Laboratory Coupling Approach

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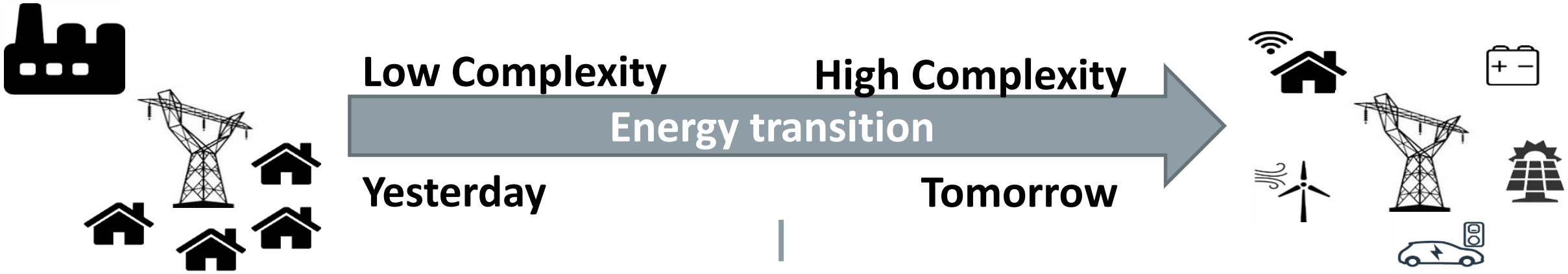
Context



Methods: test the response of a component to different voltage and frequency input using a grid simulator

Domain: electrical

Testing procedure: simple test description without a general overview

Methods: test interaction of control, components and power system using Hardware In the Loop

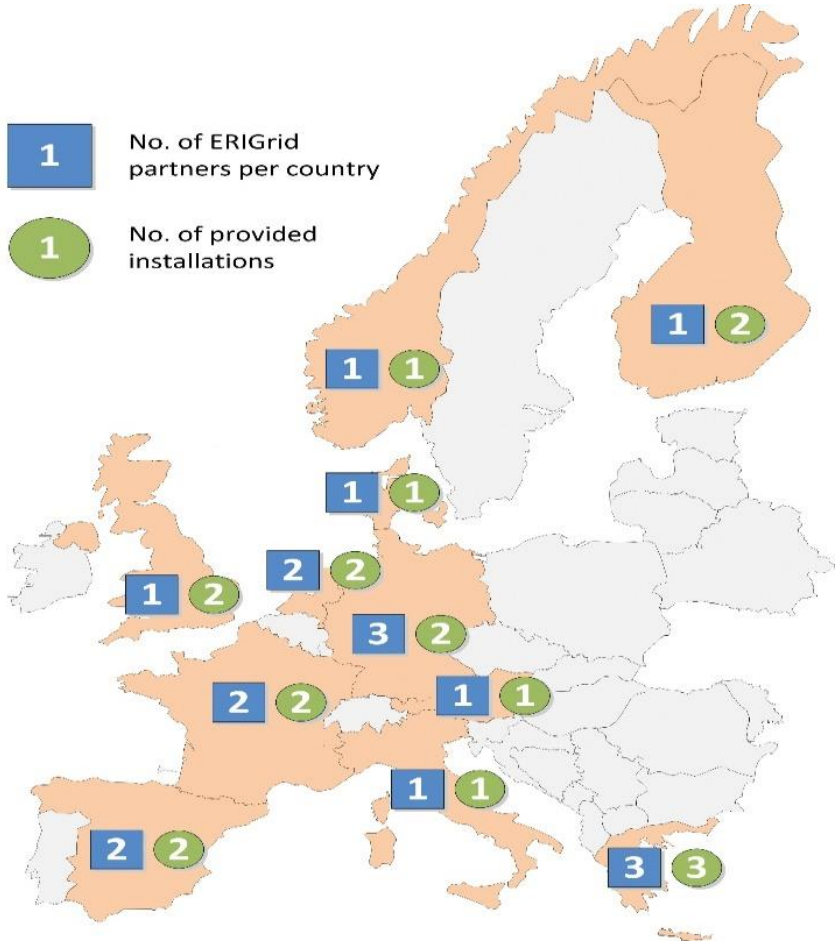
Domain: electrical, ICT, business, ecc.

