Advanced Mission Module Autonomy

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Agenda

- Automated System Overview
- MPAIIS
- MPAIIS Accomplishments
- MST
- MST Accomplishments
- Summary

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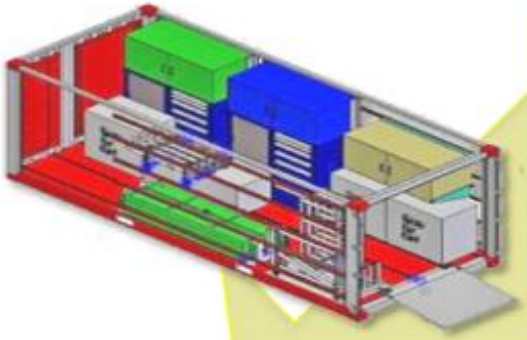
Advanced LCS Support Container Autonomy

Using Automation to Reduce Workload

- Remote Operation and Control
- Inventory Management and Control
- Environmental Status
- Occupancy Status



- Automated Pre and Post Mission Operations
- Real-time System Condition & Status
- Automated assembly and maintenance

Autonomous Transport To Launch/Recovery

Project focus on capability to operate and maintain LCS Mission Systems with minimal human assistance.

LCS Mission Package Automated Inventory Information System

Description:

- A first-of-it's-kind RFID-based automated inventory system
- Operation inside standard metal tool cabinets. No special modification is required.
- Passive RFID tag/type emplacement enables multiple tool and support equipment configurations
- Unique software developed by NSWC PCD provides easy system management
- Remote inventory capability

Warfighter Payoff:

- > 96% inventory accuracy in less than 2 minutes
- 100% repeatable
- 99% workload reduction to perform inventory
- Remote inventory capability enables automated replenishment
- Significant Total Ownership Cost reduction

Accomplishments:

- Designed, developed, and installed a prototype passive Radio Frequency Identification (pRFID) System in an LCS support container
- Technology Transition Agreement signed
- Exceeded TTA performance goals
- Patent applications submitted for unique concept(s)
- Spawning several local efforts

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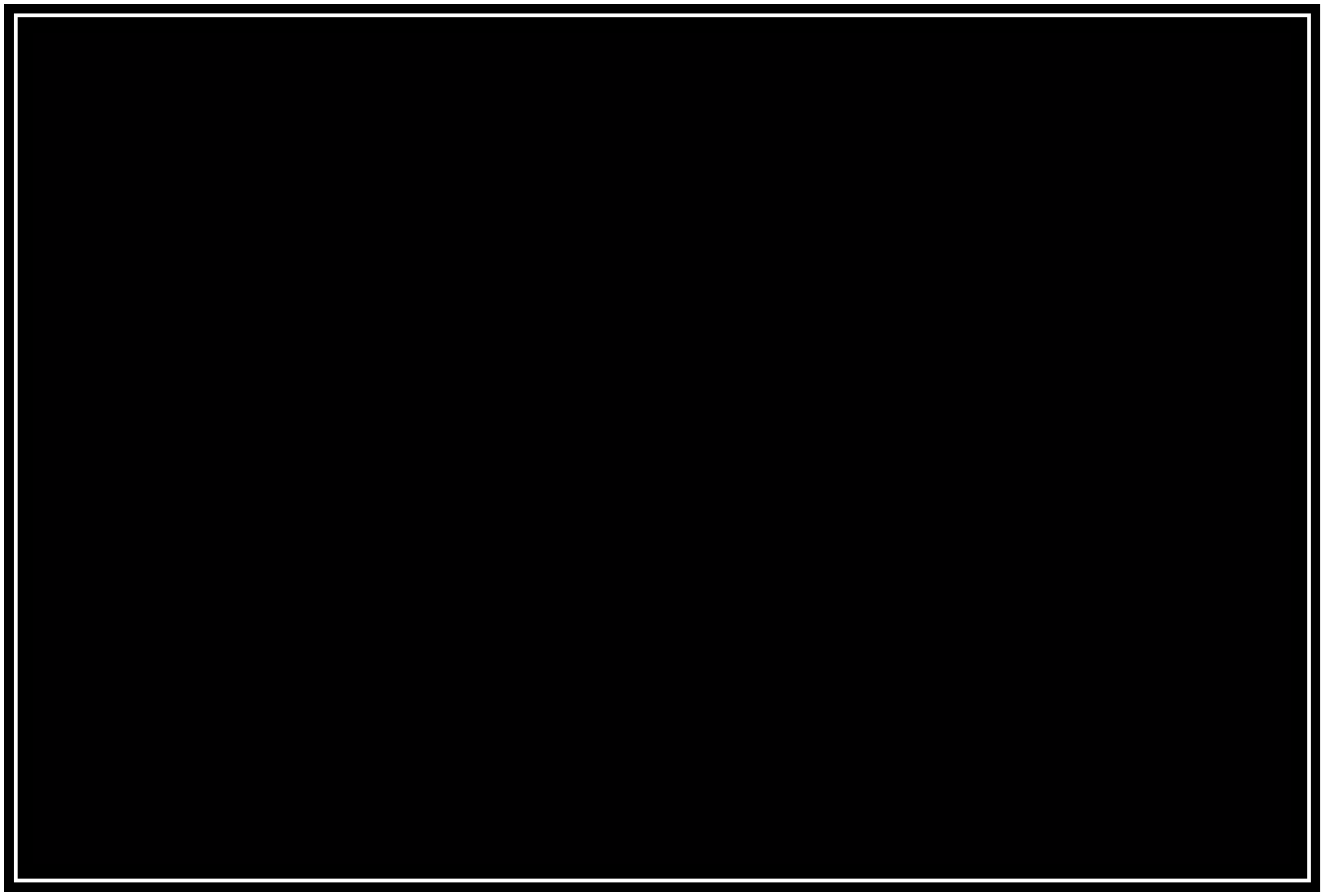
Mission Package Automated Inventory Information System (MPAIIS)



