Secure and Reliable Wireless Networks for Critical Infrastructure Facilities

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Project Overview

- *Teaming*
  - *Sandia National Laboratories*
  - *Honeywell International*
  - *Funded by DHS S&T via BAA 07-09 (1 year)*
- *Wireless Mesh Network Improvements*
  - *Industrial wireless mesh networks are becoming a reality*
    - *Honeywell OneWireless*
    - *Emerson/Cisco solution*
  - *Security and robustness improvements*
  - *Fast, easy integration of emergency first responders*
  - *Development*
    - *Commercially available OneWireless mesh network*
    - *COTS 802.11 wireless routers*

What is the Problem?

- Attacks against link-layer communication
  - Routing information modification
    - Source routing
    - Distance vector routing
  - Network/Transport layer header modification
  - Fragmentation
  - Rogue nodes
- One key used by all nodes
  - Single point of failure/compromise
- First Responder situational awareness
  - Easy access to mesh network – insecure
  - Secure access to mesh network – too hard to use

Key Management Options

- **Single network key with manual rekey**
  - Simplest, easiest approach
  - Compromise of single node can be catastrophic
- **Single network key with electronic rekey**
  - Two communication layers: data, rekey message
  - No attribution of nodes
- **Unique network identity and multiple network keys**
  - Public key management: *increased complexity*
  - Each node has a unique key
    - Supports distinct link encryption and authentication

Our Solution

- **Distinct link encryption authentication**
  - Cryptographic protocol for registration of mesh nodes with certificate authority (CA) and key exchange between pairs of nodes
    - CA establishment
    - Node registration
    - Node removal/Certificate revocation
    - Symmetric key exchange
- **First Responder**
  - Pre-emergency first responder credentialing
  - Use of flash memory cards for authentication
  - Time-limited mesh network access

Benefits

- **Distinct Link encryption/authentication**
  - Having a compromised node will no longer lead to the entire system being compromised
- **Secure mesh routing**
  - Losing an interior mesh node (i.e. DoS) no longer causes interruption of data acquisition

Benefits

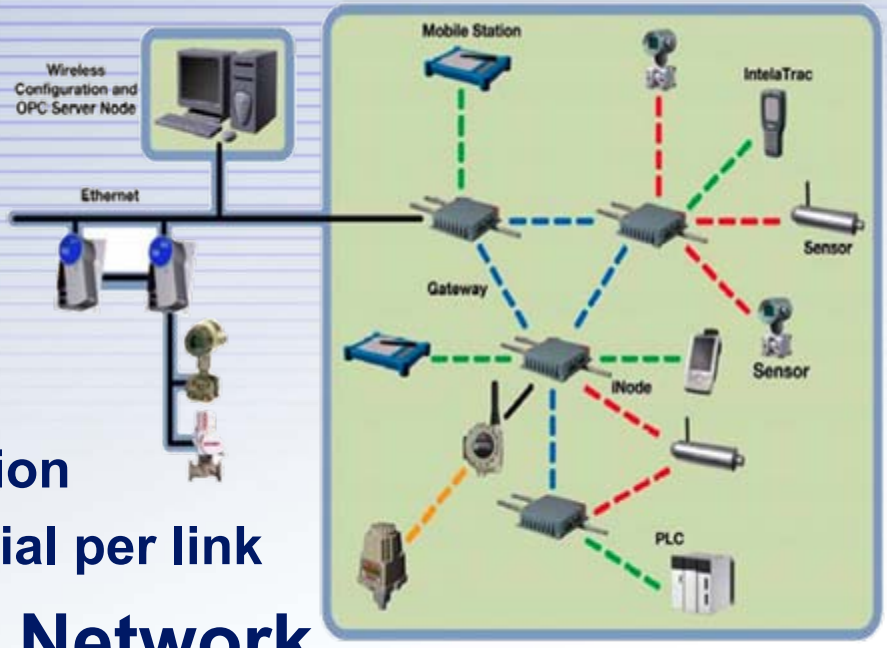
- First responders get access to the wireless network for intra-group communication and situation awareness.
  - Recommend best practices of read-only data
- First responders no longer have to fumble with security, yet communication is still secure

Transition Plan

- **Commercialization**
  - **Enhancements developed as part of this project will be proposed to Honeywell for the next version of the OneWireless product offering**
- **Standards**
  - **Relevant technologies will be offered to the appropriate standards bodies**
    - IEEE 802.11, 802.15.4, ISA 100.11a

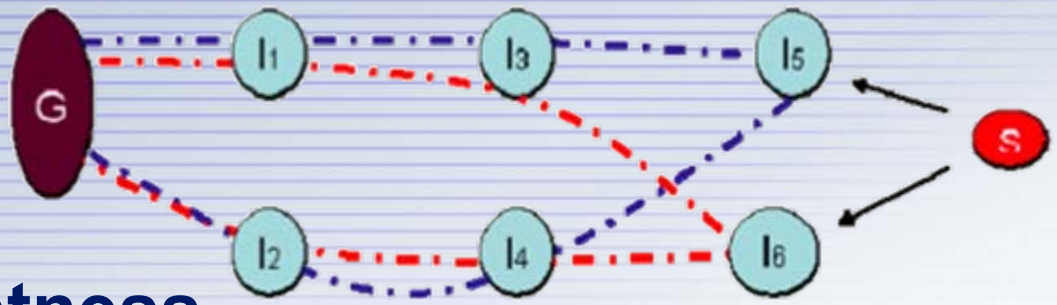
Backup Slides

Technical Activities



- **Enhanced Security**
  - Automatic node authentication
  - Unique cryptographic material per link
- **Multi-functional Mesh Network**
  - Fast, easy deployment of time-limited security credentials to emergency responders
- **Quality of Service (QoS)**
  - Specific QoS for emergency situations

Technical Activities



- **Enhanced Robustness**
  - Dual redundant, non-overlapping routes
- **User Interface**
  - First responder access to data from the site
  - Data condensed using predefined filters
  - Simple and easy to understand interfaces
- **Testing and Demonstration**
  - OneWireless and COTS mesh networks
  - Integration with Honeywell Experion PKS System

Milestones and Deliverables

- **Milestones**
  - Use case scenario definition and requirement gathering for enhanced system demonstration
  - Implementation and functional testing based on voice of customer inputs
  - System integration, deployment, and testing utilizing Sandia's Honeywell Experion PKS System
  - Enhanced system demonstration
- **Deliverables**
  - Technical Performance Report
  - Commercialization Plan
  - Relevant technology will be made available to standards bodies, such as IEEE and ISA