How to realise G3-PLC smart meter interoperability in the field

G3-PLC Alliance

Welcome to today's Webinar!

How to realise G3-PLC smart meter interoperability in the field

G3-PLC Alliance
September 14th 2022

Today's presenters

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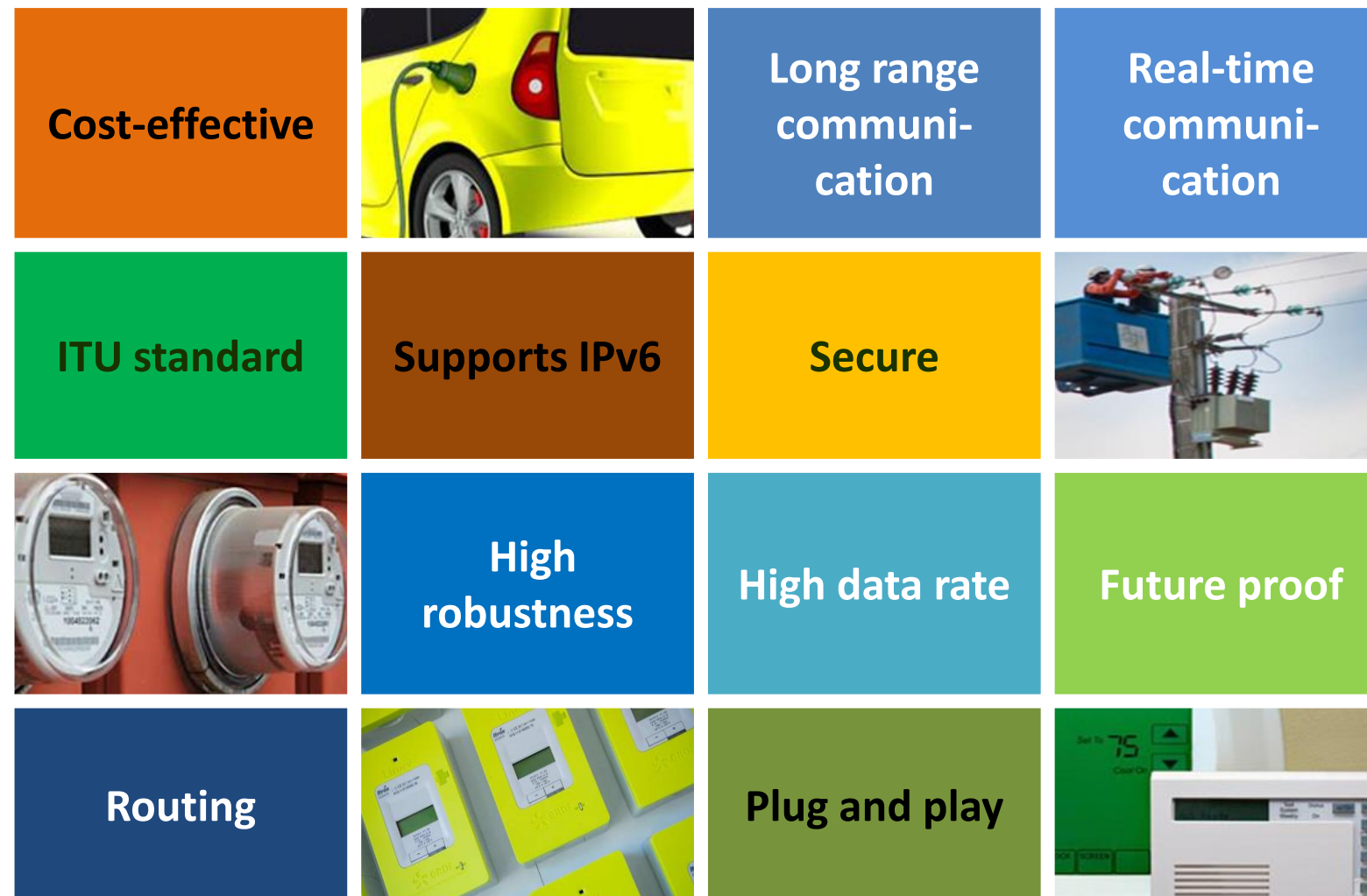Enedis
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Nicole Gugerel
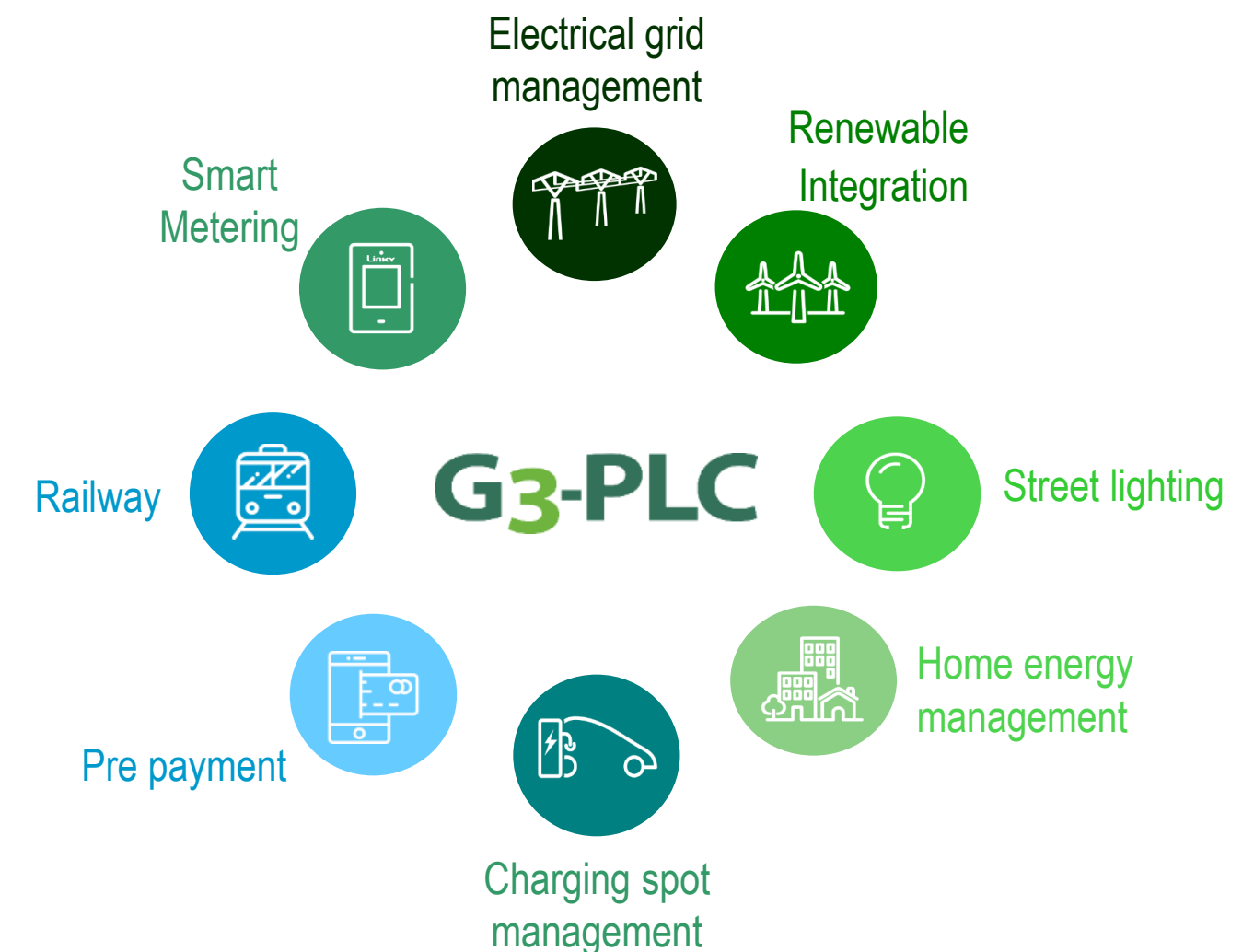Smart Meter Operation Center
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A proven Powerline Communication technology offering lowest total cost of ownership and independency on telco operators

