

Lockheed Martin Systems Integration – Owego
1801 State Route 17C Owego, NY 13827-3998
Telephone 607-751-2000



In Reply Refer To: 2008-ONRTEAM-0005

17 March 2009

NAVSEA Naval Surface Warfare Center
110 Vernon Avenue
Panama City, FL 32407

Attention: James S. Taylor, Program Officer

Subject: CDRL A004, Contract Data Requirements List (CDRL), Requirements
Specification, Contract No. N00014-08-C-0142, Distribution Statement A

The enclosed data is submitted in accordance with the Contract Data Requirements List
(CDRL):

CDRL Information:

-	CDRL:	A004
-	Data Item Title:	Demonstration Slides

Enclosed please find the subject CDRL submittal. Consistent with contract requirements, this submittal is being made in accordance with enclosure number 1 of the CDRL.

Any technical questions concerning this submittal should be directed to John Deopuria at (607) 751-3667 or via e-mail at john.deopuria@lmco.com.

Any other questions should be directed to the undersigned at (607) 751-2919, fax at (607) 751-3910 or via e-mail at Bob.Rieg@lmco.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Robert B. Rieg".

Robert B. Rieg
Contracts

RBR/dlg

Enclosure: Demonstration Slides dated 16 March 2009

cc:	Mr. K. Wallace	DCMA/ACO	(Letter only)
	Ms. N. Kochinsky	Owego/0532	
	Mr. J. Deopuria	Owego/0902	
	Mr. R. Szczerba	Owego/0902	
	Director, Naval Research Lab	Washington, DC	
	DTIC	Ft. Belvoir, VA	

Report Documentation Page

Form Approved
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Demonstration Slides For
Team-Based Execution Of Autonomous Missions (TEAM), Spiral 1
CDRL A004
Contract No: N00014-08-C-0142
March 16, 2009
Lockheed Martin Systems Integration
Owego, New York

