Research Alliance in Math and Science Faculty/Mentor Workshop

Cyber Security and Information Infrastructure Research

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Cyber Security and Information Infrastructure Research

- **Focus**
  - **Using various subject domains, conduct research on information infrastructures with emphasis on cyber security by:**
    - **Establishing a critical information infrastructure,**
    - **Collecting data and fusing it into information, and**
    - **Protecting the critical infrastructure.**

  All while providing to our customers a product that they can only get from a National Lab, specifically ORNL.

- **Examples**
  - **IMR*ic*S (Identification and Monitoring of Radiation in commerce Shipments)**
  - **Weigh-in-Motion (WIM)**
  - **ICETECH (IAVA Compliance Enabling Technology)**
  - **Enterprise-Wide Distributed Zero-Day Attack Detection**

IMRicS

Identification and Monitoring of Radiation (in commerce) Shipments

Integrated Safety and Security Enforcement System for the 21st Century with Homeland Security Benefits

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VISION

Identification and Monitoring of Radiation (in commerce) Shipments

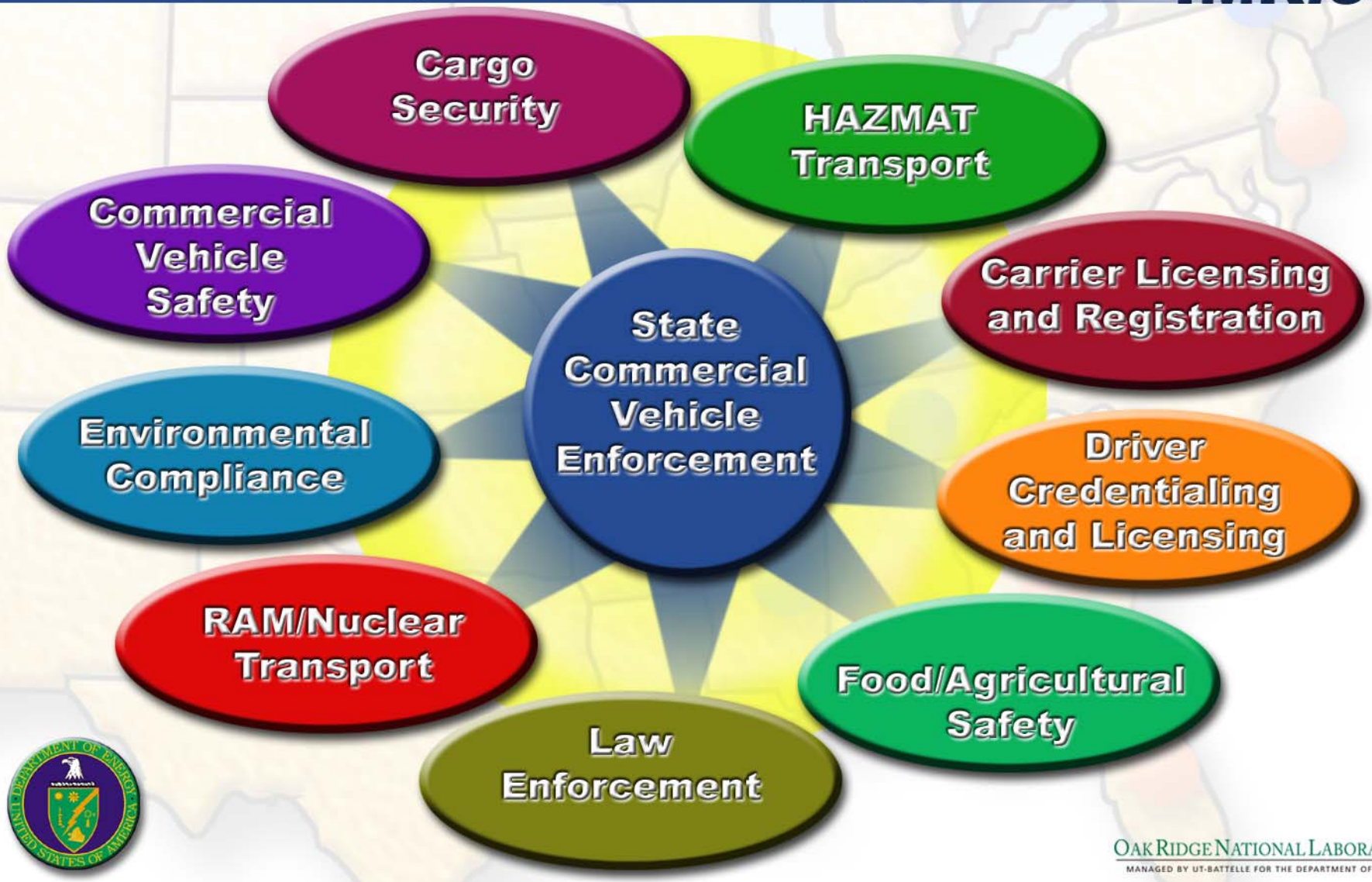
IMRicS

- **To increase the safety and security of the domestic transportation system by developing a vehicle monitoring system that will identify shipments not compliant with the following Federal and State regulations:**
  - **Transportation Safety,**
  - **Transportation Security,**
  - **Law Enforcement**
  - **Agricultural, and**
  - **Environmental**

FOCUS State Enforcement *"In Commerce" Issues*

Identification and Monitoring of Radiation (in commerce) Shipments

IMRicS



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Weigh Stations are "accepted" *in commerce* Inspection Infrastructure

Sensors Deployed *in commerce* infrastructure:

- **Static Scales**
- **Weigh in Motion**
- **Weigh Station RFID Pre-Clearance Systems such as NORPASS and PrePass®**

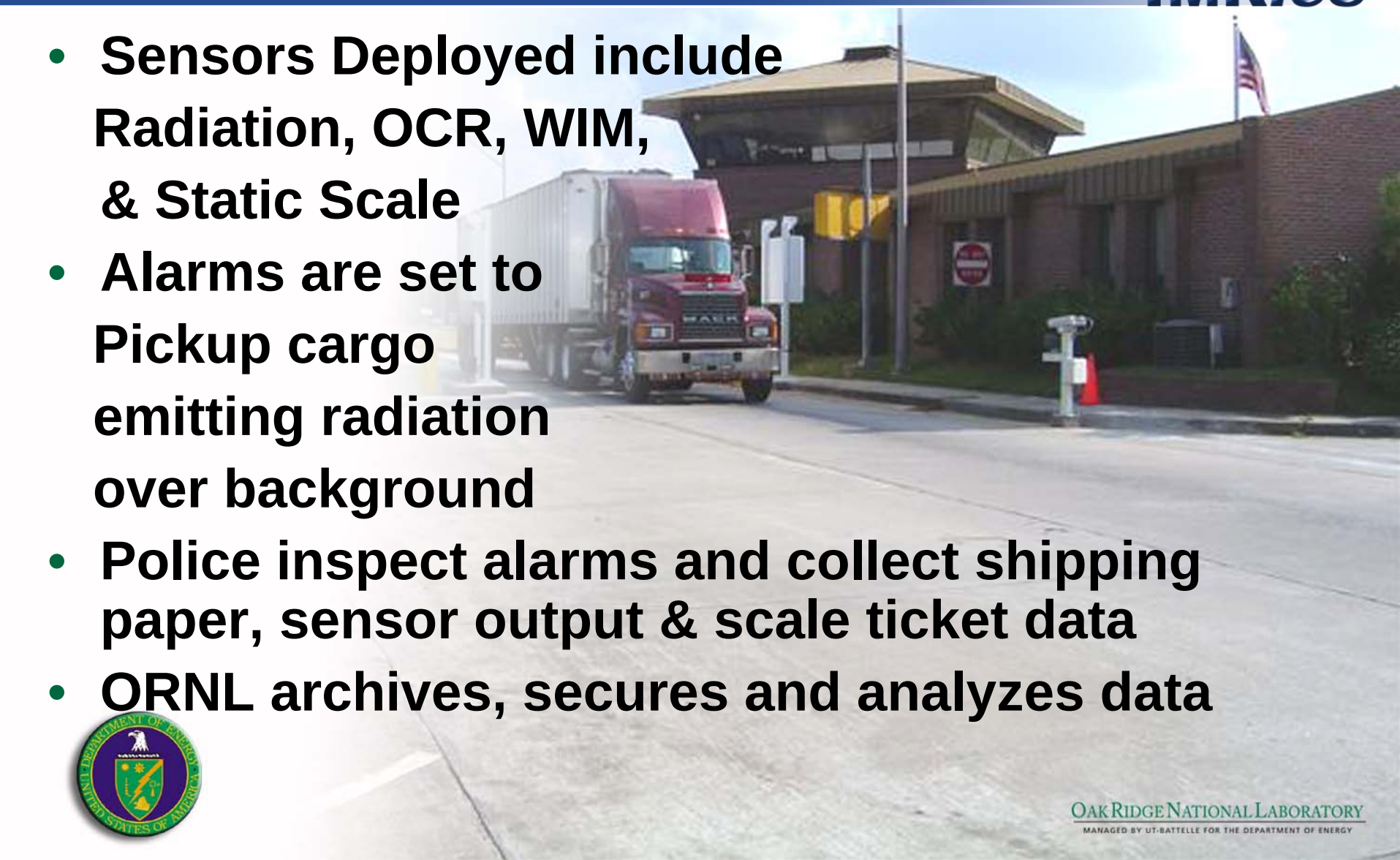
Sensors DHS desires to Deploy include:

- **Radiation Detection**
- **Chemical/Explosives Detection**
- **Optical Character Recognition**
- **Mobile/Deployable CBRNE Detection**

Current Concept of Operations

Identification and Monitoring of Radiation (in commerce) Shipments

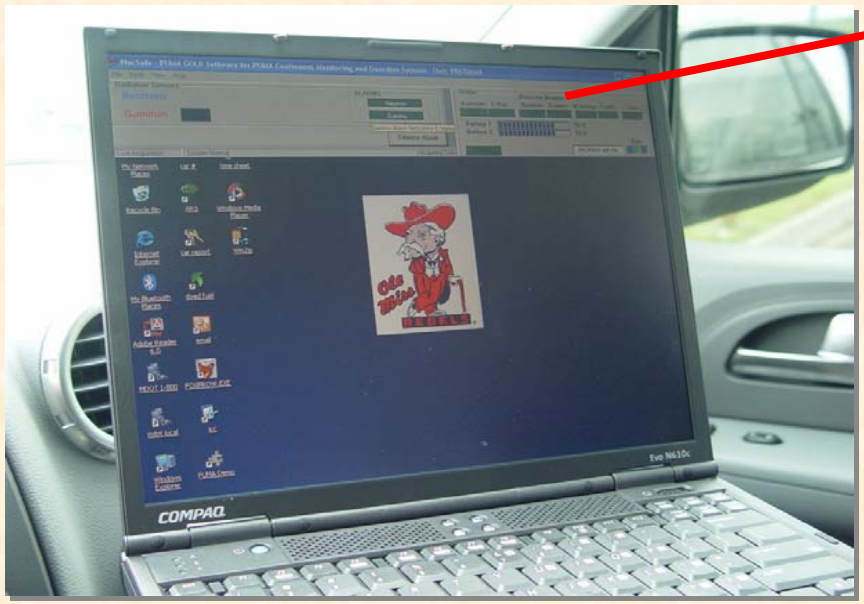
IMRicS

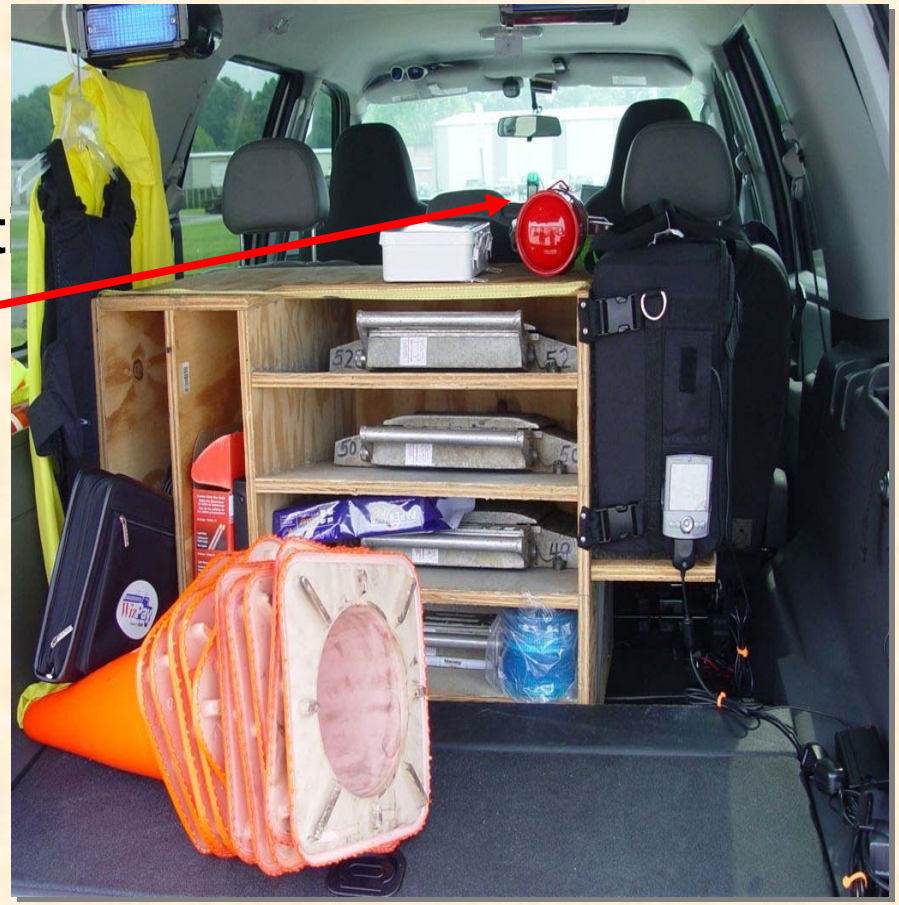


- **Sensors Deployed include Radiation, OCR, WIM, & Static Scale**
- **Alarms are set to Pickup cargo emitting radiation over background**
- **Police inspect alarms and collect shipping paper, sensor output & scale ticket data**
- **ORNL archives, secures and analyzes data**

