Real-Time Tracking of Nuclear and Radioactive Material Packages in Transport
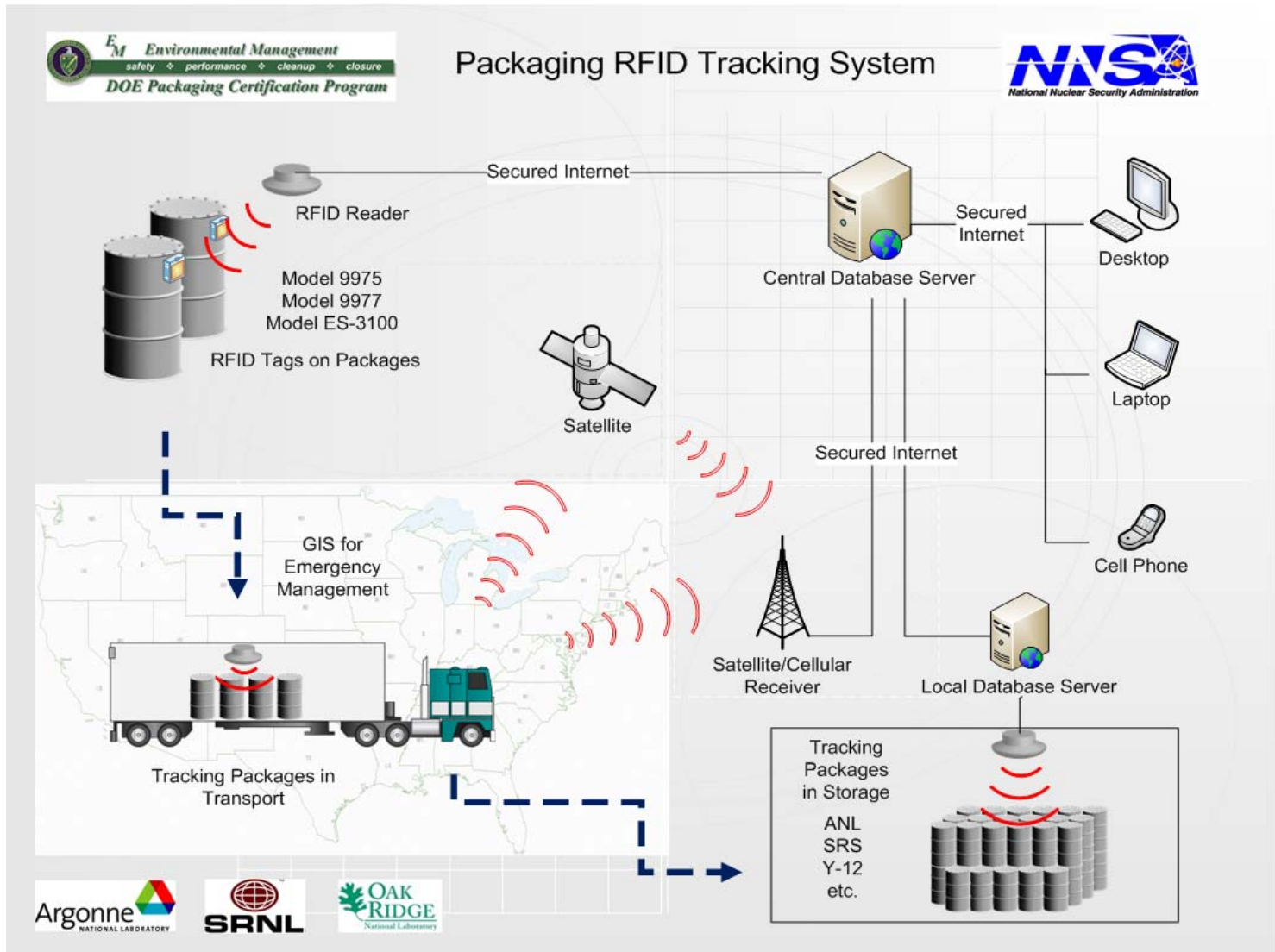
Yung Liu and Jim Shuler

PATRAM 2010
London, UK
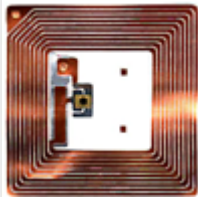**October 3-8, 2010**

Real-time tracking and monitoring – based on RFID

What is RFID (Radio Frequency Identification)?