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	

… in a wide range of applications

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

➡ Mature technology with >80 million products in >30 countries worldwide

➡ Backed by international group of nearly 100 DSO's and industrial players

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G3-PLC: International standard with strong certification program

Total number of certified devices already over 500 since opening of the certification in 2014!

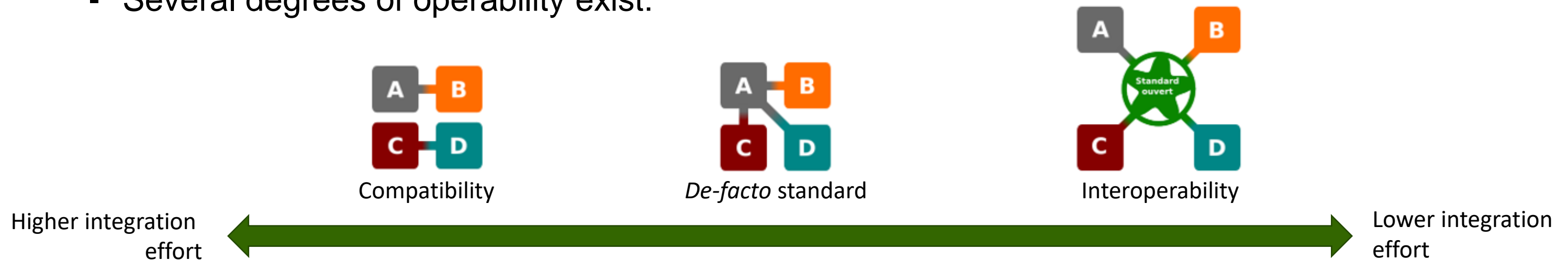Number of certified devices (cumulative)
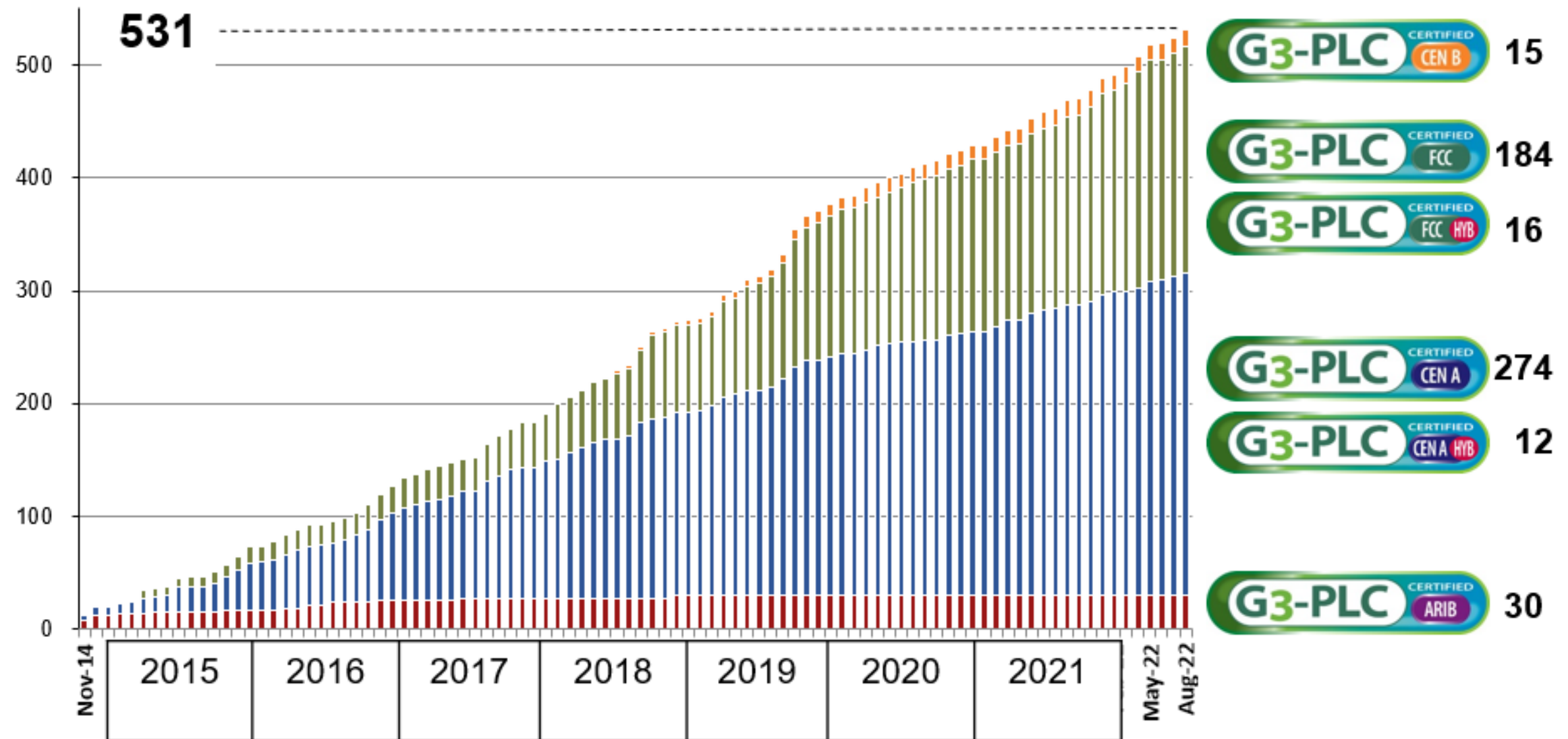
Agenda

1. Introduction

2. **General approach to achieve interoperability**

3. Experience from Enedis in France and EVN in Austria

4. Questions

What is interoperability?