Testing procedure: need of an holistic approach

Context

In order to guarantee a sustainable and secure supply of electricity in a **Smart Grid system** with considerable **higher complexity** as well as to support the expected forthcoming **large-scale roll out of new technologies**, a proper **integrated Research Infrastructure** for Smart Grids is necessary.

An integration of the European RIs allows to exploit the **synergies** between them. Indeed each RI has specific features and a laboratory coupling enables **new use cases and set up**.



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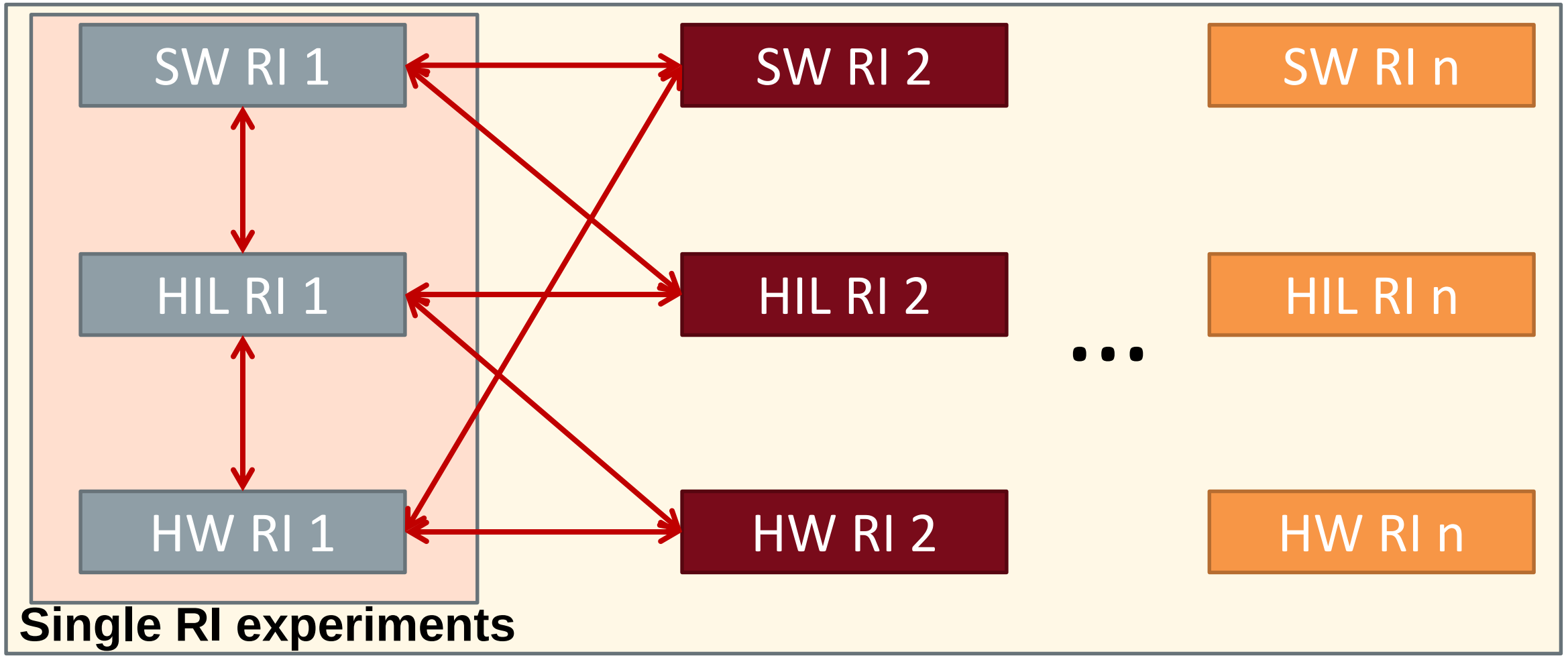
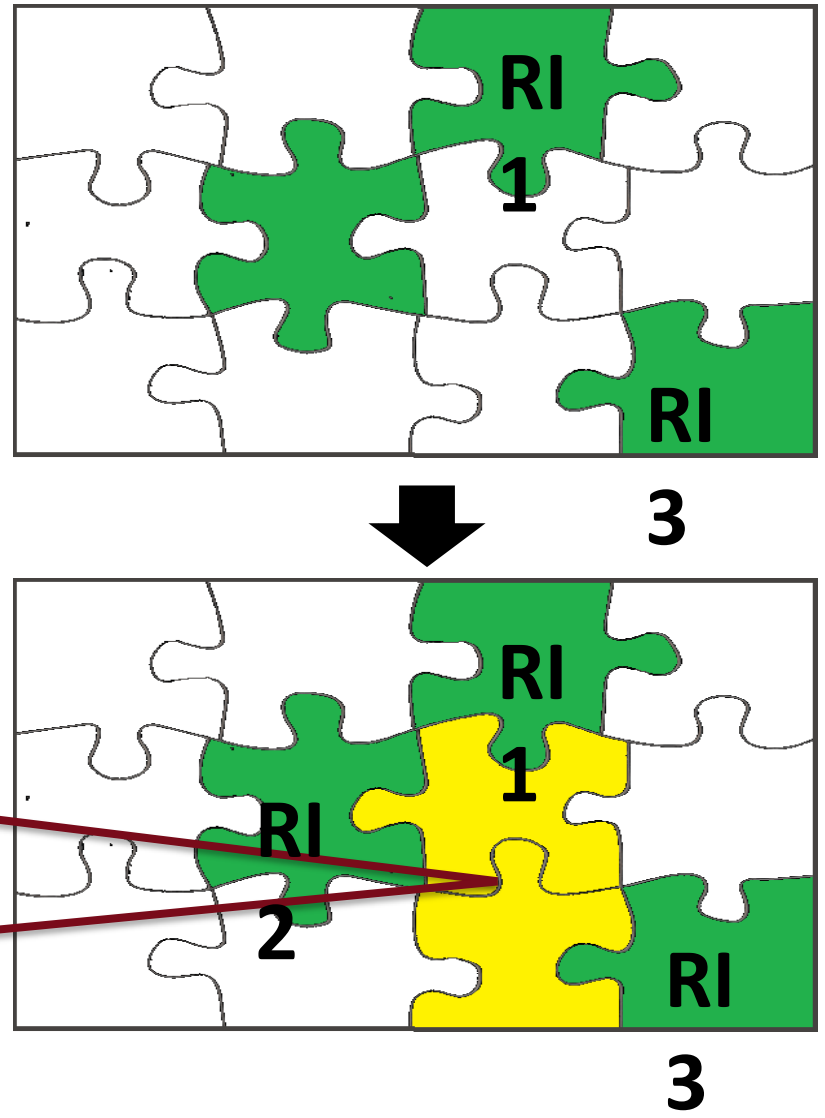
Virtual Research Infrastructure



