# Moving the DOE Industrial Wireless Program Forward

## International Instrumentation Symposium

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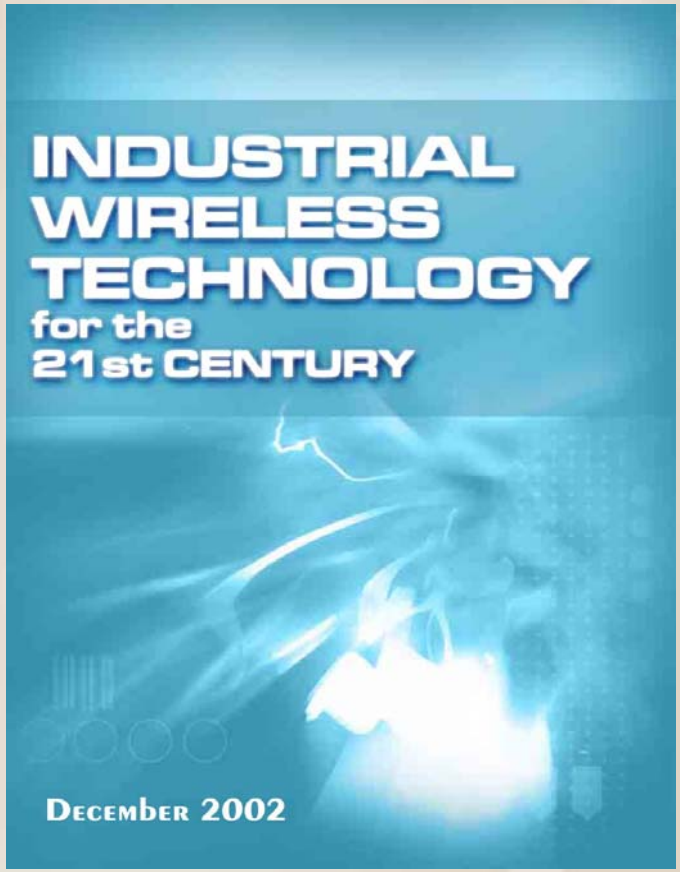
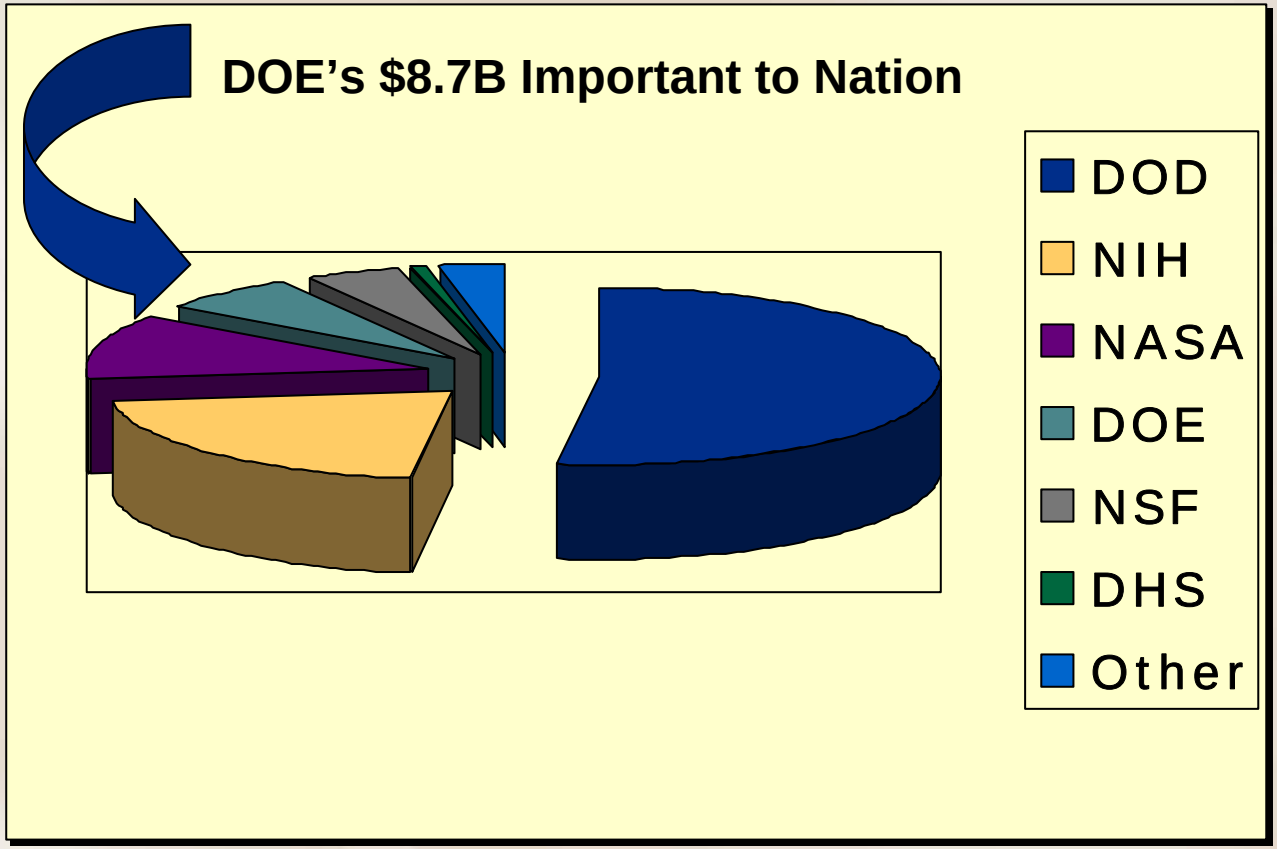
# Why DOE, Why Here, Why Now?