Mobile Detection allows Constant Monitoring & Data Analysis for Police

- **Radiation Sensors in MDOT Vehicle**
- **SensorNet Enabled Connect**





High Risk Commodity Packaging can be Identified and Monitored In Transit

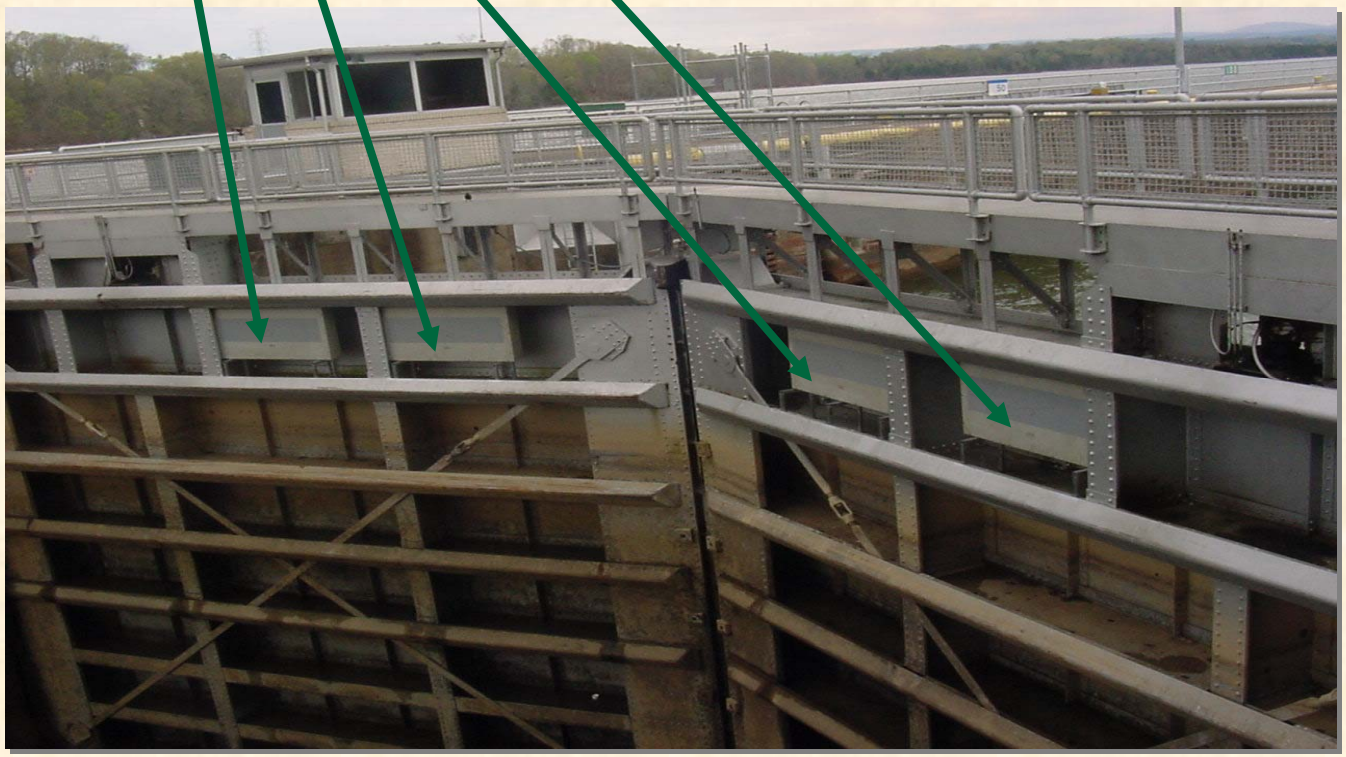
Radioactive Material Package RFID Equipped and Monitored

Expansion to other Modes of Transportation

- **Radiation Monitors installed in Inland Waterway Infrastructure**

Monitoring of Barges and Personal Watercraft on the Tennessee River