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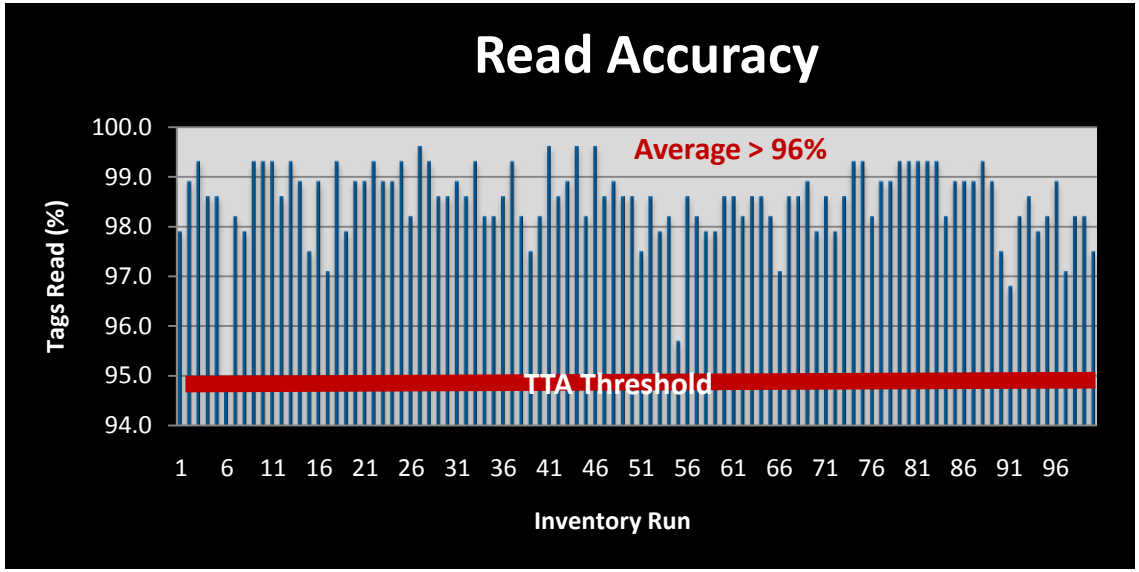
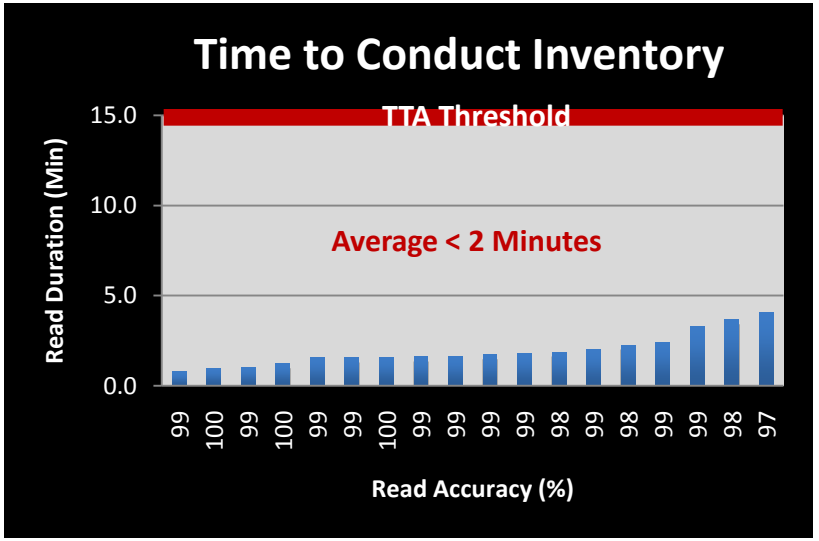
Demonstration Results



