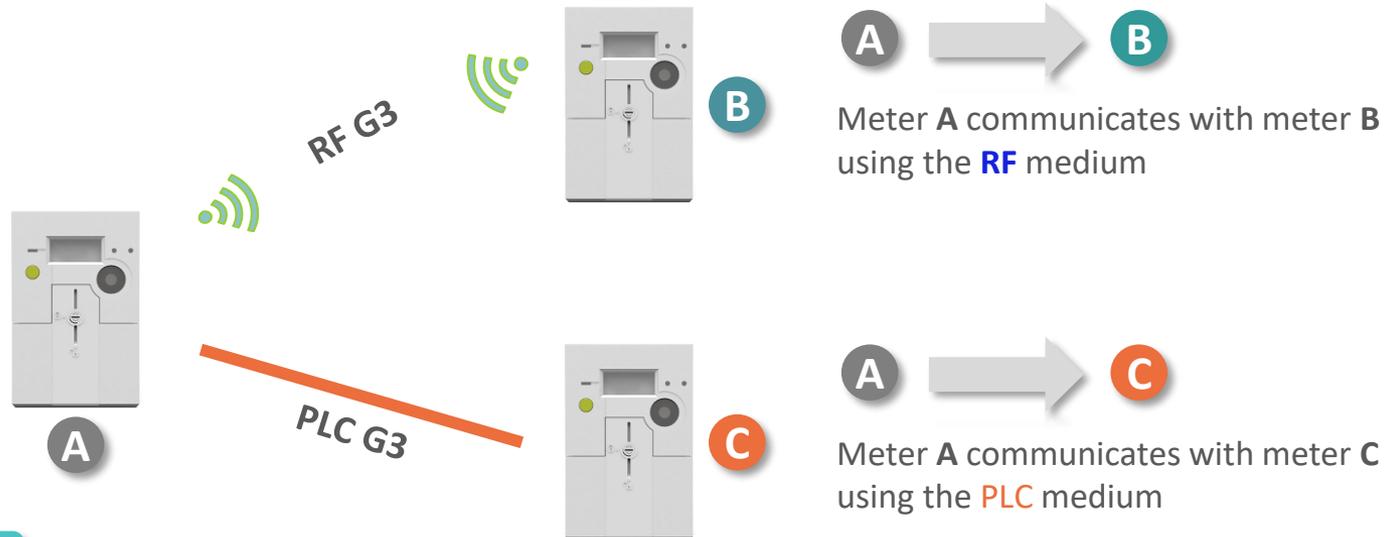
## Result

The mechanism for **switching** from one medium to another does indeed satisfy the criterion of the quality of the communication of the channel concerned, and the switchover takes place **automatically**.

## 1.2. Labo CPL tests – Duality

### Objective

Verify that the meters can communicate in PLC and RF with neighbouring meters



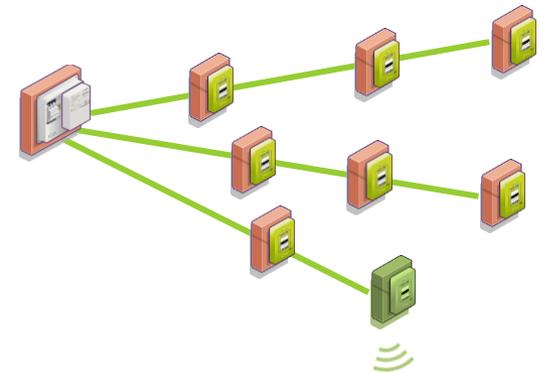
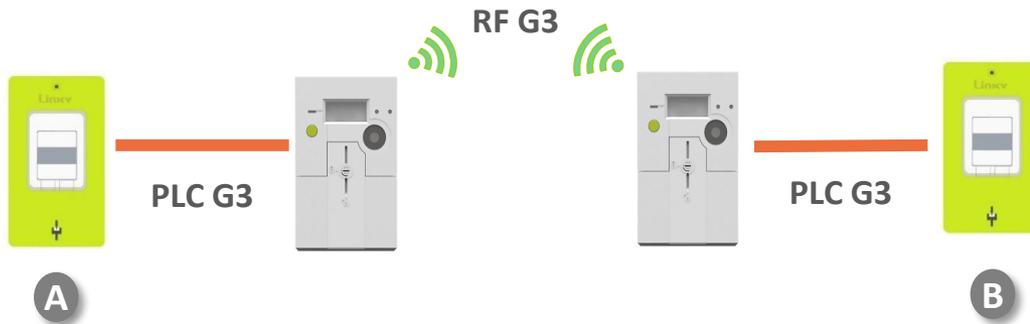
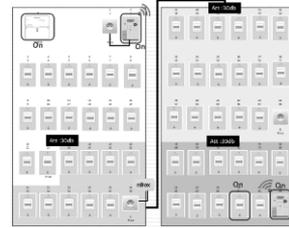
### Result

