



**LOCKHEED MARTIN**



# Flightline of the Future Through Asset Visibility

September 23, 2020

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Senior Program Manager, Advanced  
Logistics Technologies and Concepts







**AERONAUTICS**



**MISSILES AND FIRE CONTROL**



**SPACE SYSTEMS**



**ROTARY AND MISSION SYSTEMS**





# Agenda



- **What is iTrakG?**
- **F-35 Asset Tracking Program**
  - Lockheed Martin's unique requirements and challenges
  - System overview
  - Stakeholder Improvements
- **Glimpse into new R&D Initiatives**





# ITrakG.....The Beginning



iTrakG is a real-time asset tracking and inventory management enterprise system to improve asset accountability. It is an agnostic Enterprise P2P asset tracking system that was specifically co-developed from Curo International's original iTrak software which has been in use by the VA and US Navy since 1986.

Core elements included:

- Item Level Tracking and Inventory
- Asset Tracking and Management
- Parent-Child Relationships
- Purchasing & LM P2P Integration
- Software and IT Assets
- Maintenance Contracts
- Local & Enterprise Reporting
- pRFID integrated with iPhones



LOCKHEED MARTIN										Purchase Requisition Form		P2P REQUESTION	
Check ACTION Box That Applies: <input checked="" type="checkbox"/> New <input type="checkbox"/> Change <input type="checkbox"/> Delete <input type="checkbox"/> Supporting Docs										To: Ellen Kondrath (856) 792-4620 ellen.kondrath@lmc.com		Today's Date: 17-OCT-2016 Period of Performance Date: 01-MAR-2016 - 29-FEB-2017 Expected Delivery Date: 24-OCT-2016	
Requester: Wayne Burke										Phone: 301-947-9200		Original PO/PR/PRR: CERF if Applicable: PR Line Item: Vendor LM Code:	
Point of Contact for Delivery: Adam Shannon Invoice Approver Name & WTB #: Jeannette Taylor Ship To Address: 12321 Middlebrook Road, Suite 200 (Valid LMCO Address Required for ALL Requests) Germantown, MD, 20874										Company Code: 4 Digits 000 Cost Element or General Ledger #: 8 Digits 00 Cost Center or Cost Object or WBS #: Up to 10 Digits 02		Account Break Down: Cost Object: 1 Letter 0 * Multiple or deliver account numbers per line, insert acct # in description field below and also, if account # is for 12 digit, indicate percent.	
BUYER NAME (Use Drop Down Arrow): *DEFAULT - NON IT (GA2)										Check if Account Override is required for invoice processing (allows invoice to be paid against different account numbers)			
SW or HW	Goods or Service	Expense or Capital	Allowable or Unallowable	QTY	PER	Item Description of product or service being ordered. Provide separate lines for each item. <u>Item Description below</u>	Material Group Code	Unit Price	Total				
HARDWARE	SERVICE	EXPENSE	ALLOWABLE	1	EA	(1004571 - 6047 5003) 3825 Cisco network router	43000000 - COMPONENTS FOR IT OR BROADCASTING ON TEL	15.00	15.00				
									TOTAL:	15.00			

Some key notes to provide in the text fields below should include: a description of the service being procured, who its for, what the period of performance is, where its to be performed, etc...