- Definition
    - Interoperability is a characteristic of a product or system to work with other products or systems. It is based on open standards.
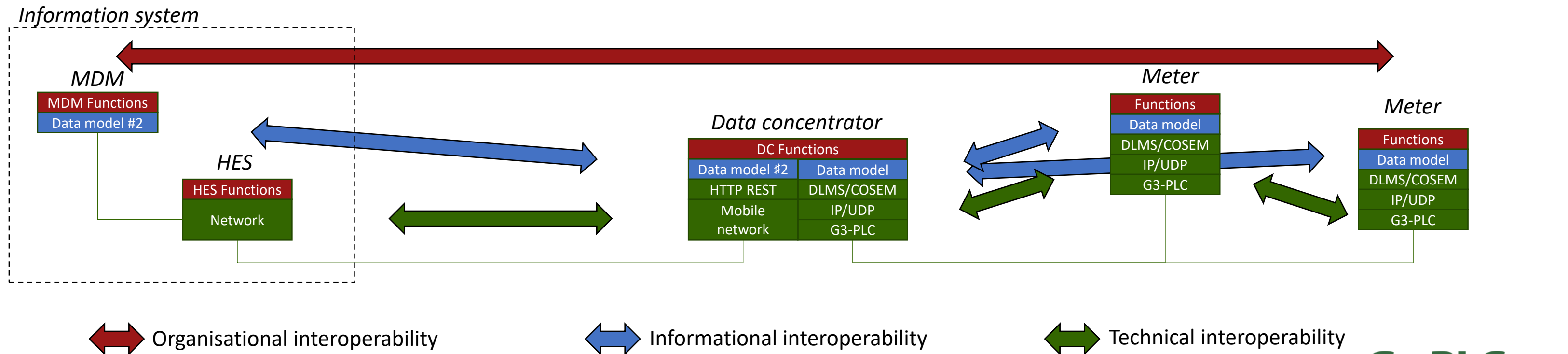   - Several degrees of operability exist:

Compatibility   *De-facto* standard   Interoperability

Higher integration effort ← ────────────────────────── → Lower integration effort

- Layers of interoperability *(based on GWAC interoperability framework)*
    - Organisational: business procedures & objectives, regulatory, …
    - Informational: semantic, business context
    - Technical: connectivity, network, syntax

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Interoperability in a smart metering system

- Interoperability vs interchangeability
  - « Interoperable » means that two devices can work together / understand each other
  - « Interchangeable » means that one device can be replaced by another one and offer the same functions
  - A DC and a meter are *interoperable*. However, they are not *interchangeable*.

- Interoperability within a Smart Metering system
  - Organisational: functions, system use-cases, business use-cases, regulation
  - Informational: DLMS/COSEM data model
 - Technical: G3-PLC protocol, DLMS/COSEM protocol

Information system

MDM
| MDM Functions |
| Data model #2 |

HES
| HES Functions |
| Network |

Data concentrator
DC Functions	
Data model #2	Data model
HTTP REST	DLMS/COSEM
Mobile network	IP/UDP
	G3-PLC

Meter
| Functions |
| Data model |
| DLMS/COSEM |
| IP/UDP |
| G3-PLC |

Meter
| Functions |
| Data model |
| DLMS/COSEM |
| IP/UDP |
| G3-PLC |

Organisational interoperability

Informational interoperability

Technical interoperability

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Interoperability challenges in a smart metering system

Where are the interoperability challenges, depending on the system procurement strategy?

