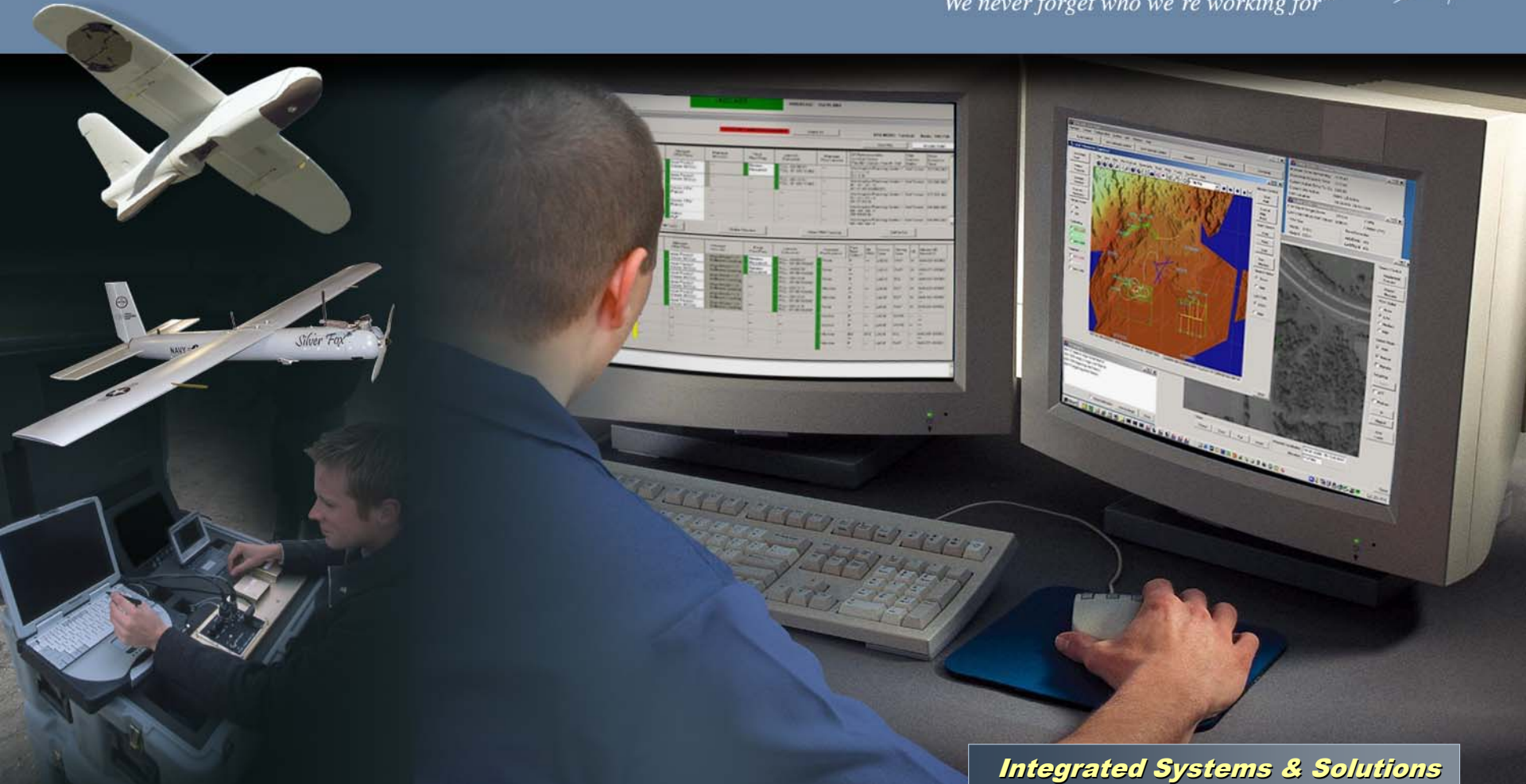


LOCKHEED MARTIN

We never forget who we're working for™



Integrated Systems & Solutions

Tactical Control Systems

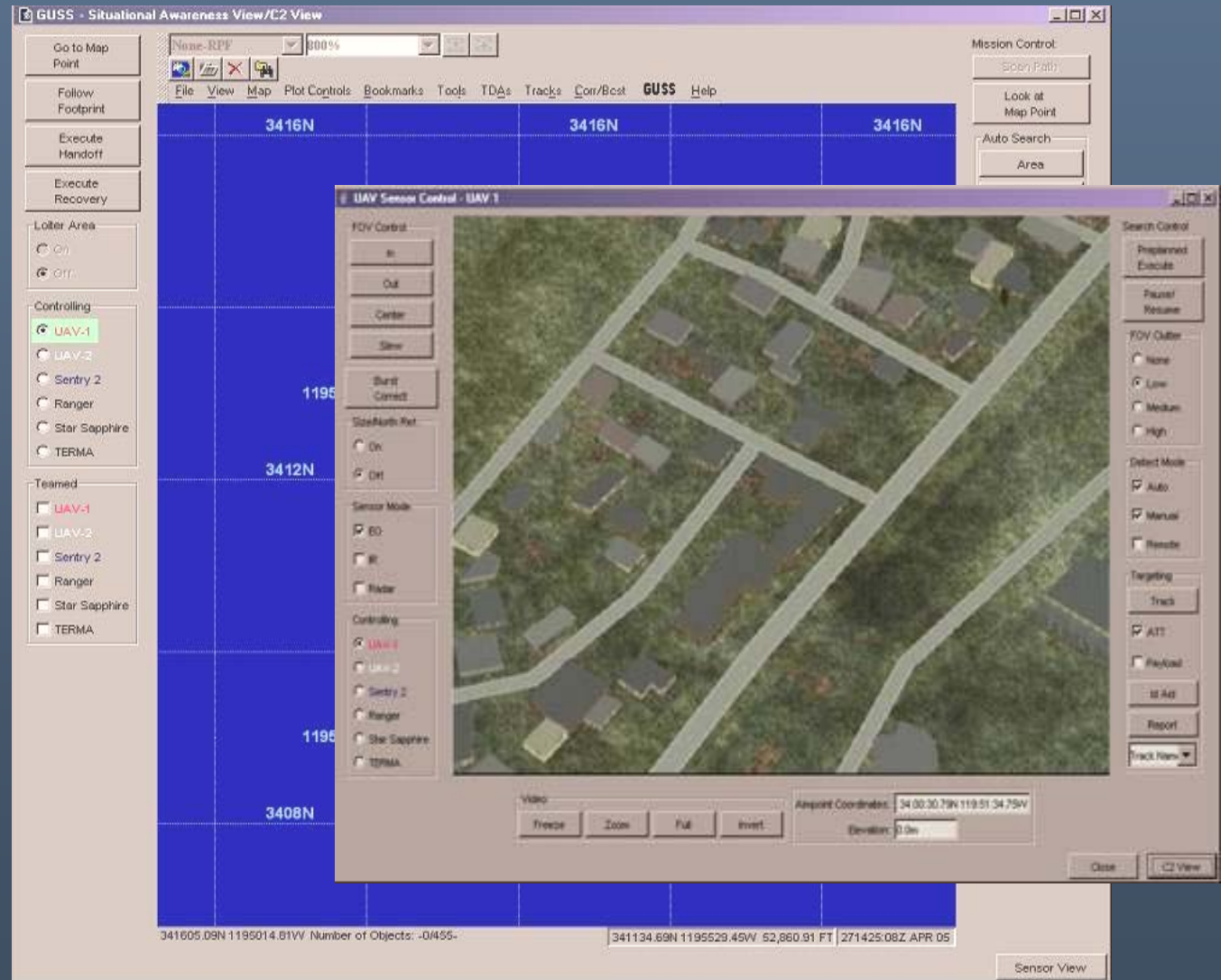
Optimizing the UAV Mission

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- **Central Premise**
- **Optimizing The Mission**
- **Benefits To The Warfighter**
- **Potential Applications**
- **Summary**



To Advocate Change To The Current Practice Driving UAV Command And Control: Uncoupled Vehicle And Sensor Control By...

