KTH ROYAL INSTITUTE
OF TECHNOLOGY

HVDC Protection IED

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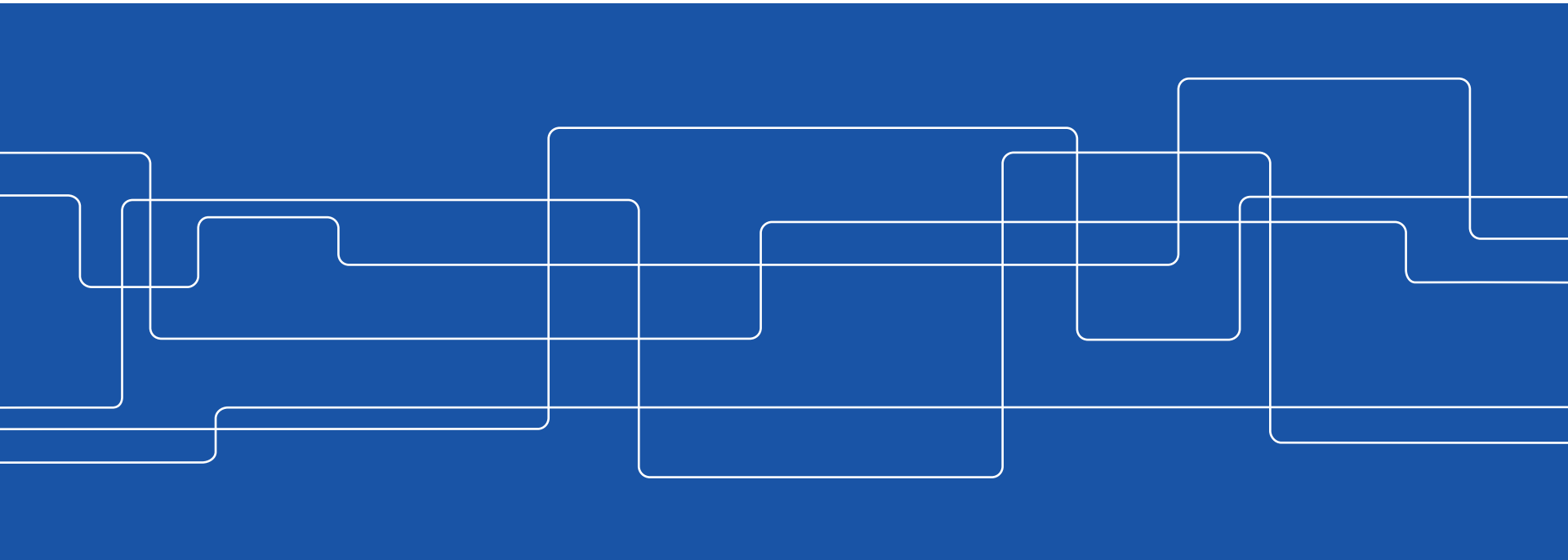
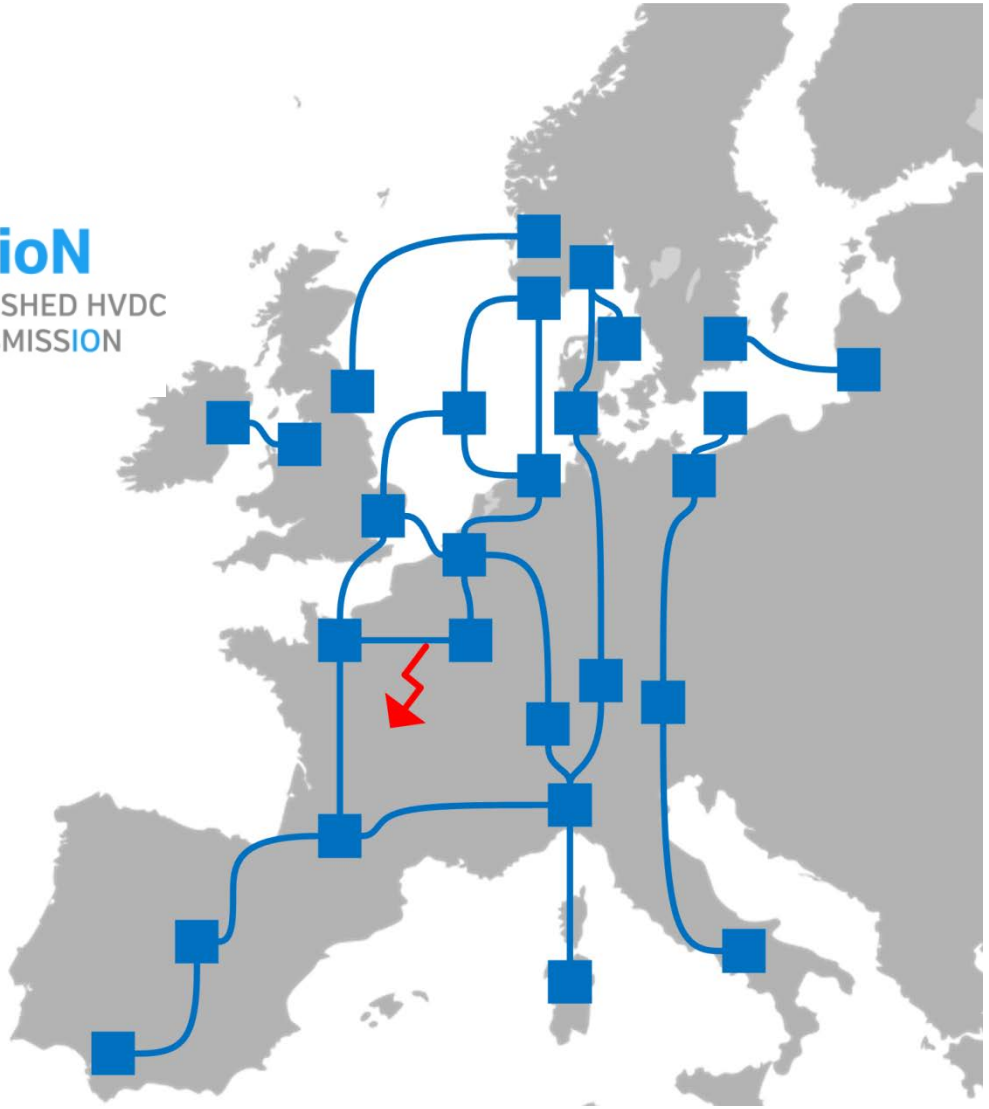