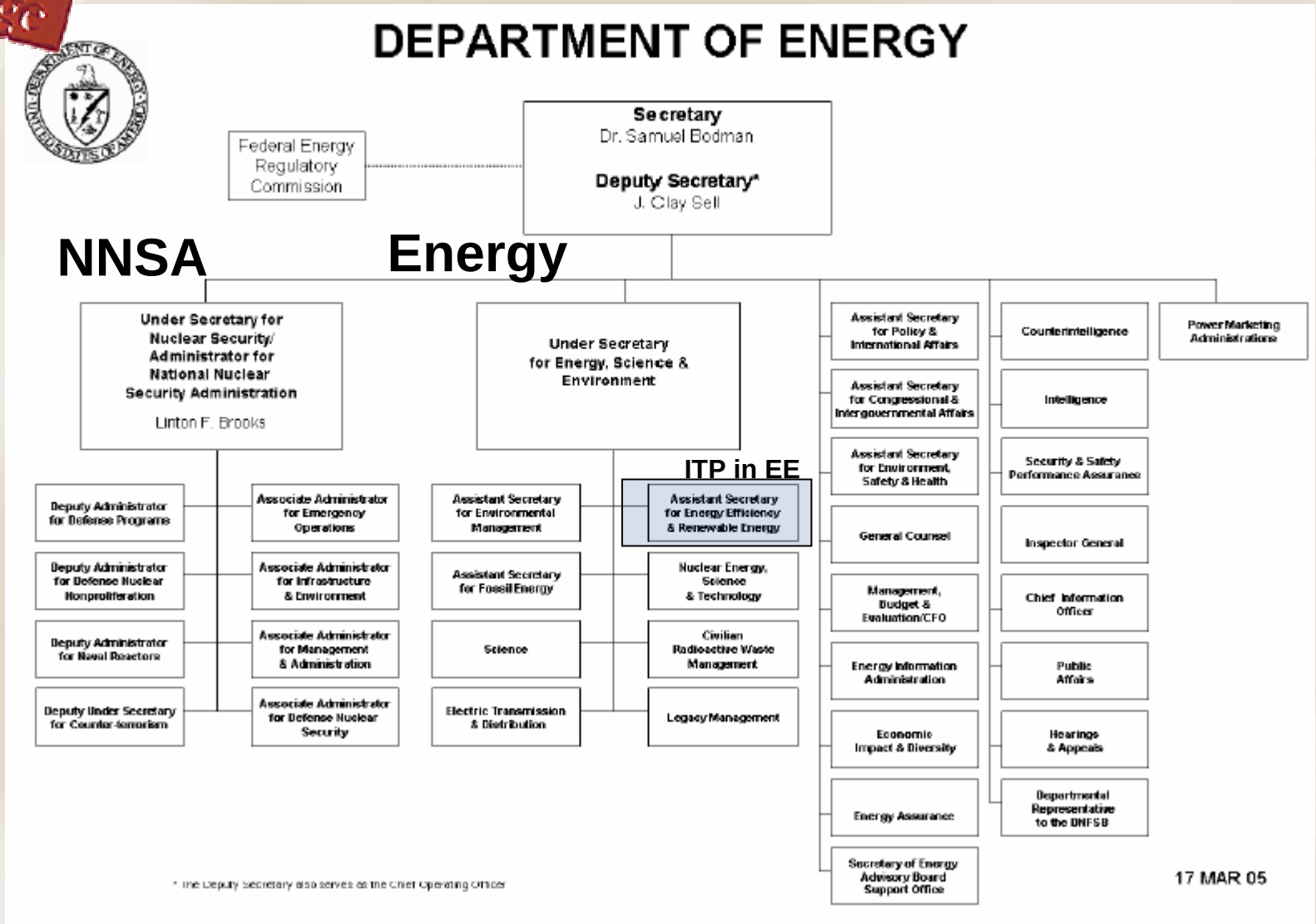
- History – Why a DOE Program, Why ORNL?
- Goals – Program charter, mission, approach
- Path – Where program is today, Partners involved
- Future – Where program is headed and why.
- Winners – WINA, NIST, Suppliers, End Users, ISA, IEEE, Researchers



