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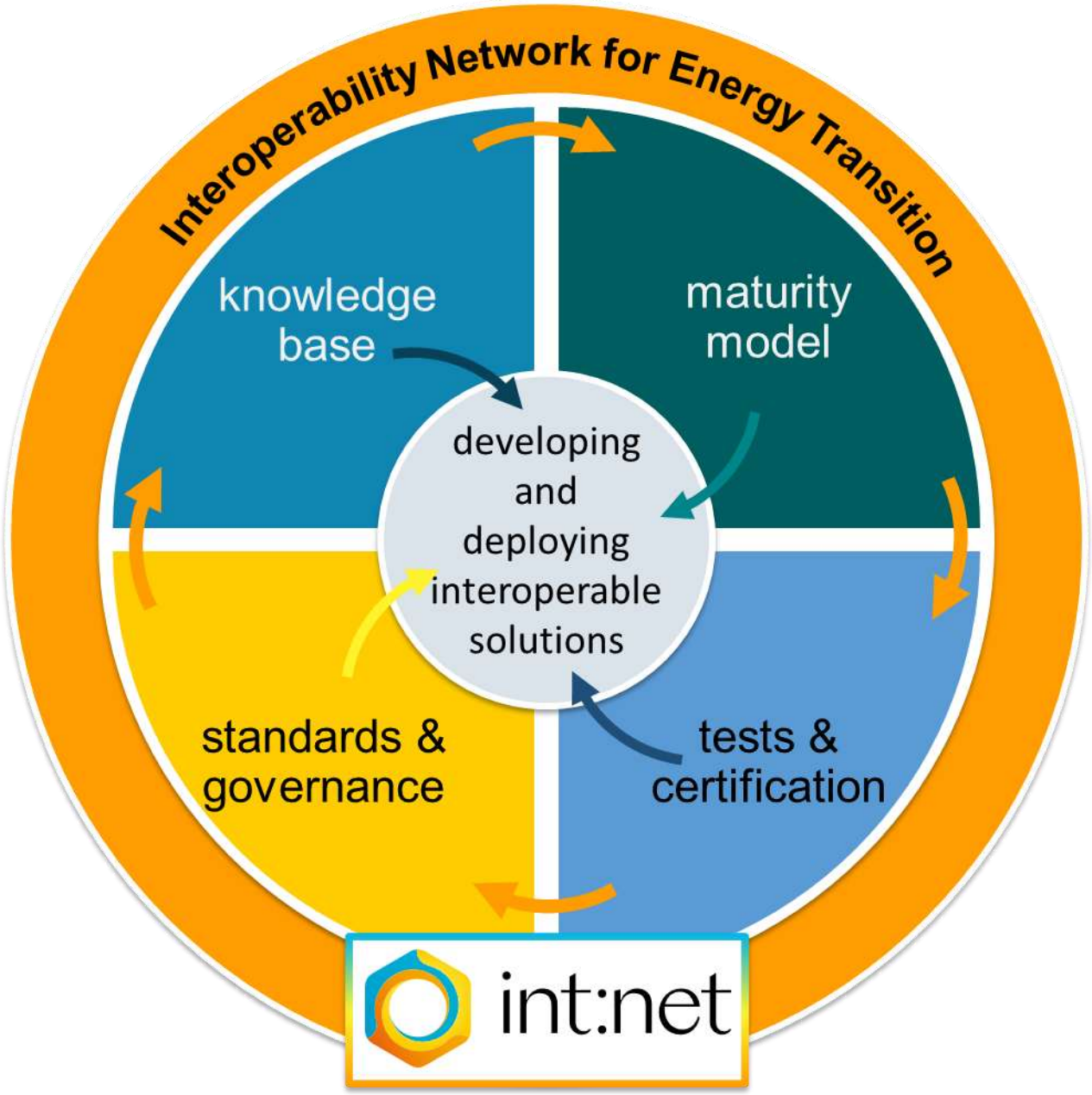
Interoperability Network for the Energy Transition