Virtual Research Infrastructure

Nowadays several Research Infrastructures in Europe are performing experiments on Smart Grid activities, and each of them has particular strengths (hardware, software, models or controls).



RI integration

OFFLINE

Specific testing procedure

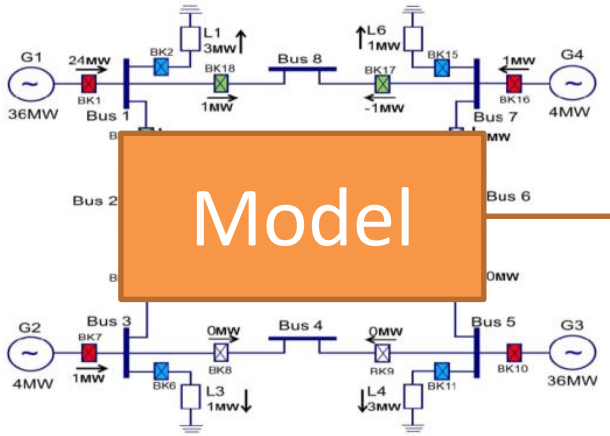
ONLINE

Real-time communication platform

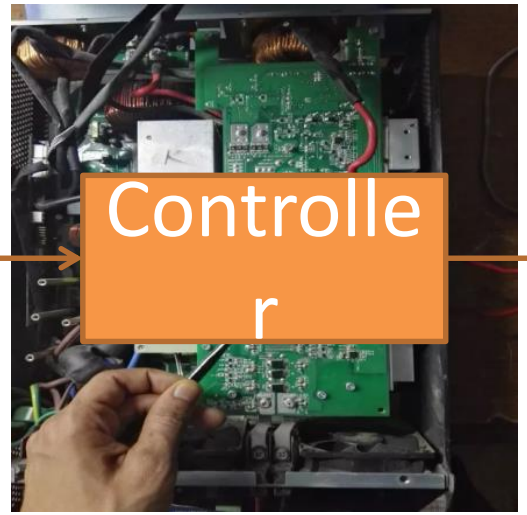
Testing chain

The testing chain approach covers the whole range of testing possibilities including simulation, SIL, CHIL, PHIL and field testing sequentially in order to cover the smart grid functionalities. Advantages:

- Increase of the experiment reality
- Reduce the time to market
- Decrease the risk of failure



Model

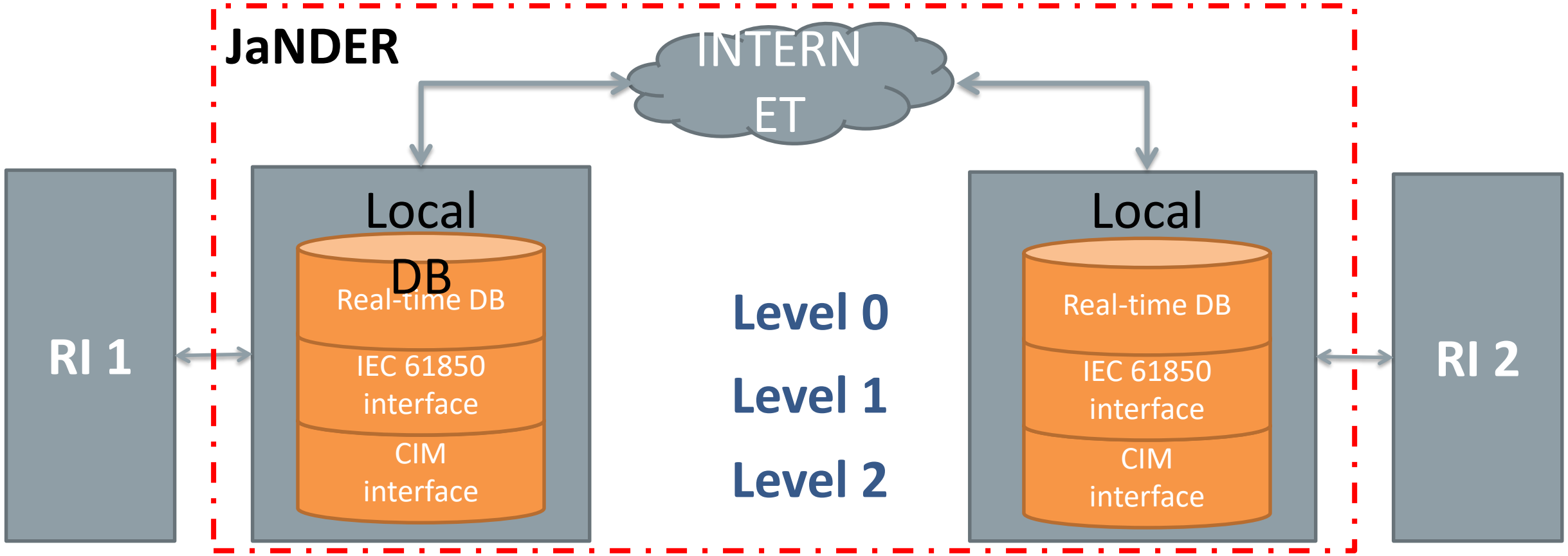


Controller

Real world

JaNDER

JaNDER is a communication platform for exchanging live data (i.e. typically measurements and controls) between different RIs.