To:
NAVSEA
Naval Surface Warfare Center
110 Vernon Avenue
Panama City, FL 32407

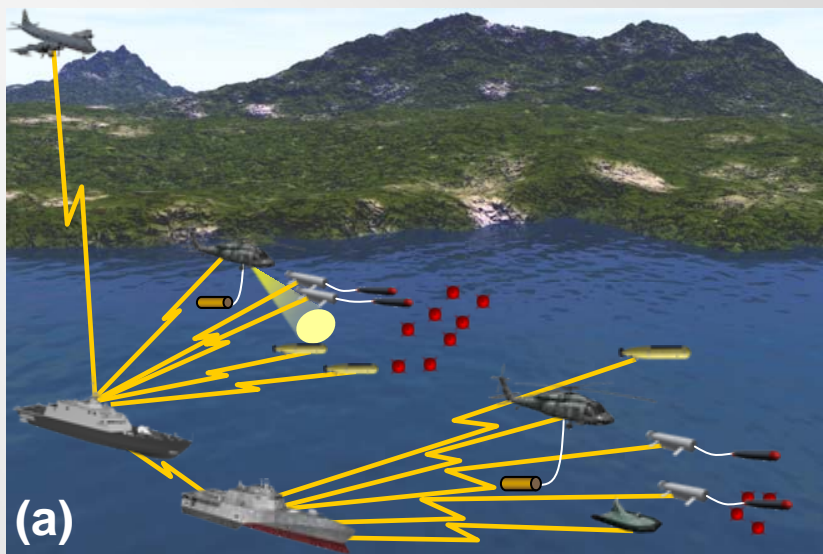


MCM Systems for LCS Advanced Flight Mission Package

**Team-based Execution of
Autonomous Missions (TEAM)**

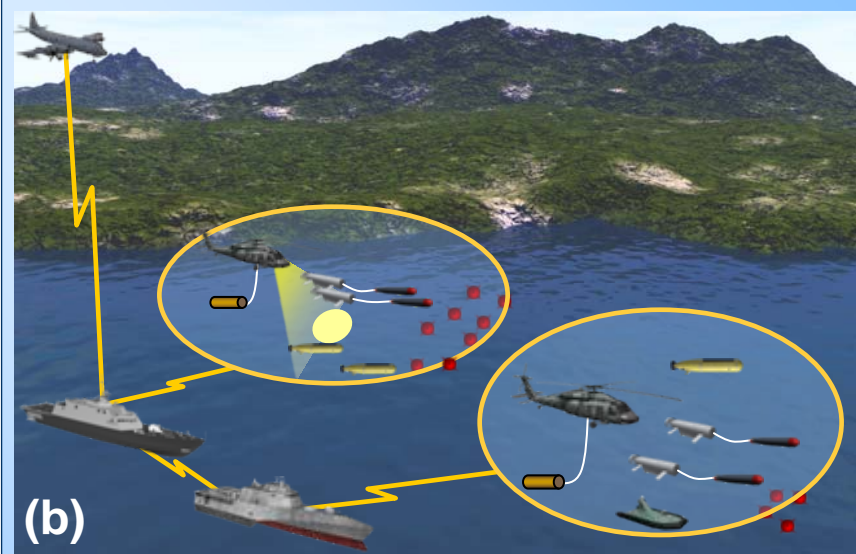
Spiral 1 – Demonstration

Lockheed Martin Systems Integration – Owego



(a)

- **Current LCS Approach**
- **Vehicle-Centric C2**
 - Focus on “Control” of Individual Vehicles / Payloads
 - Mission Execution Coordination is Manually Intensive
 - Many Sequential Operations