Hybrid meters can route in RF and PLC several neighbouring meters using one channel at a time.

# 1.3. Labo CPL tests – Interoperability / RF

## Objective

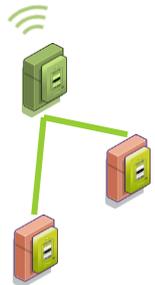
Verify the interoperability of hybrid meters with Linky meters



The PLC frames exchanged between the two Linky A and B meters pass through the RF bridge of the hybrid meters

## Result

Hybrid dual-band meters are compatible with the G3 PLC protocol of current Linky meters  
(Discovery, Authentication, Routing, ...)



# Labo Dense tests

1. G3 / FCC Collection Test
2. Performance test G3 / FCC
3. Performance test G1 / FCC

## 2. Labo Dense test

Equipments  
configured in PLC  
CENELEC A

- 1 DC
- 38 meters



Equipments  
configured in PLC  
FCC

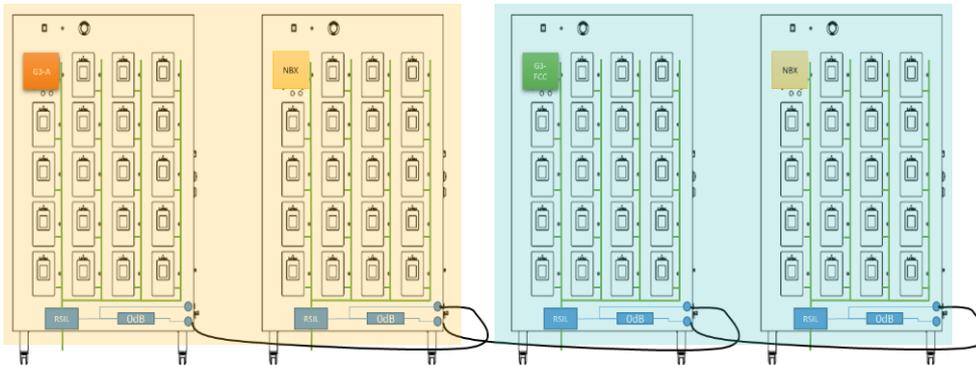
- 1 DC
- 38 meters

## 2.2. Labo Dense tests : CENELEC A G3 and FCC

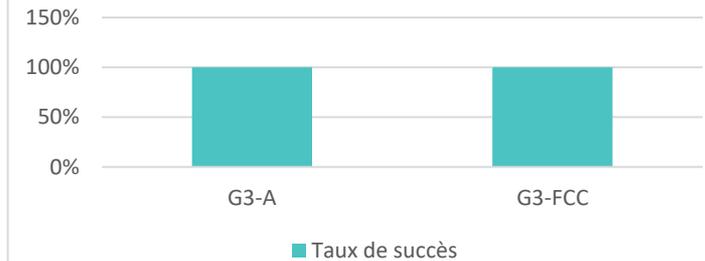


### Objectif

Compare the performance and cohabitation of CENELEC A and FCC technology



### Performance Cohabitation G3-A et G3-FCC

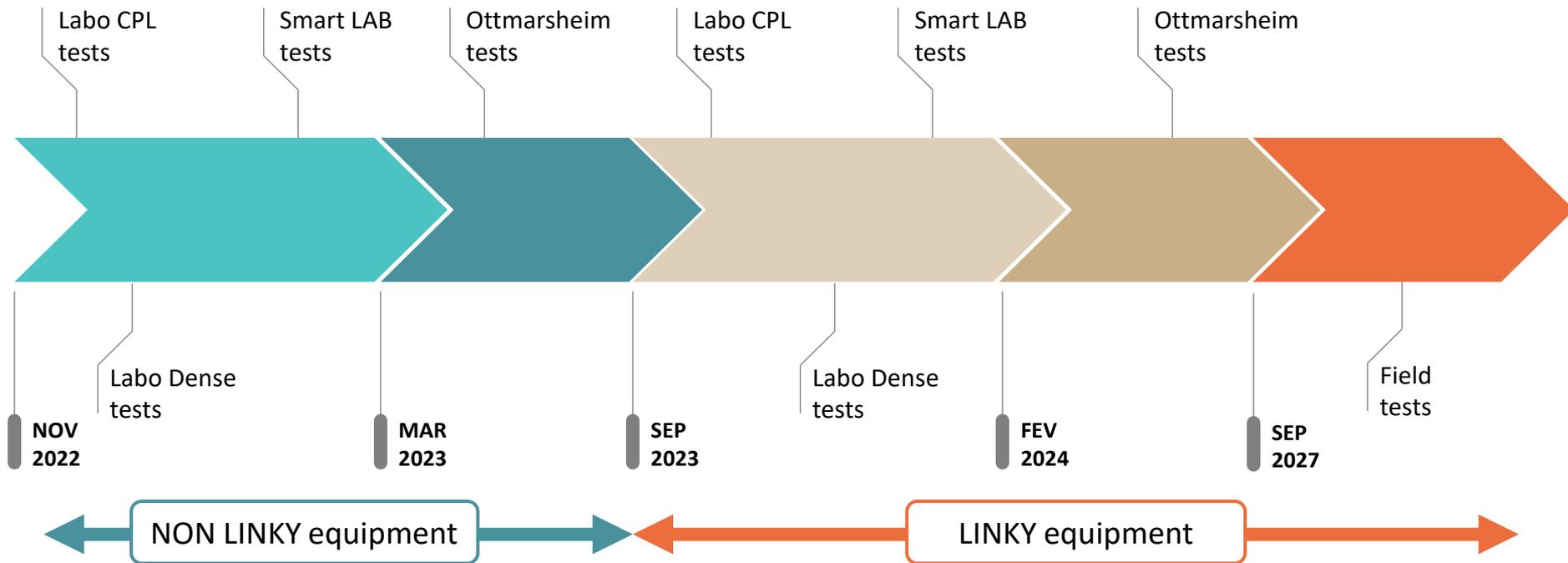


### Result

The two "networks" operate in parallel without loss of performance on their continuous collection.

# Testing phases

The test campaign consists of two major phases, testing of **non-Linky meters** and **Linky meters**



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Netbeheer  
Nederland

# DSMR6 and RF G3 Hybrid

Introducing DSMR6 and the NextGen project at the webinar where G3 Alliance is launching the battery operated RF Standard

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# Some names and contact details



## Martin Idsinga

- Technology Consultant at Liander. Involved in metering since 2002.
- Solution Architect within the NextGen project

Email: [Martin.idsinga@alliander.com](mailto:Martin.idsinga@alliander.com)

LinkedIn: <https://www.linkedin.com/in/martinidsinga>

Contact me at LinkedIn and I will invite you to the closed group “NextGen - Dutch Energy Metering System” at LinkedIn

# Agenda



1. The Dutch Smart Metering environment
2. A more flexible design is required
3. DSMR6 concept
4. Wireless connection in DSMR6

# 1 The Dutch smart metering environment

- DSOs are responsible for metering for small-scale connections and strictly regulated;
- 2010 smart meter roll-out started
- 2015 start large scale roll out, completed in 2020
- In the Netherlands the DSO's work closely together which resulted in the the Dutch DSMR4 and (E)SMR5 meter generations;
- “Netbeheer Nederland” (NBNL) is the Dutch association of grid operators.
- The NBNL umbrella is used for the NextGen project that