– **Tags: to collect and send signals autonomously or when prompted**

– **Readers: to communicate with tags and receive signals**

– **Application software: to process data into information for action**

ARG-US RFID for DOE nuclear materials management

- **Potential benefits of RFID**
  - enhanced safety, security, safeguards and materials accountability
  - reduced radiation exposure and need for manned surveillance
  - real-time access of status, i.e., State of Health, and event history data, including continuous monitoring of environmental conditions of packaging for aging management
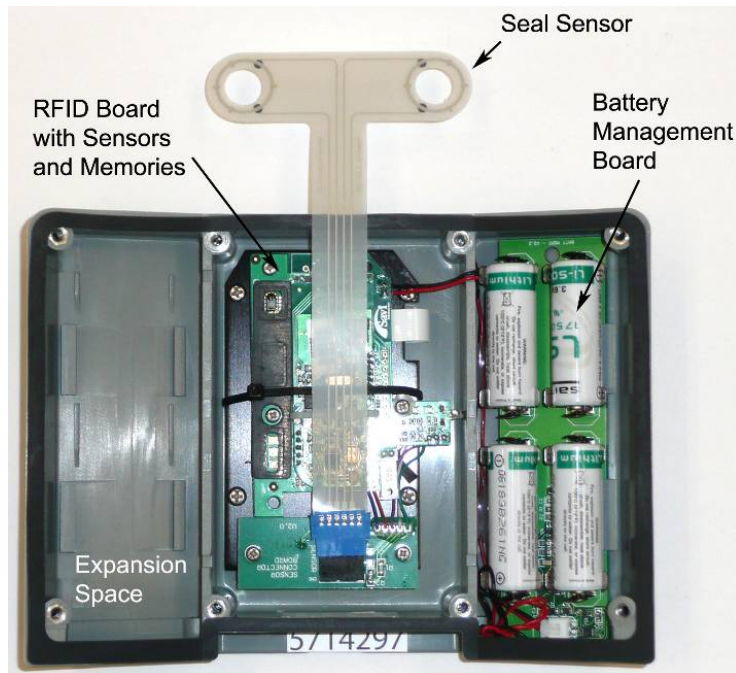 - Overall cost savings

- **Sensors and on-board memories are the key; RF acts as carrier of messages**

- **433 MHz active RFID selected for development in 2006**
  - low-power,
  - acceptable communication range (100-m), and
  - non-linear, effective communication near metal