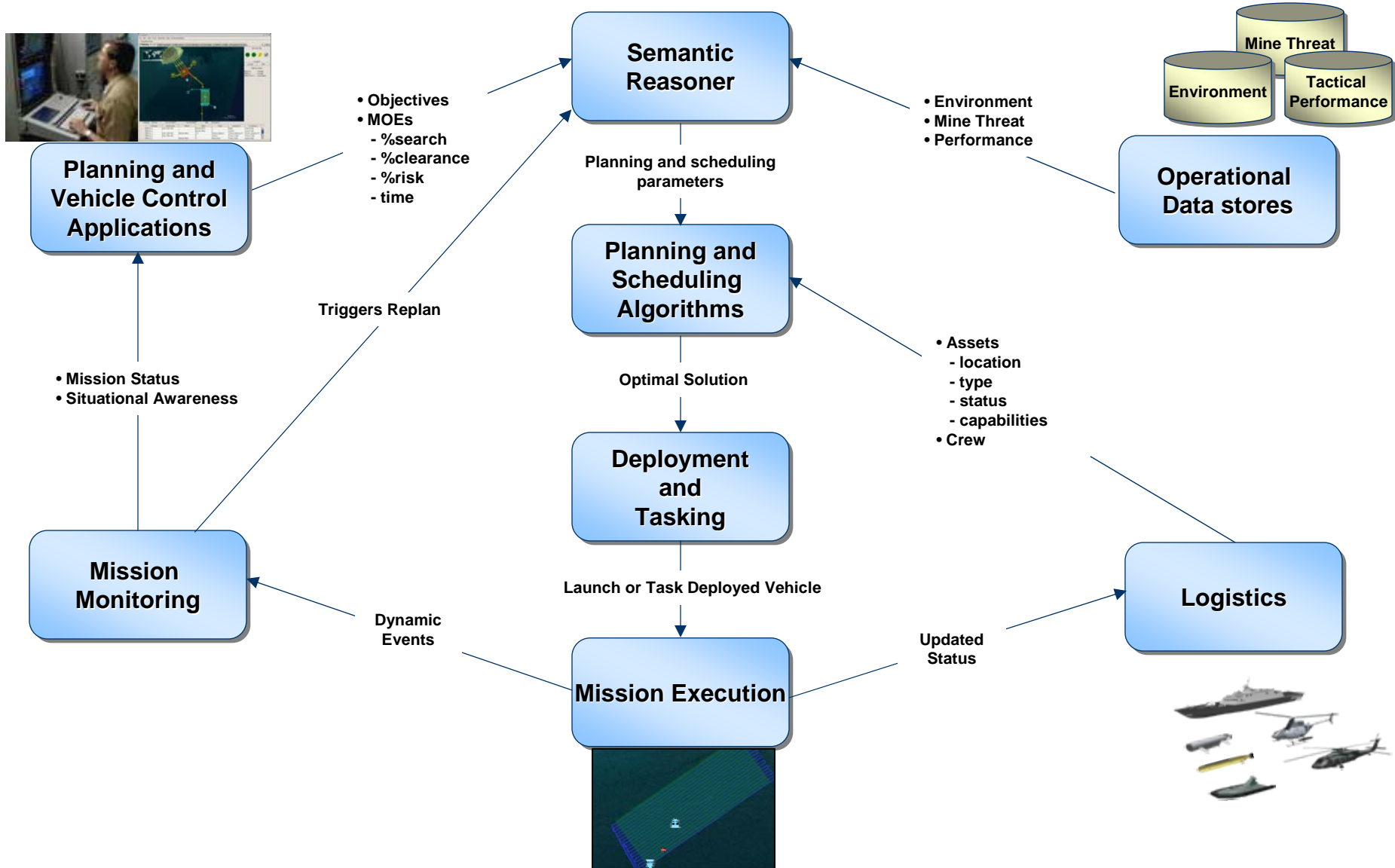


(b)

- **Proposed TEAM Approach**
- **Mission-Centric C2**
 - Focus on “Command” of Multi-Vehicle Teams
 - Allows Autonomous Mission Execution Coordination as Needed
 - Focus on Parallel Operations

Optimization Across the Entire Mission Results in Reduced Workload and Increased Operational Effectiveness

Logical TEAM Representation





- **Programmatic**

- Show an intermediate snapshot of progress to date
- Preview of aspects of Spiral 2 Capstone Demo in Sept. 2009
- Framework for Spiral 2 and Phase II Capability Discussions

- **Operational**

- Multi-asset team-based MCM mission planning
- Integrated manned and unmanned vehicle team
- Integrated legacy planning systems (MEDAL, JMPS, etc.)
- Automating key mission aspects:
 - Tasking, Scheduling, & Route planning

- **Technical**

- Instantiation of Standards-Based SOA Infrastructure
- Integration of Multiple Legacy Components



MH-60 Cockpit Sim

- Pilot
- Sensor Operator
- Out-the-window



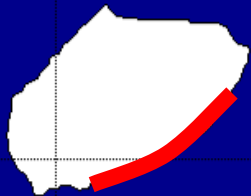
Video Wall

- TEAM Planning
- MEDAL
- JMPS
- Presentation

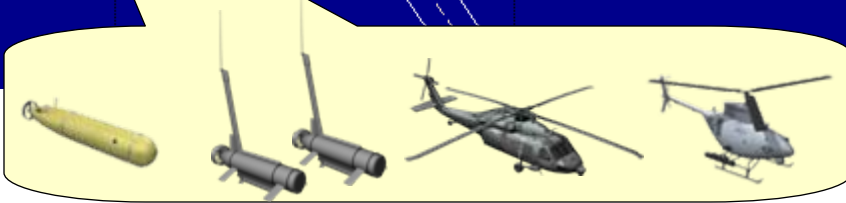
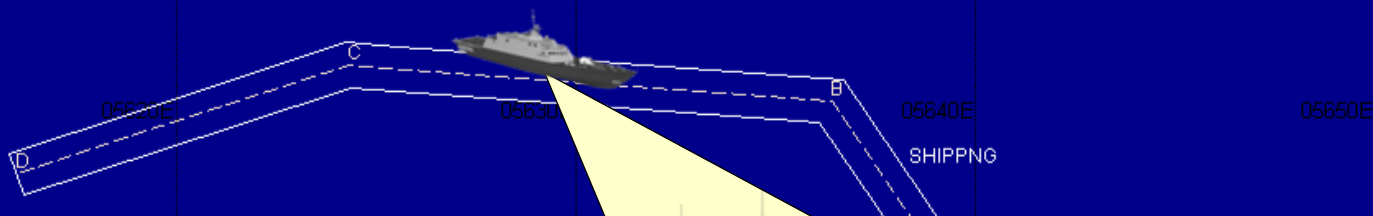
MH-60S Display Cart