## 2 A more flexible design is required



Increasing rate of technological development shortens the lifecycle of meter components, such as telecom modules



The energy transition is expected to lead to new requirements for the metering system, to enable new grid management functions or new market models



Changing customer expectations regarding the availability of energy data and control over data



Increasing workload for DSOs because of the energy transition. Availability of (technical) workforce and funding is under constant pressure

*Future requirements for the metering system are becoming increasingly hard to predict.*

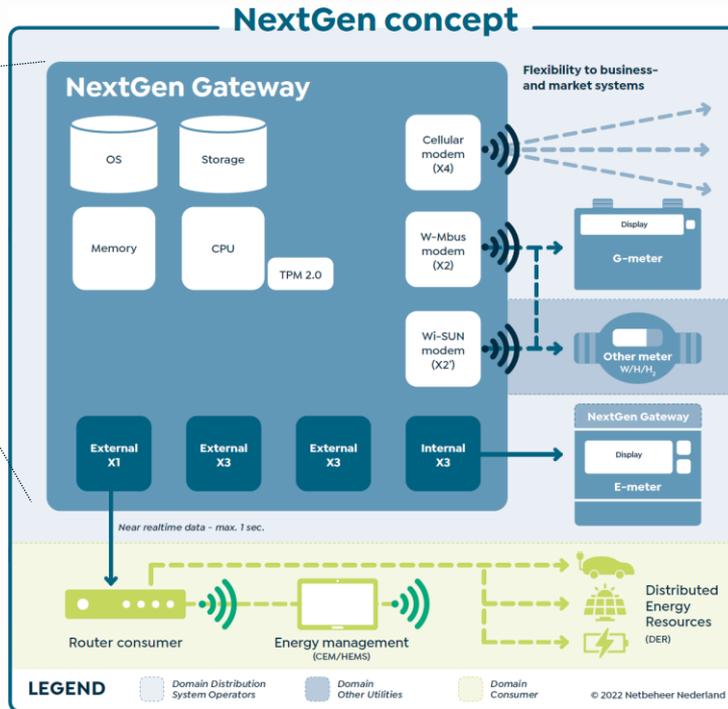


*Therefore, we want to develop a completely **new generation metering concept** that is more flexible, so that we can continuously adapt to new developments.*



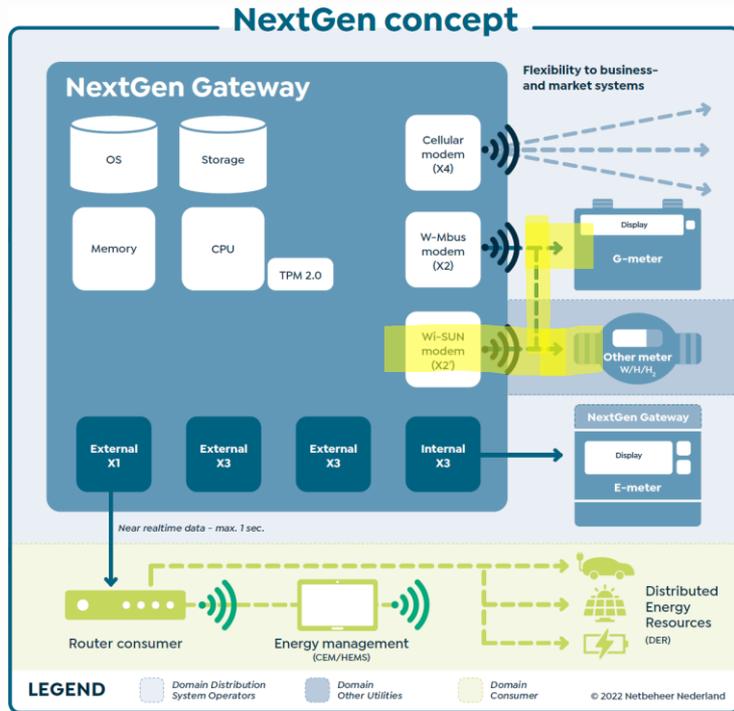
# 4 DSMR6 Concept

A reference design!



