Secure and Reliable Wireless Networks for Critical Infrastructure Facilities

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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
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
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
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