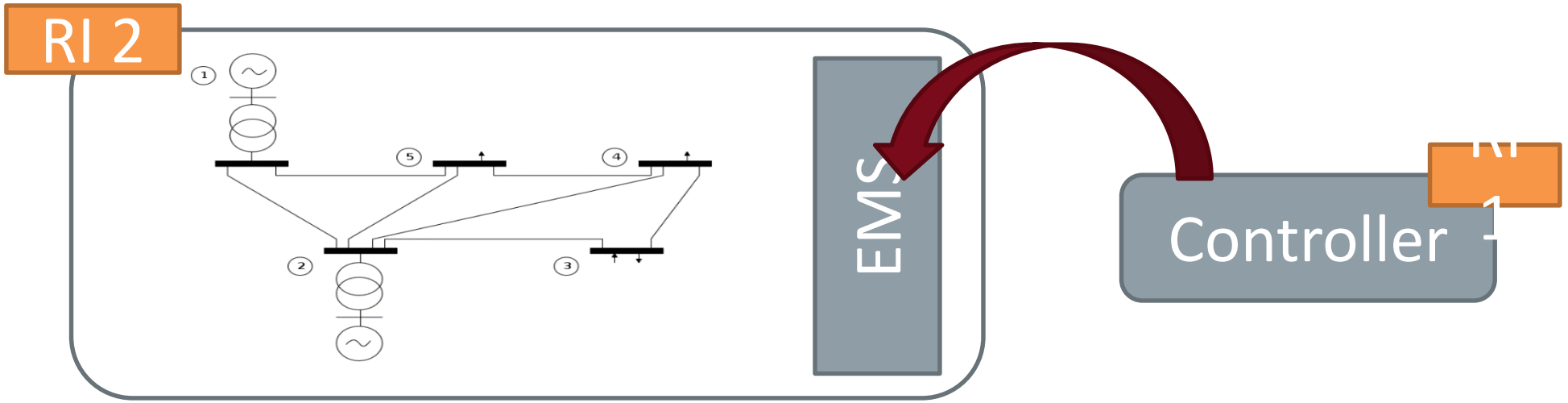


HW/SW integration

Different solutions (e.g. different control algorithms) in realistic conditions and for different systems and scenarios can be studied implementing a software developed by one RI in another RI.

Advantages:

- Facilitate the comparison of different solutions
- Consider the actual behavior of the controller