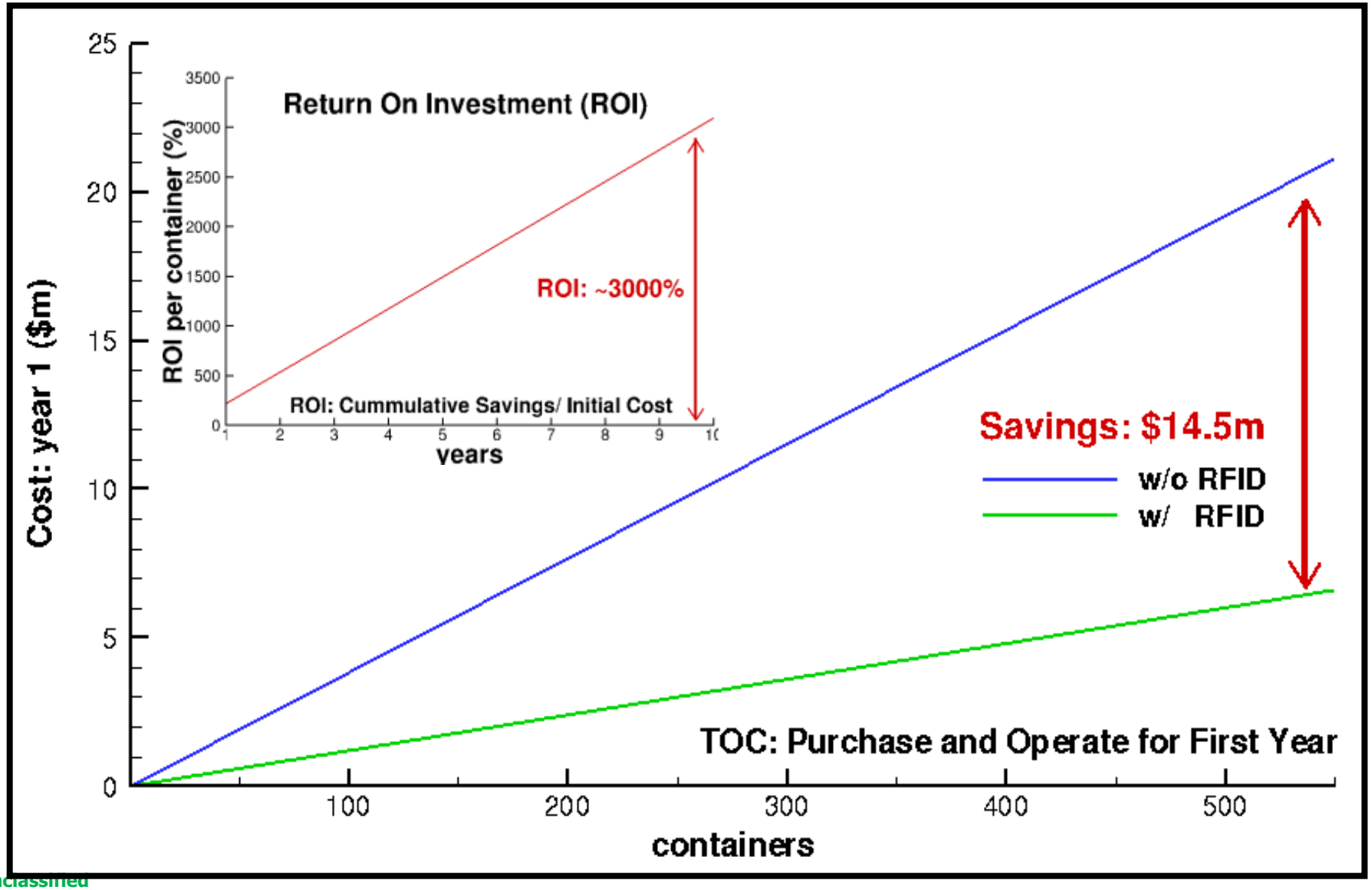
EXCEEDED ALL TTA PERFORMANCE GOALS

TTA GOALS		
Attribute / Parameter	**Threshold**	**Actual**
Inventory accuracy	95%	**> 96%**
Man-hours required to conduct inventory	15 minutes	**Average < 2 minutes**
Repeatability of inventory accuracy	95%	**100%**
Human factors	50% reduction in inventory workload	**99% * reduction in inventory workload**