- Two main questions to assess the interfaces:
  - Are the two sides of the interface provided by the same actor?
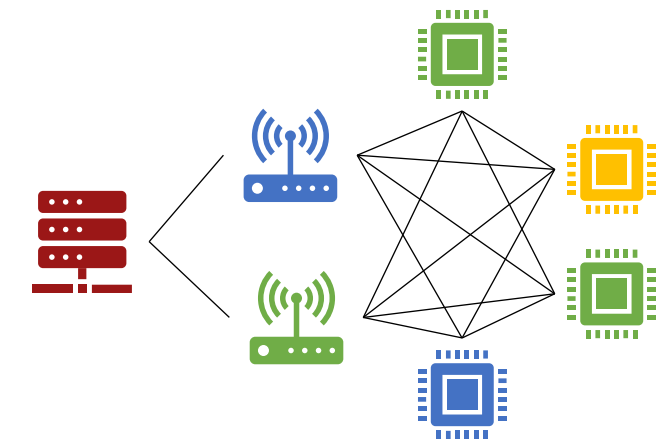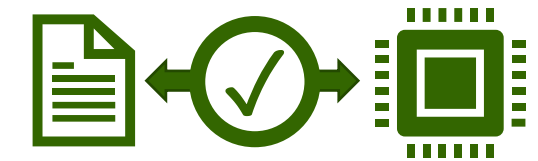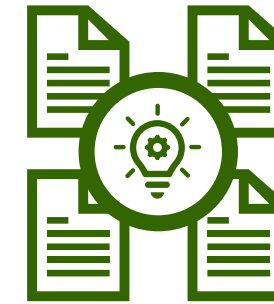 - If not, how many different actors are involved? Only 2 or more?
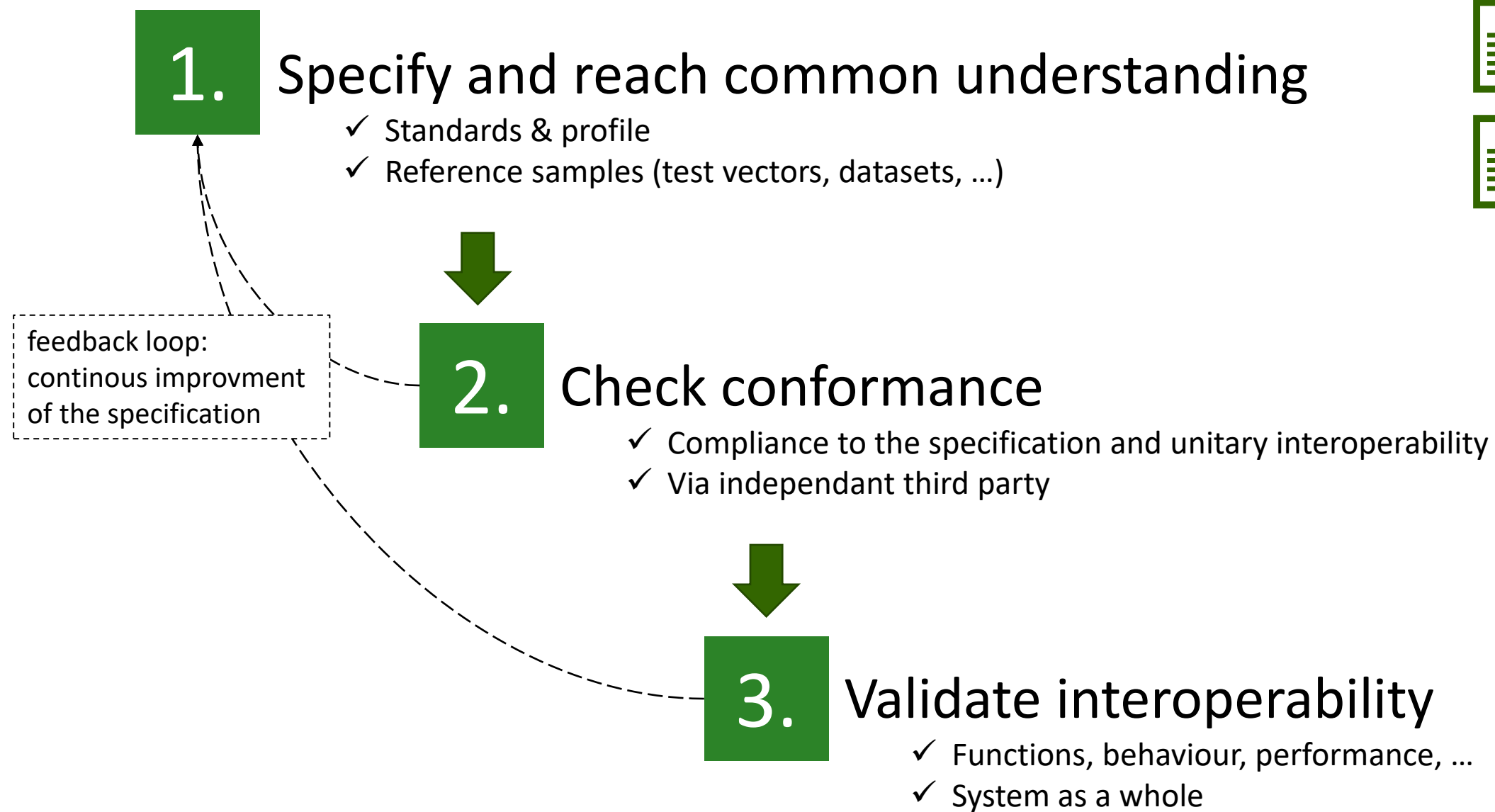
Same actor	Two actors	Many actors
Low challenge	Medium challenge	High challenge

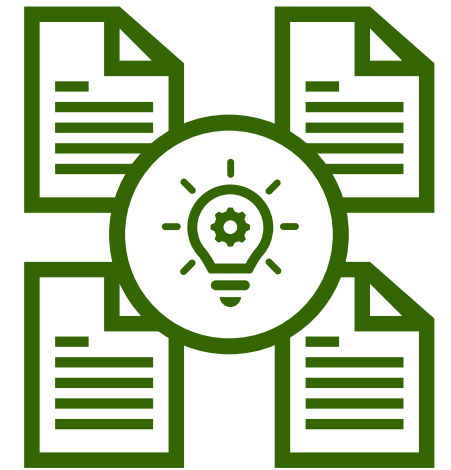- Some examples of Smart Metering systems (highest challenges in red circles):
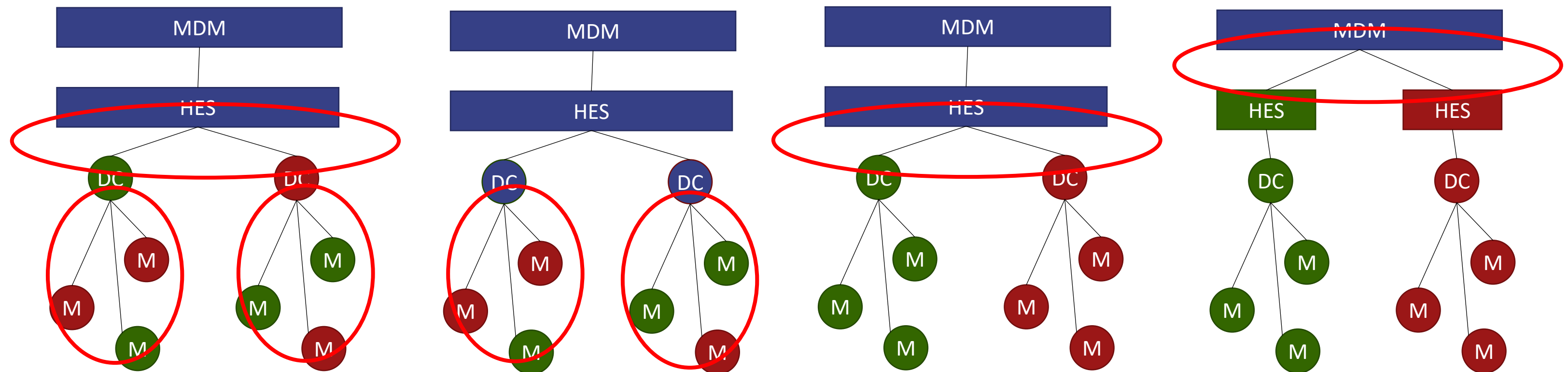
⇒ Trade-off between design complexity (due to high interoperability challenges) and operation complexity (due to dependency and low flexibility)

3 main steps to achieve interoperability

1. Specify and reach common understanding
- ✓ Standards & profile
- ✓ Reference samples (test vectors, datasets, …)

feedback loop:
continous improvment
of the specification

2. Check conformance
- ✓ Compliance to the specification and unitary interoperability
- ✓ Via independant third party

3. Validate interoperability
- ✓ Functions, behaviour, performance, …
- ✓ System as a whole

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1. Specify and reach common understanding

- The specification must be as <u>clear</u> and <u>explicit</u> as possible
  - Select the standards to be used + define the profiles / companion specifications
    - Make explicit which parts are mandatory and which options/parameters must be used
    - Define the upper layers mechanisms (e.g. for G3-PLC: how the bootstrapping is launched)