- 
- **Integrated Sensor/Vehicle Control**
 - **Automating Tasks & Reduced Operator Workload**
 - Point & Click Mission Generation
 - Automated Search & Sensor Control
 - **Optimizing Probability Of Detection**
 - Enhanced Target Tracking & Detection
 - **Accurate Passive Object Location**
 - **Managing Multiple, Different Unmanned Vehicles**
 - **Open Systems, Web-enabled Services**
 - Timely Data Sharing For Time-Sensitive Engagements
 - Scalable Software Solutions

Simple, Scalable, Low-Cost UAV Mission Management Focused On The Warfighter

Simplicity: Through Automation

- **One Operator - Multiple UAVs/Payloads**
- **Real-Time Tactical Mission Generation & Updates**
- **Automated Sensor Control**
- **Automatic Target Tracking & Detection/Recognition**
- **Airspace Deconfliction Management**



Speed: Sensor-to-shooter Timeline

- **Fast, Accurate Passive Target Location**
- **Common Operating Picture – Report, Image, Location**

Sharing: Web Services, Common Op Environment

- **Highly Flexible – Laptop Or In Current Ground Control**
- **Robust, Intuitive Training – Embedded Simulation, Scenes & Forces**



Combined With Low Cost UAVs For Low Cost/Overhead UAV Capability:

- *Reduced Manning For Any UAV Operations*
- *Tactical Decision Aid Combined With Existing UAV Ground Control*
 - *Precision Targeting*
 - *Convoy Escort - On Land Or Sea*
 - *Station Keeping At Sea Or In Port For Self Ship Protection*
 - *Perimeter Surveillance – Border Surveillance*
 - *Oil Platform Based Surveillance*
 - *UAV Mission Management Using Existing Processors On Ships/Land*
- *Other Potential Improvements*
 - *Automatic Target Detection; SAR Sensor; Laser Designator*



Simple, Scalable, Low-Cost UAV Mission Management Focused On The Warfighter

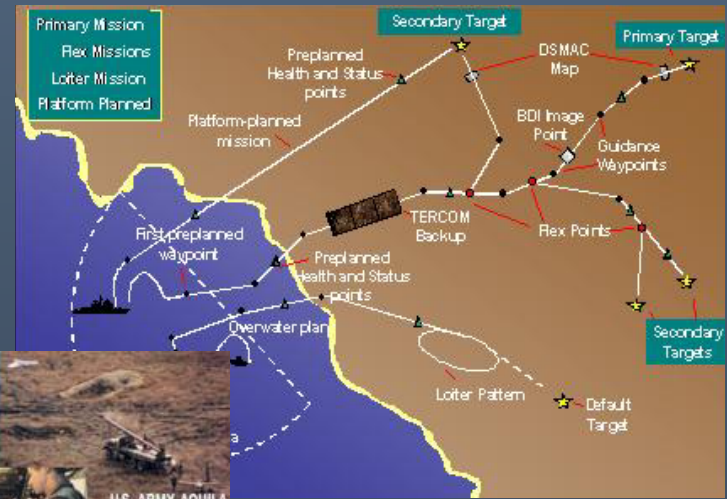
Generic UAV Mission Management

- **Evolved IR&D Over 4+ Years; JAVA Code**
- **Successfully Flight Tested On Small UAVs**
 - **2004: Five Weeks Of Flight Testing – Fixed Sensor UAV – At Sea (San Diego) & On Land (Aberdeen PG, Tucson)**
 - **2005: One Week Desert Flight Testing – Gimbaled Sensor--Using Auto Track (Tucson)**

Tactical Control Systems, Valley Forge, PA

- **UAV Heritage**
 - **Tomahawk: Legacy Prime Contractor For Tactical Tomahawk Weapon Control Systems (TTWCS) - US & UK**
 - **Aquila Lessons Learned – Focus On The Mission, Not The Vehicle**

