Enhanced simulation methods and tools

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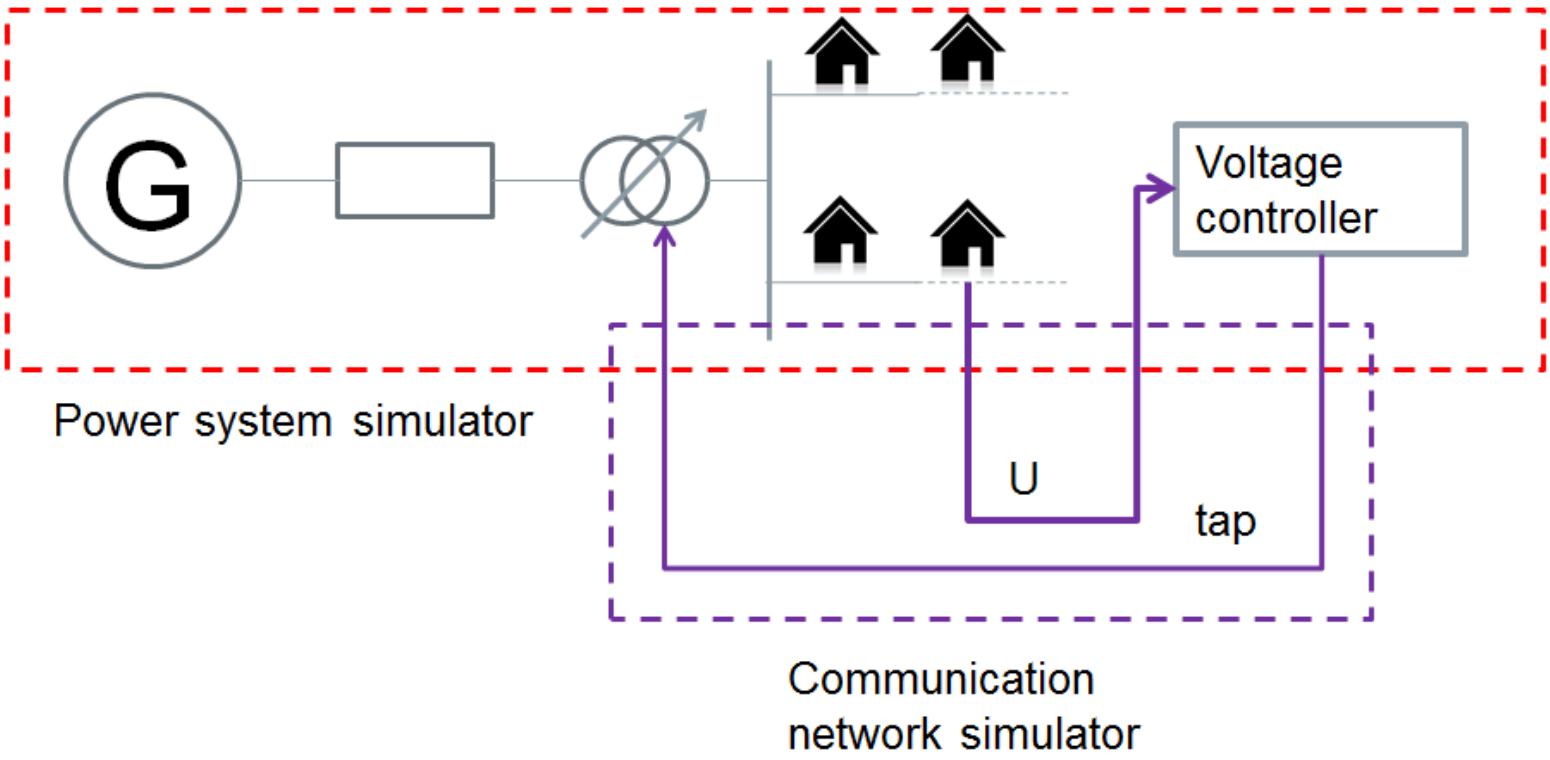