- Interoperability requires to reach a "common understanding"
  - It means that all the implementers will understand the specification the same way
  - This can be checked via:

<table>
<tr><td>

<u>Sharing reference samples</u>
- *test vectors*[1] for technical interoperability
- *datasets* for informational interoperability
- *simulators* for organizational interoperability

</td><td>

Plug-fest or *integration-fest*
- Connect implementations together to check that they understand each other
- Mostly for technical interoperability

</td></tr>
</table>

- "Grey zones" (ambiguity) lead to interoperability issues ⇒ they need to be tracked and fixed <u>continuously</u> during the life of the project
  - Each time an interoperability issue is faced, the specification should be challenged and clarified if needed (also the test coverage could be improved, see step 2)

[1] *Test vectors* are analog or digital frames used to check identical frame generation or decoding

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2. Check conformance
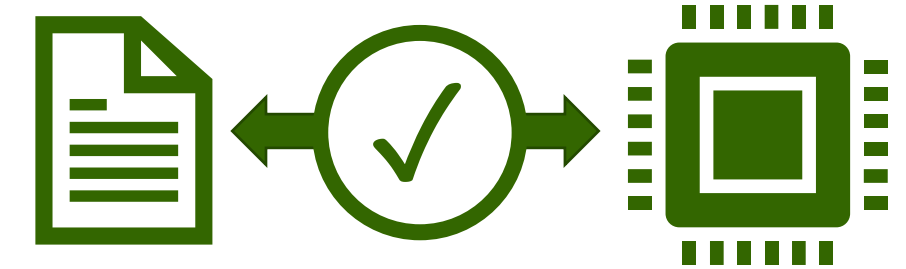
- Conformance testing
  - Objective: check that the component correctly implements the specification
    - Unitary testing: one test for each statement of the specification
    - Both valid and invalid behaviours are tested
    - The conformance tests are defined based on the specification: it has to be clear and explicit enough to allow to establish a verdict (PASS ☑ / FAIL ☒)
  - It usually relies on an automated test tool
    - With hundredths of test scripts
  - It may include some basic interoperability tests
    - It is sometimes a way to implicitly test some features that can hardly be explicitly unitary tested
    - E.g. G3-PLC 1-to-1 IOT tests allow to implicitly test G3-PLC PHY layer (all modulations)
- It is recommended to rely on an independent third party (not one of the suppliers)
  - It is neutral in case of interoperability issue / disagreement on how to implement a case
  - It brings another perspective to the project (like an external review)
- Many alliances or associations provide certification programs covering conformance testing for specific interfaces
  - E.g. G3-PLC certification covers conformance, 1-to-1 IOT and performance of G3-PLC stack // DLMS UA certification covers DLMS application layer conformance // ENTSO-E offer a conformity assessment scheme for CIM CGMES profile // …

3. Validate interoperability

- Interoperability should be tested as part of the system integration
  - Interoperability of each interface (1-1, 1-many)
  - Impact on
    - Functions: the system functions must be achieved with interoperability
    - Performance: interoperability must not deteriorate the performances
    - Scalability: interoperability must not reduce scalability
    - …

- The system should be considered as a whole
  - System functions involve several components and different layers ⇒ interoperability validation requires to keep these dependencies in mind
  - Final goal is to achieve end-to-end interoperability
  - However it might be useful, when possible, to build the system iteratively and work first on a subsystem (e.g. DC + Meters) to reduce the complexity and ease debugging
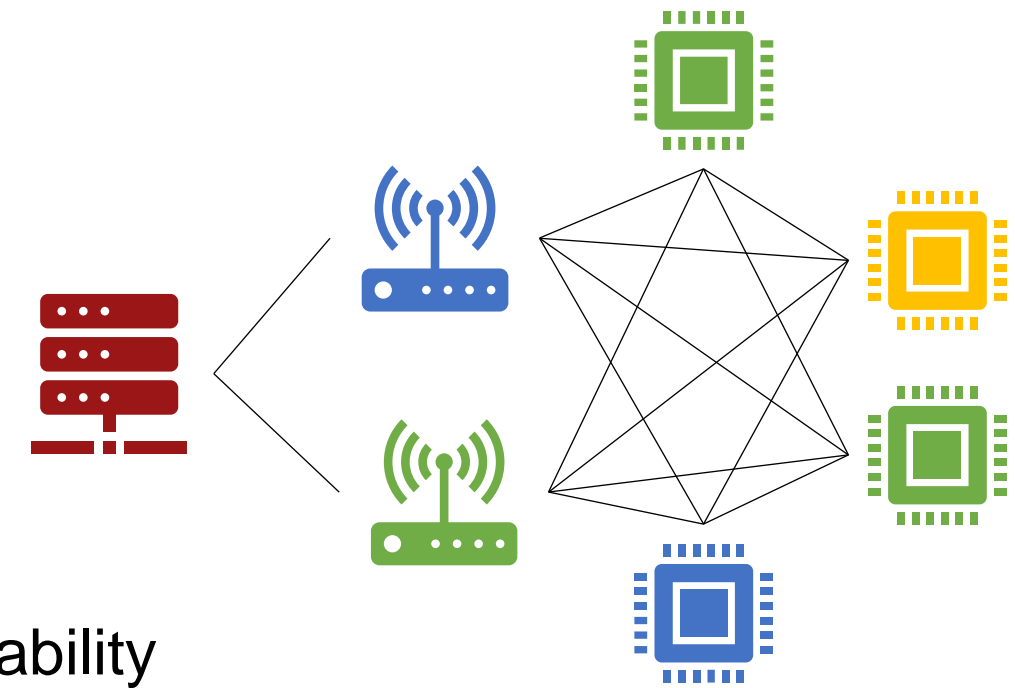
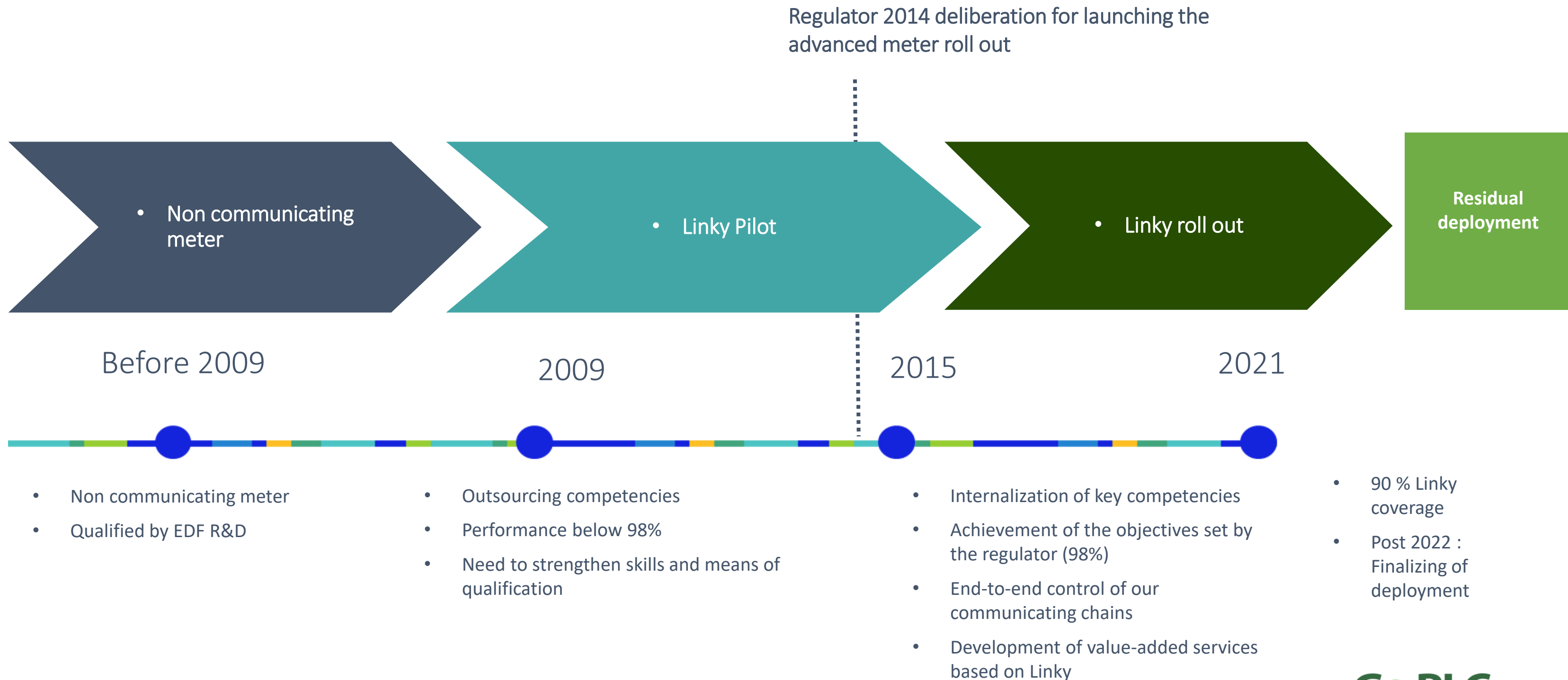# Feedback loop: continuous improvement of the specification