- Out-the-window
Pilot mission and
flight display
- MCM control and
sensor display

Mission Overview



- Location: Strait of Hormuz
- Enemy: Hittite People's Front
- Enemy Location: Larak Island
- Mission: Beach Incursion
- Friendly Forces:
 - LCS (FREEDOM)
 - BPAUV (BPAUV-1)
 - RMMV 1 (VICTOR-1)
 - RMMV 2 (VICTOR-2)
 - MH-60S (SIERRA-1)
 - FIRESOULT (SCOUT-1)





BPAUV



RMS



AQS-20A

MH60S



VTUAV



COBRA



AQS-20A



ALMDS

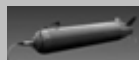


AMNS

USSV



RAMICS



OASIS

MIW Additional Attributes

Mine hunting using off-board sensors against volume, bottom and near bottom mines

Mine identification using off-board sensors against bottom mines

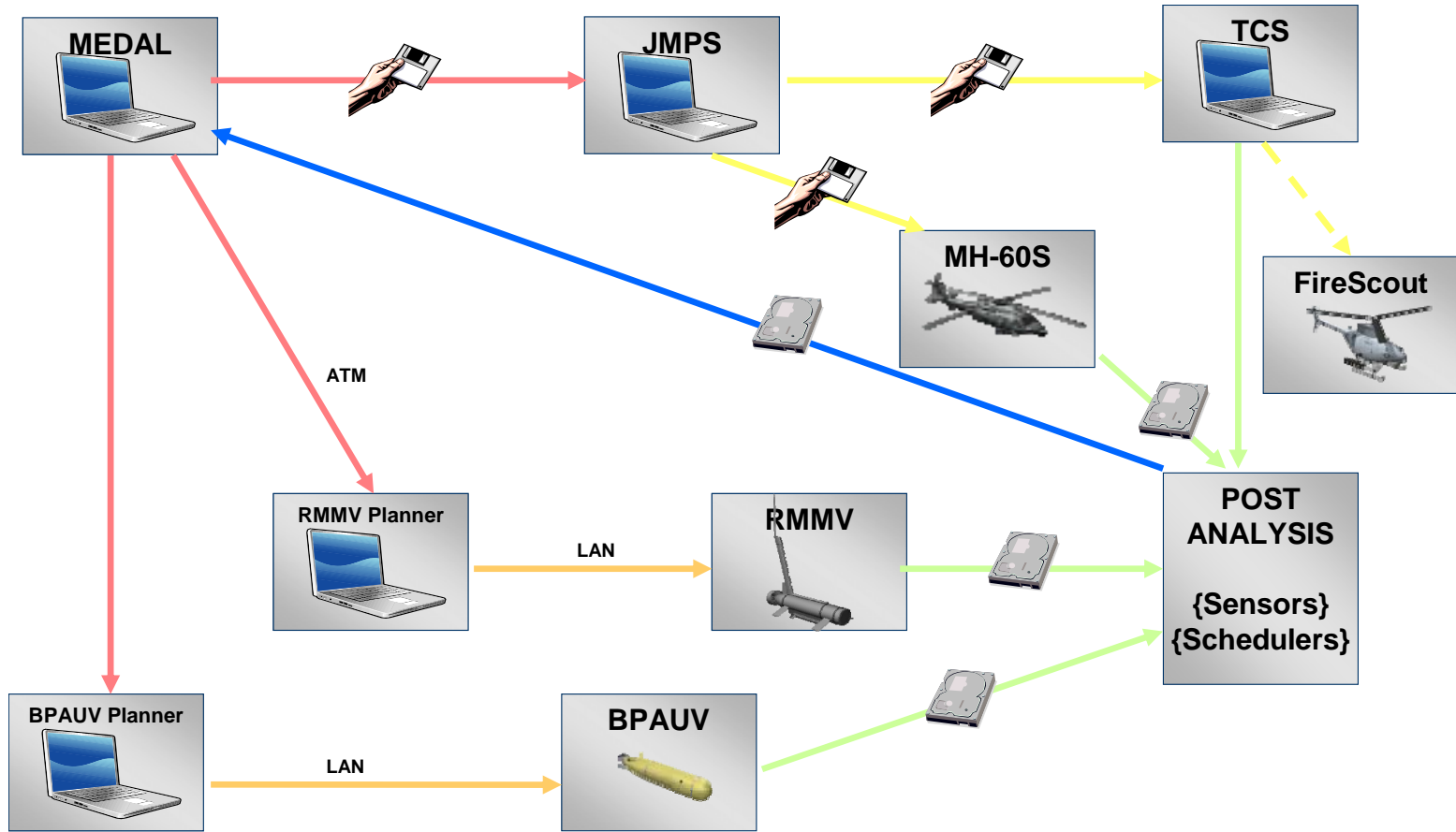
Mine hunting using off-board sensors against near surface and floating mines