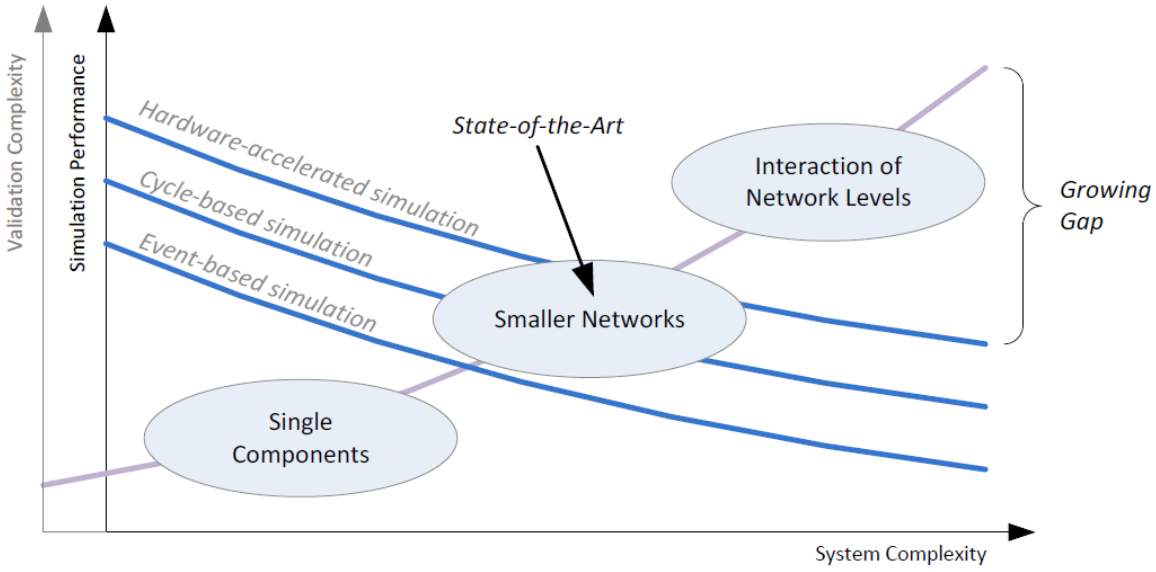
Motivation Example
Coord. Voltage Controller (CVC)