# iTrakG Overview

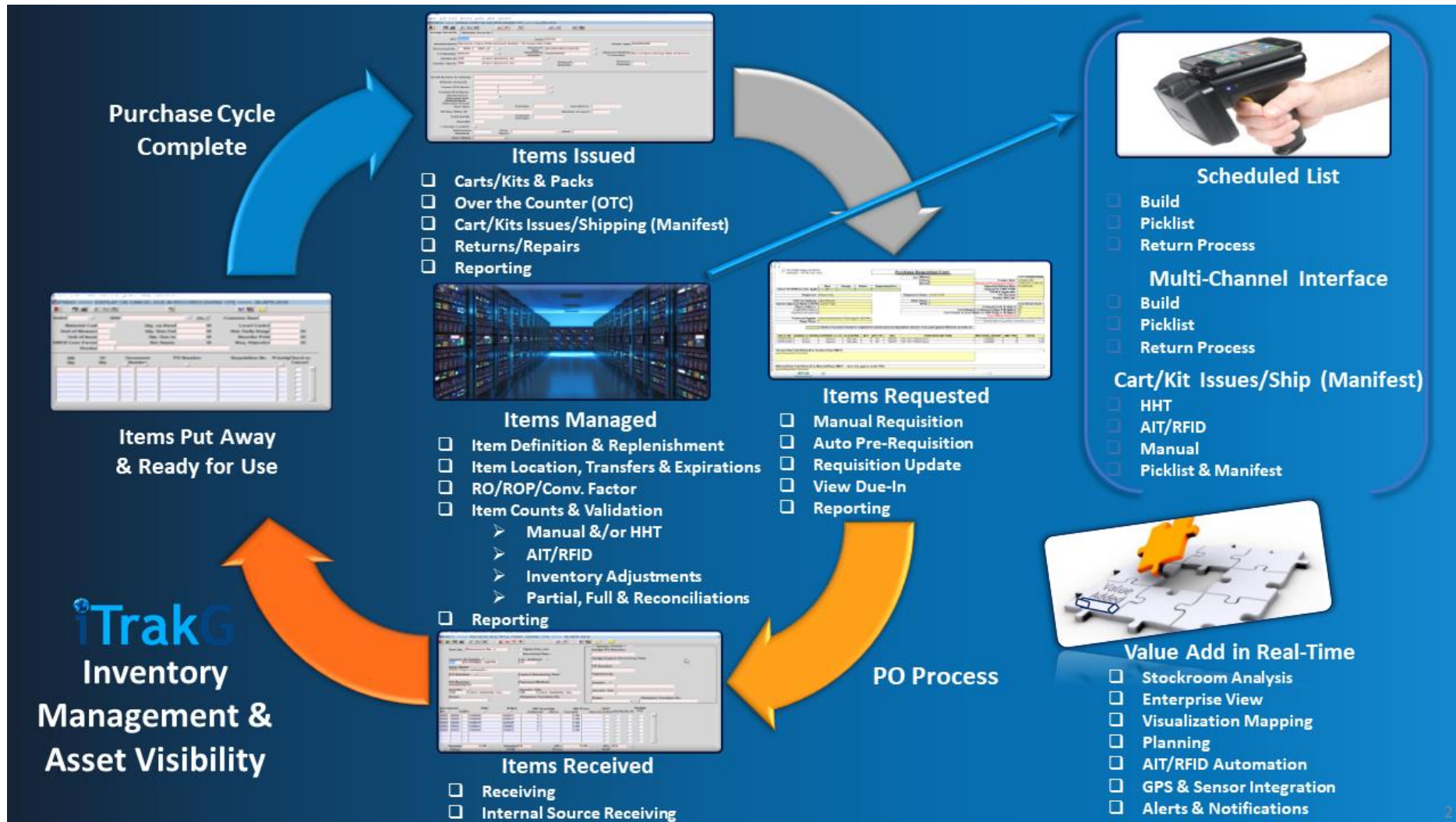


- **Agnostically integrates with various vendor technologies on one platform**
- **Easily integrates with existing LM systems of record with minimum effort**
- **User friendly, affordable, simple to maintain & sustain across the enterprise**
- **Implemented behind the Lockheed Martin firewall.**
- **Manages multiple inventory groups and their assets from one system.**
- **Easily integrates RFID and GPS technologies with LM's current barcode naming system.**
- **Integrates sensors to monitor temp., humidity, speed, shock, location, etc.**
- **Reduces inventory errors & unnecessary reorders while increasing timely replenishments.**
- **Maintains ability to quickly find spot inventory assets (Corporate and Gov't audits)**
- **Manages an infinite number of parent-child relationships of different asset types.**
- **Learns and recommend consumable asset replenishments.**
- **Allows users to subscribe to alerts (i.e. temperature, shock, location, etc.)**
- **Meets global defense customers & intermodal shipping security requirements**
- **Trade Agreements Act (TAA) and Buy American Act (BAA) compliant**





# One Single Platform







# Enterprise Capabilities







# F-35 Global Asset Tracking







# F-35 Key Focus Areas



- **Readiness – Fleet Performance**

- Increasing Aircraft Availability
- Improving Low Observable Maintainability

- **Affordability**

- Committed to Sustainment Cost Reductions
- Setting Annual Service Affordability Targets
- Actively working cost reduction initiatives in F-35 Affordability

- **Sustainability**

- Implementing GSS and staying out in front of major warfighter milestones
- Increase security, accountability and visibility while reducing liabilities and transit times



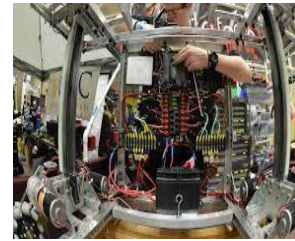
***Focused on Increasing Warfighter Capability!***



# F-35 Complex Supply Chain Challenges



- Global manufacturing environments
- Significant security requirements
- Non-standardized processes
- Dynamic productivity
- Vast inventory requirements