Mine neutralization of volume, bottom and near bottom mines using off-board systems

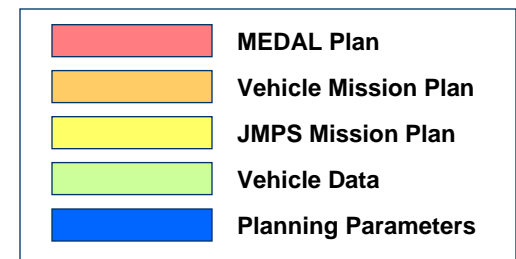
Mine neutralization of near surface and floating mines using off-board systems

Magnetic / acoustic influence minesweeping using off-board systems against magnetic / acoustic influence mines

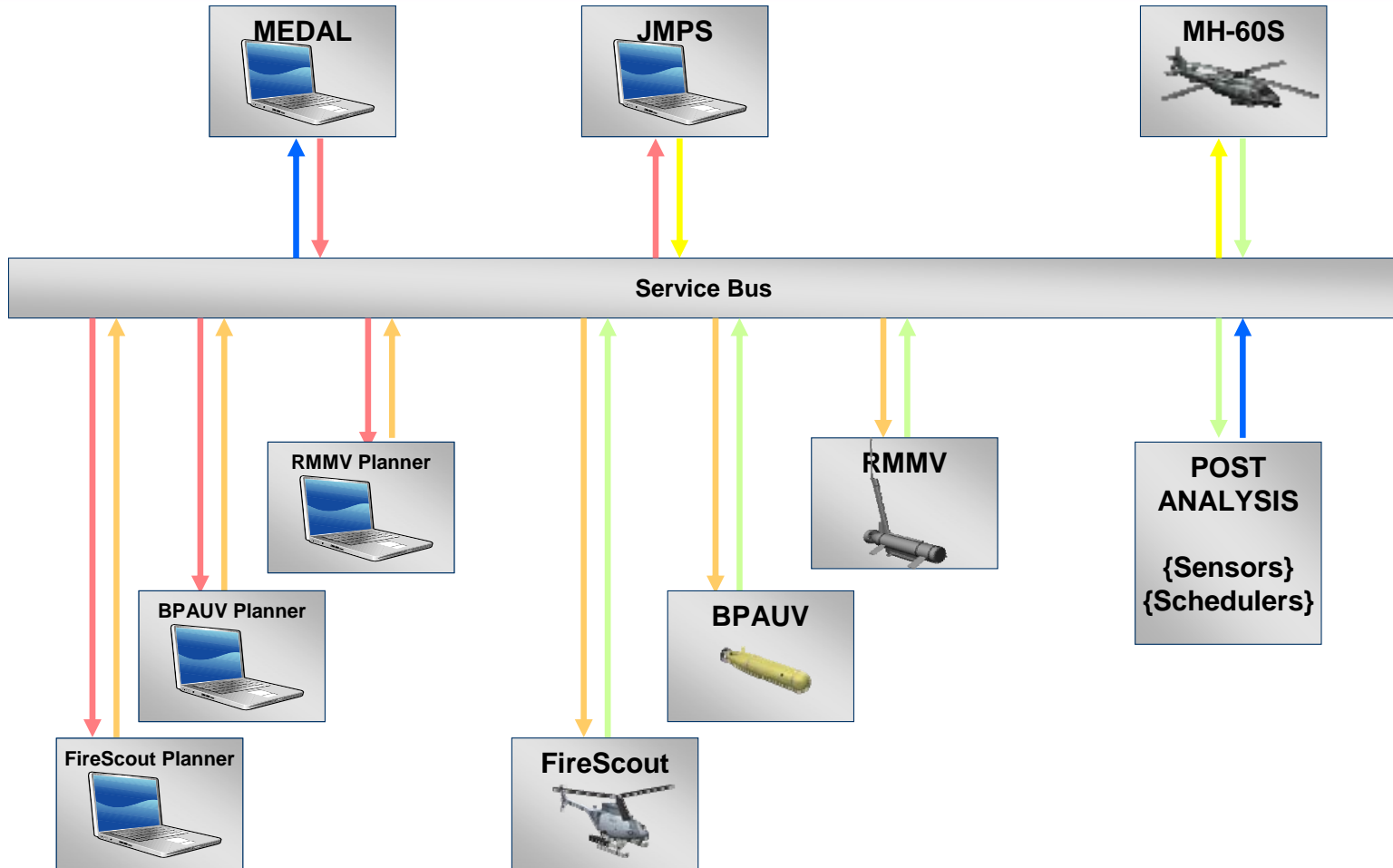
Deploy Plan to Assets (Current Data Flow)