General Setup of CVC system

Co-simulation

- Smart grid system comprises of complex infrastructure, involving interaction among various domains
- This continuous interaction among the various components, devices and domains leads to huge amounts of data being exchanged
- Co-simulation helps in coupling among these domains to create a realistic representation of any smart grid infrastructure and its behaviour



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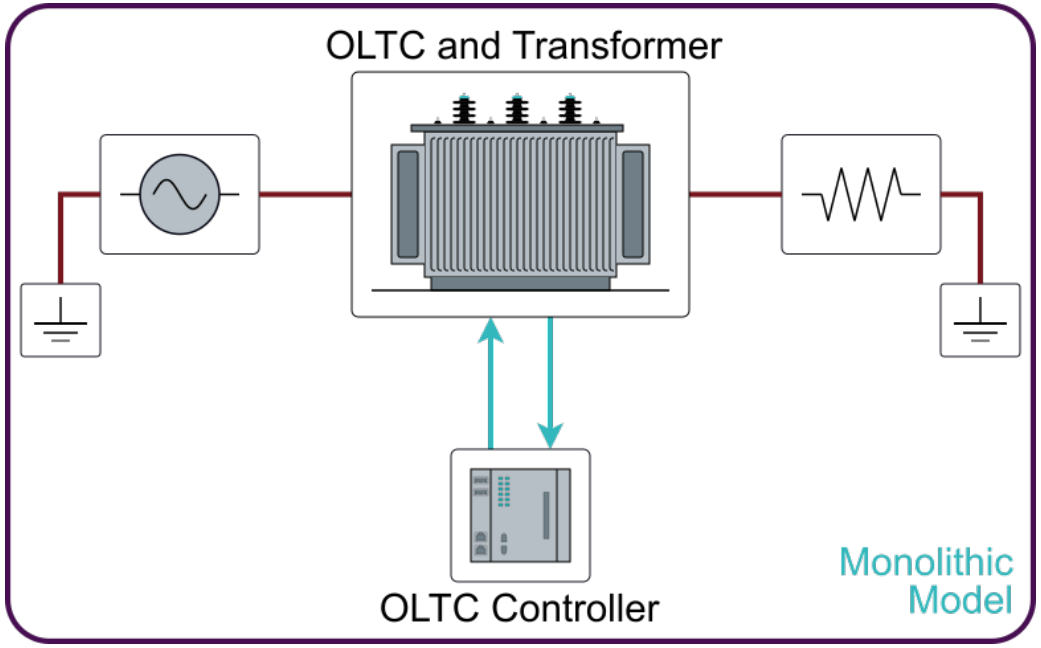
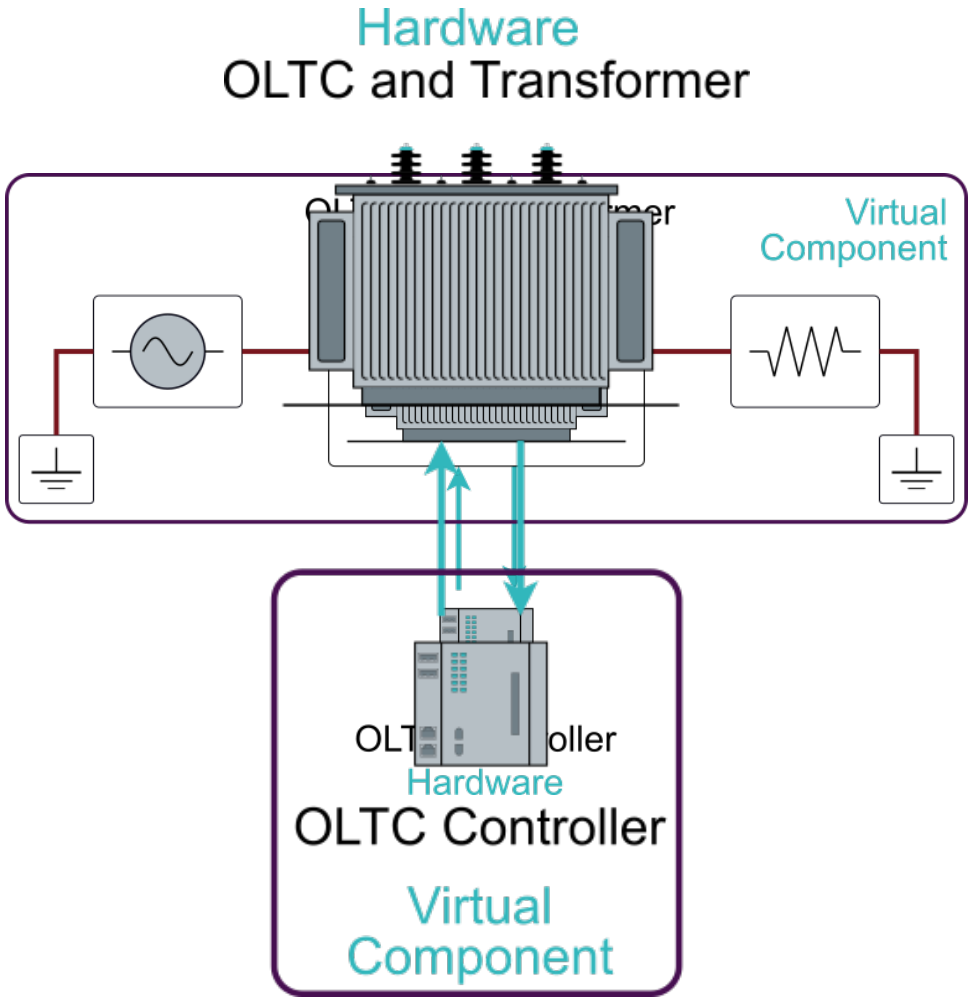
Problem Statement