int:net Final Conference

The Making of int:net

18 September 2025

The int:net Vision



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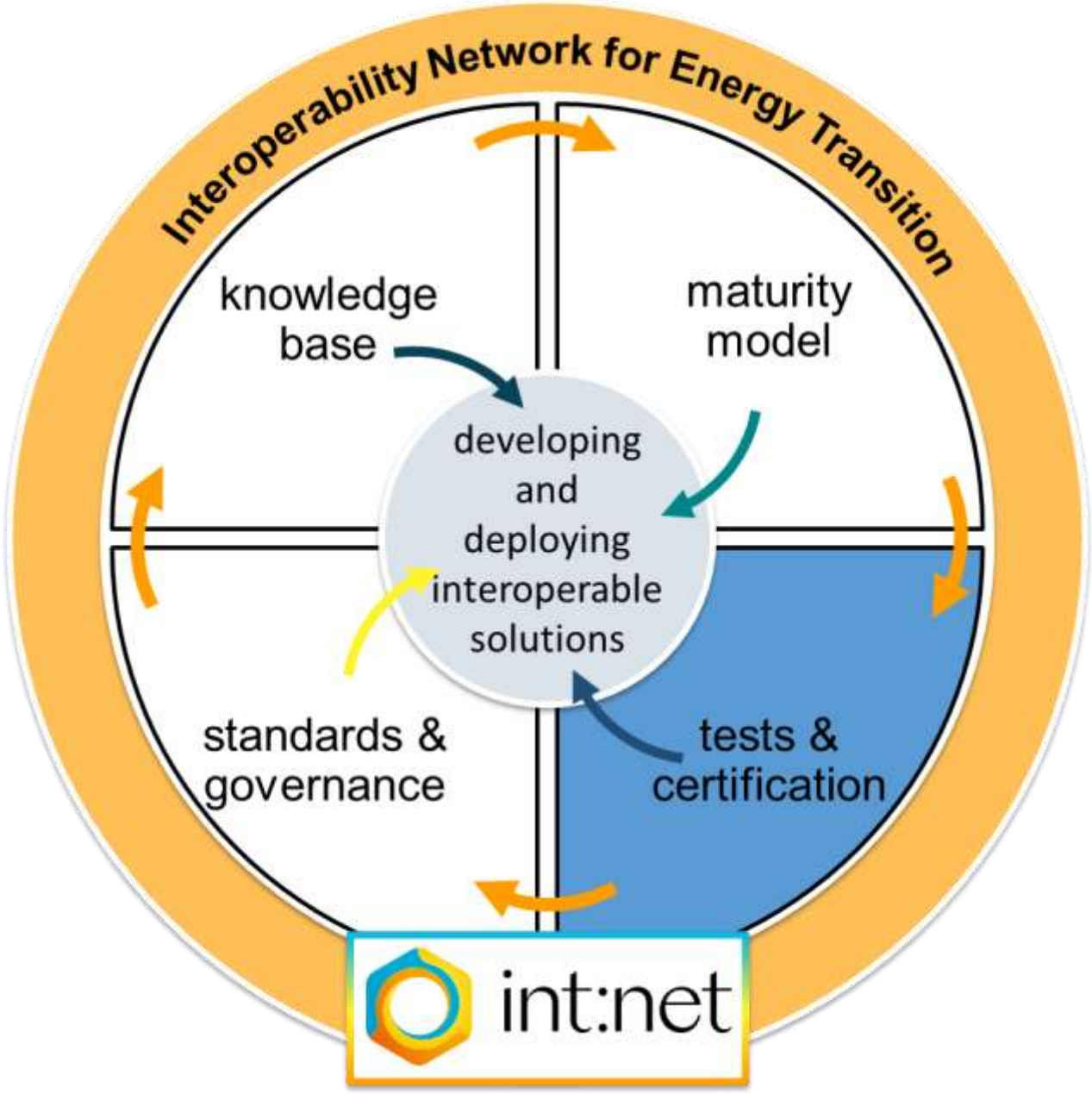
Testing systemic interoperability



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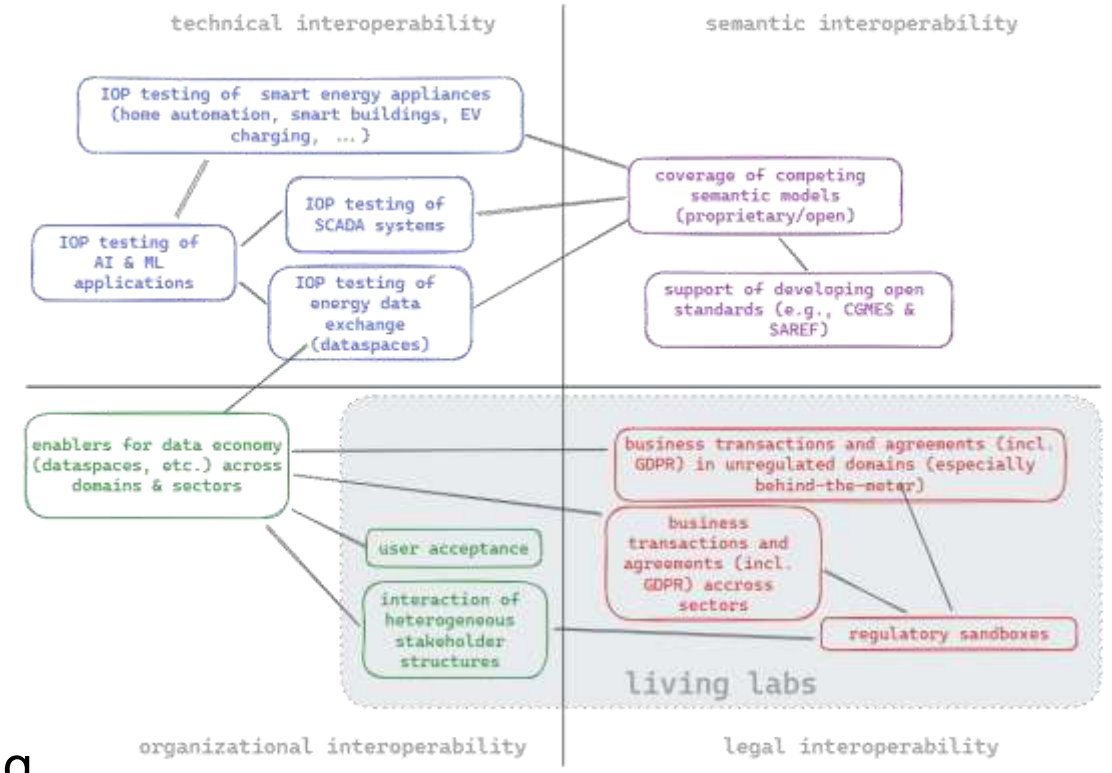
Interoperability (IOP) Testing Challenges