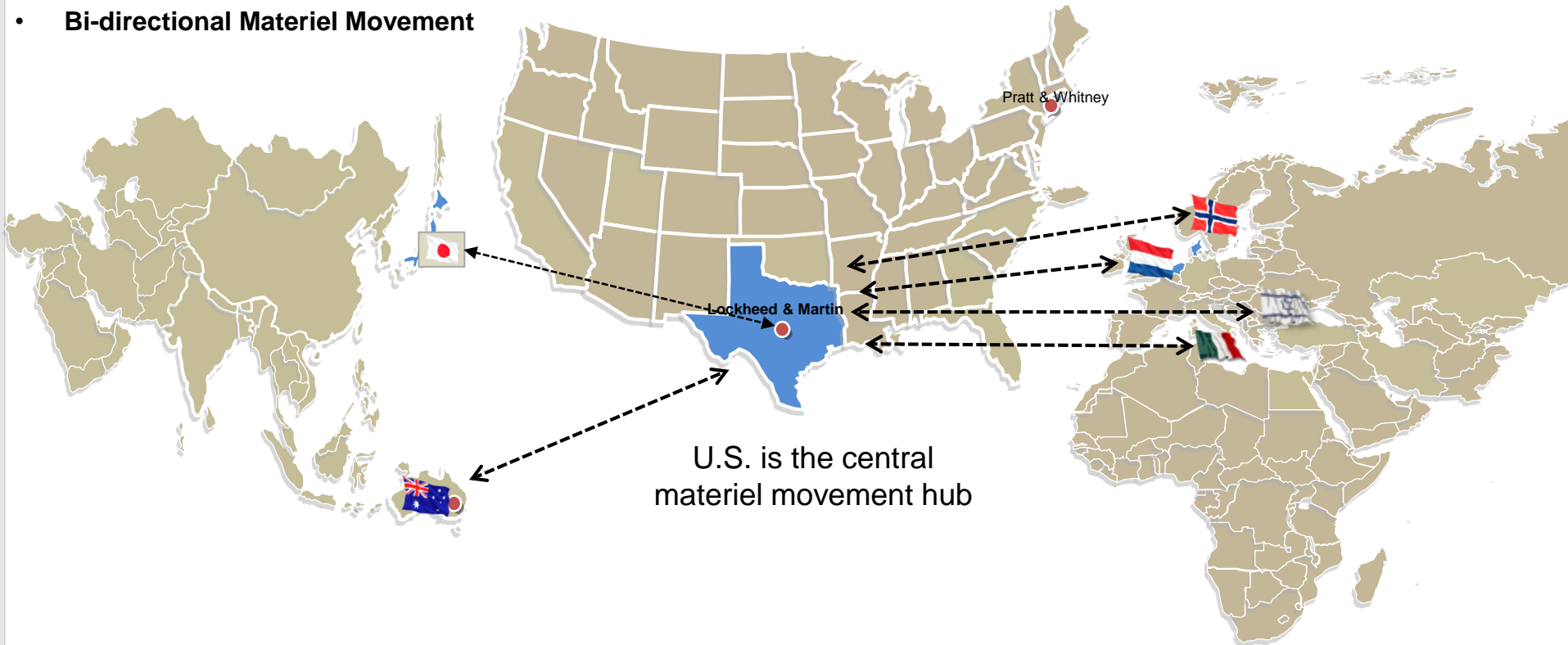


# Global Asset Management Current State



## Central Characteristics

- Hub and Spoke Operation
- Bi-directional Materiel Movement



## Across Three Regions

Pacific

North America

Europe

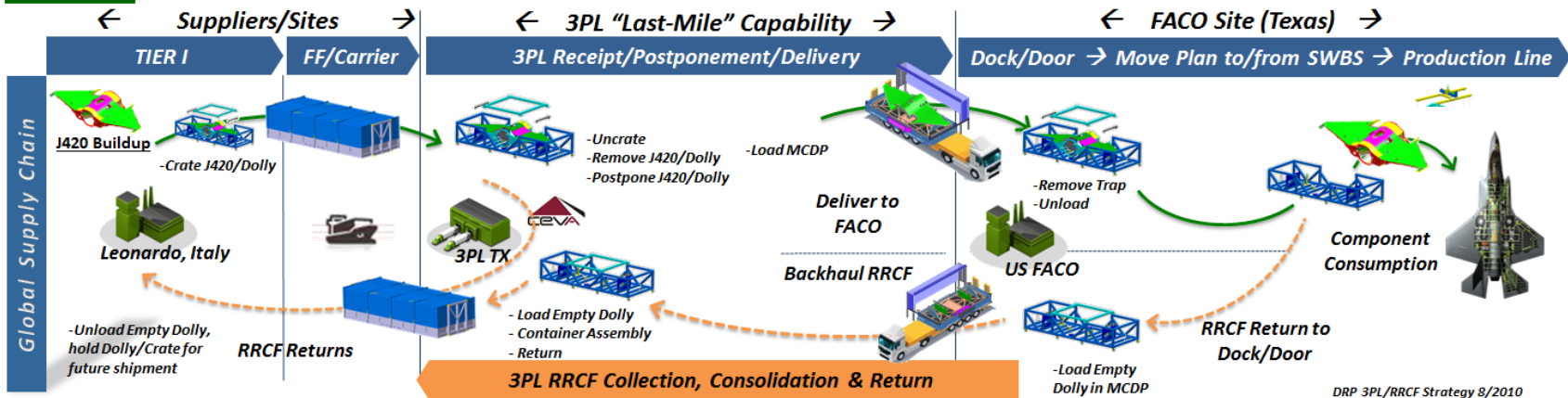




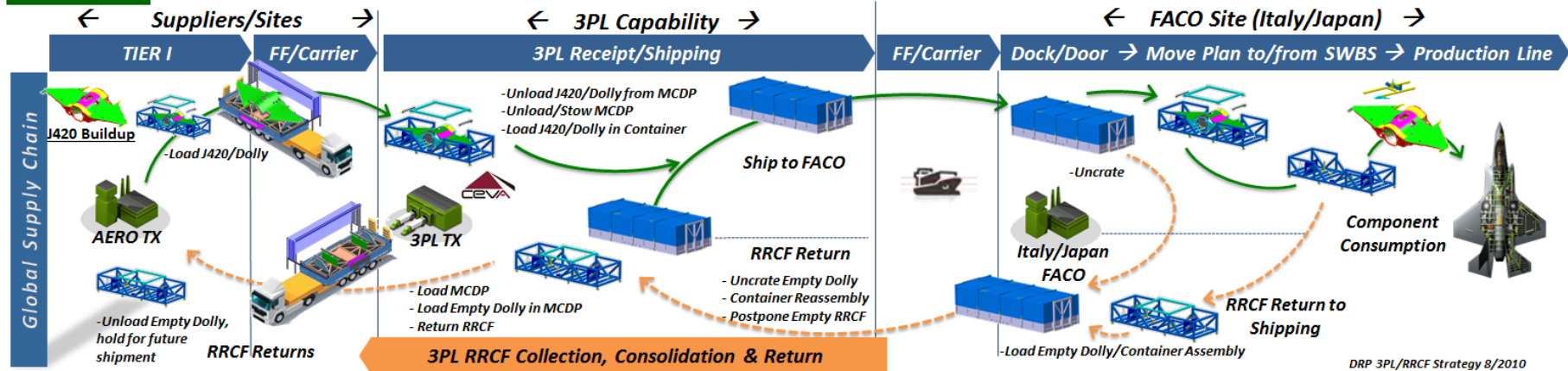
# F-35 Major Component/ Container Flow Example



## INBOUND



## OUTBOUND







# Customized Containers



Observation Ports



Observation Ports



Observation Windows







# Integrated Hardware



## GPS Tracker with RFID Reader

- Cellular and Satellite Communications
- 3G Modem
- Motion and GPS Location (Lost/Stolen)
- Light (Anti-Tamper)
- Tilt (This Side Up)
- Shock (Mishandling/Drops)
- Utilization Mode (RE-Programmable)
- Flight Travel OK (LI Metal Content <0.3g/Comms-Off)
- Dimensions < 2 in and < 0.5 lbs.
- 5 Year Battery Life

## RFID Sensor Tags

- Small, Temperature, Humidity and Parented Location





# iTrakG Software



## iTrakG Real-Time Telemetry

- Security Reporting
- Cargo Monitoring Event Based or Constant Updates
- Intrusion Detection
- Geolocation and Geofence Reporting
- Temperature Fluctuations
- Humidity and Dew Point
- Door Lid Opening
- Shock Detection (X, Y & Z)

