The impact of ICT on WAMPAC applications – a new level of detail needed in the development of applications and in dynamic security assessment?

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Motivation

- Transition towards smart grids and rise of WAMPAC
  - Interaction of power system and ICT becomes more and more important but is often simplified in simulations

- For many smart grid applications (in particular WAMPAC), it is important to investigate their impact on the power system dynamics
  - Is there a need for new simulation tools for an integrated analysis of power system dynamics and ICT and to evaluate real-time performance of time-critical smart grid applications?

- ICT performance can determine the sequence of events, e.g. in case of centralized protection and control
  - Is there a need to include ICT in dynamic security assessment?
Interdependencies of power and ICT system

- Overload
- Decision-making
- Countermeasure
- Transmission Delay
- Event 1
- Event 2
- Event 3
- Event 4
- Event 5
- Event 6
- Event 7
- Event 8
Interdependencies of power and ICT system

Wide-Area Communication Layer

Substation

Centralized Protection and Control

Decentralized Protection and Control

Centralized Monitoring and Control Layer

Power Plant

Control Center

Local Process Layer

Measurements and Local Process Control

Centralized Communication Layer

Substation

Decentralized Protection and Control
Simulation platform INSPIRE: Integrated Simulation of Power and ICT Systems for Real-time Evaluation

- Accounting for timely behaviour at all relevant components
- Challenge: time-synchronized simulation of power systems (TDS, discrete time steps) and ICT network (event based)
Implementation: Co-simulation with High-Level Architecture (HLA)

- Generic and flexible (can include applications in MATLAB, JAVA,..), observing standards (IEC 61850, IEC61970 (CIM))
First insights in simulations

- Simulations in the course of an interdisciplinary research unit
  - DFG FOR1511 – „Protection and Control Systems for Reliable and Secure Operation of Electrical Transmission Systems“
  - Development and joint evaluation of WAMPAC applications (e.g., coordinated power flow control, protection of transmission corridors, automated load shedding) under explicit consideration of ICT system

- First findings
  - Relevant delays of countermeasures can occur in highly loaded communication networks
  - Initializing new routing path can cause relevant delays (e.g., in case of a failure of a communication link in parallel to an electrical transmission line)
  - Both effects can have an impact on the sequence of events
Key questions

Q1: To what extent should ICT processes be represented for developing and evaluating WAMPAC applications? What is current practice?

Q2: To what extent should ICT processes be represented in Dynamic Security Assessment? What is current practice?

Q3: In which additional fields might combined ICT and power system analysis be of relevance? (e.g., for investigating the impact of protocols, decryption, bandwidth, fall-back communication solutions, etc.)
Thank you very much for your attention!

For more information visit us at www.for1511.ie3.tu-dortmund.de!

References:
Müller et. al., "Hybrid simulation of power systems and ICT for real-time applications", IEEE ISGT Europe 2012
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