ARG-US RFID surveillance tags — patent pending

9975

9977,9978

ES-3100

DOT 7A

Seal Sensor

RFID Board with Sensors and Memories

Battery Management Board

Expansion Space

5714297

- **Universal form factor**

- **Full sensor suite (seal, shock, temperature, humidity, dosimeter, etc)**

- **Good radiation resistance (>17 yr at 200 mrem/h)**

- **Long battery life (>10 yr)**

- **Clock and non-volatile memory**

ARG-US OnSite — copyright asserted

Web-based ARG-US platforms

Storage and Disposal ↓   Transport →

ARG-US TransPort — RFID equipment integration with Qualcomm OmniTRACS satellite communication module
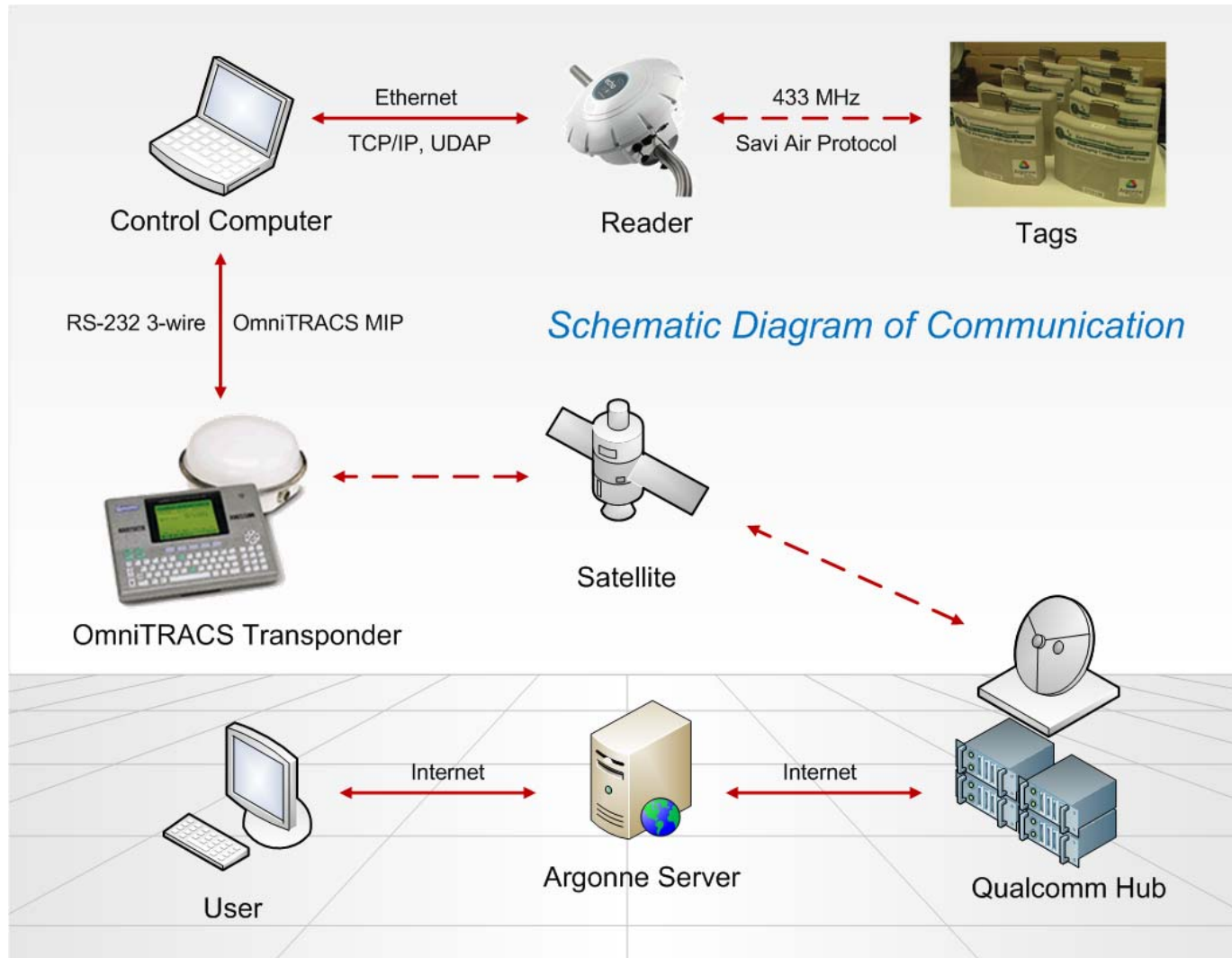
Enabling vehicles with RFID — NNSA's OSRP/GTRI

(1) The "Bid Bird" LANL truck with Qualcomm OmniTRACS satellite module

- **Install RFID equipment in truck**
- **Integrate with Qualcomm OmniTRACS**

Reader in trailer

RJ45 line in cab

(2) Dodge Sprinter van with Qualcomm OmniTRACS satellite module

- **Install RFID equipment in van**
- **Integrate with Qualcomm OmniTRACS**

Process took <1 day to complete

Enabled "Big Bird" in 300-mile road rest (3/24/2010)

https://rfid.dis.anl.gov/pcp-test/webform1.aspx

"Big Bird" road test (3/24/2010, 19:28 GMT)

