Sixth Annual Cyber-Physical Systems Principal Investigators' Meeting

Arlington, VA – November 16-17, 2015

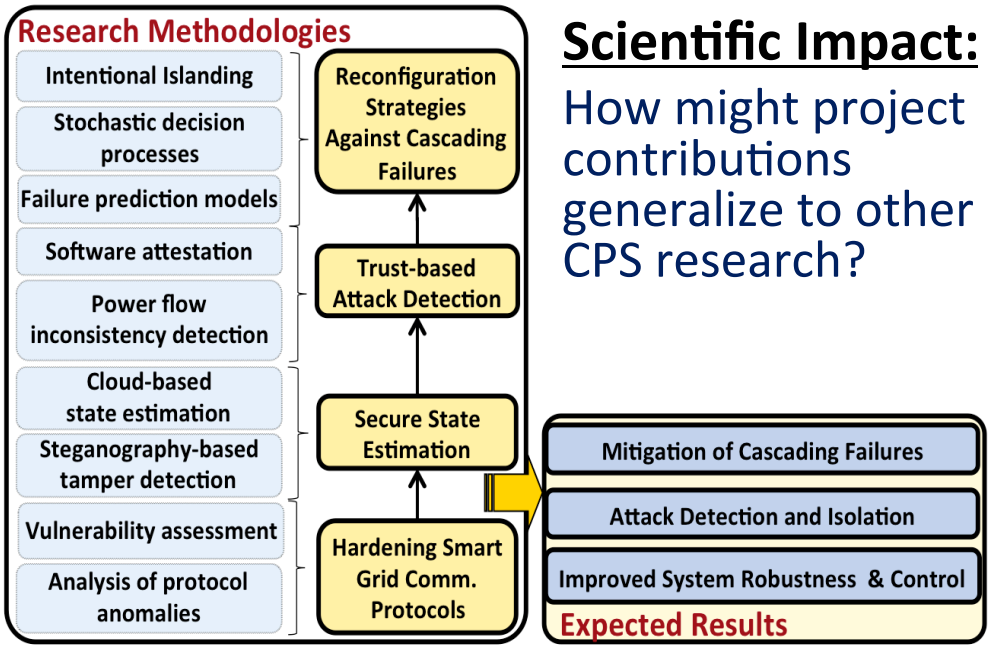
CPS: Breakthrough: Collaborative: Securing Smart Grid by Understanding Communications Infrastructure Dependencies

Challenges:

- Characterize inter-dependence between Smart Grid and communication systems
- Make state estimation and protocols more robust
- Detect impacts (failures and attacks) and prevent cascades
- Build models for attack mitigation.
- Validate with real test-bed.

Solution:

- IEC81650 Protocol hardening
- Steganography based robust state estimation
- Game theory and trust models for attack detection, failure spreading
- Situation-aware models and tool suite for CPS threat monitoring, analytics and decision control



Scientific Impact:

How might project contributions generalize to other CPS research?

Broader Impact:

- Influencing the standards.
- Multi-disciplinary security training in CPS.
- Experiential learning in real-life micro-grid

CNS-1544904 (K. Kant and A. Srinivasan, Temple University)

CNS-1545037 (S. K. Das, M. Crow, S. Silvestri, Missouri S&T)