- **Radiation Detectors in Watts Bar Dam Lock Doors**



Components of Transportaton Systems

Identification and Monitoring of Radiation (in commerce) Shipments

IMRicS

Cyber Security and Information Infrastructure Research

- Examples
  - IMRicS (Identification and Monitoring of Radiation in commerce Shipments)
  - **Weigh-in-Motion (WIM)**
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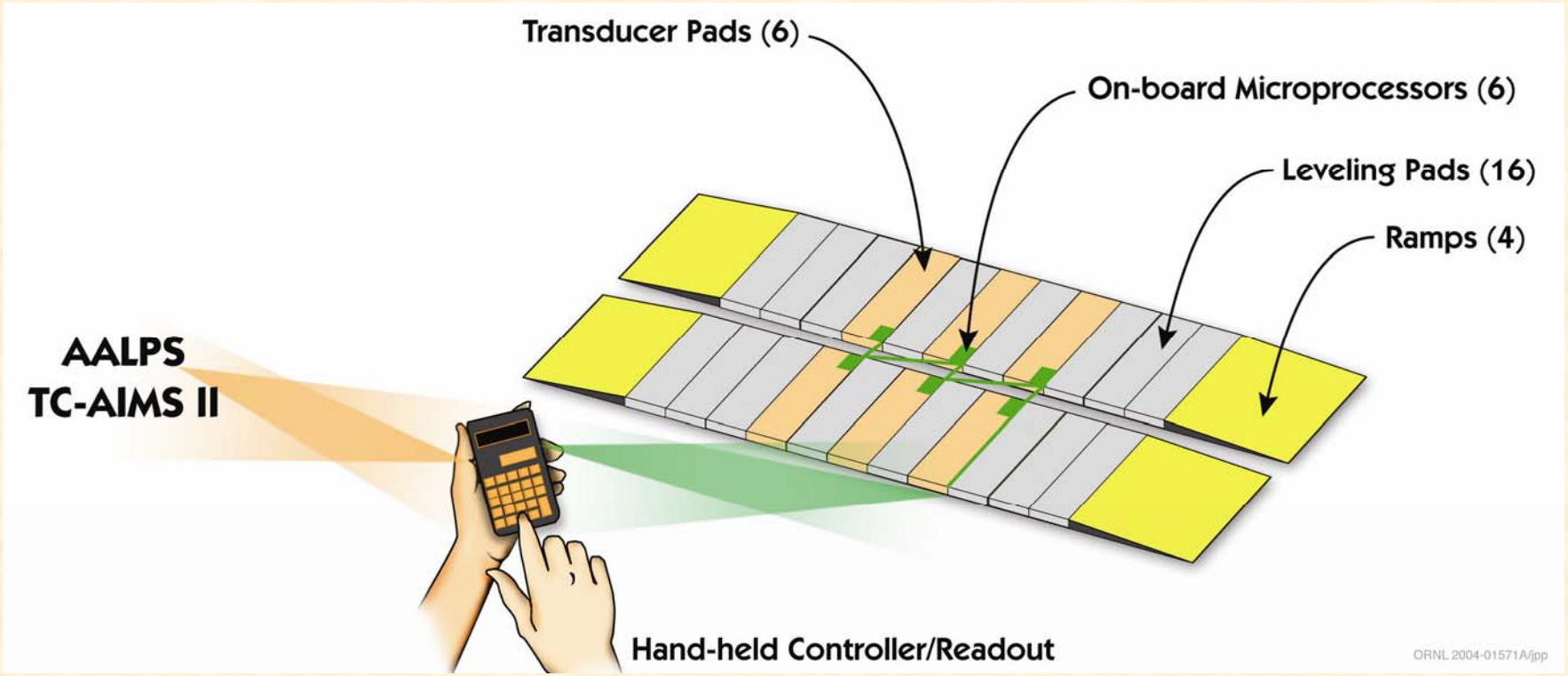
  - Enterprise-Wide Distributed Zero-Day Attack Detection