- Model available
- Use model of one sub-system to develop and test other subsystems
- Requires emulation of components



Virtual (Lab-) Components

- Simulated system components which interact with physical component
- Requires infrastructure
  - Interface components
  - Specialized simulation tool



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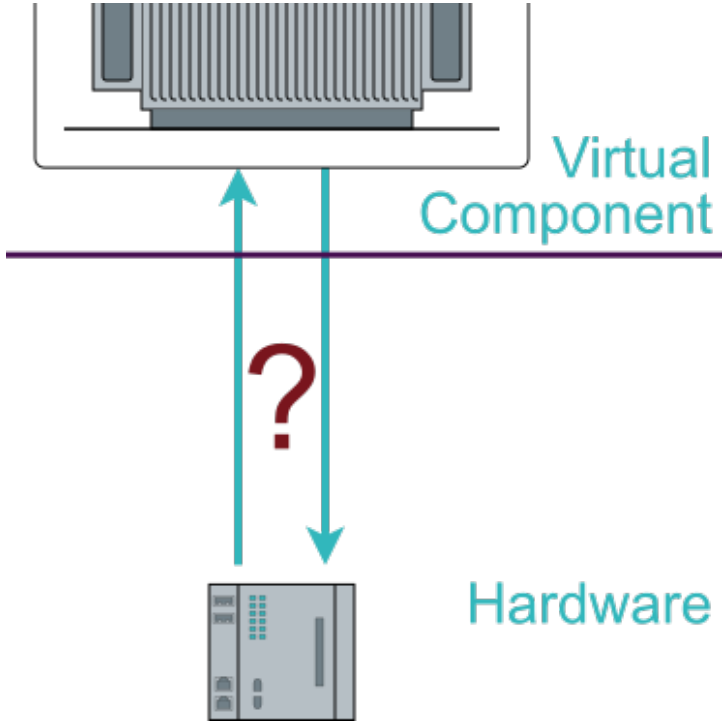
Design Decisions

Several alternative approaches:

- Dedicated hardware real-time simulators
- Standard simulators with tool specific coupling
- Implementation of models in standard automation infrastructure (PLCs)



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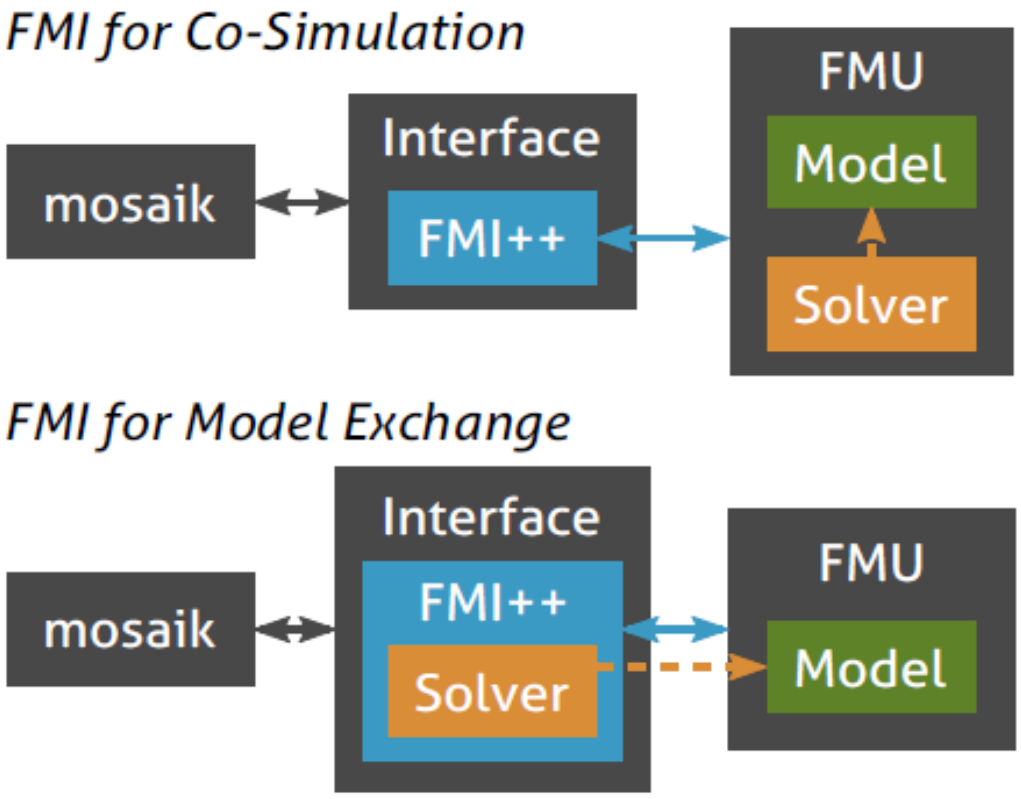
Functional Mock-up Interface (FMI)