https://rfid.dis.anl.gov/pcp-test/webform1.aspx

GIS (Geographical Information System) Reports

- **Issues in seconds**
- **Assists first responders**

Sprinter van road test (8/16/2010, 20:55 GMT)
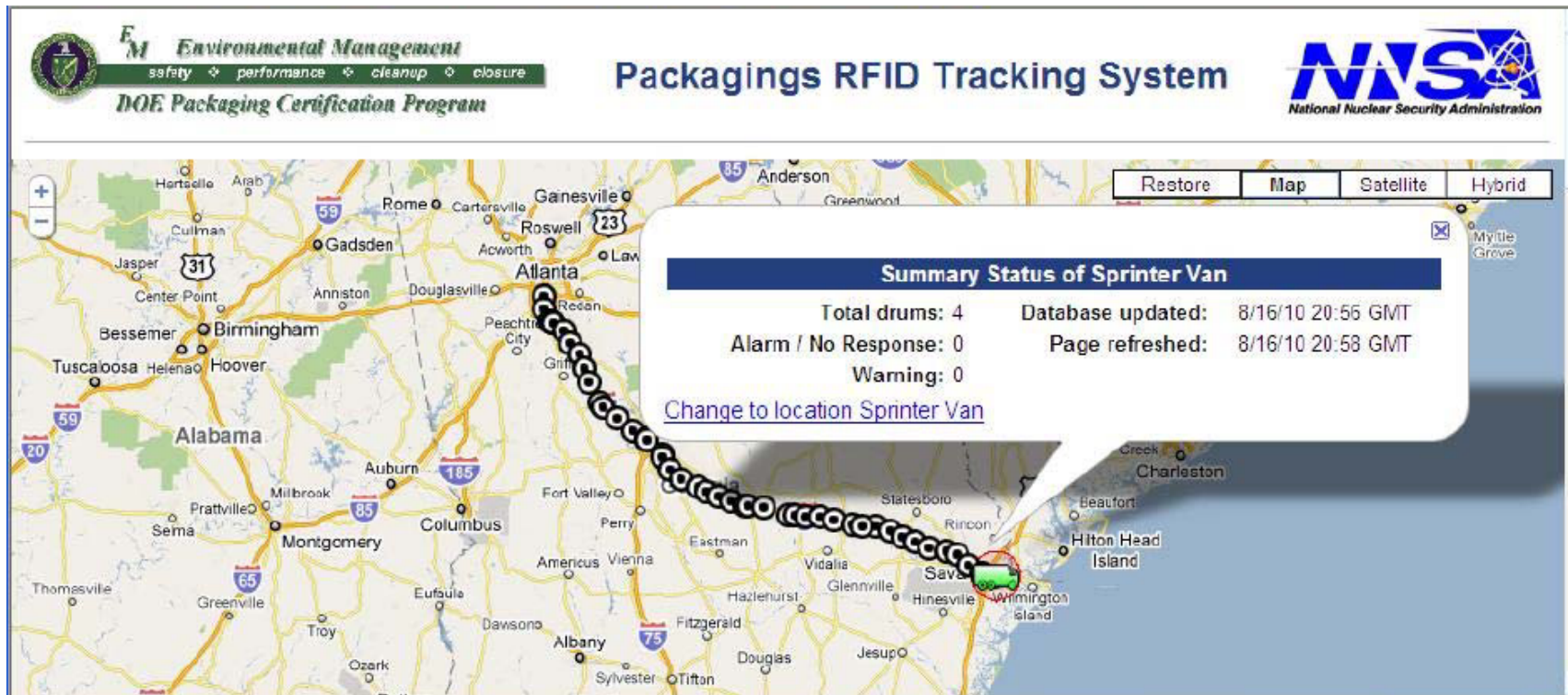
- **Viewed from a remote laptop during a DOE meeting in Savannah, GA via wireless Internet (https://rfid.dis.anl.gov/pcp-test/webform1.aspx)**

- **Tracking and monitoring performance similar in a 1-h road test conducted for a large audience on 8/18/10 across the city of Savannah and onto expressways**