5 Ton Truck Crossing WIM
Demonstration at Ft. Bragg, NC

WIM Gen II Information Infrastructure Conceptual View



WIM Process

- **Retrieve Deployment Information**
- **Vehicle ID**
- **Weight & Balance**
  - **Dynamic/Static**
  - **Center of Balance**
  - **Actual Data processed**
- **Disseminate Actual Vehicle Information**

WIM provides the foundation to automate the monitoring of assets and their movement

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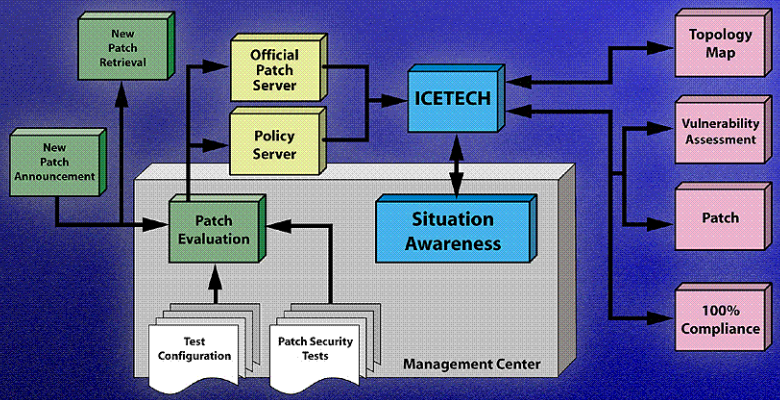
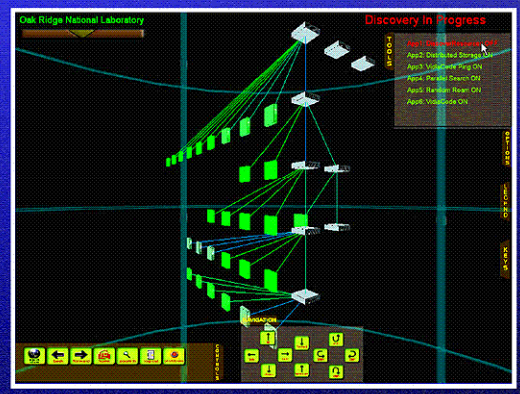
IAVA Compliance Enabling Technology (ICETECH)

