



Mitigating Container Security Risk Using Real-Time Monitoring with Active RFID and Sensors



Background

Motivation

90% of the world's goods are transported by **container**

If a **container** is tracked and its contents are monitored using the correct metrics, as the security levels of the system increase, the overall cost of international transportation will decrease; despite the cost of the system. This will occur because of the following:

- Reduced number of inspections
- Shorter waiting times at the border
- Reduced transaction exceptions

Container Types



The **dry freight** container is used primarily for any type of good that is not affected by most weather conditions. This type of container will be used for transporting goods ranging from clothing, to other packages, automobiles, etc.



Insulated containers are used for transporting goods that are more weather sensitive such as electronics, and foods that do not require refrigeration.



Refrigerated containers (known as reefers) are used for transporting goods that must remain at specific temperature and humidity levels. Examples are frozen goods, perishable foods, and medicine.



Open top containers are used in situations where the goods require very little protection from the elements. The best example is hauling dirt, or tree branches, or even garbage.

Container Types



When transported by truck, the containers are loaded onto trailer chassis. The chassis is pulled by trucks.



When transported by rail, the containers are loaded onto an empty rail car. Containers can be stacked two high (double stacked).



Containers travel on ships stacked many stories high.



It is important to note that containers are loaded and unloaded onto rail cars, ships or trucks individually
Picture taken at Intransit Rail Yards, December 2004

By Adam Schlesinger, Stephen Miles, Chris Caplice and David Brock, MIT Auto-ID Laboratory

Increasing Container Security through RFID and Sensors

Container Risks

- Stowaways & Human Smuggling
- Weapons Smuggling
- Nuclear Materials Smuggling
- Drug Smuggling
- Contamination with Chemical and Biological Agents
- Theft of Containers and their Contents (Piracy)
- Explosion or Leakage of Hazardous Materials
- Risk of Damage to Goods During Inspection

Container RFID

Container Security Device

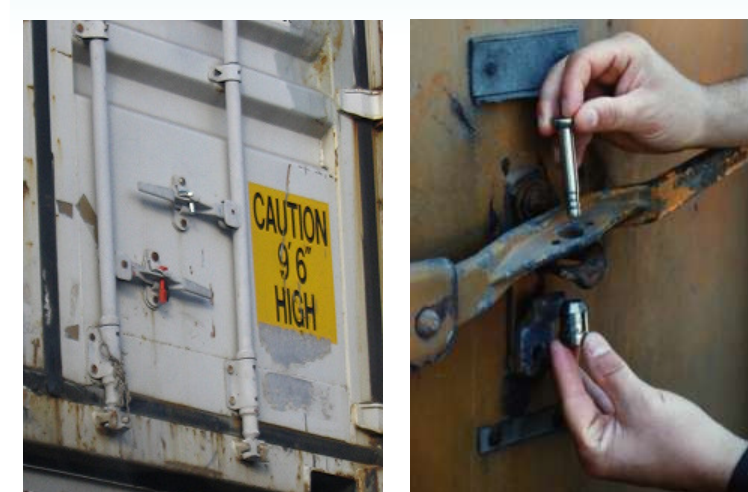


www.geindustrial.com/ge-interlogix/docs/2004-2838_Sell.pdf

"Looking to push a new technology into the nascent market for electronically securing shipping containers used around the world, U.S. conglomerate General Electric's Security division is developing a new security system that uses radio frequency identification (RFID) and can be built into a new generation of containers."

RFID Journal January 12, 2005

Container Security Systems



- Very small rubber and metal locks and/or bolts that are attached to the clasp of containers
- If broken, container will be inspected
- Known issues: containers are generally treated fairly roughly by large machinery, and seals are often damaged accidentally
- This causes unnecessary inspection

Sensors and their Application

1. Ambient Temperature
 - a. Determine if a container has been opened
 - b. Determine if a chemical reaction is occurring
 - c. Determine if a person is moving in the container and generating heat
2. Light
 - a. Determine if a container door has been opened
 - b. Determine if a fire has started
 - c. Determine if lights are changing (electronic devices such as a timer)
3. Humidity
 - a. Determine if a person is breathing
 - b. Determine if a liquid is leaking inside the container
 - c. Determine if the container itself is leaking
4. Air Pressure
 - a. If a container is sealed air-tight, determine if the seal is broken
 - b. Determine if pressure is building inside the container from heat.
5. Vibration
 - a. Determine if something mechanical is running inside the container
 - b. Determine if the container is being treated in a violent fashion
6. Sound
 - a. Determine if a person is speaking inside the container
 - b. Determine if a machine is running inside the container
 - c. Determine if items inside the container are banging or breaking
7. Acceleration
 - a. Determine damage from impact
8. Motion
 - a. Determine if someone/something is moving inside the container
9. Air Exchange
 - a. Determine if a substance is being piped into or out of the container
12. Chemical Sensing
 - a. Determine if there are explosives or toxins inside the container
13. Position
 - a. Geospatial position ensures proper routing

The 'e-Container' Sensor Suite

Phenomena and Sensors

Phenomena Sensors May Detect	Stowaways & Human Smuggling	Light	Humidity	Air Pressure	Vibration	Sound	Acceleration	RFID Tag Removal	Current Draw	Motion	Air Exchange	Explosives	Radioactive	Weapons	Chemicals
Container Breach															
Container Seal Breach															
Heat Generation															
Chemical Reaction															
Fire															
Light Level Change															
Motion															
Pressure Change															
Mechanical Activity Inside the Container															
Noise Levels															
Shock and Violent Treatment															
RFID Tags Added to Container															
RFID Tags Removed from Container															
Current Draw on Active Tag Changes															
Air Quality															
Existence of Explosive Material															
Global Position															
Existence of Radioactive Material															
Intensity of Radioactive Material															
Existence of Weapons															
Existence of Blot Drugs/Anthrax															

Phenomena and Threats

Phenomena Correlated to Identified Risks	Risks	Stowaways & Human Smuggling	Weapons Smuggling	Injection of Chemical and Biological Agents	Nuclear Materials	Drug Smuggling	Theft of Containers and their Contents (Piracy)	Explosion or Leakage of Dangerous Materials	Damage Done or Theft During Inspection
Container Breach									
Container Seal Breach									
Heat Generation									
Chemical Reaction									
Fire									
Light Level Change									
Motion									
Pressure Change									
Mechanical Activity Inside the Container									
Noise Levels									
Shock and Violent Treatment									
RFID Tags Added to Container									
RFID Tags Removed from Container									
Current Draw on Active Tag Changes									
Air Quality									
Existence of Explosive Material									
Global Position									
Existence of Radioactive Material									
Intensity of Radioactive Material									
Existence of Weapons									
Existence of Blot Drugs/Anthrax									

Threats and Sensors

Sensor Choice Model for Container Risk Mitigation	Stowaways & Human Smuggling	Light	Humidity	Air Pressure	Vibration	Sound	Acceleration	RFID Tag Removal	Current Draw	Motion	Air Exchange	Explosives	Radioactive	Weapons	Chemicals
Stowaways & Human Smuggling															
Weapons Smuggling															
Injection of Chemical and Biological Agents															
Nuclear Materials															
Drug Smuggling															
Theft of Containers and their Contents (Piracy)															
Explosion or Leakage of Dangerous Materials															
Damage Done or Theft During Inspection															
Interfering with the RFID tag															

Sponsors: EPCglobal, Altria, Intel, Raining Data and Reva Systems