

# **Naval Total Asset Visibility**

# **Precision Asset Location**

**UWB MURI Review** 

**Baltimore, Maryland** 

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# Overview

- Problem: Desert Storm
- Logistics Application
  - Navy Total Asset Visibility (NTAV)
- Technical Challenges
  - Shipboard RF Environment
- Precision Asset Location (PAL)
  - WhereNet DSSS RTLS
- NTAV PAL Tests
  - Shipboard: Open Space, Blockage
     <u>UWB Environment</u>
  - Test Objectives
- Test Results
  - WhereNet
- Point of Contact



### **Problem: Desert Storm**

#### **Desert Storm**

#### First MRC with ISO Containers

- 40,000 Containers, Opened 25,000
  - » Paper Manifests Were Inaccurate and Easily Lost
- ISO Containers <u>Hid the Stuff</u> » Previous MRCs Used Break Bulk
- Misplaced & Lost Stuff = \$3 Billion
   » GAO Report B-246015, Dec 1991

#### The Four BIG Questions

- What Do I Have?
- Where Is My Stuff?
- What Is In the Box?
- What Is Its Condition/History?





# **Logistics Application**

### **Naval Total Asset Visibility (NTAV)**

- Precision Asset Location (PAL)
  - Where's my Stuff?
  - State-of-the-Art DSSS RTLS = 10 ft
  - Objective: <u>1 ft Accuracy</u>

### • Autonomous Manifesting (AM)

- What's in the Box?
- The "Holy Grail of Logistics"
- Objective: <u>1 in Accuracy</u>

### Infrastructure Reduction (IR)

- Cost Reduction (\$K's/Reader)
- Ad-Hoc Installation & Networking

### • Transportation is a \$0.5T Industry

- DoD is Largest Purchaser of Transportation



# **Technical Challenges**

### **Shipboard Environment**

- RF Environment
  - Multipath
    - » All Metal, 30-40 dB Nulls
    - » Analog RF Does Not Work Reliably
  - Reflections are Often Stronger Than Direct Signal
  - Electromagnetic Issues
    - » Electromagnetic Interference (EMI) & Compatibility (EMC)
    - » Hazards of Electromagnetic Radiation on Ordinance (HERO)

#### Seabasing / MPF Operational Issues

- Location Accuracy
- Mis-Reads
- Blocking

#### ISO Containers

- Stacked Container Blockage



(Size = Required Accuracy)

(Dead Spots = Inventory Errors)

(Masking & No Direct Line of Sight)

## **Precision Asset Location**

#### **WhereNet**

#### Real-Time Location System (RTLS)

- Beacon System
  - » Differential Time of Arrival (DTOA)
  - Long Tag Battery Life, 5-7 years
    » Accuracy: 10 ft (67%) / 6 ft Resolution
    » Range: 750 ft Out / 250 ft Indoors

#### • Architecture

- ISM II Band / DSSS
  - » 2.45 GHz, 1 mW Peak, Unlicensed

- DSSS

- » 511 Chips/Bit, 27 dB Process Gain
- » 30 Mchips/sec, 60 MHz Bandwidth
- » 17 Gops/sec Custom ASIC Processor
- Star Architecture -- Calibrated Cables » 2nd Generation: Wireless 802.11b LAN





# **NTAV PAL Test**

#### **Shipboard Tests**

#### SS Curtiss

- MPF Capable

### Open Space Accuracy

- Reference Laser System: 1/8 inch
- Grid: 10 ft & 2.5 ft -- 1 Mile of Tape
- Test Sled: Tags at 4, 8 & 12 ft

### Container / Blockage

- 20 ft ISO Containers and HMMWVs

### UWB Environment Testing

- USC Ultra Lab -- Delay Spreads
  - » Pulser / Sampling Scope
  - » Network Analyzer



# **NTAV Shipboard Test**



#### **Objectives**

- Two Technologies
  - DSSS WhereNet COTS
  - UWB MSSI Emerging

#### Open Space

- Do DSSS & UWB Work in Ships?
- Are There Dropouts/Dead Zones?
- What Are the Accuracies?
  - » Correlated with Laser Surveying System

#### Container Blockage

- What are Affects of Blockage?
- What are Optimum Tag and Antenna Locations?

#### Environment Characterization

- How Long Are the Delay Spreads?
- What Are the Effects of Blockage?





## **Test Results**

#### **WhereNet**

- Open Space
  - 8 Antennas
- Tag Reports
  - Correlated With Laser Surveying System
- Accuracy
  - 6 ft RMS
- Trends
  - Offset: 2 ft Stbd
  - Away From Corners



### **Point of Contact**



#### **Principal Investigator**

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FIG. 8. — HIGH-POWER OUTFIT, WITH ROTATING SPARK-GAP MOUNTED ON LEYDEN - JAR BATTERY FRAME, AND HOT-WIRE CURRENT METER MOUNTED ON INDUCTANCE FRAME. —Navy Yard, Washington, D. C.

#### UWB (Ultrawideband) Transmitter Ca 1908