Argonne Pilot RFID command center — Information for Action

- **Platform and protocol development**
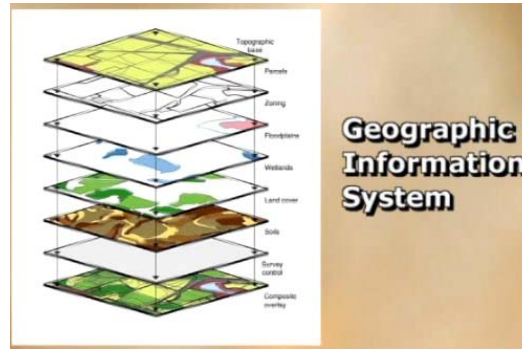
- **Training and certification**

What is real time tracking?

All messages sent at 5-min interval
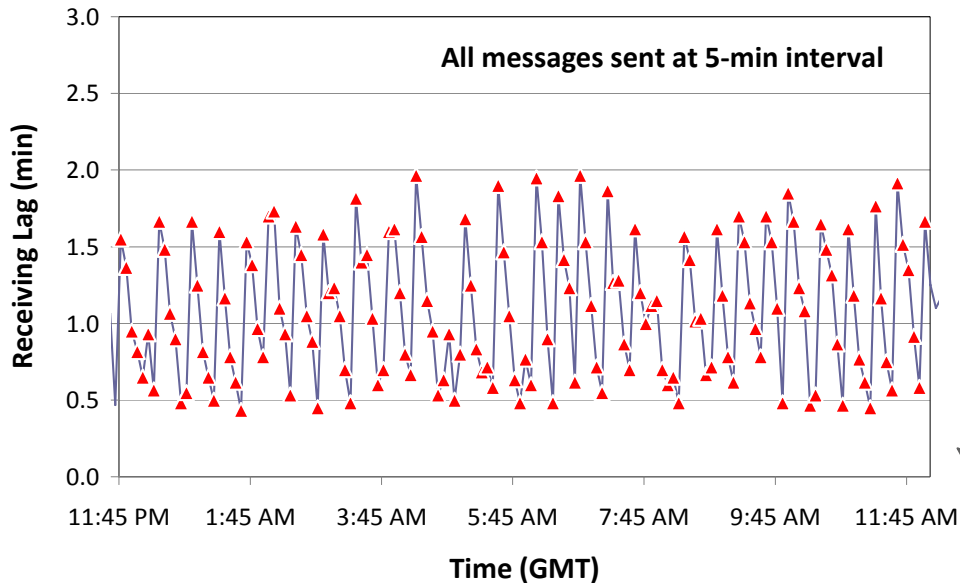
- **Inherent latency of satellite transmission of send and receipt signals from a moving vehicle**

- **Signals affected by weather, nearby tall trees, buildings, bridges, obstructions, interferences — even sharp turns**

Stationary and road tests

- **Signal delay ≤2 min in stationary test (15.3 h) and alerts/alarms during road test (7 h; 4 staged incidents)**