# Department of Energy – A Major Player in US R&D Landscape

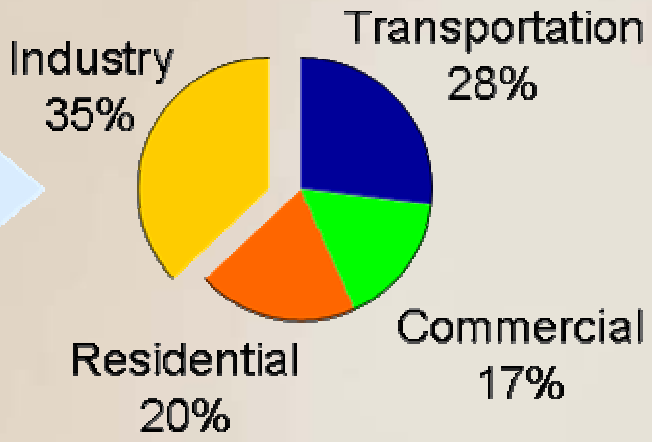


# DOE Has Broad Mission



# Why Work with Industry?

Industry is the largest single energy-consuming sector in the Nation.



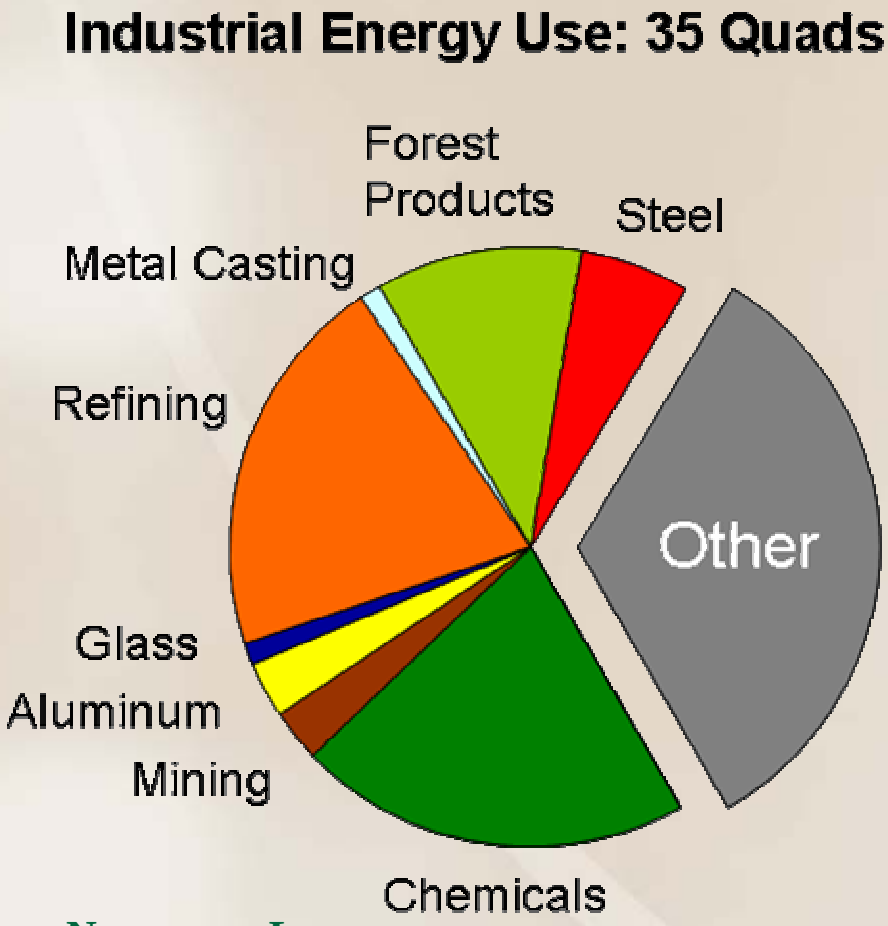

## Energy Savings Benefits

- Lower production costs
- Environmental compliance
- Reduced waste
- Increased productivity
- Improved competitiveness