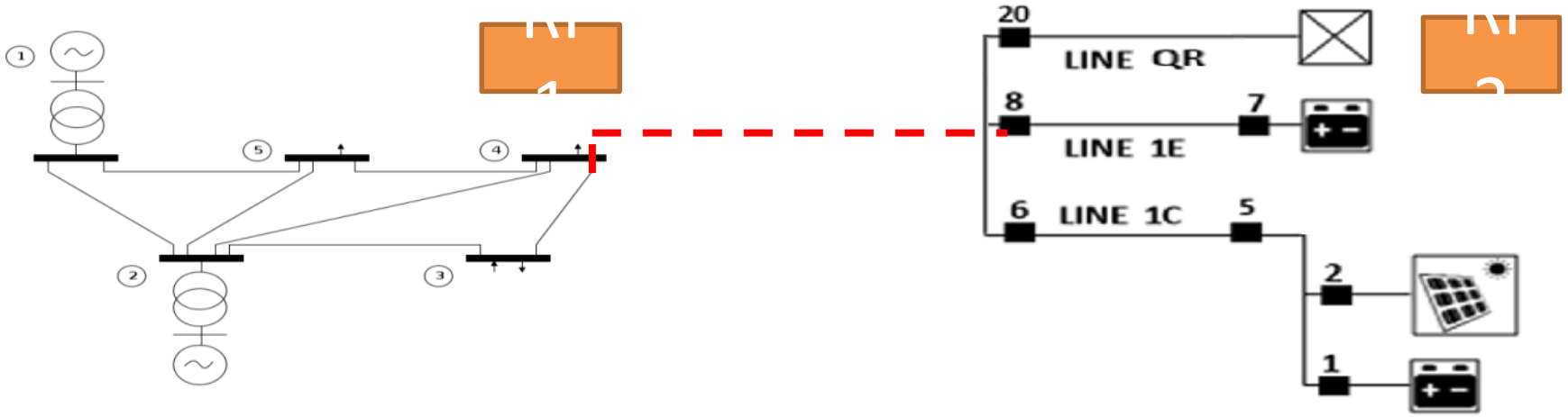


Geographically Separated Research Infrastructure Coupling

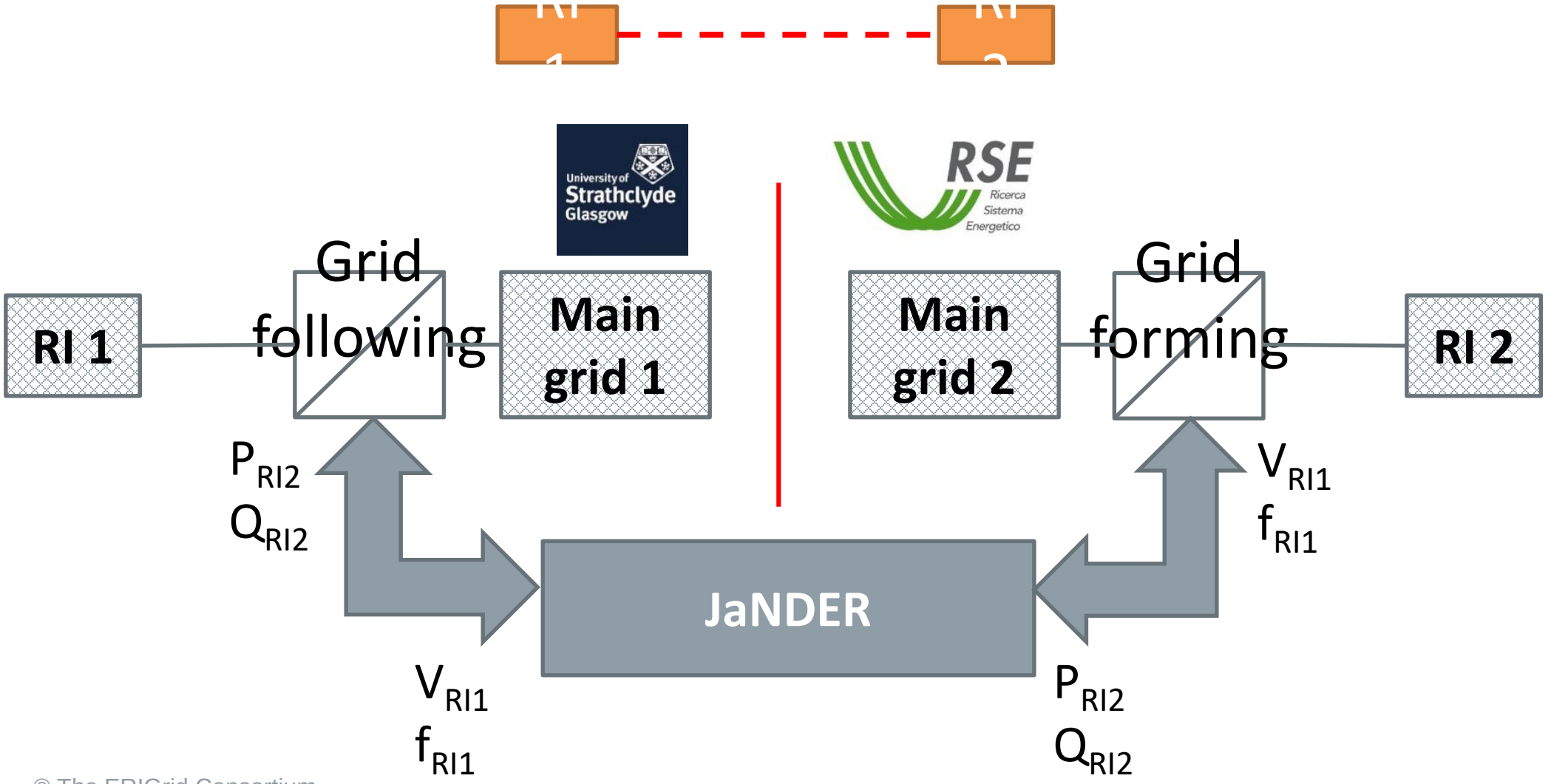
Integrate remote hardware as a part of testing, sharing the components of the integrated RIs. Exchanging real-time data between two or more RIs, a Points of Research Infrastructure Interconnection can be developed.