- Increased flexibility by eLinux OS and a separate application layer;
- Telecom flexibility, e.g. by using multiband and RSP;
- Data signing (E&G) for data integrity;
- Possible to add multiple e-meters to one gateway, as well as other utility meters;
- Different types and generations of base meters and gateways are interchangeable;
- New consumer interface allows for easy data sharing (P1 ► X1).

# 4 Wireless connection in DSMR6



- Only a wired connect between the base E-Meter and the Gateway
- Wireless connections to all other devices, both powered and battery operated
- The G-Meter
  - wM-Bus and on the backlog: wireless supporting TCP/IP
- Other (second) E-Meter
  - A wireless solution supporting TCP/IP

Wi-SUN or RF G3 Hybrid?

- Earlier research → Wi-SUN
- G3 Hybrid → suggested in Market Consultation, but did – so far – not support battery operated devices

## And next..

- Current planning : start tendering the solution in Q4/2023
- Today, we expect that we decide the final wireless solution together with the selected suppliers.

# Agenda

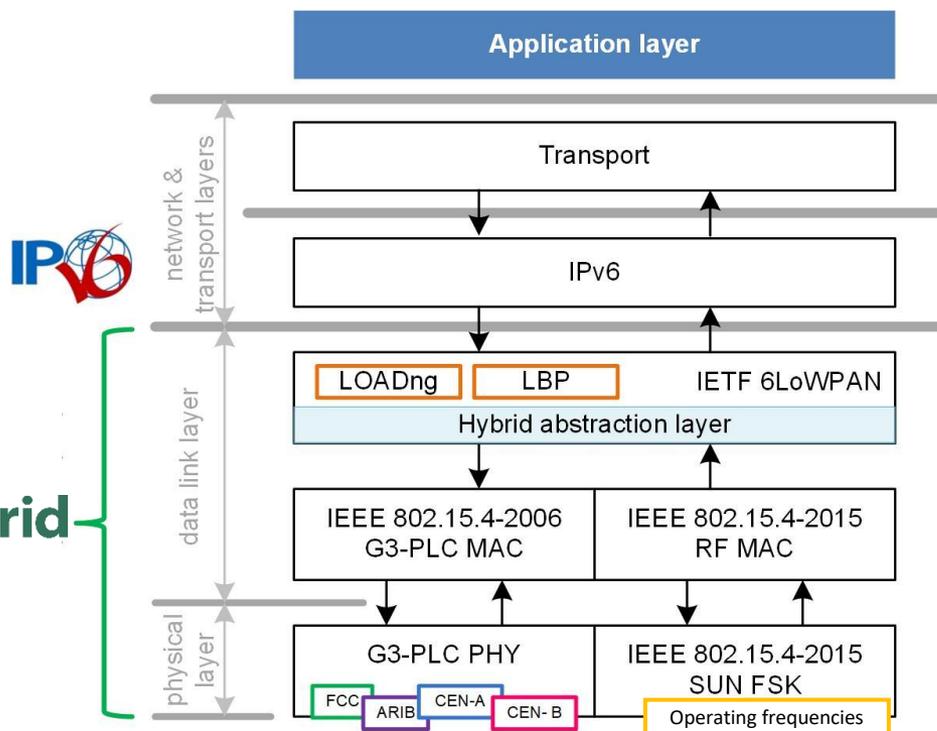
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# The G3-Hybrid unifies powerline and radio frequency technology creating one, seamlessly managed network using both media

## Unified G3-Hybrid PLC+RF protocol stack



- Unifies wireless RF and wired power line communication
- One, seamlessly managed network over both media
- The hybrid protocol stack is built using open standards IEEE 802.15.4-2020 in addition to the existing G3-PLC protocol
- Switching between PLC and RF is decided above the hybrid abstraction layer