* Based on a 32-hour inventory

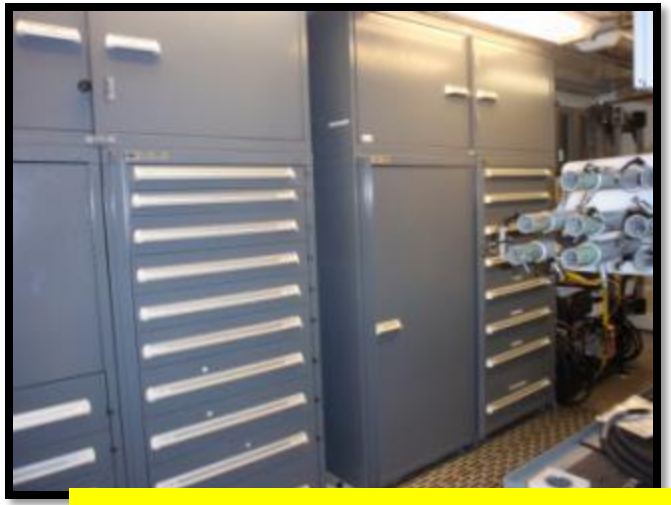


MPAIIS Total Ownership Cost (TOC)

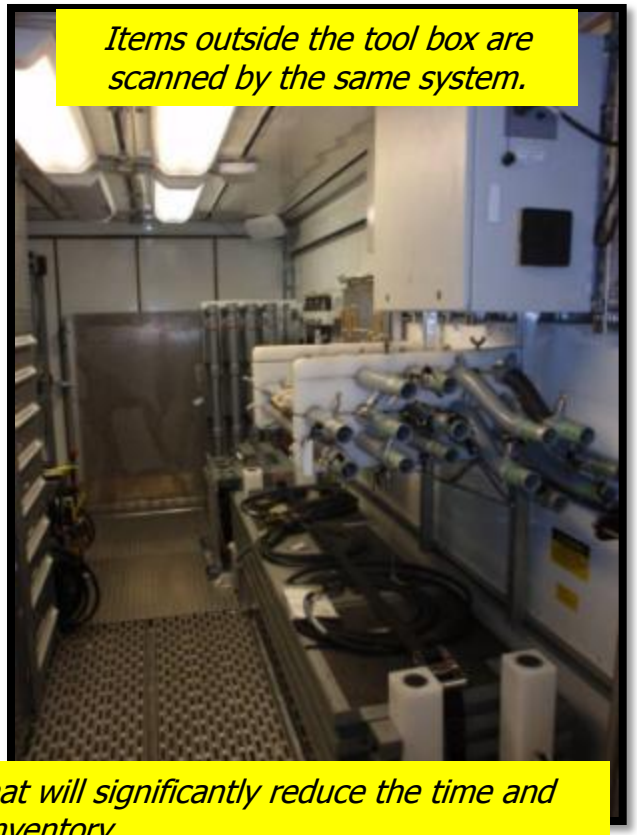


LCS Remote Minehunting System Support Container with the Mission Package Automated Inventory Information System (MPAIIS) installed

Unique passive RFID system installed inside shipping container with tools/parts in a metal tool box. No special modifications to the tool box are required.



Items outside the tool box are scanned by the same system.

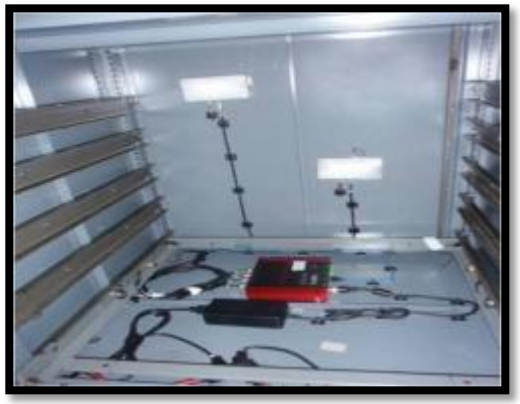


A first-of-it's-kind RFID-based automated inventory system that will significantly reduce the time and labor required to perform an inventory.

