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ABB

Collaborative Defense of Transmission and Distribution Protection and Control Devices Against Cyber Attacks (CODEF)

Cybersecurity for Energy Delivery Systems Peer Review

December 7-9, 2016

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BONNEVILLE
POWER ADMINISTRATION

Ameren
ILLINOIS

I L L I N O I S
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

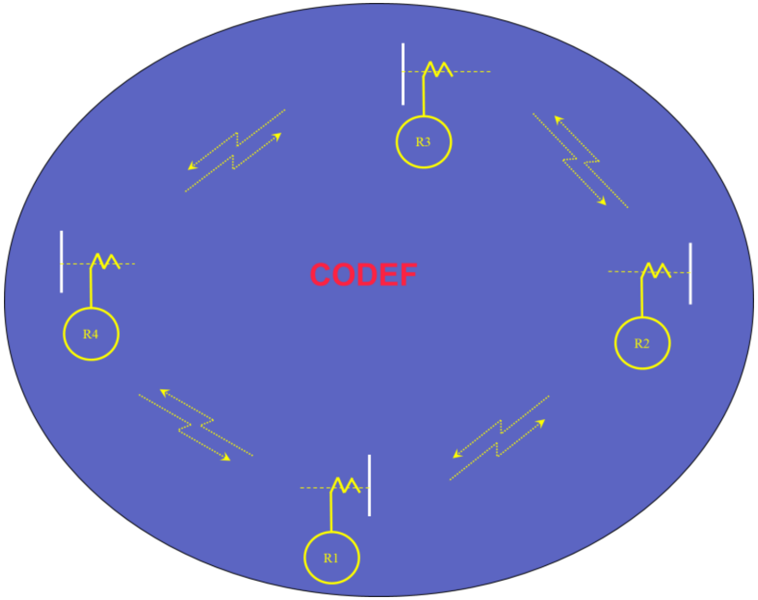
CODEF

Objective

- TO advance the state of the art for cyber defense methods for transmission and distribution grid protection and control devices by developing and demonstrating a distributed security domain layer that enables transmission and protection devices to collaboratively defend against cyber attacks in an IEC 61850 environment.

Schedule

- 10/2013 – 12/2016
  - Distributed Security Enhancement Layer Design – July 14, 2014
  - Distributed Security Enhancement Layer Implementation – March 13, 2015
  - Security Demonstrator – May 12, 2016
- Capability to the energy sector:
  - Inter-device level solution for smart detection of cyber attacks using power system domain knowledge, IEC 61850 and other standard security extensions

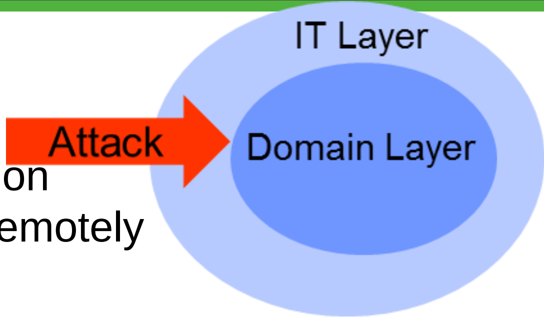


Performer:	ABB
Partners:	University of Illinois at Urbana-Campaign, Bonneville Power Administration, Ameren-Illinois
Federal Cost:	2,765,755
Cost Share:	936,729
Total Value of Award:	$ 3,702,484
Funds Expended to Date:	% 90

Advancing the State of the Art (SOA)

- Current “state of the art”
  - “Security by obscurity”
  - Unsecured or slightly secured data communication protocols
    - An attacker could inject false command and measurements and if they are syntactically correct will allow control of substation equipment.
- Why this approach is better than the SOA
  - Real time cyber security that is aware of power system operations
  - The physical state of the protected system is used to validate commands and measurements from the cyber layer.
  - Intelligence is distributed, collaborative and co-located or located close to the protected devices
- Feasibility of the approach
  - IEC 61850 substation automation protocol’s GOOSE and sampled value messages were used to realize collaboration among devices
  - Cyber secure mechanisms prototypes were embedded in each device’s firmware or in separate hardware.

Advancing the State of the Art (SOA)



- How the end user of your approach will benefit
  - Utilities benefit from increased cyber security of their substation automation devices and equipment from attacks conducted remotely or from insider threats in electrical substations.
- How the approach respects the operational requirements of energy delivery systems
  - CODEF works with existing substation automation protocols and devices with no need for additional instrumentation in electrical substations.
  - CODEF intelligence could be deployed as part of normal firmware updates and engineered using existing tools and software.
- Describe how your approach will advance the cybersecurity of energy delivery systems
  - The approach advances the cyber security of energy delivery systems by reinforcing existing IT security layers and adding an extra inner domain-based defense layer

Progress to Date

Major Accomplishments

- Transmission level cyber security functions demonstrated at Bonneville Power Administration in May 2016

- Distribution level cyber security functions demonstrated at Ameren-Illinois TAC substation in March 2016

- CODEF roadshow cyber security demonstrator featured at the PAC-World Americas Conference and Western Protective Relay Conference

Challenges to Success

Challenge 1: Speed of cyber security functions

- Sub cycle fault detection algorithm, GMAC authentication of GOOSE and sampled value streams

Challenge 2: Embedding the prototype solutions in commercial relay platform

- Utilized dedicated commodity hardware that are connected in hardware in a loop with the IEC 61850 enabled relays.

Challenge 3: Engineering the utility demonstrations

- Very close collaboration and teamwork with UIUC, BPA and Ameren-Illinois.
- Using a multitude of space heaters to mimic a real fault in a live test circuit

Collaboration/Technology Transfer

Plans to transfer technology/knowledge to end user

- Category of targeted end user for the technology or knowledge
  - The targeted end users are asset owners, specifically, electric utilities in both transmission and distribution business
- Plans to gain industry acceptance
  - Utility demonstrations with participants from both OT and IT groups present – 2 utilities
  - Roadshows in focused conferences using a self contained CODEF rack for on-demand demonstrations
  - Dedicated demonstrations within electric utilities
  - Publications, presentations and panel sessions in conferences
    - BPA and Ameren presented their utility demonstration experiences
  - Engaging standard making bodies to influence the adoption of the project's standard security extensions

CODEF Roadshow and Utility Demonstrations

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