Advantages:

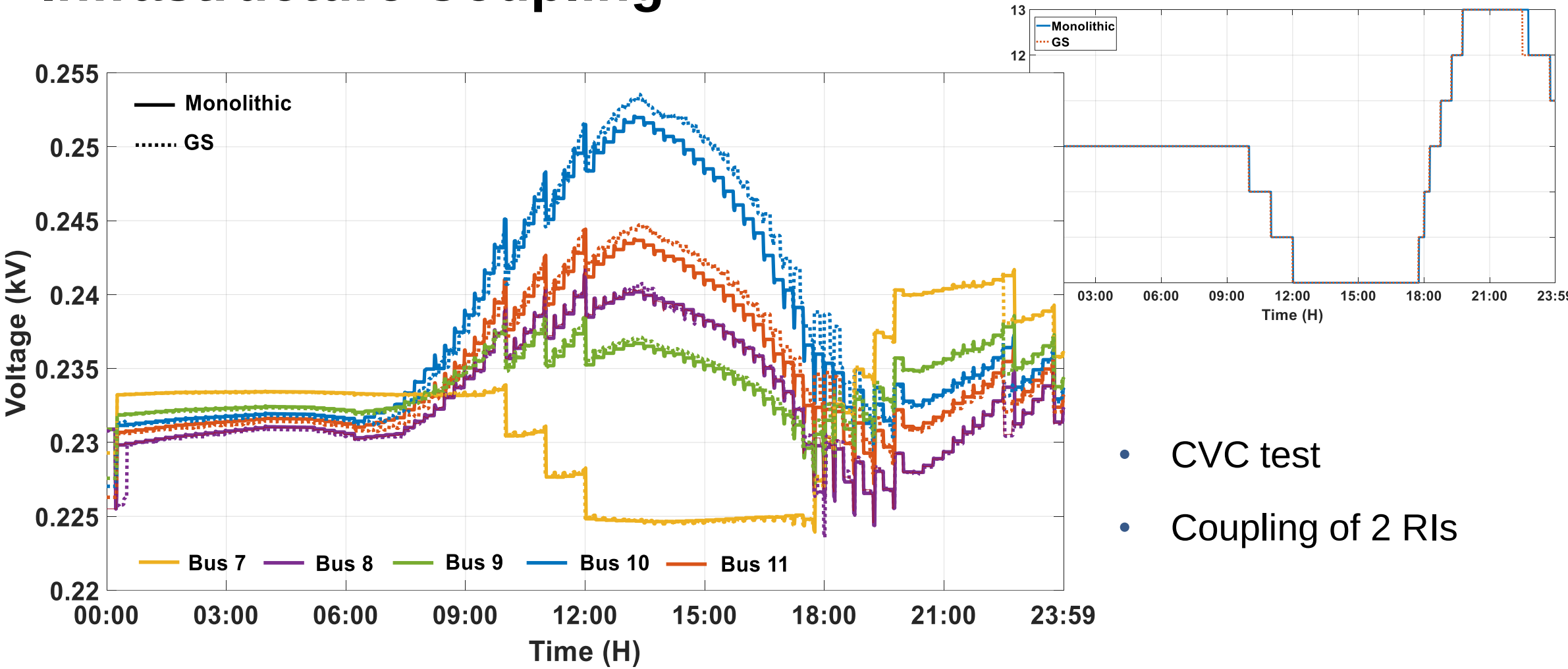
- Extension of the System under Test
- Avoid additional investments in new hardware



Geographically Separated Research Infrastructure Coupling



Geographically Separated Research Infrastructure Coupling



- CVC test
- Coupling of 2 RIs

Types of Coupling

Geographically separated real-time experiments

- Asynchronous Coupling
  - RMS value of interface signals
  - No phase information
  - Application: Slower Dynamics

Hardware In the Loop

- Synchronous Coupling
  - Instantaneous values
  - Carries phase information
  - Application: Faster dynamics and potentially transients

Conclusion

The laboratory coupling approach:

- enables new use cases and extend the system under test;
- can promote the collaboration of industry and research centers;
- can decrease the time required to validate an advanced smart grid solution before the actual field implementation;
- allows to evaluate the impact of the industrial protocols (such as IEC 61850) on the electrical grid.

Thank you for your attention!