Henry Loehner
Schweitzer Engineering Laboratories

Secure Software (SW) Defined Radio Project

Cybersecurity for Energy Delivery Systems Peer Review

December 7-9, 2016

Summary: Secure SW Defined Radio

Objective

- Securing last mile wireless communications for electric utility distribution automation

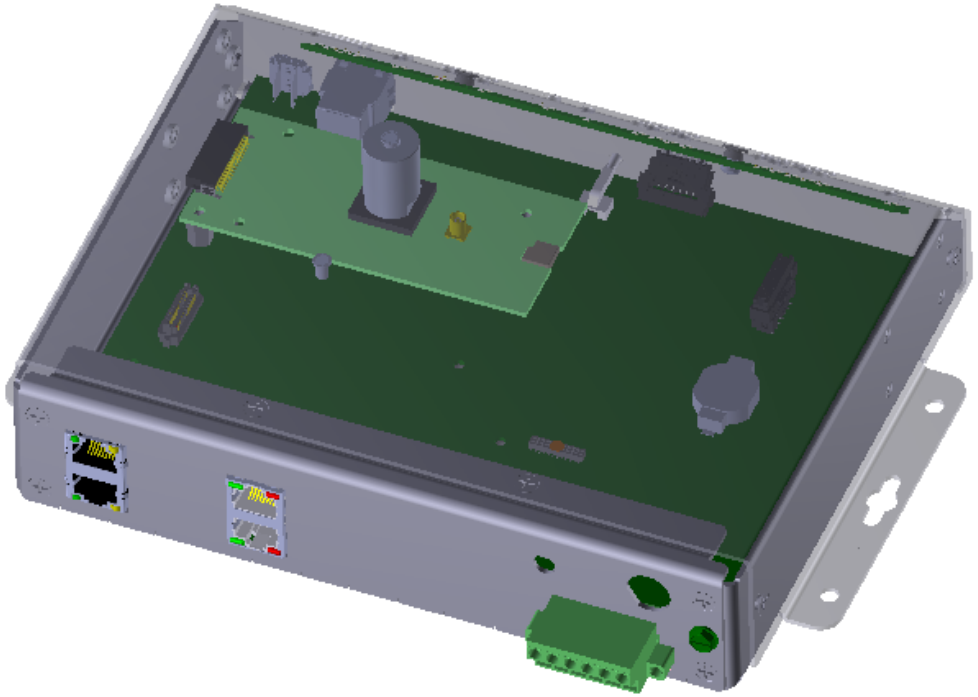
Schedule

- Project Kickoff – Dec 2013
- System Design Complete – Sept 2014
- Platform FW – Feb 2016
- Proto 1 HW Test Complete – Jul 2016
- Wireless Networking – Mar 2017
- Project Complete – Nov 2017

Performer:	**Schweitzer Engineer Labs**
Partners:	**PNNL, San Diego Gas & Electric**
Federal Cost:	**$3.77M**
Cost Share:	**$1.07M**
Total Value of Award:	**$ 4.84M**
Funds Expended to Date:	**% 71%**

SDR Platform Capabilities

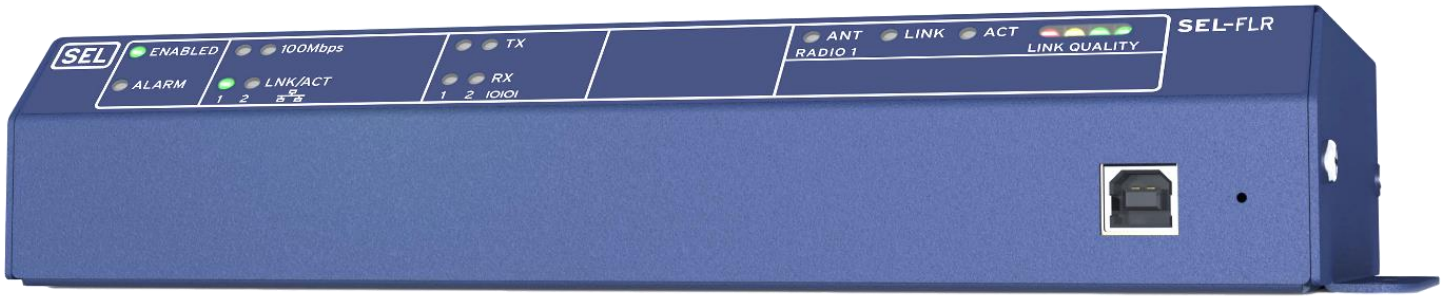
(Secure Wireless Comm's Platform for DA)



- Configurable
- Integrated Security Features
- Ethernet/serial ports
- GPS/IRIG time capable
- Dual radio capable

SDR Integrated Security Features

- **Wireless message and device authentication**
- **Syslog**
- **Support for complex passwords**
- **User authentication with role-based access**
- **Ability to lock down unused ports**
- **X.509 certificates for device authentication**



Advancing Cyber-security for Sensor Networks

Security for sensor networks…

- Not strongly promoted my manufacturers
- Customers lack awareness of need for security

Current cyber-security gaps in the industry:

- Permanent passwords configured at factory
- Global passwords
- No Encryption or SSL
- Lack of device and message authentication

No one provides the SDR's combination of…

- Superior user account management
- NERC Compliance
- Logging via Syslog

SDR Sensor Network Industry Benefits

Enhanced wireless sensor network security

- Aggregation of security features in advanced radio platform

Improved utility reliability metrics

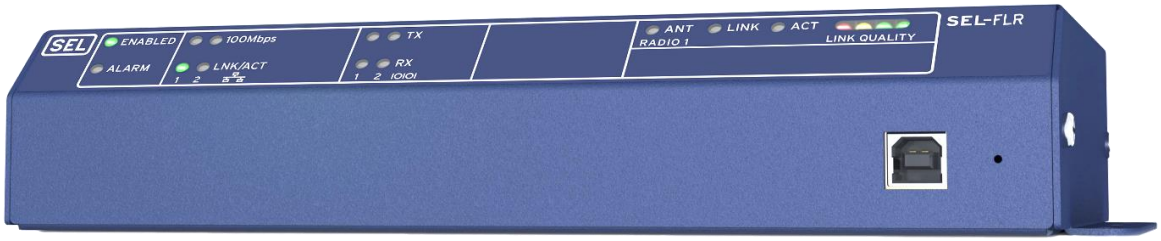
- Faster fault detection
- Enhanced load switching

Operational Simplicity

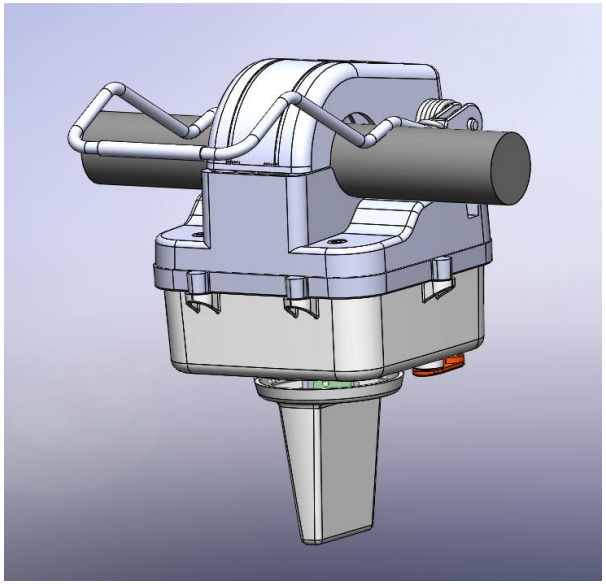
- Integration into existing SCADA and OMS applications
- Low cost of ownership

SDR Sensor System

(Initial SDR Product Release Q3 2017)



- SDR Platform
- SEL Advanced Line Sensor



Challenges to Success

Performance, Feature and Project Scope Tradeoffs

- Work with utilities on core features and priorities
- Adopt multiple release product/feature rollout plan
- Identify first release features

Identifying Target Market Segment

- Spoke to dozens of customers to define their needs
- Analyzed competitor products in different product segments to determine performance gaps

SDR Project Progress

- **Initial Research and Technology Investigation: Dec 2013 – Sept 2014**
  - Partner customer requirements gathering, identification of industry benefits, technology research, definition of design specifications
- **Development Kickoff Sept: 2014 – Mar 2015**
  - Initial system design, functionality scoping, vetting capabilities with broader user base.
  - **Learnings:** product cost too high, performance focus too narrow for broad market needs, greater platform flexibility desired.
  - **Re-scoping of product capabilities:** lower cost, configurable multi-radio platform, same cyber-security capabilities

SDR Project Progress

- **Proto 1 Development: Apr 2015 – July 2016**
  - HW and platform infrastructure FW development, HW test automation development, radio module performance characterization, unit builds, type testing, environmental testing.
  - **Learnings:** Solid HW platform developed, radio module performance exceeded performance requirements, proto 1 HW platform was able to pass all type and environmental tests with minor modifications.
  - **Schedule update:** product development will not complete in late 2016 as per original plan, wireless protocol development and cyber-security features will take longer than expected.
  - 1 year No-cost project extension requested and granted in May 2016, project completion in Q4 2017

SDR Project Progress

- **Proto 2 Development: June 2016 – Ongoing**
  - Proto 2 HW design, and fab, user interface and web page design and implementation, wireless protocol architecture, design, wireless message exchange implemented.
  - **Learnings:**
    - Development of common webUI across SEL products allows sharing of components resulting in less unique work for SDR project team.
    - Initial wireless protocol turn-on and integration with radio module HW took longer than expected, but has helped accelerate future work need to complete development

Project Completion Plan

- **HW, FW Development: Nov 2016 – Sept 2017**
  - Wireless protocol data transfer, device and message authentication, network join and dynamic network configuration; webUI completion; cyber-security feature completion, security threat analysis/evaluation
  - Proto 2 HW turn on, unit build, radio performance characterization, type testing, environmental testing
  - Product validation and customer use case testing
- **SDR Field Trial: Aug 2017 – Nov 2017**
  - Customer lab and field trial of sensor network demonstrating cyber-security and operational benefits.