- Economic Strength
- Environmental Quality
- National Security

# Industries of the Future - IOF

*Focus on energy-intensive industries…*

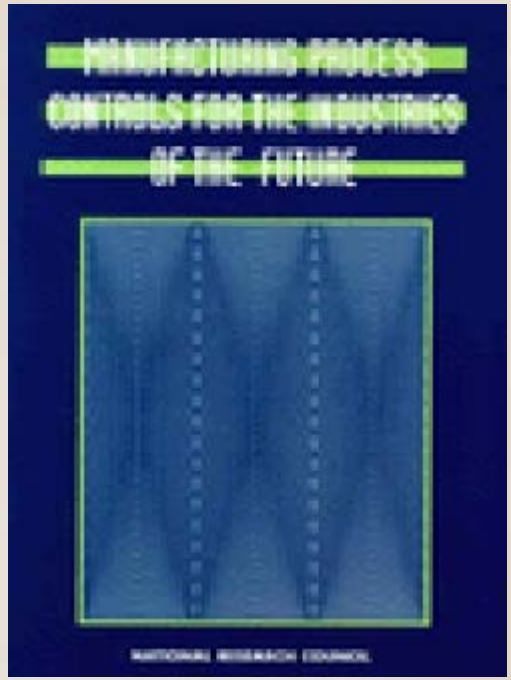



*…and cross-cutting areas:*

- Sensors & Automation
- Advanced Materials
- Combustion
- Industrial Energy Systems
- *Technology Delivery*

# National Research Council (NAS) Identified Research Needs

- **Interference Rejection – self-interference from metal surfaces, lots of sparks and other sources**
- **Integrated Intelligence – reduces need for host communication**
- **Reliable Networks – ad hoc routing, security**
- **Power – harvesting and new batteries**
- **Standards – communication, interfaces, and protocols**

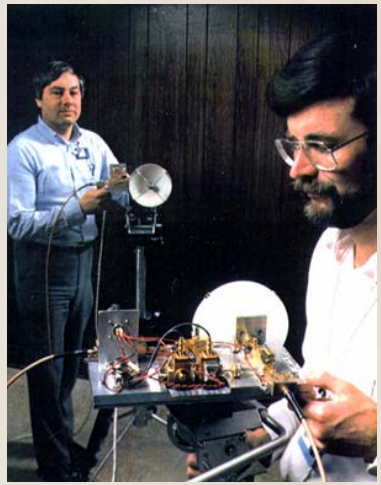


**Manufacturing Process Controls for the Industries of the Future - Free PDF version at NAS**

***National Academy of Sciences report identifies industrial wireless with potential for 10% energy reduction and 15% emission reduction.***

# ORNL's History of Harsh Environment Wireless and Microsystems Pushes On

- Robust Communications in Extreme Environments
  - Markets: Energy, National Security, and Transportation
- Tagging and Tracking Systems
  - Markets: Energy, National Security, and Transportation
- RF and Microwave Measurements
  - Markets: Energy, National Security, and Science



**94 GHz Reflective-Environment Communications System**

Video Intercept Receiver

Shipboard Cargo Tracking System

**Innovative Technology Base**

**OAK RIDGE NATIONAL LABORATORY**

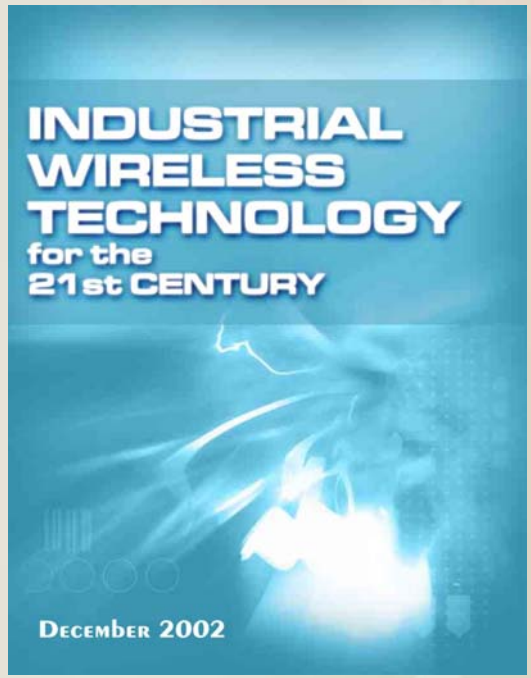
**U. S. DEPARTMENT OF ENERGY**

UT-BATTELLE

# Vision: Industrial Wireless – Moving Forward

**Industrial wireless technology will be**

- **robust,**
- **reliable**
- **cost-efficient**
- **totally secure**
- **often integral to the measurement device**
- **the *obvious choice* for monitoring and controlling industrial processes to optimize resource efficiency and productivity.**




***Get pdf at WINA web site***

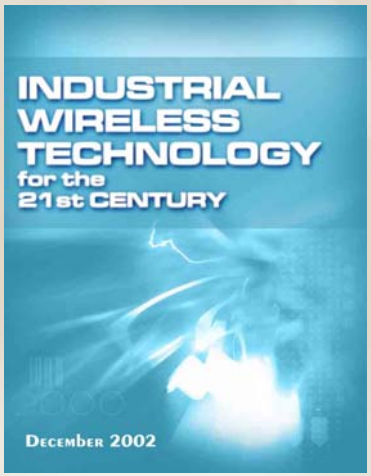
# Industrial Wireless – Deployment!