## The G3 specification to support battery-powered devices is based on proven mechanisms and ready to be used

- A Taskforce within the Technical Working Group has been working on the G3 specification to support battery-powered devices
- Members participating in this group include Renesas, Vertexcom, STMicro, Microchip, Enedis, EDF, Sagemcom and Trialog
- The specification is ready for approval in the Alliance on July 7<sup>th</sup>
- The specification is based on proven mechanisms
  - For example, the 802.15.4 CSL (Coordinated Sampled Listening)
  - we did not intend to develop something new
  - we adopted proven mechanisms for usage in G3

**HYB\_E\_066 BATTERY LEAF NODES V0.10**

Authors (alphabetical order): El [Gob-Job](#), Klaus Hueske, [Wooct](#), Mairy, Greg Tseng

Date: 21/06/2023

Version 0.1: Requirements [consolidated](#)

Version 0.3: Draft for NETWORK JOIN and NETWORK JOIN

Version 0.4: Update during 2023/03/29 call

Version 0.5: Update during 2023/04/19 call

Version 0.6: Integrated changes by Vincent, Greg & Klaus

Version 0.7: Updates during 2023/05/17 call

Version 0.8: Updates during 2023/05/31 call (including proposals by Vincent & Klaus)

Version 0.9: Updates from Greg discussed in WS1, Updates during 2023/06/14 call

Version 0.10: Updates from Greg, Vincent, [JLpy](#) and updates during 2023/06/21 call

### 1 REQUIREMENTS FOR G3 BATTERY LEAF NODES

A battery leaf node is an RF only & battery-powered device (limited resources) [that](#)

- Has the capability to join the hybrid mesh network through a PAN device via [BLE](#)
- Provides low-power operation for maximum battery [lifetimes](#)
- Does not participate in the network's mesh [routing](#)

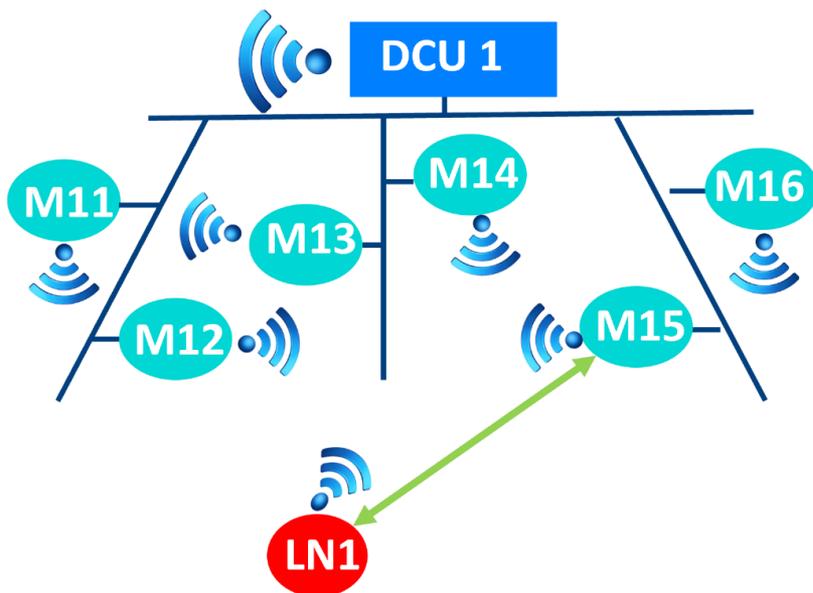
Constraints for battery leaf node operation

- Energy budget
  - Low-power operation requires long deep-sleep [cycles](#)
  - Unnecessary communication shall be [avoided](#)
    - Shall not forward messages in the mesh network
    - Shall not answer beacon request [messages](#)
  - Typical use cases for battery powered operation shall be supported (battery capacity for whole meter operation, split by rule of thumb: 1/3 communication, 1/3 metrology, 1/3 leakage)
    - 8 to 15 years lifetime with capacity of 8000 [mAh](#) for 1 read per [day](#)
    - 5 to 10 years lifetime with capacity of 8000 [mAh](#) for 3 to 6 reads per [day](#)
    - can reach 20 years lifetime with capacity of 30000 [mAh](#) for 3 to 6 reads per [day](#)
- Channel Access