Lockheed Martin's Sea Slice



Tomahawk Mission

LM Functions Flight Test Verified 2004 - 2005

Controlled UAV in Mission and Shipboard Recovery

Mission Mode:

- **Vehicle - Sensor Integrated Control**
 - Automatic Search & Target Tracking
 - Station Keeping, Auto-Follow Footprint
 - Map or Image Point & Click Control
 - Controlled Flight Altitude, Airspeed
 - Contact Report Generation

Shipboard Recovery Mode:

- GPS Data For Navigation Reference
- Auto-Generation Of Recovery Waypoints
- Enter/Exit Recovery Mode By Operator
- Flyby Over Recovery System
- Recovery Camera ATT

Name: track1 Location: 32:02:07.47N 111:21:25.40W Elevation: 787.0m



Demonstration Session

Scenario:

Multiple UAVs/Single Operator; Synthetic Scene Generation Using LM ReadSim™; EO/IR Sensor Package; Dynamic Tactical Mission Execution; Common Operating Picture Connectivity; Target Tracking and Precision Localization; Track Reporting and Coordination; Strike

The screenshot displays the GUSS - Situational Awareness View/C2 View interface. The main window shows a 3D map of a synthetic scene with several UAVs (UAV-108, UAV-109, UAV-3) and their tracks. The interface includes a menu bar (File, View, Map, Plot Controls, Bookmarks, Tools, TDAs, Tracks, Corr/Bcst, GUSS, Help) and a toolbar. On the left, there are control panels for 'Go to Map Point', 'Follow Footprint', 'Execute Handoff', 'Execute Recovery', 'Loiter Area' (On/Off), and 'Controlling' (UAV-108). On the right, there are panels for 'Mission Control' (Scan Path, Look at Map Point, Auto Search, Area, Point, Line, Pre-Planned, Station Keeping), 'UAV 108 - Status Overlay' (Mission Time Remaining: 11:49:27, Reserved Recovery Time: 0:33:31, Current UAV Action: Orbiting - Idle, UAV Location: 34:36.02N 43:40:13E, FOV Slant Range / Zoom: 3304m / 88%, UAV Comms Status: 100%, UAV Altitude (AOL/MSL): 6887ft / 7254ft, UAV Velocity (Airl/Gmd): 75kt / 75kt), 'Simulation My Site Control W...', and 'Prompts' (11:31:33) UAV 3 beginning Area Search). Below the main map is the 'UAV Sensor Control - UAV 108' window, which includes 'FOV Control' (In, Out, Center, Slew, Burst Correct), 'Size/North Ref.' (On/Off), 'Sensor Mode' (EO, IR, Radar), 'Controlling' (UAV-108, UAV-109, UAV-3, UAV-229, Star Sapphire, TERMA), 'Search Control' (Preplanned, Execute, Pause/Resume), 'FOV Clutter' (None, Low, Medium, High), 'Detect Mode' (Auto, Manual, Remote), 'Targeting' (Track, ATT, Payload, Id Aid, Report, Track Name), and 'Video' (Freeze, Zoom, Full, Invert). At the bottom right, there is a 'UAV 108 - Sensor Status Overlay' window showing 'FOV Slant Range/Zoom: 3304m / 88%', 'UAV Orbit Offset / Ref. Object: Right / Jeep (2.5m)', 'FOV Size' (Width: 311m, Height: 363m), 'Burst/Correction' (Add/Drop: n/a, Left/Right: n/a), and 'Target Position' (Location: 34:35:15.76N 43:41:34.83E, Elevation: 104.5m, Sample Count: 39, Est. Location Error: 4.8m, Reset).

UAV Sensing Mission Can Be Optimized & Simplified

- ***Put the Sensor First***
- ***Automation = Reducing Manning & Higher Probability of Mission Success***
- ***Precisely Locating Targets***
- ***Sharing The Data and Shortening the Timeline***



Mission Success

Manpower

Result: Simple, Scalable, Low-Cost UAV Mission Management Focused On The Warfighter