Supporting Technologies

Mission Package Automated Inventory Information System

Custom System Designed by NSWC PCD

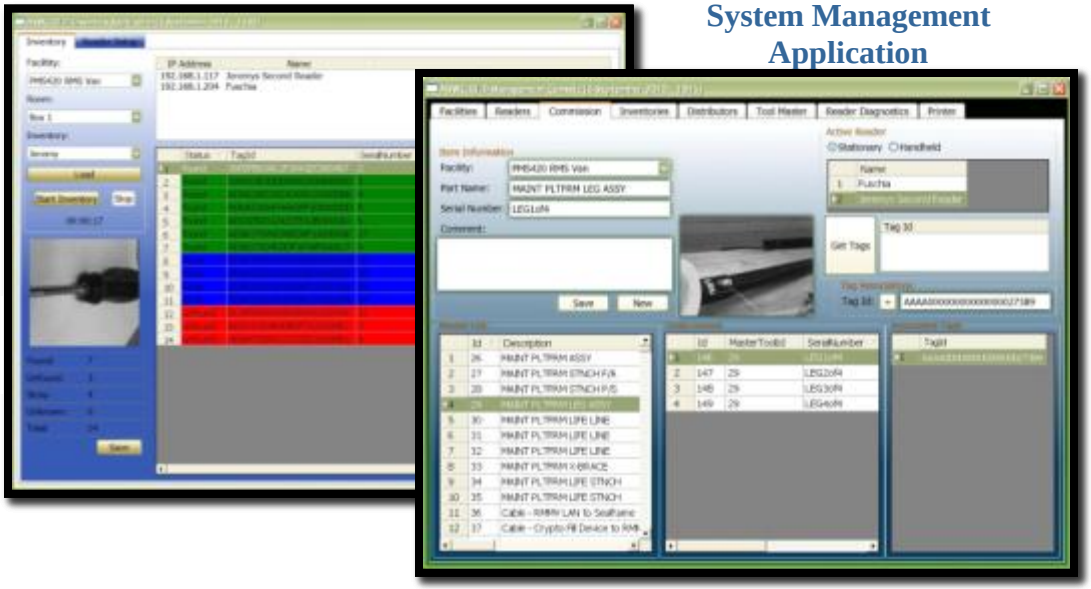


Extensive Experimentation with Passive Tags

NSWC PCD Software to Control the System

Inventory Application

System Management Application



Significant Accomplishments

Mission Package Automated Inventory Information System

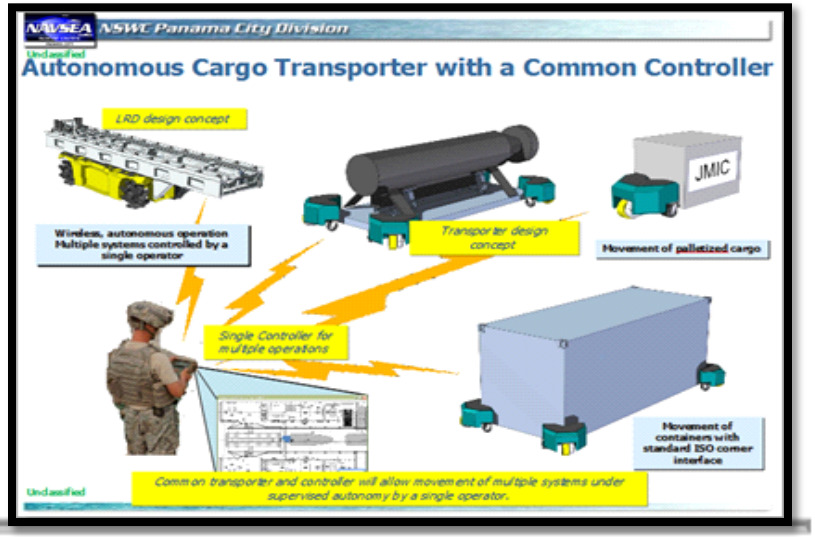
- Designed, developed, and installed a prototype passive Radio Frequency Identification (pRFID) System in the Remote Minehunting Vehicle (RMV) support container.
- Designed and fabricated unique antennas that provide the capability to automatically (i.e., without human assistance) inventory parts and supplies that are stored inside metal tool boxes.
- Designed and implemented a unique software application that integrates RFID hardware management, inventory, and database management capabilities.
- Completed significant experimentation to determine the best configuration of pRFID tags, tag placement, materials, and application methods for the parts and supplies within the container.
- Data to support the feasibility assumptions for level of effort (cost) and return on investment (ROI) validation for the turn-around time at the LCS mission package support facility (MPSF) were collected and validated.
- The MPAIIS was demonstrated on board the SEA FIGHTER (2011 MCM S&T Demonstration).
- A Technology Transition Agreement was signed.
- The System exceeded TTA performance goals.
- Patent applications submitted for unique concept(s).
  - Patent application titled, "RFID System for Use In Storing and Inventorying Items" was recently filed with the U.S. Patent and Trademark Office
- Spawning several local efforts.