## What is a battery leaf node?

- A battery leaf node is an RF-only & battery-powered device that:
  - can join the hybrid mesh network through a PAN device via RF
  - provides low-power operation for maximum battery lifetimes
  - does not participate in the network's mesh routing

Example network topology



- DCU1 is a G3-Hybrid coordinator
- M11 - M16 are G3-Hybrid devices (electricity meters)
- LN1 is battery-powered device (water or gas meter)

## Battery leaf nodes requirements that have been used to define the technical solution (1/2)

Topic	Requirements
Energy budget	<ul style="list-style-type: none"><li>• Low-power operation requires long deep-sleep cycles</li><li>• Unnecessary communication shall be avoided</li><li>• Typical use cases for battery powered operation shall be supported:<ul style="list-style-type: none"><li>- 8 to 15 years lifetime with capacity of 8000 mAh for 1 read per day</li><li>- 5 to 10 years lifetime with capacity of 8000 mAh for 3 to 6 reads per day</li><li>- can reach 20 years lifetime with capacity of 30000 mAh for 3 to 6 reads per day</li></ul></li></ul>
Channel Access	<ul style="list-style-type: none"><li>• Leaf node operation shall support fixed channel as well as frequency hopping operation</li><li>• Synchronization periods, frequency of reception and transmission etc. will have impact on battery lifetime</li><li>• To support different use cases, wake-up times and sleep cycles should be configurable, even after initial bootstrap</li></ul>
Backwards compatibility	The mechanism shall be fully interoperable with G3 PLC/RF devices

## Battery leaf nodes requirements that have been used to define the technical solution (2/2)

Topic	Requirements
Leaf node to parent communication	<ul style="list-style-type: none"><li>• A parent PAN device shall support serving several battery-powered leaf nodes</li><li>• Communication between parent and leaf node only uses RF medium</li><li>• Parent and leaf establish a unicast route (point-to-point communication) to communicate bi-directionally</li></ul>
Join process	<ul style="list-style-type: none"><li>• If a leaf node attempts to join a PAN that it is not allowed to join, the authentication shall fail, and the application shall blacklist that PAN in the next attempt</li><li>• To avoid multiple join attempts, network information could be provided either via beacon payload or SSID information element</li><li>• Battery-powered leaf nodes shall bootstrap like regular G3 PAN devices, i.e. obtain GMKs and short addresses during the join procedure</li><li>• The battery leaf node shall be allowed to join any PAN device, there is no fixed pre-assignment to a particular parent node. The parent device shall be selected based on information from beacons frames, such as route cost or LQI</li></ul>

## Our roadmap



Leaf node Specification ready July 7<sup>th</sup> 2023



Plugfest to demonstrate interoperability in H2 2023



Certification battery-powered devices opens in 2024



G3-Alliance has liaison agreement with DLMS ua and will be represented in DLMS Gas working group

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Q&A

## The alliance is ready to support gas/water/heat manufacturers to implement G3-Hybrid technology!

- Technical session can be planned in September
- Contact us any time if you have questions!

Topic	Who can help you:	
General and Certification	G3-Alliance General Secretary	<a href="mailto:leon.vergeer@g3-alliance.com">leon.vergeer@g3-alliance.com</a>
Specification	G3-Alliance Technical working group	<a href="mailto:cedric-2.lavenu@edf.fr">cedric-2.lavenu@edf.fr</a>
Technical questions	Renesas <sup>1</sup>	<a href="mailto:klaus.hueske@renesas.com">klaus.hueske@renesas.com</a>
	STMicroelectronics <sup>1</sup>	<a href="mailto:eric.djakam@st.com">eric.djakam@st.com</a>
	Vertexcom <sup>1</sup>	<a href="mailto:greg.tseng@vertexcom.com">greg.tseng@vertexcom.com</a>
	Microchip <sup>1</sup>	<a href="mailto:david.sancho@microchip.com">david.sancho@microchip.com</a>

Note 1: These chip manufacturers participated in the working group for battery-powered devices