- **Standards – ISA SP100, IEEE 802.15.4, IEEE 1451.5!**
- **Suppliers – growing group but still struggling to meet real requirements**
- **Government – Looking for impact on environment, energy efficiency, global competitiveness and even jobs!**

*So, What's the Holdup?!?!*

# We're In It Together!

- **Project Success – credibility, cash flow, profit, impact**
- **Project Focus – Standards and WINA**
- **Project Status – Prototypes ready**




Extreme Measurement Communications Center

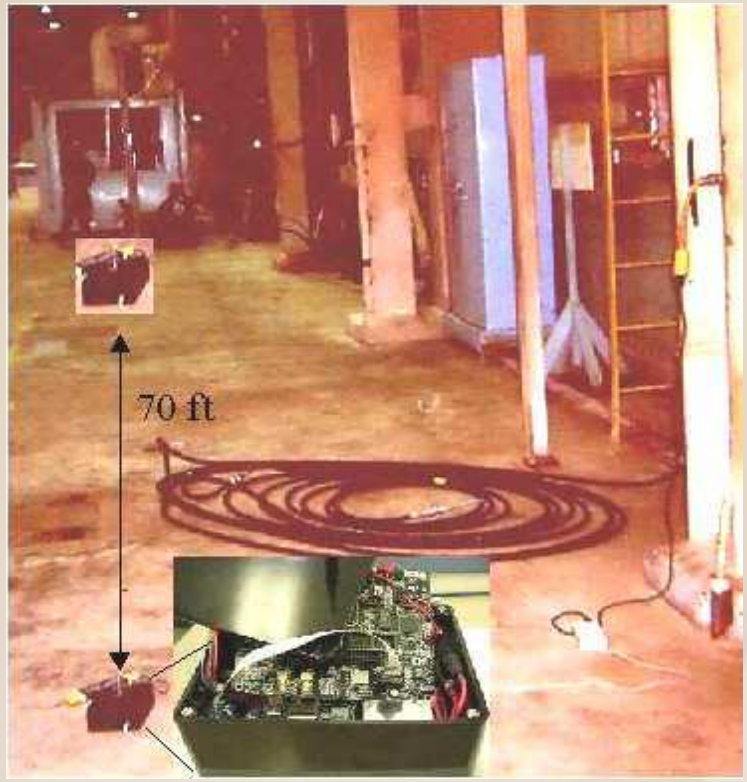
# Standards – Maximum Impact

**DOE Program Impact on Standards – permit introduction of entire suite of wireless products from many vendors supporting the "ubiquitous sensing" model in vision.**

- **Standardized methodology to**
  - **Assess environment – light to harsh, RF and other**
  - **Assess application – latency, throughput, etc.**
  - **Assess options – technologies, products, standards**
  - **Assess deployment – initial stability, ease**
  - **Assess performance – against requirements**
  - **Maintain – tools, costs, upgrades**