Mission System Transporter

Description:

Platforms for Autonomous Transport of LCS Mission Systems

- Simultaneous operation of multiple platforms using one controller
- Omni-directional/holonomic platform mobility for precise maneuverability in tight spaces
- Common JAUS-based controller design
- Autonomous RFID-based navigation/control design



Warfighter Payoff:

- Significant manpower reduction
- Weight reduction on LCS
- Enabler for workflow efficiencies
- Removes sailors from harm's way and allows for mission-centric focus
- Total Ownership Cost
- Reduction

Accomplishments:

- System Design Concept
- ¾-Scale RMV model and cradle
- Two technology demonstration platforms
- Developed JAUS-based control architecture
- Common operator control unit development
- Functional system demonstration
- RFID-based navigation

- Developed simulation for autonomous control

Unclassified

Mission System Transporter Technology Demonstrator Concept

Modifications

- Cradles
- On-board Controllers
- RFID-based Navigation System
- Human Interface
- Demo Payloads (¾-Scale RMV, LRD)

The MST provides a high precision omni-directional capability to move heavy objects in a crowded ship environment.

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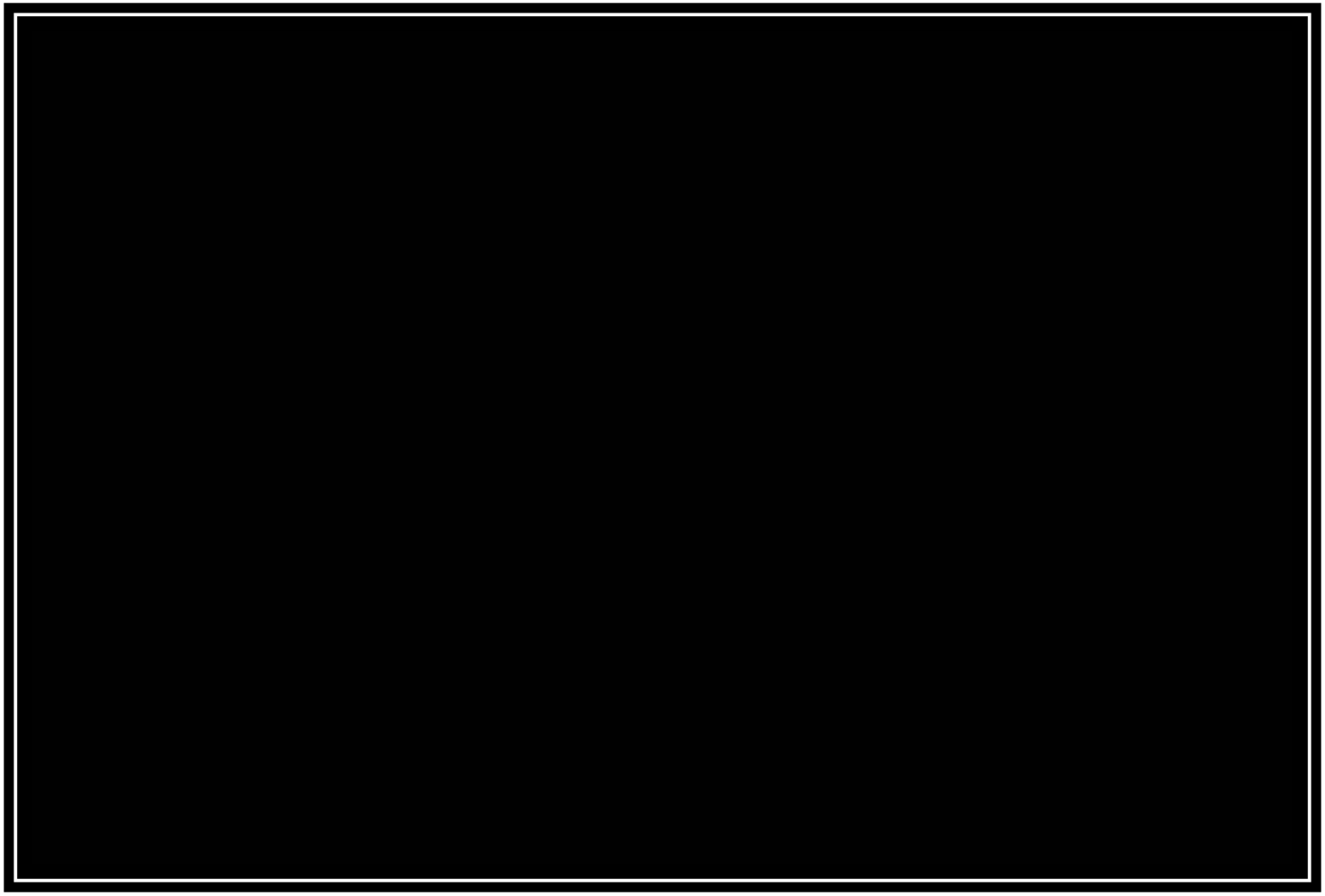
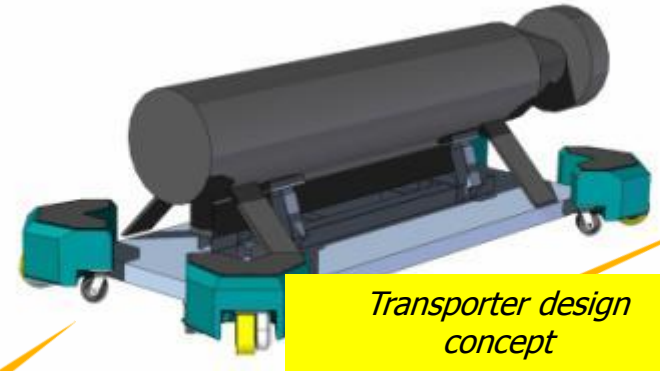
Mission System Transporters Movie