- **All messages received (regular and alarms)**

Four Staged Incidents

Time (GMT, 3/24/2010)
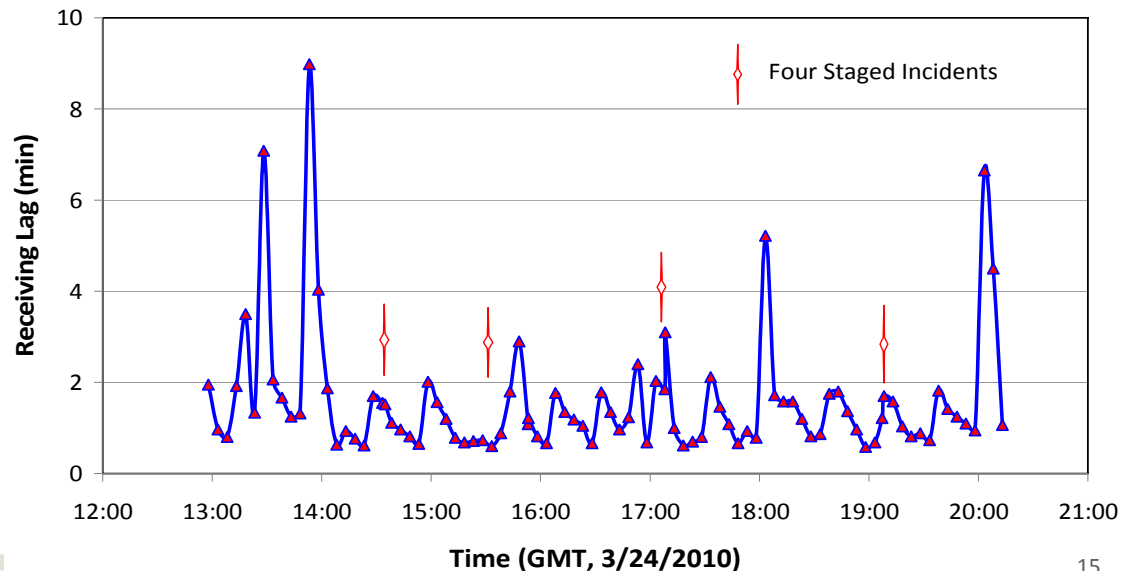
Summary and conclusions

- **Argonne has developed the ARG-US TransPort system for "real-time" tracking and monitoring of nuclear and radioactive materials packages during transportation.**

- **ARG-US TransPort combines active sensor-based RFID with OmniTRACS satellite module, GPS and GIS technologies, secure database and web servers, and a pilot command center at Argonne for end-to-end continuity of knowledge and chain of custody tracking and monitoring.**

- **Extensive testing conducted on multiple transportation platforms demonstrated that ARG-US TransPort has worked as designed, and will significantly enhance safeguards, security and safety of nuclear and radioactive materials packages during transportation.**