- At every step, the cornerstone of interoperability remains the specification
  - If they are different ways to understand the specification, there is a significant risk that not all the implementers will follow the same implementation
  - Therefore, the specification should be a living document, continuously improved to <u>clarify</u> the expected understanding (=avoid any ambiguity)
    - One option may also be to maintain and publish in parallel a FAQ (*Frequently Asked Questions*)
- This should be done not only during the early phases of the project, but during the whole duration of the project
  - Every time an interoperability issue is faced, it should be assessed if the specification should be improved or not
    - Also, a conformance test could be added to check the proper behaviour of future implementations
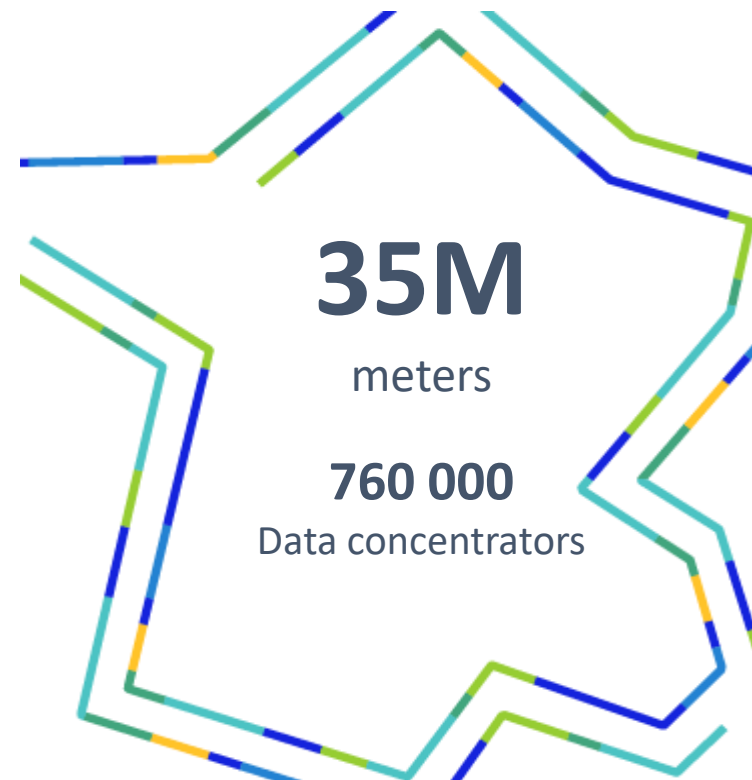 - The purpose is to avoid to face the same issue in the future

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3. **Experience from Enedis in France and EVN in Austria**

4. Questions

Enedis Linky smart meter roll-out and product interoperability

Regulator 2014 deliberation for launching the advanced meter roll out

- Non communicating meter

- Linky Pilot

- Linky roll out

Residual deployment

Before 2009

2009

2015

2021

- Non communicating meter
- Qualified by EDF R&D

- Outsourcing competencies
- Performance below 98%
- Need to strengthen skills and means of qualification

- Internalization of key competencies
- Achievement of the objectives set by the regulator (98%)
- End-to-end control of our communicating chains
- Development of value-added services based on Linky

- 90 % Linky coverage
- Post 2022 : Finalizing of deployment

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Linky Program, key feature

35M
meters

760 000
Data concentrators

6 years

2015 - 2021

Massive roll out

4 vs 5 billions €

Investment until 2021

6 suppliers
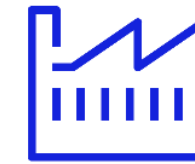
with assembly plants based in France

COMMISSION DE RÉGULATION DE L'ÉNERGIE

Match Regulatory constraints

CNiL.