## Data Analytics

- Ship and Route Performance
- Transit Times
- Routing Changes
- Geofencing

**iTrakG**  
Login Page

**F-35 LIGHTNING II**  
LOCKHEED MARTIN

GPS Tracking System

Log In





# Visibility, Alerts and Alarms

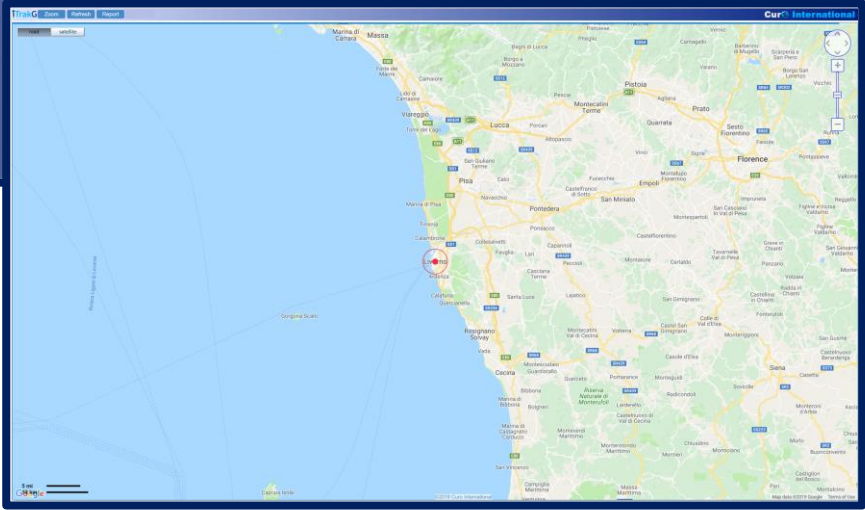
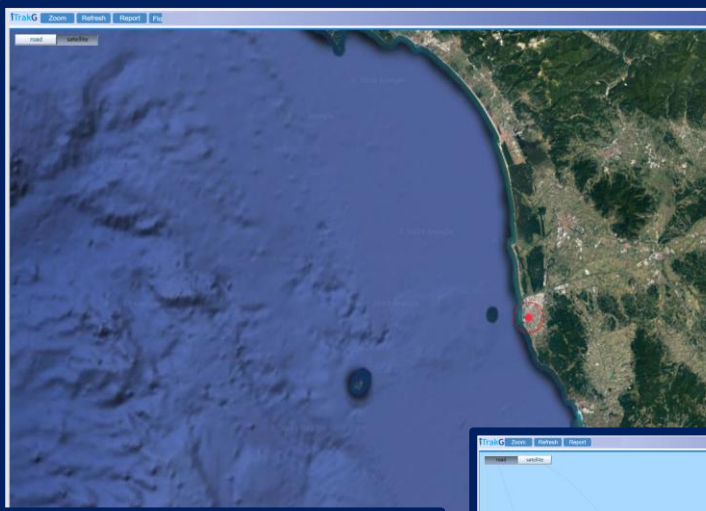
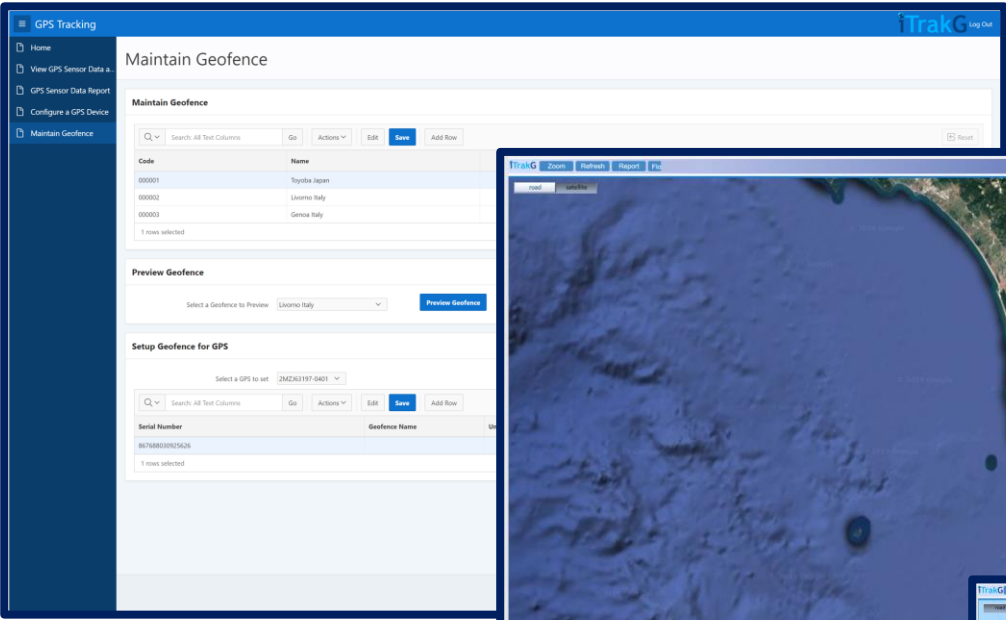


- **Visibly Know Where All Assets are Located and Where They Have Been**
- **Schedule Reporting Times (Routine)**
- **Receive Automatic Report When Exceeding Thresholds**
- **Report When in Motion, Tilted, Shocked, Light, Etc.**
- **Report on Temperature, Humidity and Dew Point**
- **Alert When Route Changes**
- **Alert When Lid Open**
- **Alert When Batteries are Low**
- **Alarm When Away or In Geo Locations**
- **Alarm When in Motion**
- **Alarm When RFID Tags are Away**
- **Change Reporting Anytime**





# Geofence Reporting



The LMF35PD1 iTrakG environment is reporting that the following asset triggered a Geofence alert:

MA-10840-2-U9 <= Asset (iTrak Stock No.)  
865851039617527 <= GPS Tracker Serial Number