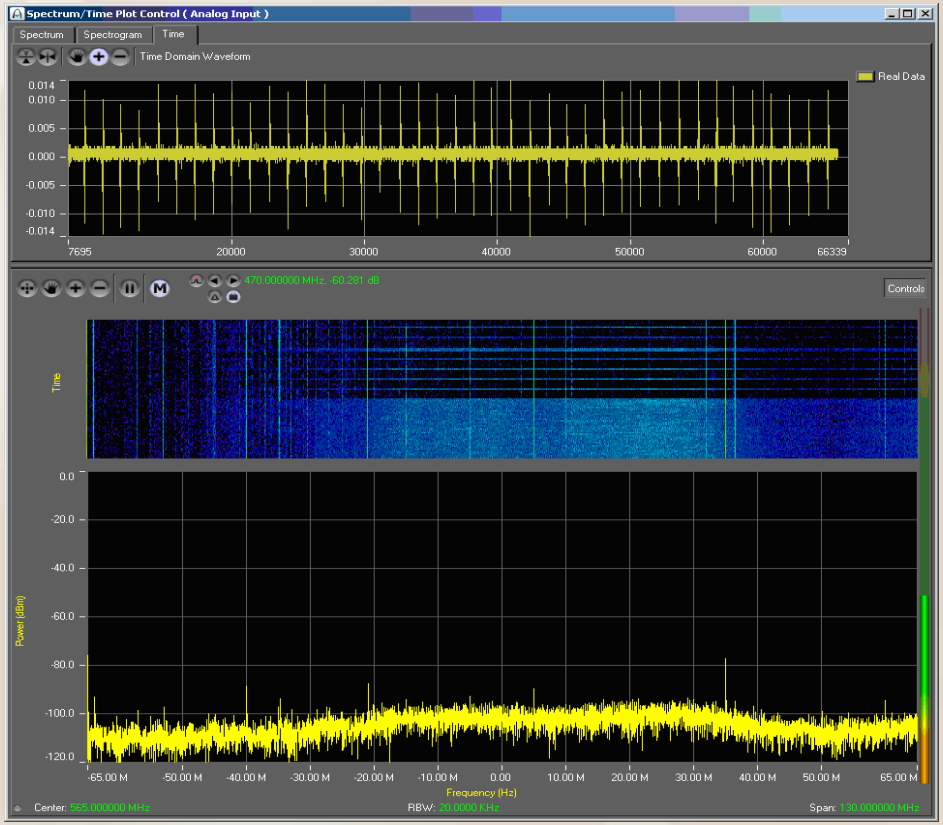
# Wireless Industrial Sensor Networks – Multidisciplinary!

- **Wireless – radio, packaging, antenna**
- **Industrial – harsh environment, fault tolerant, safety related, cost**
- **Sensor – filters, sampling, sensitivity, interferers, controls**
- **Networks – real-time, latency, throughput, security, integrity, vertical integration**

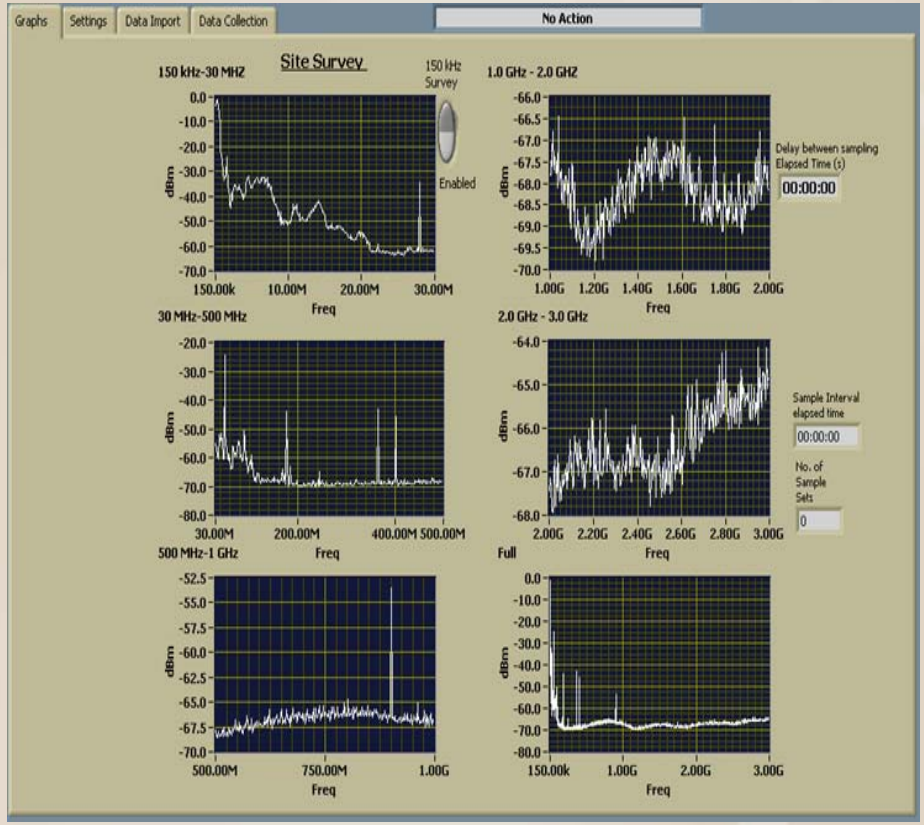



*Data – The Coin of the Realm!*

# RF Environment – Surprise!



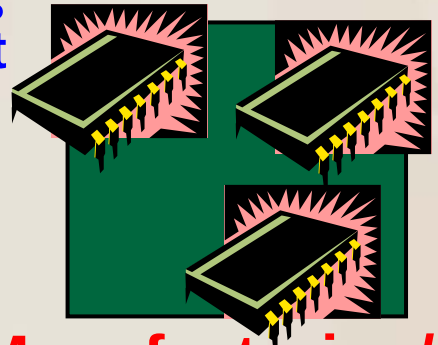

A Broadband Noise Source detected




PSD from 150KHz – 3GHz

# Can Commercial Grade Cut It?

**Wireless Intelligent Network**



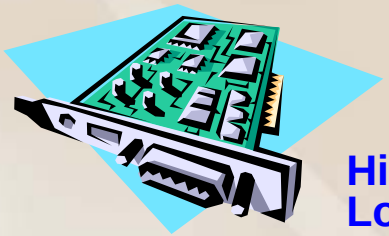
**Government Labs**
**Academia**
**Industry/Consortia**