- FMI is a tool independent standard to support
  - Co-simulation of dynamic models
  - Model exchange
- FMI is supported by more than 100 tools and is being used extensively by automotive organisations



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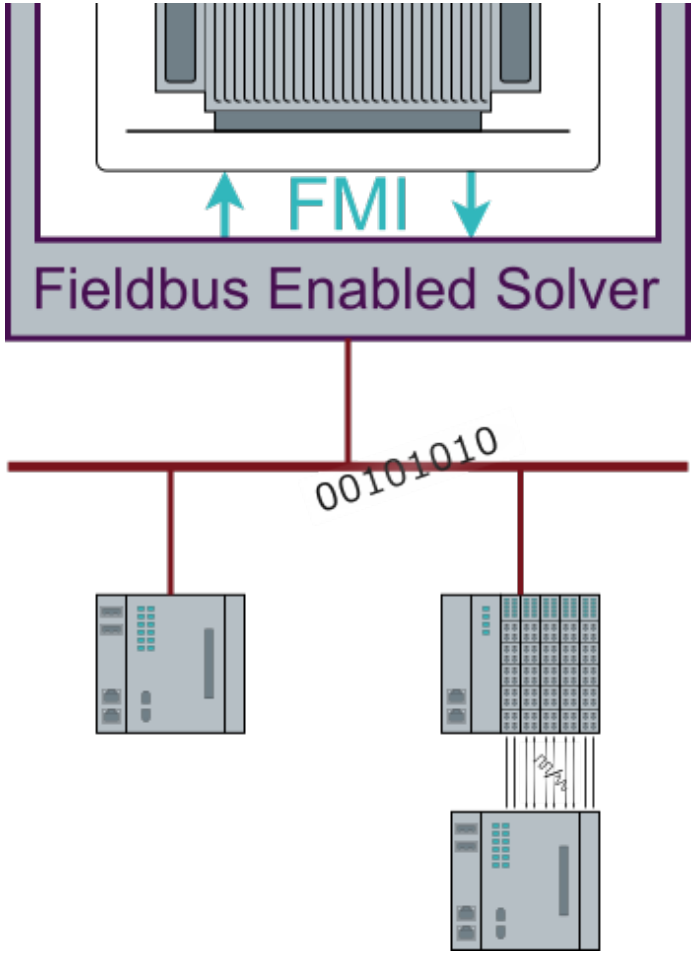
ERIGrid Co-Simulation Approach