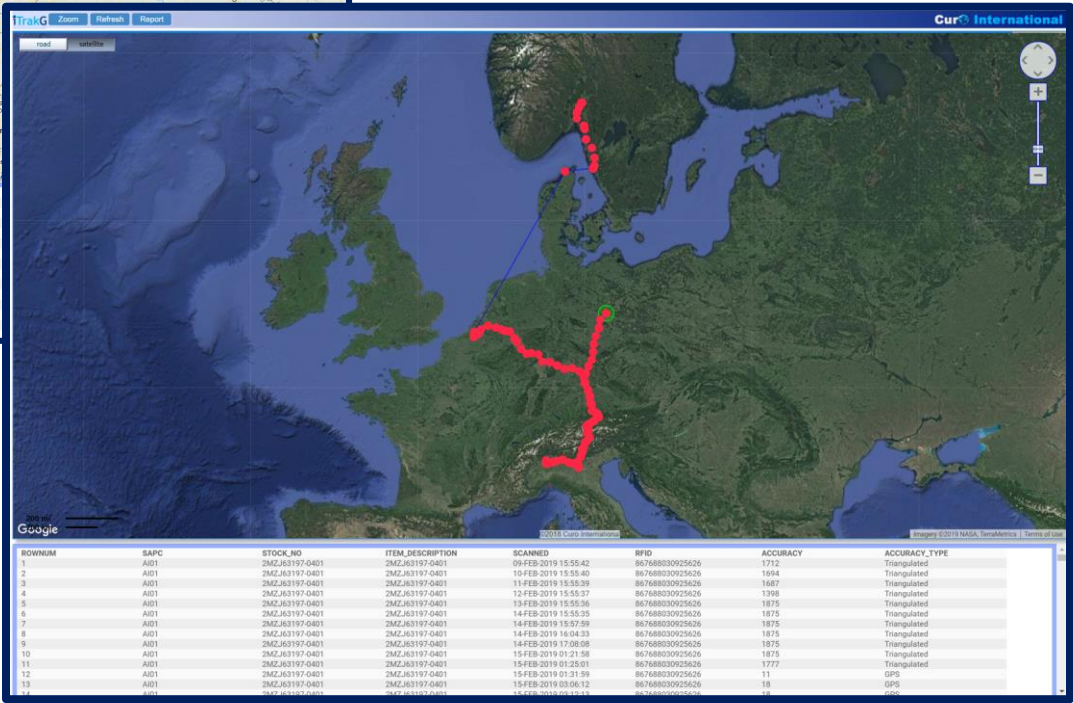
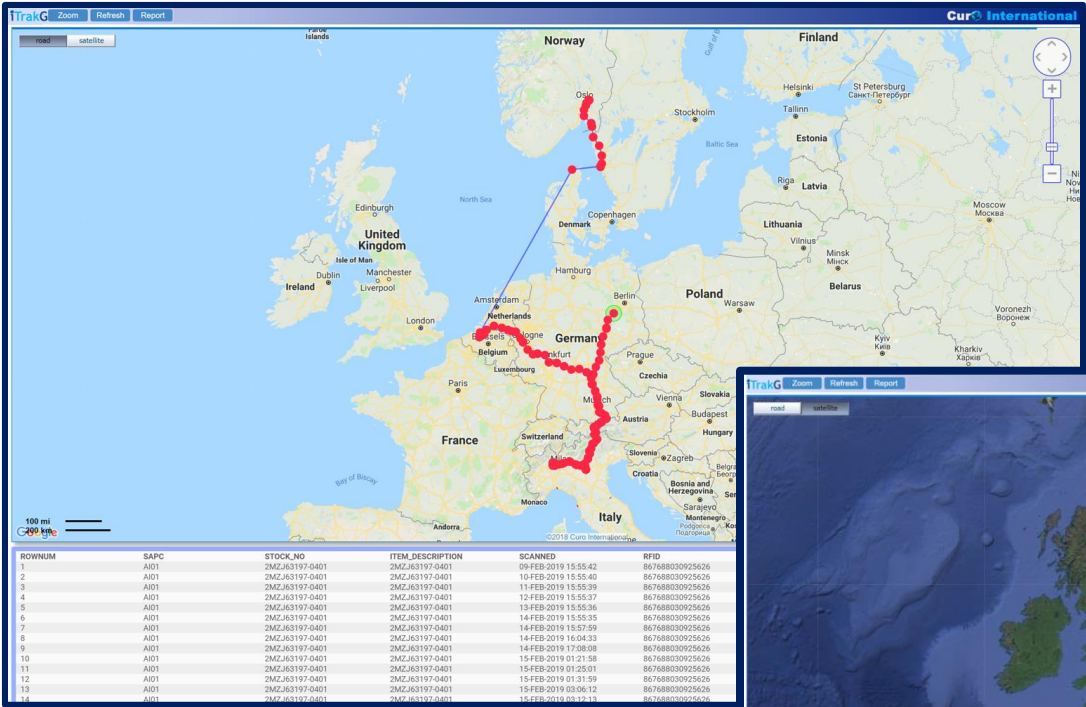
Has ENTERED Geofence "Livorno Italy (000002)" At 01-APR-2019 14:48:59

\*\*\*\*\*  
NOTE: The iTrakG Application automatically generates this email.  
Do NOT REPLY to this message. The reply-to address is not monitored.  
\*\*\*\*\*





# In-Transit Visibility











# Real-Time Reporting



GPS Tracking

Home

View GPS Sensor Data a...

GPS Sensor Data Report

Configure a GPS Device

Maintain Geofence

View GPS Sensor Data and Device Location

Search GPS Unit

2MZJ63197-0401

Display Option

Temp. Unit: Celsius Fahrenheit

Time Zone: Universal Coordinated Time

Search Abnormal Condition

Abnormal: Normal Temperature Freezing Temperature Overheat Low Battery Excessive Acceleration

Show GPS Device Path

From Date: 01-JAN-2019 To Date: 03-APR-2019

Build Path Show Path

Show Selected GPS Device Location

Show Location

GPS Tracking

Home

View GPS Sensor Data a...