Match Privacy requirements

Match cyber requirements

97 %
tele-operation success rate

98 %
daily collect success rate

> 3 billion
data Collected and stored per day

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Smart meter roll-out and product interoperability

6 Partners

Landis+Gyr

Single phase meters

Three phase meters

Data concentrator

Sagemcom

Single phase meters

Three phase meters

Data concentrator

Honeywell

Single phase meters

CAHORS

Data concentrator

Itron

Single phase meters

Three phase meters

alfanar

Three phase meters

2 device types tested

Meters

Data concentrators

N° Firmware versions
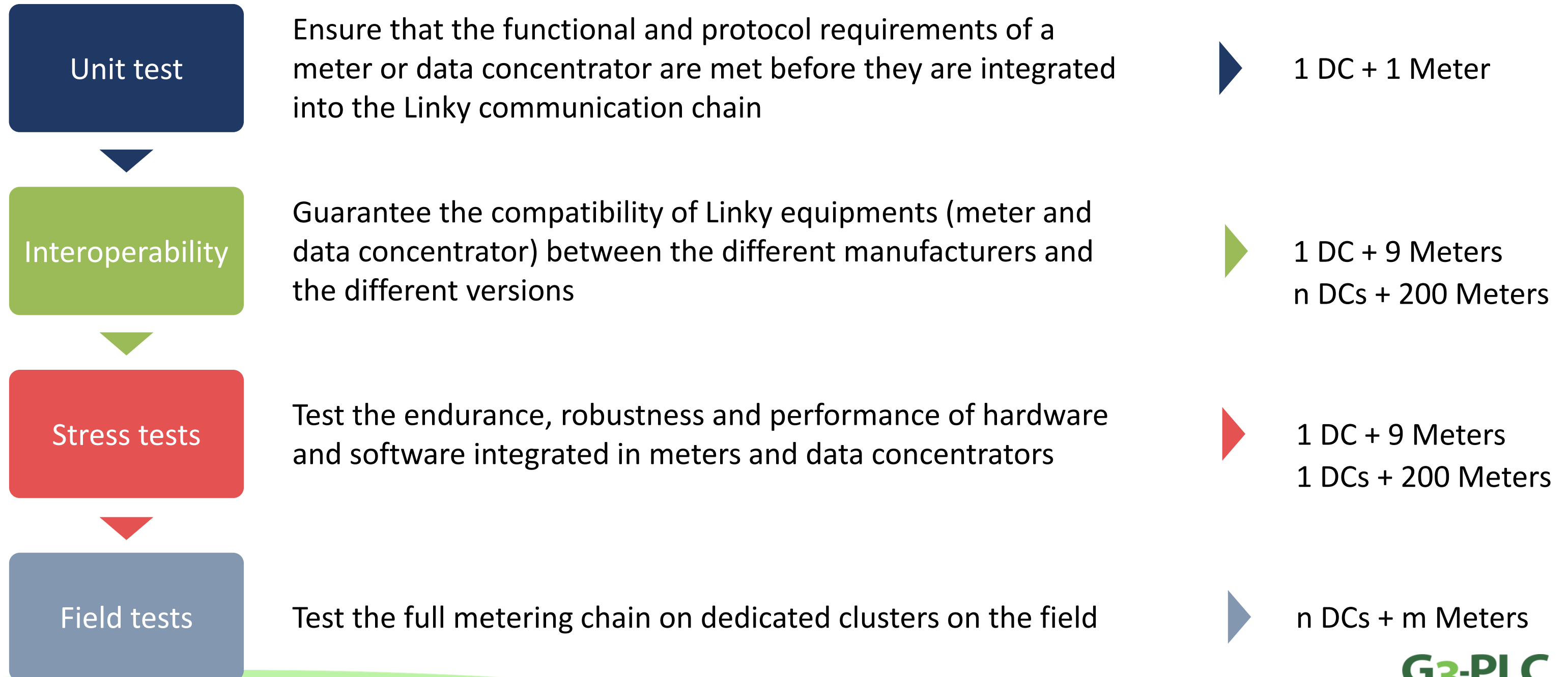
70 📱

G3-PLC Alliance specifications

- 2 G3-PLC Alliance specifications version on the field (2015/2017)

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How did Enedis achieve interoperability?

Requirements : All Equipments and softwares must be G3-PLC Alliance certified

Unit test	Ensure that the functional and protocol requirements of a meter or data concentrator are met before they are integrated into the Linky communication chain	▶	1 DC + 1 Meter
Interoperability	Guarantee the compatibility of Linky equipments (meter and data concentrator) between the different manufacturers and the different versions	▶	1 DC + 9 Meters n DCs + 200 Meters
Stress tests	Test the endurance, robustness and performance of hardware and software integrated in meters and data concentrators	▶	1 DC + 9 Meters 1 DCs + 200 Meters
Field tests	Test the full metering chain on dedicated clusters on the field	▶	n DCs + m Meters

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Enedis facilities / capabilities to realise and manage interoperability

Since 2019, Enedis had tested

+ 47 Products

Based on

3600 tests for meters

1700 tests for DC

Test facilities

1 DC – 1 Meter test

- 30 PCs driving a total of 90 test bays
- LinkyMat: software for planning and executing automated remote campaigns

1 DCs – 200 Meters tests

- 37 bays with 20 slots
- Cluster testing from 20 to 200 meters
- Meters of all generations and representative of the field

Field Tests

- Pilot cluster for test
- Several cluster sizes for test

1DC → 20 DC → 100 DC → Rollout by packets of 50.000 DC

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What issues/barriers did Enedis face?

1. The end of support by some chipset manufacturer, that's why it's good to have several manufacturers/suppliers.

2. The G3 PLC Alliance specification allows some openness/interpretation, so the algorithms from different suppliers can provide different SNR results for the same configuration. This is why interoperabilty tests are so important.

Recommendation for other DSO's

1. Being part of the G3 PLC Alliance and other standardisation committees helped us to handle the complexity of smart meter and to write our own specifications.
   Don't hesitate to ask help from other DSOs / Committees

2. Don't forget that « What is not tested does not work »

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Status Smart Meter Rollout Netz NÖ