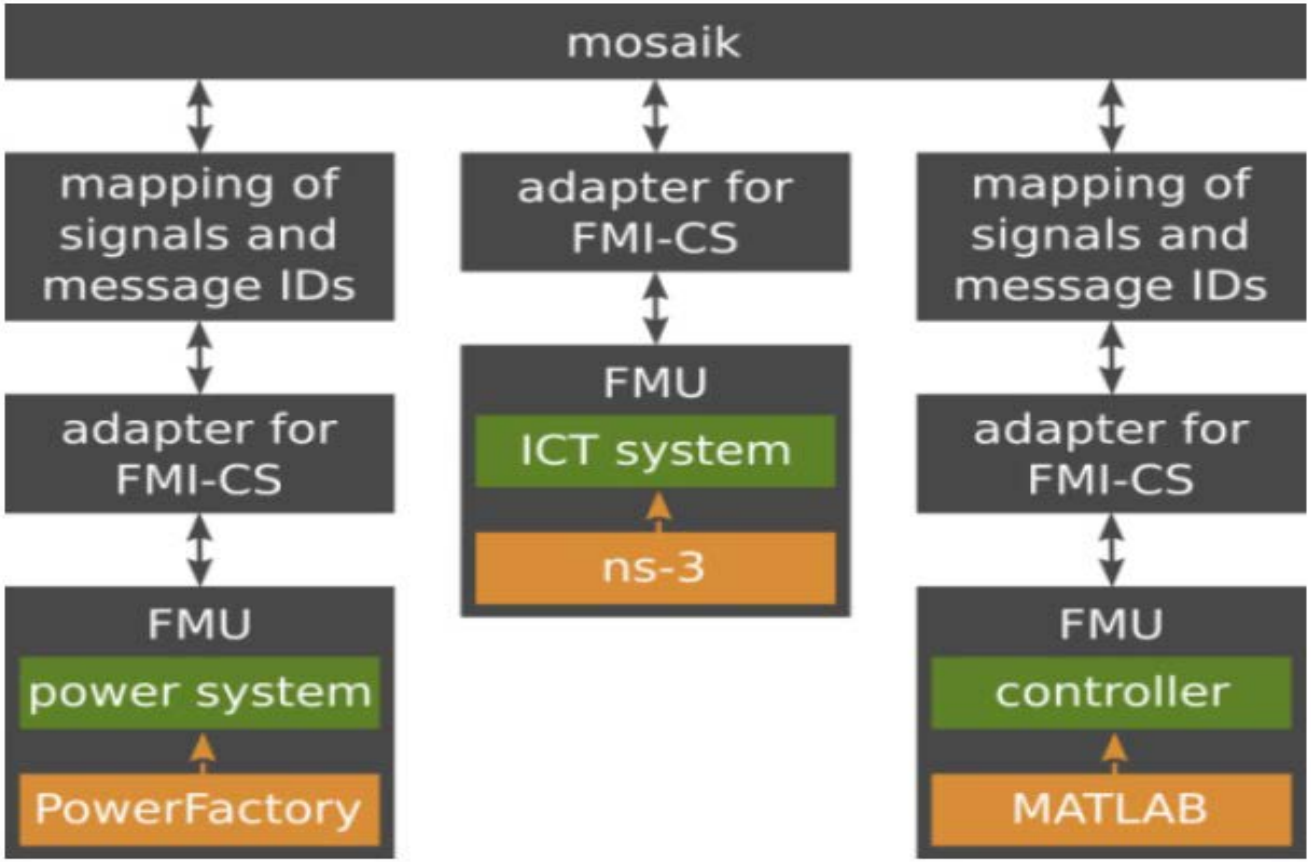
- *FMI compliance*
  - The tools selected in each domain (power system, ICT, etc.) should have a FMI-compliant simulation interface or have an API (or equivalent mechanism) that allows to control the execution of the tool
- *State-of-the-art approach*
  - The selected tool has to represent the state-of-the-art for its respective domain and ideally available to all partners
- *Model libraries*
  - A model library is setup to select and develop models for validation
  - They can be exported as FMU's (Functional Mock-up Units) compliant to FMI specifications across different domains

ERIGrid Co-Simulation Approach

- Off the shelf components
- Standard simulation interface (FMI)
- Interface hardware with industrial communication protocols
- Protocol agnostic design



Validation Example
Coord. Voltage Controller (CVC)



Experimental setup of CVC system

Next steps and future work

- Large scale co-simulation studies to be conducted for scalability assessment and to find methods for improvement