GPS Sensor Data Report

Configure a GPS Device

Maintain Geofence

Device Name	Serial Number	Tag Number	Universal Coordinated Time	Temperature (F)	Tag Humidity	Tag Dew Point	Battery Percent	Tag Battery Low	Peak Accel X	Peak Accel Y	Peak Accel Z	Position Type
2MZJ63197-0401	867688030925626	INTERNAL	15-FEB-2019 06:25:01	62.6	-	-	92	-	3464	304	728	Triangulated
2MZJ63197-0401	867688030925626	INTERNAL	20-MAR-2019 14:16:18	73.4	-	-	86	-	2848	740	704	GPS
2MZJ63197-0401	867688030925626	INTERNAL	02-APR-2019 14:26:39	75.2	-	-	85	-	2688	1308	768	GPS

GPS Tracking

Home

View GPS Sensor Data a...

GPS Sensor Data Report

Configure a GPS Device

Maintain Geofence

GPS Device Sensor Data Report

Enter Chart Parameters

GPS List: 2MZJ63197-0401 Tag: INTERNAL Temp. Unit: Celsius Fahrenheit Chart Name: Internal Temperature Month April, 2019 /Year

Show Chart

Chart of Internal Temperature

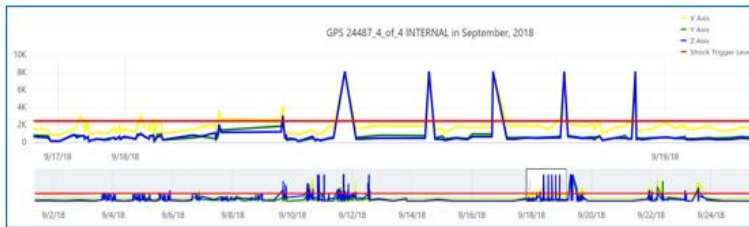
Chart of Sensor Acceleration

GPS 2MZJ63197-0401 INTERNAL in April, 2019





# 3+G Acceleration

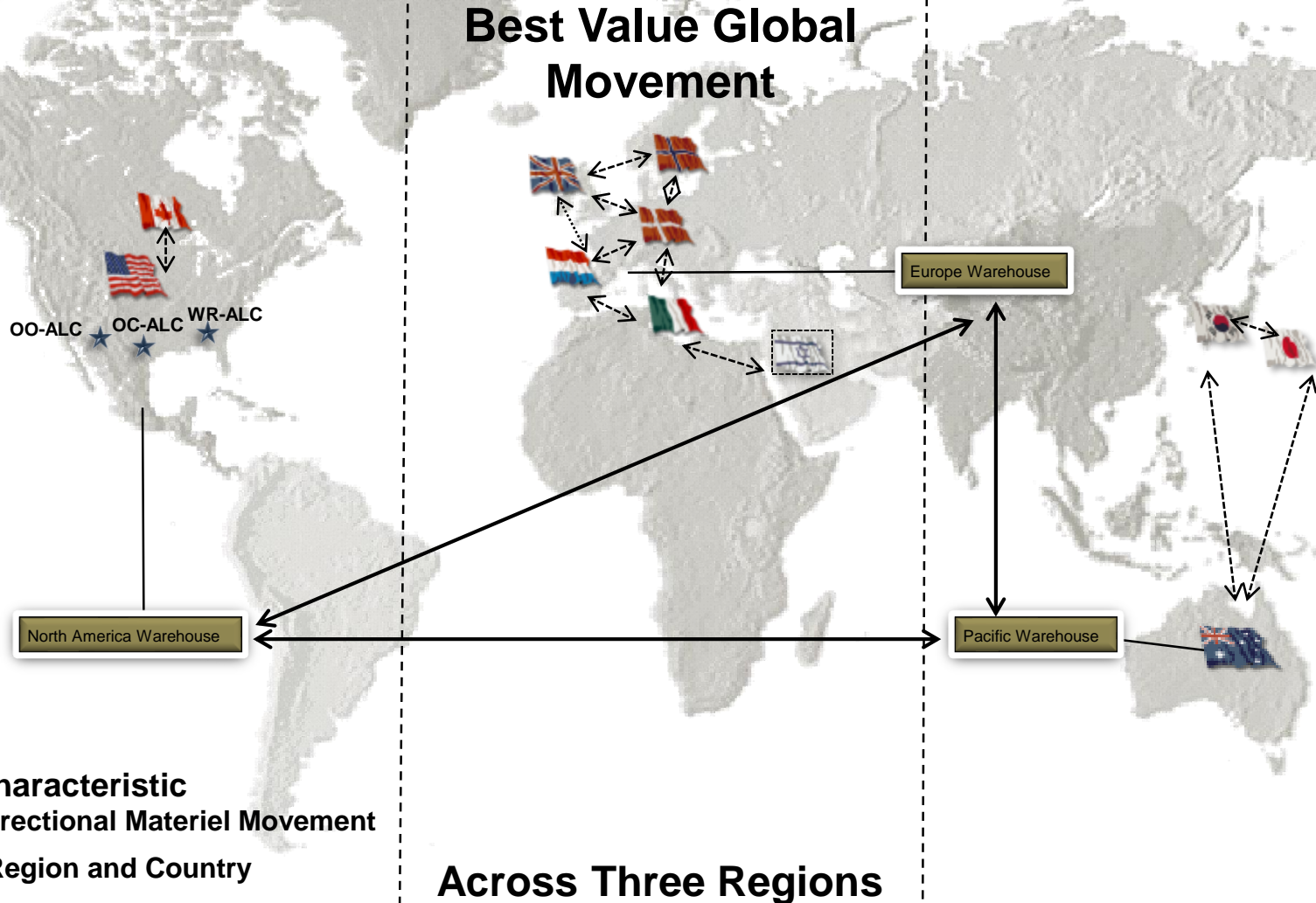


Device Name	Serial Number	Tag Number	Universal Coordinated Time	Temperature (°F)	Tag Humidity	Tag Dew Point	Battery Percent	Tag Battery Low	Speed (m/s)	Altitude (m)	Position Type	Position Accuracy (m)	Peak Accel X	Peak Accel Y	Peak Accel Z	Light Level
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 14:25:40	82.4	-	-	51	-	4.81	-25.6	GPS	12	5732	2644	1740	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 14:17:22	87.8	-	-	51	-	-	-	Triangulated	1081	8544	4332	1068	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 14:16:41	87.8	-	-	51	-	1.74	27.8	GPS	7	2596	2480	1112	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 13:47:56	80.6	-	-	52	-	1.12	29.5	GPS	7	4512	4164	2204	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 13:47:07	82.4	-	-	52	-	23.15	24.9	GPS	7	5744	3812	3376	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 04:23:55	91.4	-	-	52	-	12.79	43.9	GPS	7	3194	2280	1168	0
24487_4_of_4	865851036680833	INTERNAL	23-SEP-2018 03:15:27	75.2	-	-	52	-	5.4	18.6	GPS	8	3328	2156	1484	0
24487_4_of_4	865851036680833	INTERNAL	22-SEP-2018 09:59:18	64.4	-	-	53	-	16	15.2	GPS	6	3816	1872	984	0
24487_4_of_4	865851036680833	INTERNAL	22-SEP-2018 09:27:20	59	-	-	53	-	46	-5.3	GPS	7	5024	5264	2576	0
24487_4_of_4	865851036680833	INTERNAL	22-SEP-2018 05:00:40	73.4	-	-	53	-	48	158.6	GPS	8	6640	4536	2572	0
24487_4_of_4	865851036680833	INTERNAL	22-SEP-2018 00:57:45	78.8	-	-	54	-	57	61.7	GPS	10	4792	3172	2608	0
24487_4_of_4	865851036680833	INTERNAL	22-SEP-2018 00:48:37	75.2	-	-	54	-	55	59	GPS	11	2820	1996	636	0
24487_4_of_4	865851036680833	INTERNAL	21-SEP-2018 23:54:47	84.2	-	-	54	-	7	30.7	GPS	8	2820	1020	1120	0
24487_4_of_4	865851036680833	INTERNAL	21-SEP-2018 22:55:47	75.2	-	-	54	-	20.14	50.9	GPS	10	3188	1156	1488	0