**Manufacturing/ Industrial Markets**

High Quality
Low Cost
High Volume
High Integrity

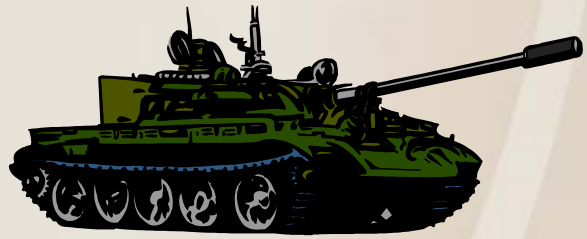
**Consumer Market**

High Quality
High Volume
Low Cost
Low Integrity



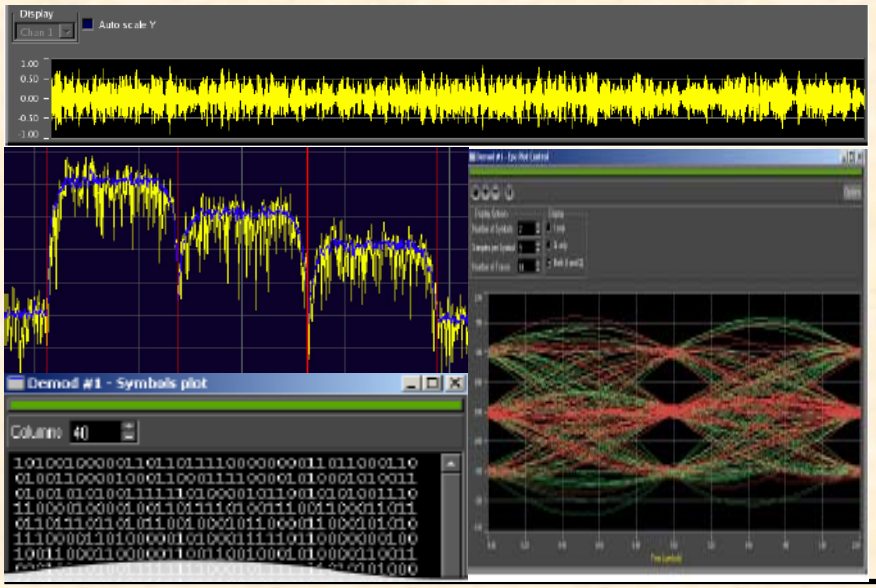
**National Defense**

High Cost
Low Volume
High Quality
High Integrity



**Wireless Warrior**

# Extreme Measurement Communications Center (EMC²)




## Operational Capability

The DoE EMC² provides modeling, simulation and characterization support for industrial wireless networks.

This facility is equipped with parallel computing resources as well as state-of-the-art measurement equipment for high performance wireless and wired network characterization from the physical layer to the application layer

Broadband RF record and playback instrument can simulate and generate characteristic waveforms to help in-lab study of the wireless device's behavior in harsh industrial environments

## EMC² Program Benefits:

- EMC² formalizes the testing of industrial wireless networks to quantify the latency, throughput, security and fault-tolerance (Interference and Noise)
- Wireless Industrial Networking Alliance (WINA) has accepted EMC² as its product testing and characterizing center to member companies
- Currently supports exhaustive modeling and simulation of the communication infrastructure for future electric grid
- Help develop or improve existing standards in industrial wireless networks to include measurement, verification and reliability of network and device parameters
- The center is being developed both as a user facility and an on-site testing provider using portable test equipment

## Milestones, Deliverables, & Contact:

**Key Milestones:** Alliance with WINA and member companies for technology assessment and characterization; Provides modeling and simulation support for developing fault-tolerant electric-grid communication infrastructure

**Deliverables:** Standards-based report generation for different wireless devices and network layouts; Software development for characteristic network testing;