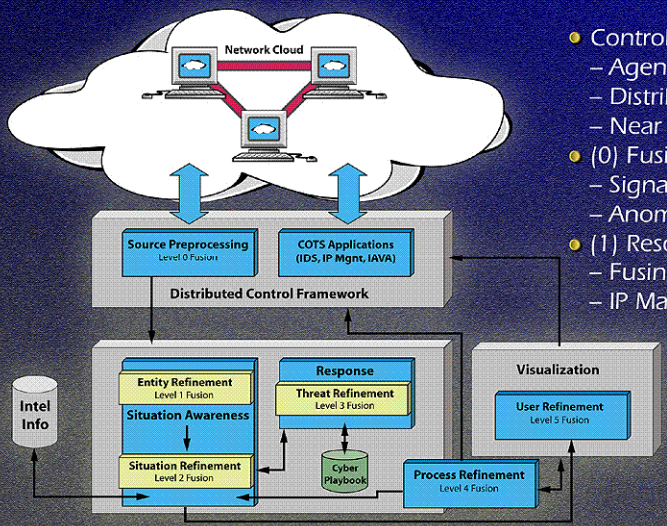
ICETECH IAVA Concept of Operations



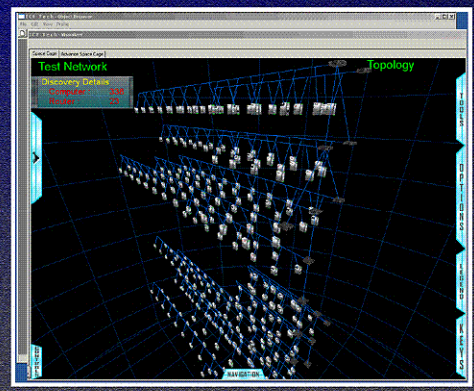
- **Goal:** Large Scale Situation Awareness and Information Assurance Vunerability Assessment (IAVA).
- Teamed effort with EigenSoft.
- Tightly coupled agent framework to monitor and control network.
  - Map the topology in near real-time including all hidden machines.
  - Assess vulnerabilities.
  - Patch vulnerabilities.
- **Current Sponsor:** Joint U. S. STRATCOM and DISA effort.
- **Demonstration Site:** U. S. Army Space Command, Colorado Springs, CO.



Cyber Situational Awareness Architecture



- Control Framework
  - Agent Based
  - Distributed
  - Near Real Time Control
- (0) Fusion of Detections
  - Signature
  - Anomaly
- (1) Resource Mapping
  - Fusing Parallel Scans
  - IP Management
- (2) Spatial Fusion
  - Source Isolation
  - Meta fusion across Domains.
  - Fusion of Alternate data.
- (3) Predictive Modeling
  - L-M Engine
  - Predictive Emulation
- (4) Real-time Refinement
- (5) Visual Fusion
  - 3-D Gaming Engine



Real-Time Resource Discovery, 3-D Topology Mapping, Monitoring

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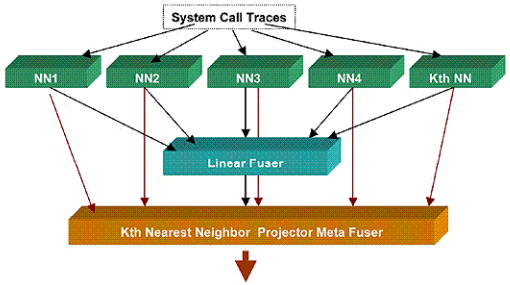
  - **Enterprise-Wide Distributed Zero-Day Attack Detection**

Enterprise-Wide Distributed Zero-Day Attack Detection

Host System Call Monitor

- Anomaly Detector
- Monitors operation of each host.
  - NN- Neutral network
  - KNN- Kth Nearest Neighbor



Illustration

- Optimal Fuser
  - Compute error regressions of information sources: project one with lowest local error
  - Fuser is better than best sub-combination
- Challenges:
  - In practice only finite measurements are given: error regressions cannot be exactly known
- Our results: **measurement-based approximation**
  - Cellular decomposition method
  - Nearest neighbor projective fuser