- Challenge
  - Convergence of many sectors with different standards, cultures and technical backgrounds
  - Single/multi-vendor devices, components should be able to inter-work on the system-level
- Status
  - Standards and experimental methods for testing the interoperability are partly missing
  - Standards do not guarantee interoperability, even if they promote it
- Solution
  - Introduction of a **comprehensive framework for interoperability testing,** including interoperability profiles, testing methods/procedures, and test facilities

Interoperability (IOP) Testing Challenges

- *Application*
  - → *"WHAT needs to be covered by IOP testing?"*
  - → Focus on applications (data exchange, IoT, etc.)
- *Testing Infrastructure*
  - → *"WHICH testing infrastructure (physical/ virtual) is required for IOP testing?"*
  - → Focus on implementation of IOP testing setups
- *Process(es)/Procedure(s)*
  - → *"HOW should IOP testing be done?"*
  - → Focus on specification and execution of IOP testing



Fragemented Landscape of Methodologies, Frameworks, and Tools

Methodologies

- JRC Smart Grid Interoperability Testing Methodology
- EU Code of Conduct for Energy Smart Appliances
- SMARTGRIDS Austria IES-Process (based on IHE)
- ERIGrid Holistic Test Description (HTD)

Frameworks and Tools

- Smart Grid Design of Interoperability Tests (SG-DoIT)
- Interoperability Test Bed (from EC DIGIT)
- IHE Gazelle Open-source Platform for Test Management
- ENTSO-E CGMES Conformity Assessment Framework
- NIST Framework and Roadmap for SG IOP Standards
- Leveraging IOP Maturity (int:net EMINENT)
- AIT Virtual Verification Laboratory Framework (AIT VLab)

Standards, guidelines, and Policies

- Integration of Quality (SQuaRE family – ISO/IEC 25000)
- Leveraging Use Cases in IOP Testing based on ISO/IEC 30194
- Leveraging Models for Privacy Engineering based on ISO/IEC 27564
- Leveraging Behavioural and Policy IOP based on ISO/IEC 21823

Other Approaches from the Literature

- Metamodel for IoT Testing
- Application of a Smart Grid Interoperability Testing Methodology in a Real-Time HIL Testing Environment
- Design of Experiments in the Methodology for IOP Testing
- EEBUS Living Lab Cologne, etc.

European Testing Facilities Landscape

- Heterogenous and scattered landscape,
  > 100 research laboratories and testing facilities
- Distributed all over Europe
- Focusing on different topics and activities
- Providing various services for stakeholders
- Some facilities focus on interoperability topics

→ *Creation of Interoperability Test Facility Inventory (incl. approach, methods, and tools)*

Source: JRC Smart Grid Laboratories Inventory Report 2022

Outcomes

Deliverables

- ✓ *Deliverable 3.1: Testing Concepts and Procedures Harmonisation Report*
- ✓ *Deliverable 3.2: Inventory of interoperability testing facilities*
- ✓ *Deliverable 3.3: Report on the integrated Pan-European community of testing facilities (upcoming)*

Lists and Repositories

- ✓ Interoperability Testing Approaches, Test Cases, and Test Facilities (IOP Focus Group (IFG) 4)
- ✓ CIM/CGMES IOP Report
- ✓ SV IOP Testing Report

Conclusions

- European test facilities play a pivotal role in advancing interoperability through
  - Standards adherence
  - Collaborative research and developments
  - Access to state-of-the-art testing facilities
  - Promotion of European-wide grid integration
- However, a harmonization and coordination of activities is necessary
  - Adoption of best practices (also from other domains/areas)