**Contact Information:**

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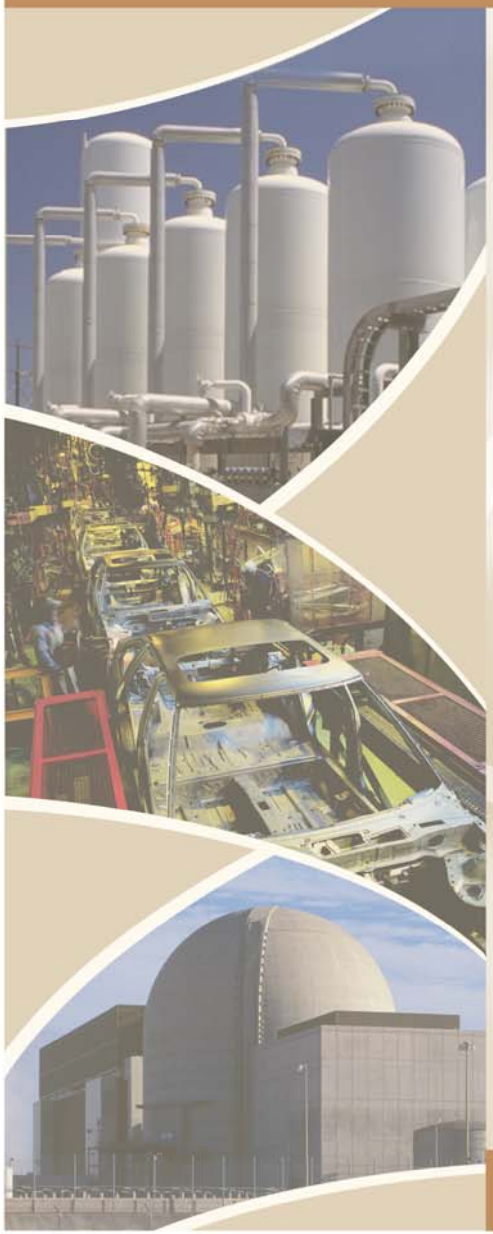
# Accelerating the adoption of wireless technologies in industry



WINA

WIRELESS INDUSTRIAL NETWORKING ALLIANCE

ISM frequencies

ZigBee™ 802.11 a/b/g

802.15.4

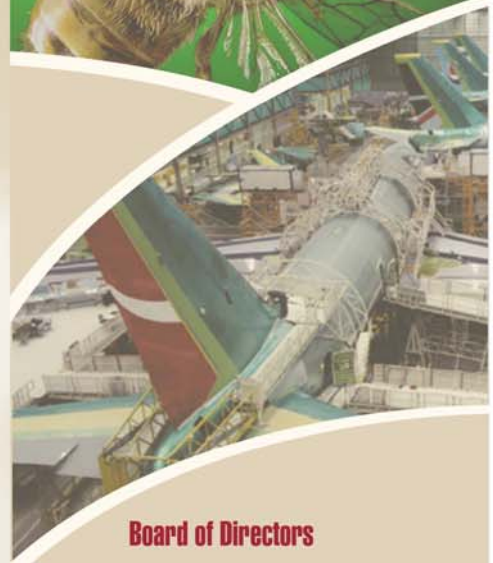
spread spectrum

UWB

1451.5

cyber-security

Bluetooth®



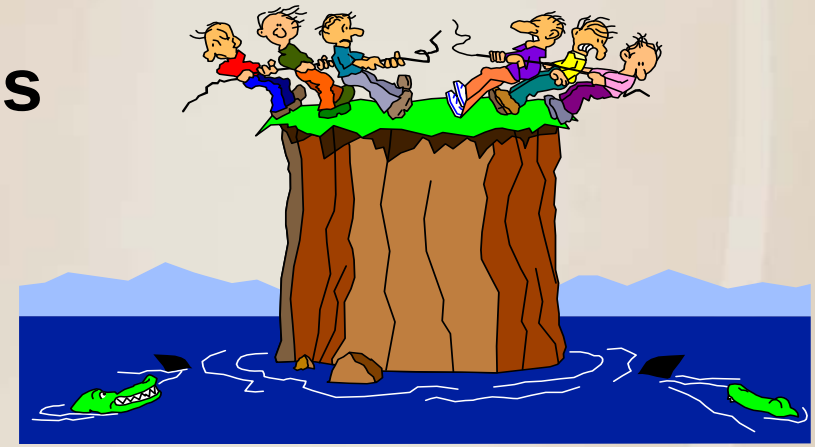
**Board of Directors**

- 3e Technologies International
- Eaton Corporation
- Ember Corporation
- Honeywell International
- Invensys
- Oak Ridge National Laboratory
- Omnex Controls
- RAE Systems
- ZigBee Alliance

WWW.WINA.ORG

# Can We Get There From Here?

- **Standards – for industrial applications**
- **Markets - attractive**
- **Confidence - successes**
- **Tools – easy, handy**
- **Information – broad-based, clear to users**



***Who Will Lead, Who Will Follow, Who Will Whine?***