Autonomous Cargo Transporter with a Common Controller

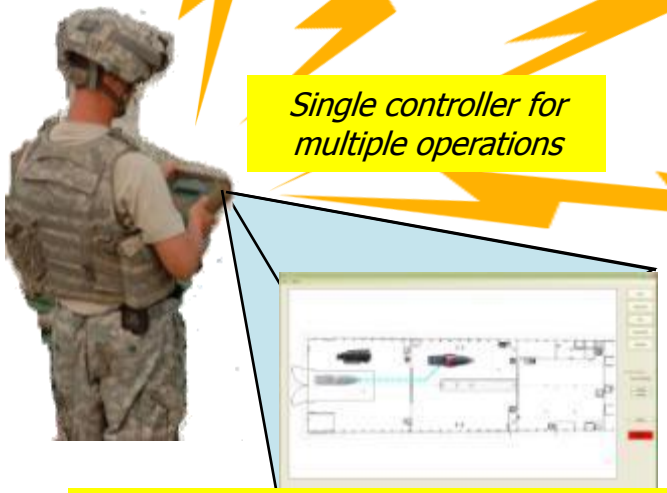
LRD design concept

Wireless, autonomous operation. Multiple systems controlled by a single operator.

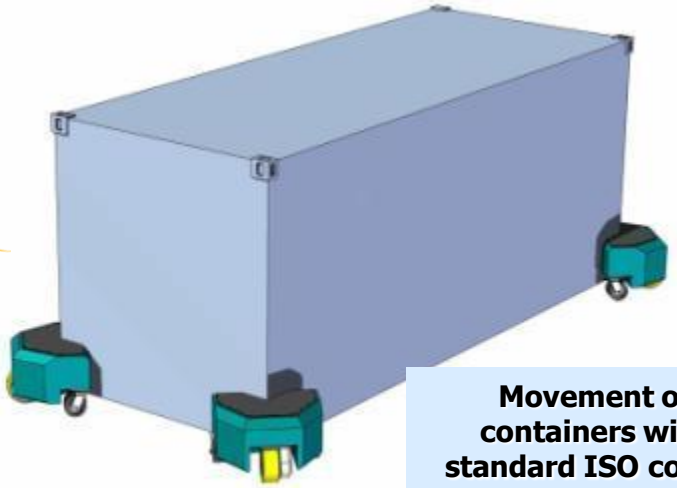


Transporter design concept

Movement of palletized cargo



Single controller for multiple operations



Movement of containers with standard ISO corner interface

Common transporter and controller will allow movement of multiple systems under supervised autonomy by a single operator.