- **Future development of ARG-US TransPort will (1) complete its integration with DOE TRANSCOM, and (2) consider a cellular-satellite hybrid communication device for better overall signal coverage, (3) further automation by eliminating the control computer in the data pathway and incorporating its functions directly into the RFID reader.**
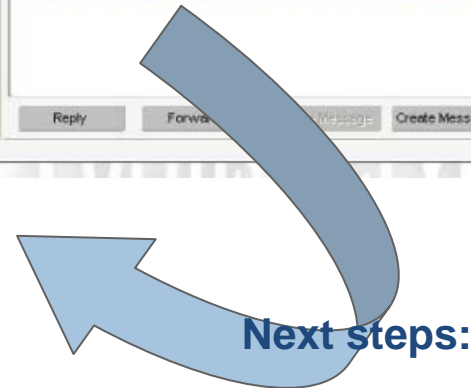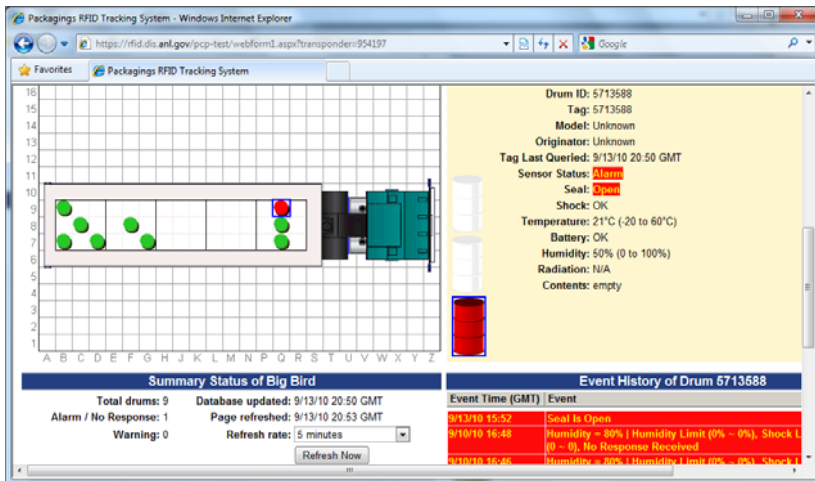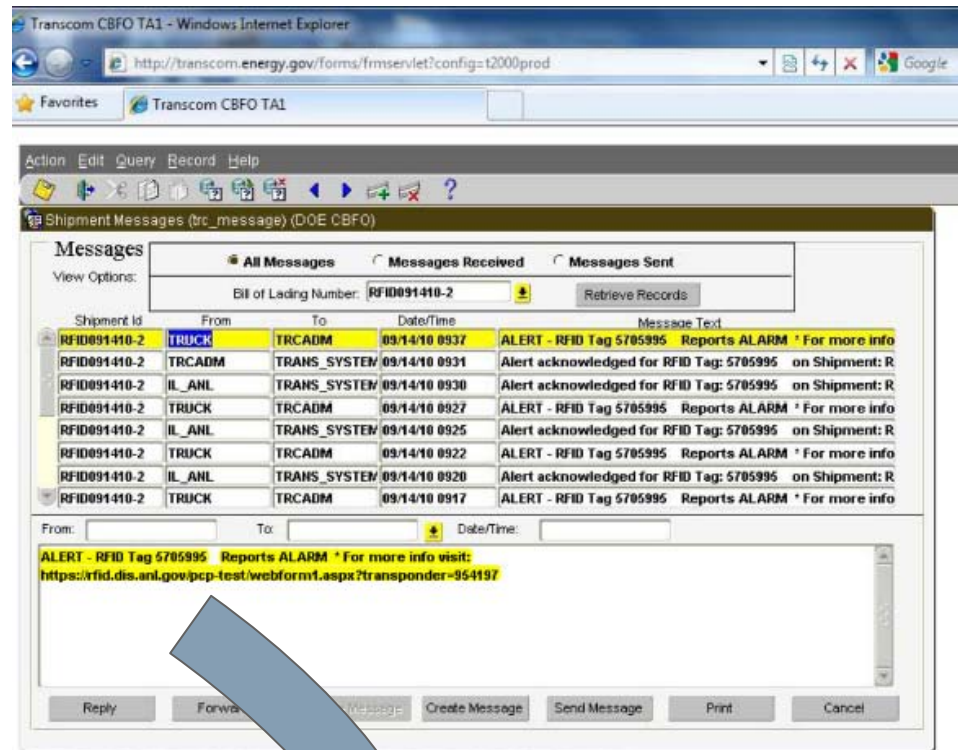
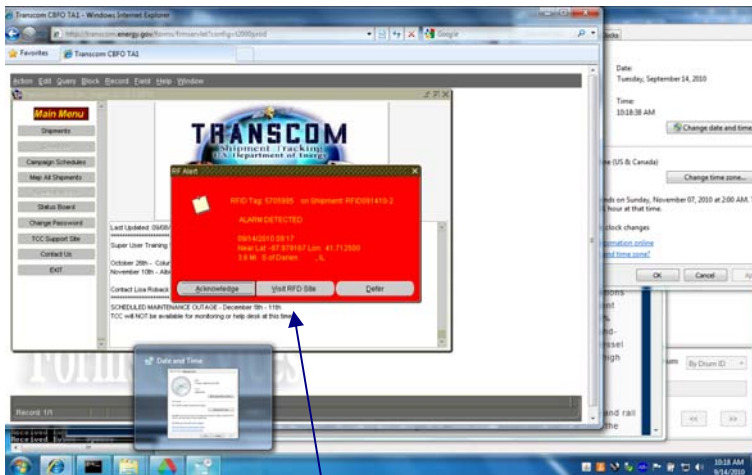# ARG-US RFID and DOE TRANSCOM — acceptance testing
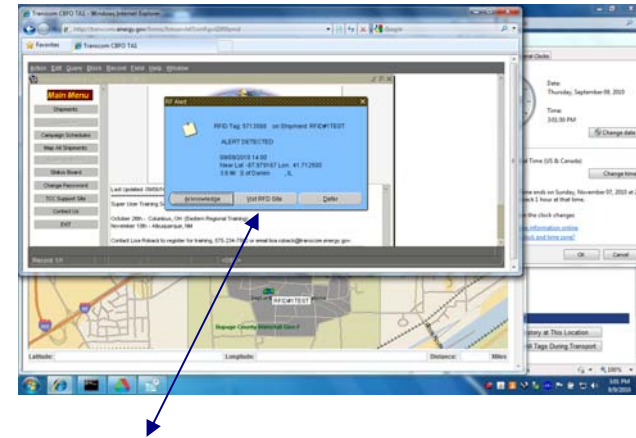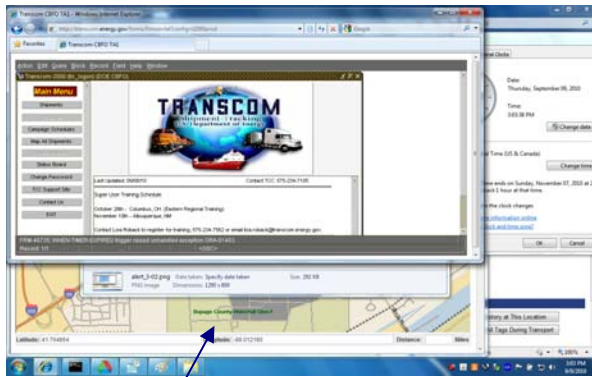
- **Sent alarm signals from one or 2 stationary transponders from Argonne at 15 min intervals**