Agenda

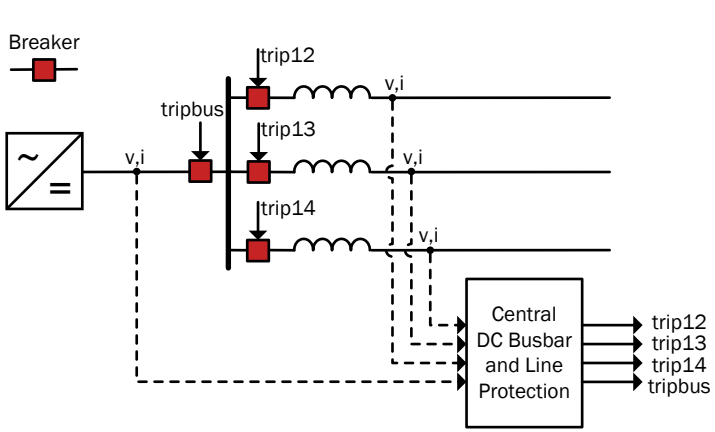
1. Project PROMOTioN
   PROGRESS ON MESHED HVDC OFFSHORE TRANSMISSION NETWORKS
2. Objectives
3. Tests & results
4. On-going work

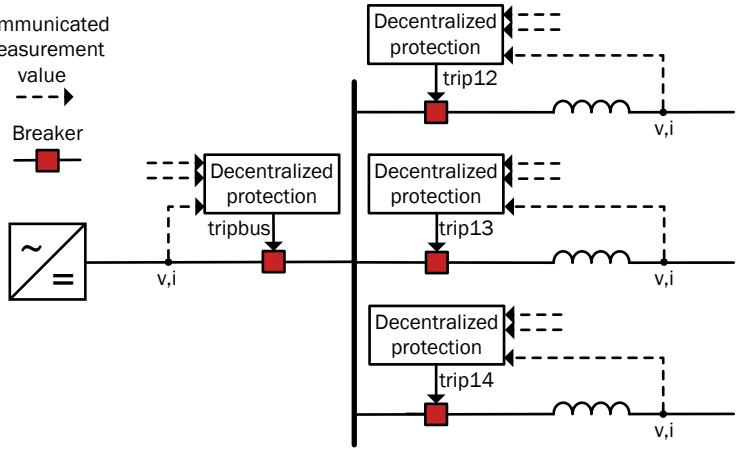


Objectives - KTH

1) Develop and test an HVDC protection IED
   - DC line protection for meshed HVDC Grids
   - Algorithms: $\frac{dv}{dt}$, $\frac{di}{dt}$, travelling wave, current directional, overcurrent, undervoltage
   - Compatible with real-time digital simulator (RTDS)

2) Use communication for decentralized protection
   - **Standardized Ethernet communication**: within substation, with remote line-end
   - Therefore: **vendor-independent**





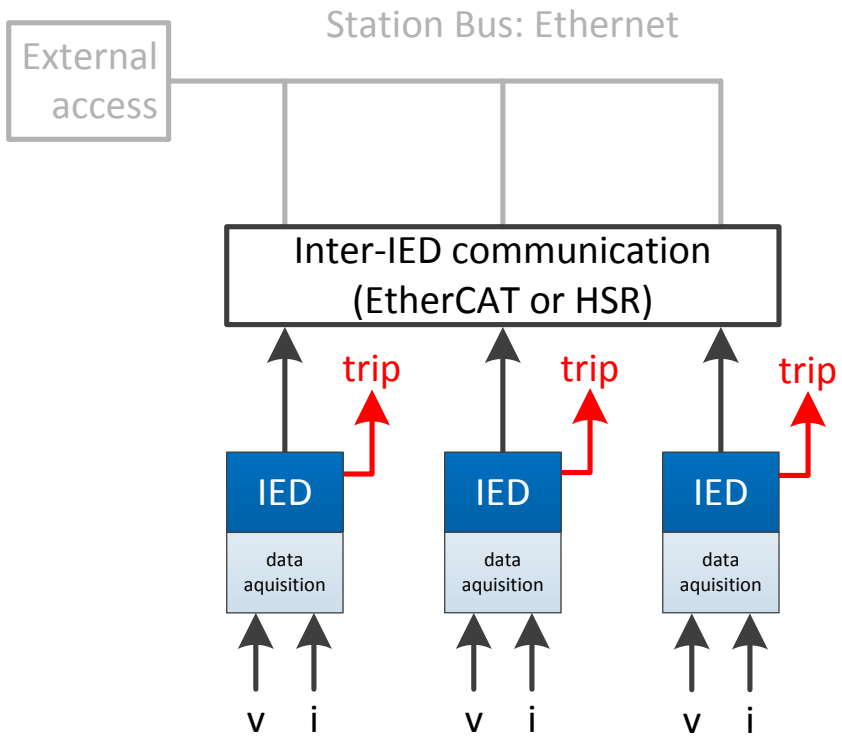
[1] Jahn et al., "Survey of Methods for Selective DC Fault Detection in MTDC Grids," in IET ACDC, Manchester, 2017.
[2] Jahn et al., "Impact of Measurement and Communication Aspects on Protection of MTDC Grids," in IET DPSP, Belfast, 2018.