Stand: 20.06.2022
Erstellt durch EVN Geoinfo
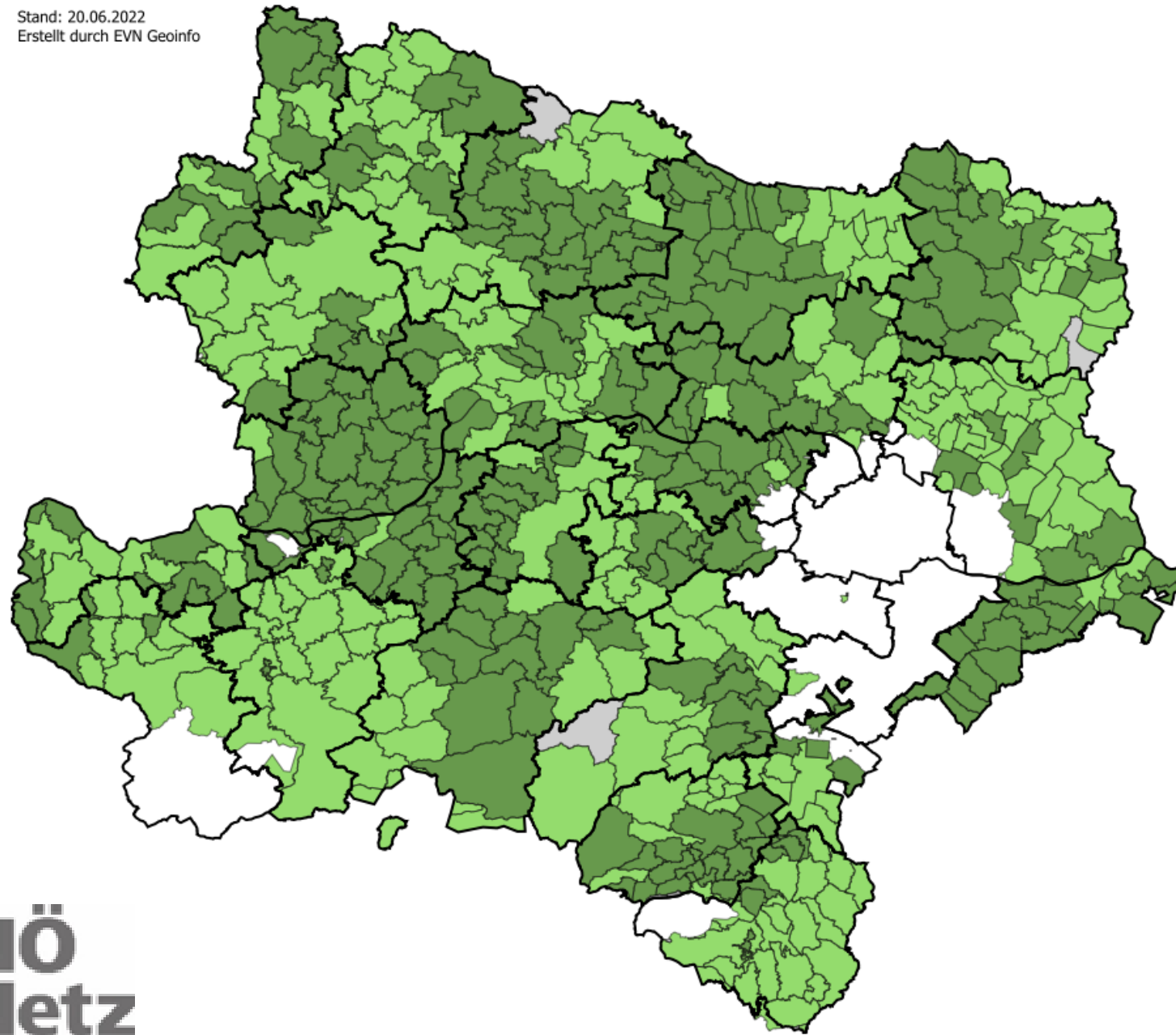
- Total number of meters: 844.000 pieces
- Start of the rollout: 1.9.2020
- Rollout status: 800.000 Smart meter (95%)
- Goal to finish the rollout: 9/2022 (minimum 95 %)
- Opt Out: 4,7%
- Daily reading rate: 99,3 %

> 95 % Smart Meter

NÖ
Netz
EVN Gruppe

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Smart meter roll-out and product interoperability

- Netz NÖ needs for the Smart Meter roll out around 844.000 meters (90 % polyphase and 10% single phase meters)

- Goal: Technical and informational interoperability for the meter and to the data concentrator

- 2 Supplier strategy to reduce technical and commercial risk
  - Technical risk: Hardware or firmware error
  - Commercial risk: Delay in production and other delivery difficulties
  - 100% meter delivery within 24 months

- The 2 supplier strategy is a compromise between cost and risk

- Costs are incurred for the development of 2 meters of the same type and the associated interoperability test

How did EVN achieve interoperability?

- The technical specification is based only on international standards
  - Electricity metering data exchange (DLMS / COSEM)
  - G3 Standard specification and G3 certification
  - 4 coloured books of the DLMS user association
  - Security concept - state of the art

- An EVN Companion Standard was jointly developed with the best bidder from the tender of meter, DC and Head End System.
  - Netz-NÖ_G3_PLC_E-Meters_Companion Standard Implementation Guide (59 pages)
  - Netz-NÖ_G3_PLC_E-Meters_Companion Standard Object Model (Excel 1.603 lines)
  - Netz-NÖ_E-Meters_Companion Standard Display Guide (20 pages)

- Goal of the Companion standard is to close all gapes in the different standards

- The 2nd meter supplier also has to implement the companion standard.

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What facilities / capabilities do you have to realise and manage interoperability?

- G3-PLC certification by the G3-PLC Alliance

- The DC and Head End System supplier is responsible:
    - Each meter type fulfils the requirements of the specific companion standard
    - Test of all different meter types in his lab with the Head End System
    - It guarantees 100% compliance with the specification

- Parallel tests have also been done by EVN – especially of the data model

- Security tests by an independent testing institute

- Field trial with 400 meters before starting the rollout

What issues/barriers did you face?
Any recommendation for other DSO's

- What issues/barriers did you face?
  - The development of a companion standard would not have been possible without external support
  - This requires a very high level of detailed knowledge about the individual objects and standards

- Any recommendation for other DSO's
  - Look for a partner which can help you but do not rely only on third party
  - Building up the necessary know-how during the project

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3. Experience from Enedis in France and EVN in Austria

4. **Questions**

G3-PLC: a standards based technology with strong certification and support enabling interoperable, multi-vendor implementations in the field!

- Interoperability has clear benefits: reducing supply chain risk, avoiding vendor lock-in and reducing costs

- Interoperability in smart metering system can be at different levels: at the HES, at the DC's or at the meters
  - depends on (procurement) strategy
  - trade-off between complexity in the design and in the operation

- Utilities can have different approaches to realise interoperability

- Interoperability in the field is very well possible with G3-PLC certified devices!

- G3-PLC Alliance is there to support your projects:
  - Open standard, strong certification program and tools available
  - Experienced manufacturers, DSO's and other members to support you
  - Experience sharing, training, testing, expert advice, etc.

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Thanks for attending this webinar today! Do not hesitate to get in touch:

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