- **Alarm window (TRANSCOM) popup ≤2 min**

- **Traffic directed to Argonne pilot RFID command center**

ARG-US RFID & DOE TRANSCOM — acceptance testing
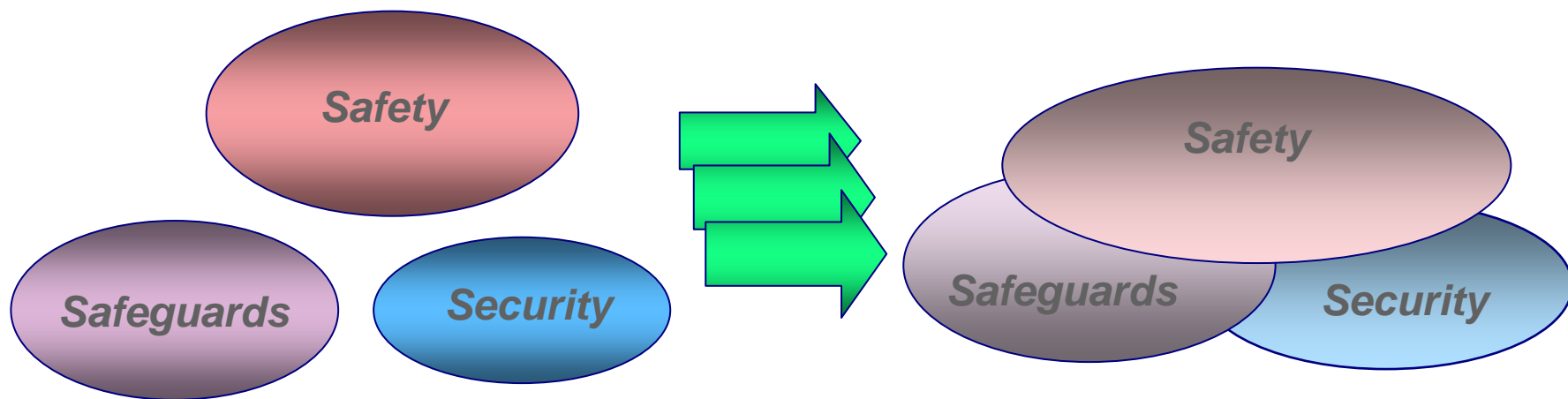

Next steps:

- **Testing with multiple vehicles**

- **OSRP shipment**

Safety, security and safeguards of nuclear and radioactive materials

- **Nuclear Safety – Accident Prevention**

- **Nuclear Safeguards – Non-proliferation**

- **Nuclear Security – Physical Protection**

A robust container-based RFID system, e.g., ARG-US, with tamper-indicating seals, 24/7 remote monitoring, and automatic alarms notification via secured Internet.