IED Software & Communication

- Requirements:

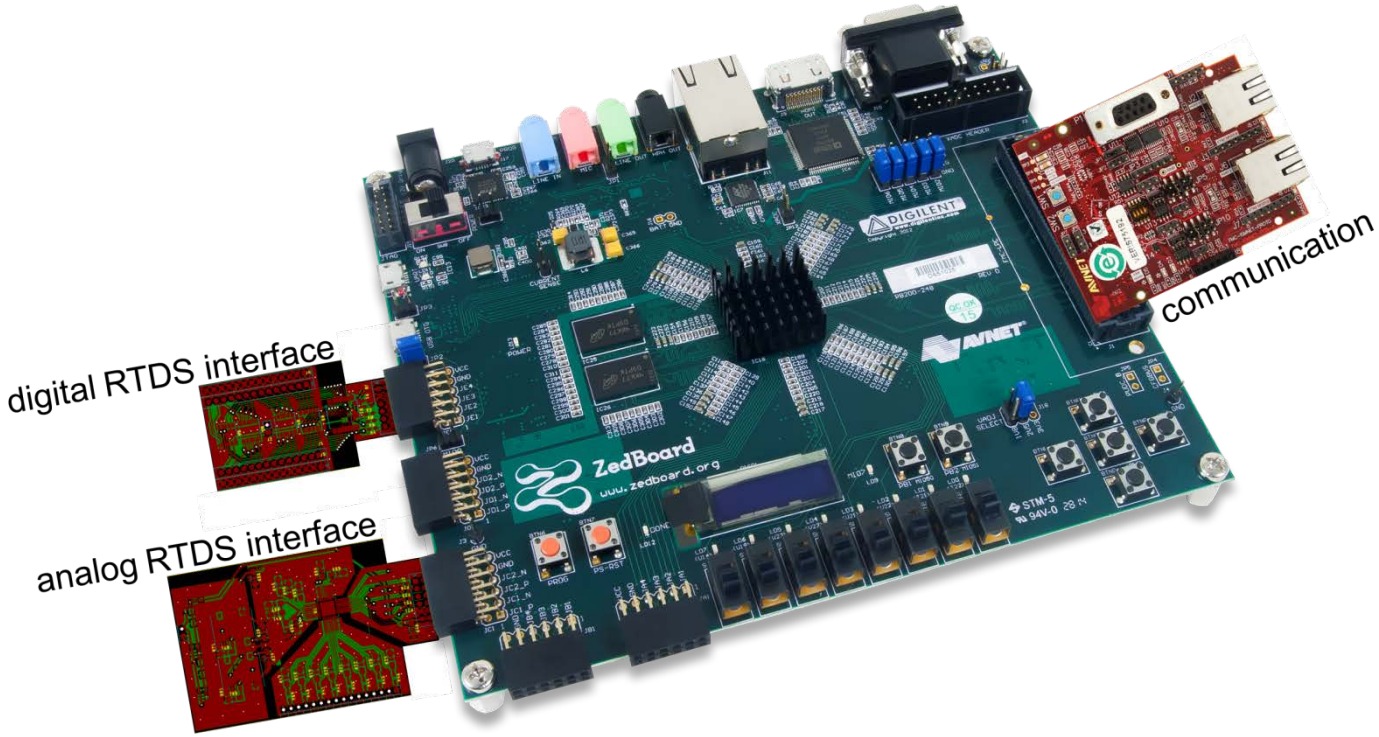
  1) fast data aquisition
  2) fast fault detection
  3) fast communication

- Realised in Vivado / Xilinx SDK using standard and open-source code



IED Hardware

- Standard and established hardware: Zedboard
- Custom and flexible I/O cards to connect to RTDS



in cooperation with:

Testing

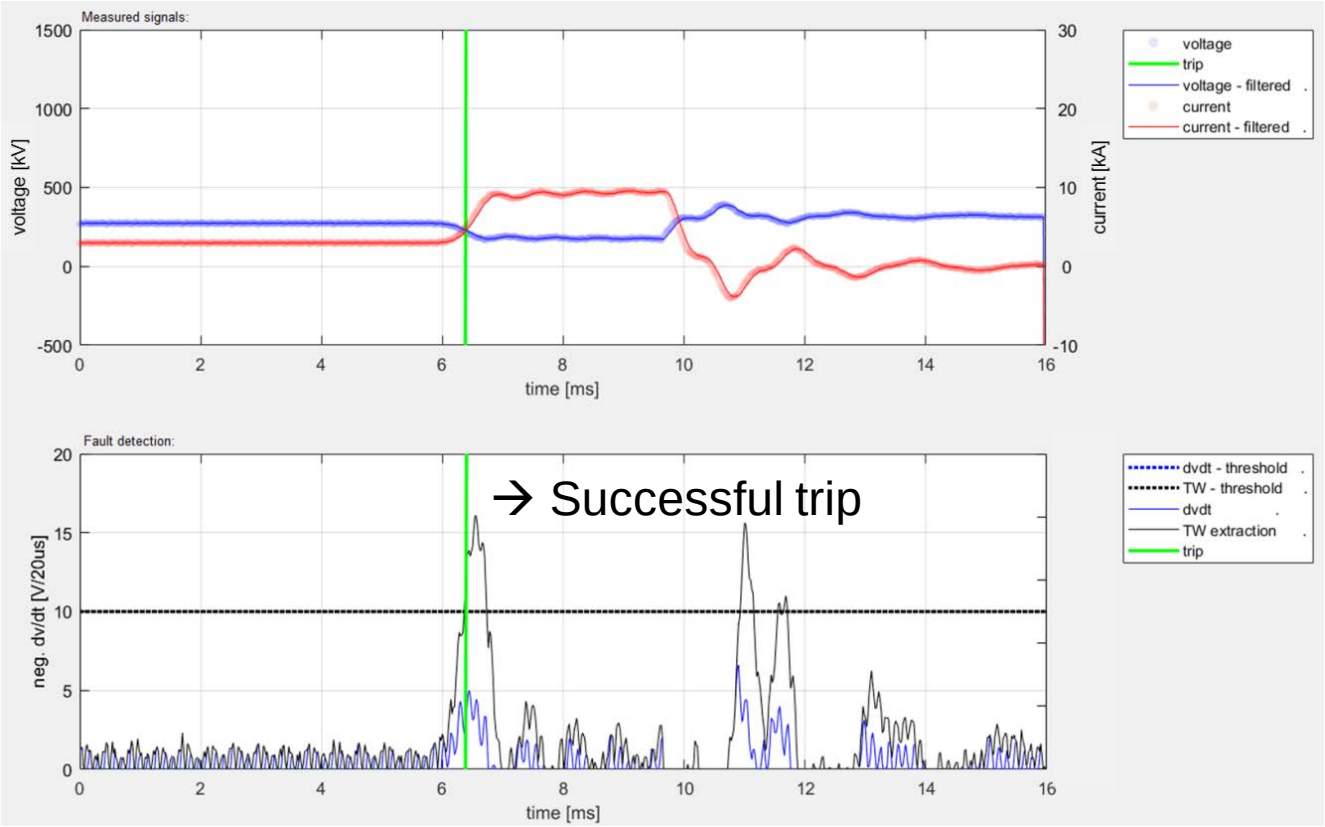
- IED with real-time digital simulator (RTDS)
- EnergyVille, KU Leuven

in cooperation with:

Results

- Test with RTDS
- Successful DC breaker tripping

- Line-GND fault
- Distance 180 km
- 10 mH line impedance



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PROMOTioN
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