24487_4_of_4	865851036680833	INTERNAL	21-SEP-2018 22:37:01	75.2	-	-	54	-	0	9.2	GPS	10	8736	3664	1372	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 16:36:22	75.2	-	-	54	-	53	20.8	GPS	9	4128	2044	2216	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 16:29:12	75.2	-	-	54	-	57	12.9	GPS	6	3032	2108	1036	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 15:54:53	68	-	-	54	-	87	14.1	GPS	9	3772	1920	1504	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 15:44:05	73.4	-	-	54	-	22.72	28.2	GPS	7	2592	1272	1528	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 14:33:25	73.4	-	-	54	-	5.77	5.4	GPS	37	3200	2008	884	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 13:33:20	78.8	-	-	54	-	6.57	74.3	GPS	12	2804	2104	1164	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 12:28:23	89.6	-	-	54	-	11	40.5	GPS	9	2344	1848	1360	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 09:07:25	87.8	-	-	55	-	-	-	Triangulated	843	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 06:26:40	93.2	-	-	55	-	-	-	Triangulated	1236	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 07:26:44	93.2	-	-	55	-	-	-	Triangulated	3223	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	19-SEP-2018 07:24:21	87.8	-	-	55	-	-	-	Triangulated	2914	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 22:40:18	91.4	-	-	56	-	-	-	Triangulated	2695	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 19:30:22	82.4	-	-	56	-	-	-	Triangulated	2117	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 19:20:34	86	-	-	56	-	-	-	Triangulated	1813	2704	752	576	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 19:17:56	80.6	-	-	56	-	-	-	Triangulated	1837	2704	752	576	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 16:20:28	84.2	-	-	57	-	-	-	Triangulated	4074	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 13:29:40	80.6	-	-	57	-	-	-	Triangulated	2994	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 09:45:17	82.4	-	-	57	-	-	-	Triangulated	3535	8192	8192	8192	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 06:58:49	82.4	-	-	58	-	-	-	Triangulated	1408	4208	2624	1120	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 06:55:31	82.4	-	-	58	-	1.31	176.2	GPS	21	2832	1920	1280	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 04:15:54	87.8	-	-	58	-	1.07	-4.5	GPS	12	2720	1456	1212	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 04:09:32	86	-	-	58	-	7.01	147.1	GPS	12	1512	1652	2128	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 04:06:29	77	-	-	58	-	40	147.3	GPS	17	2848	1568	1072	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 01:15:06	93.2	-	-	58	-	1.2	147.2	GPS	12	2560	880	780	0
24487_4_of_4	865851036680833	INTERNAL	18-SEP-2018 00:41:47	87.8	-	-	58	-	61	167.8	GPS	10	3108	1112	976	0
24487_4_of_4	865851036680833	INTERNAL	17-SEP-2018 22:00:37	87.8	-	-	58	-	73.15	184.6	GPS	9	3680	796	796	0





# Global Asset Management Future State



North America

Europe

Pacific





# Stakeholder Improvements



- **Network Security (Behind the Lockheed Martin Firewall)**
- **ITAR Compliance**
- **Received F-35 JPO approval for use**
- **Newly designed Lithium Battery Air Transport NATO Compliant**
- **Air – Flight NATO and Cargo Lux Approval**
- **Federal Acquisition Supply Chain Security Act of 2018**
- **Encompasses a mobile iPhone app available to LM users**
- **SAP/CEVA/iTrakG Systems and Process Integration**
- **Real Time In-Transit Visibility and Improved Asset Management**
- **Reacts Instantly when Required. Proactive vs Reactive**
- **Allows Reprogram of Trackers anytime**
- **Eliminates Manual Chasing and Spreadsheet Management**
- **Reduces Consuming Time and Human Errors**