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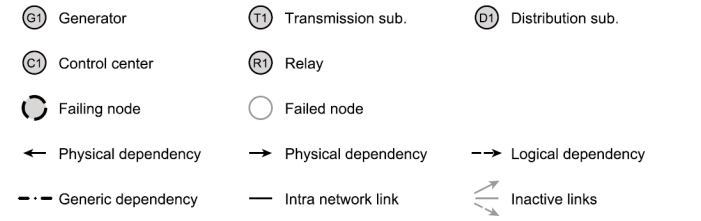
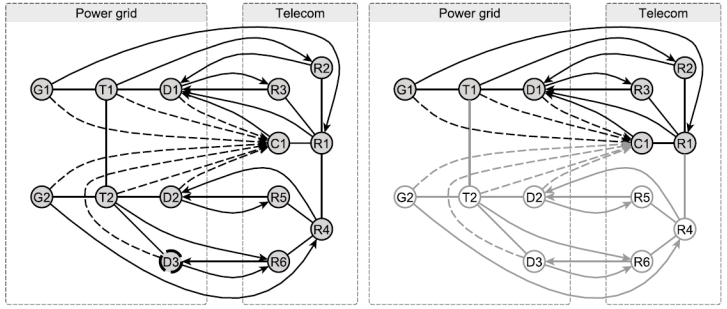
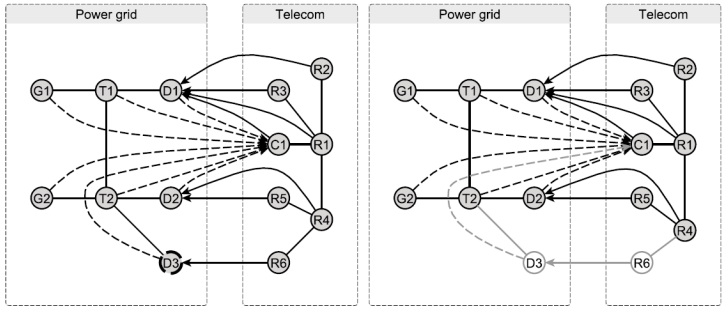


Graphical notation used for nodes and links in Figures.



(a) (b)

Scenario 1, proposed realistic model HINT: (a) initial configuration, (b) final stable state.



(a) (b)

Scenario 1, SC model: (a) initial configuration, (b) final stable state $\Delta = 4$.

PRELIMINARY RESULTS

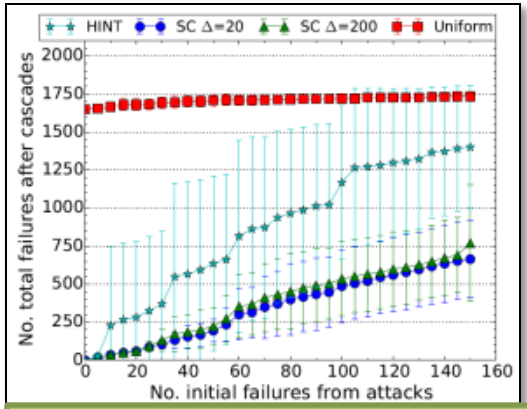
- Investigated failure propagation in the interdependent electric power and communication networks
- Overcame oversimplified existing models that are highly inaccurate when predicting failure propagation
- Proposed a model called HINT – Heterogeneous Interdependent NeTworks
- Experimented with real topologies from Minnesota Power grid and communication networks

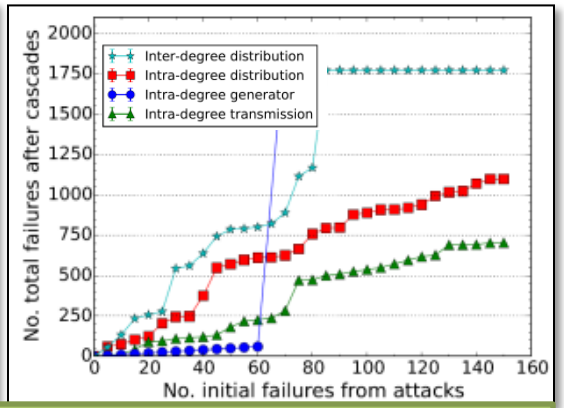
Random attacks

Total failures after cascade vs. initial number of failed nodes. Uniform model largely overestimates the failures, while Small Cluster (SC) model underestimates

Targeted attacks

Nodes failed according to their intra or inter degree, and role in power grid. HINT allows to investigate robustness of the interdependent networks.





A. Sturaro, S. Silvestri, M. Conti, S. Das, "Towards Realistic Model for Failure Propagation in Interdependent Networks," IEEE ICNC '16.