Significant Accomplishments

Mission System Transporter

- Modified two platforms to demonstrate the feasibility of supervised autonomous control of multiple vehicles within the operational context of the LCS unmanned systems concept.
- Designed and built the user interface hardware and software controller to control the demonstration platforms using a wireless network.
- Designed and built a ¾-scale Remote Minehunting Vehicle (RMV) mass model to be one of the payloads for the demonstration platforms. Two payloads were used – the RMV mass model and an existing launch and recovery device for an unmanned underwater vehicle (UUV).
- Key components of the MST were demonstrated on board SEA FIGHTER
  - Two technology demonstration platforms
  - Developed JAUS-based control architecture
  - Common operator control unit development
  - Functional system demonstration
  - RFID-based navigation
- Patent applications submitted for unique concept(s)

Summary

- Completed to date
  - ✓ Prototype Mission Package Automated Inventory Information System (MPAIIS) developed and installed in RMS support container
  - ✓ Key components of the Mission System Transporter (MST) have been developed and demonstrated
  - ✓ Significant Total Ownership Cost savings potential
  - ✓ ONR MCM S&T Demonstration June 2011
- Way Forward
  - ❑ Operational testing of the MPAIIS at the Mission Package Support Facility
  - ❑ Common operator control unit and RFID-based vehicle navigation system development
  - ❑ MPAIIS integration with Navy Automatic Identification Technology program(s)
  - ❑ MPAIIS design improvements

QUESTIONS?

ONR MCM S&T Demonstration

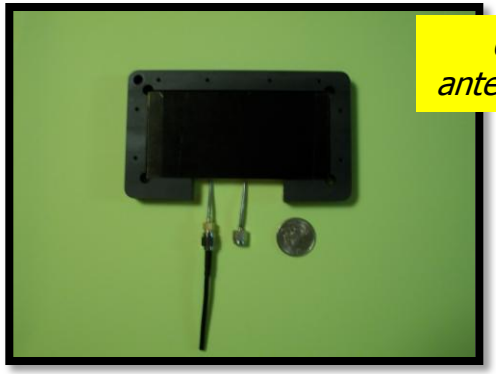
June 2011

Remote Inventory of LCS Support Container

RFID-based Vehicle Navigation System

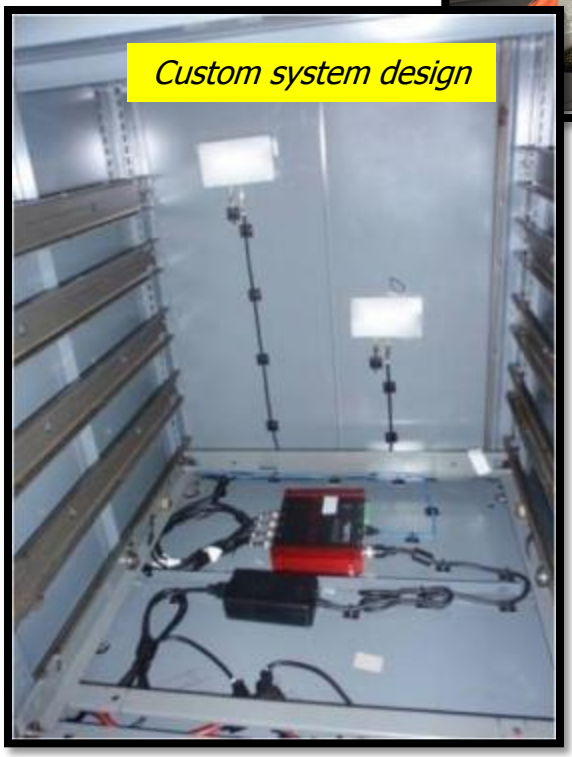
Supervised Vehicle Control with a Common Controller

Key Mission Package Automated Inventory Information System (MPAIIS) Components



Custom antenna design

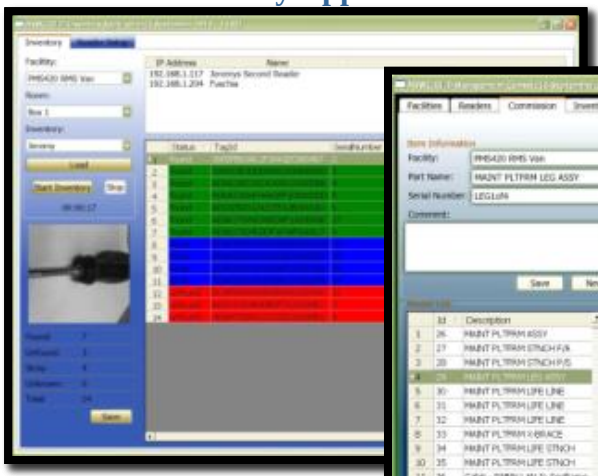
*Extensive experimentation with **passive** RFID tag emplacement*



Custom system design

Government -developed software to control the system

Inventory Application



System Management Application