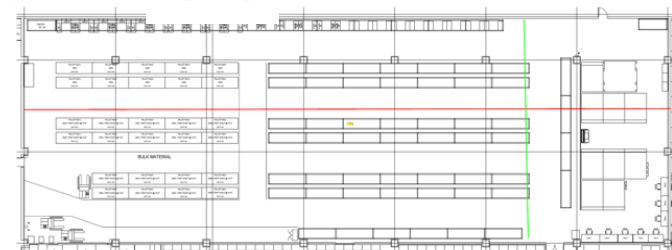


# ITRAKG R&D INITIATIVES



**Current R&D initiatives include:**

- **Holographic Asset Visualization (HAV)**
- **Warehouse Connected Worker Platform (WCWP)**
- **Enterprise Warehouse IOT enabled with Autonomous Asset Tracking (AAT)**
- **LoRa - BLE asset tag**



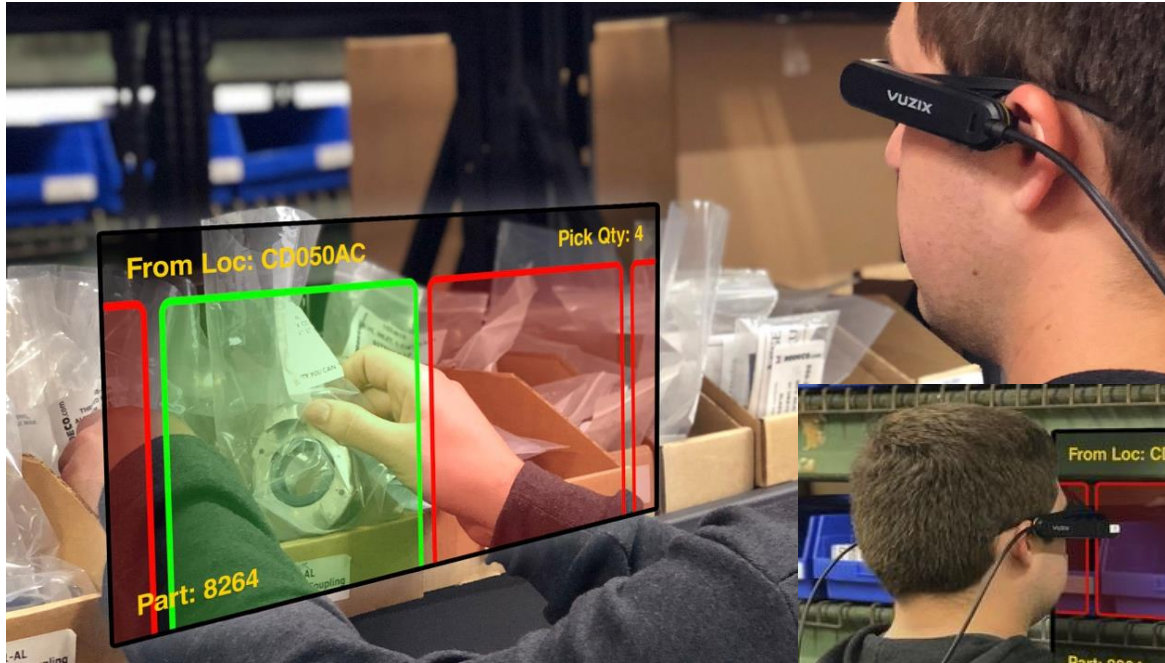


# Holographic Asset Visualization (HAV)





# Warehouse Connected Worker Platform (WCWP)





# Enterprise Warehouse IOT enabled with Autonomous Asset Tracking (AAT)



**Map Legend**  
 Counts by Type:  
 Tags  
 Maintenance\*  
 Calibration\*\*  
 \* Maintenance (info)  
 \*\* Calibration (info)

**Metrolgy: Tag Details - Google Chrome**  
 about:blank  
 Metrolgy: Tag Details Count = 5 (Yard Count = 313) Export

ROWNUM	LOCATION	Rfid	READER	CREATED
1	Metrolgy	50548840CDA000013800000	In Passive (E104a1)	Dec 16, 2019 2:2 PM
2	Metrolgy	50548840CDA000013800000	In Passive (E104a1)	Dec 16, 2019 2:2 PM
3	Metrolgy	50548840CDA000013800000	In Passive (E104a1)	Dec 16, 2019 2:2 PM
4	Metrolgy	50548840CDA000013800000	In Passive (E104a1)	Dec 16, 2019 2:2 PM
5	Metrolgy	57	In Active (R9)	Dec 10, 2019 10 AM

**Muster Station 2: Muster Station Details Count = 71 (Yard Count = 3017) Export**

ROWNUM	LOCATION	Badge ID	User	READER	CREATED	LK LOCATION	LK READER	LK SCAN DATE	IMAGE
1	Muster Station 2	0F 02000	Anthony Gray	In (01640)	Dec 10, 2019 8:57:58 PM	Muster Station 2	In (01640)	Dec 10, 2019 8:57:58 PM	
2	Muster Station 2	0F 02000	Franklin Ward	In (01640)	Dec 10, 2019 8:57:33 PM	Shop 1	In (01640)	Dec 10, 2019 8:57:33 PM	
3	Muster Station 2	0F 02000	Larissa Green	In (01640)	Dec 10, 2019 8:57:16 PM	Shop 1	In (01640)	Dec 10, 2019 8:57:16 PM	
4	Muster Station 2	0F 02000	James Coleman	In (01640)	Dec 10, 2019 8:56:39 PM	Shop 1	Out (01640)	Dec 10, 2019 8:56:39 PM	
5	Muster Station 2	0F 02000	Maurice King	In (01640)	Dec 10, 2019 8:56:00 PM	Shop 1	Out (01640)	Dec 10, 2019 8:56:00 PM	
6	Muster Station 2	0F 02000	Kevin West	In (01640)	Dec 10, 2019 8:54:40 PM	Shop 1	Out (01640)	Dec 10, 2019 8:54:40 PM	

- Development of new LoRa - BLE asset tag permitting tracking of assets from an exterior to interior environment under one single system.



A high-angle, close-up view of the nose and cockpit of an F-35 Lightning II fighter jet. The aircraft is grey with a large, curved canopy. The background is a light grey gradient with white wavy lines.

# Questions







## Point of Contact

Corey A. Cook/ [corey.a.cook@lmco.com](mailto:corey.a.cook@lmco.com) / (757) 817-9494