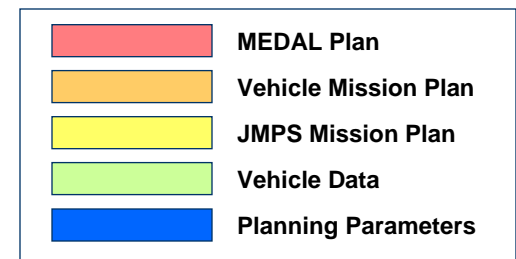
- Manually Intensive
- Highly and Diversely Skilled Operators
- Point-to-Point Interfaces Difficult to Scale



Deploy Plan to Assets (TEAM Data Flow)



- Automated Planning and Decision Aids
- Common Tools for Common Skill Set
- Interface-Managed Flow Control Eases Scaling and Flexibility





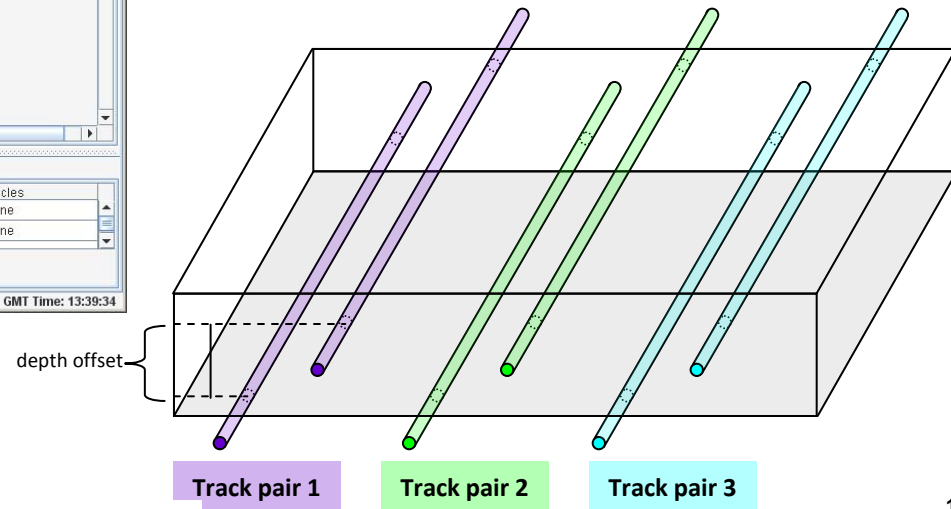
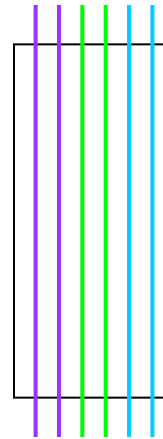
- **BPAUV Environmental Survey**
- **Update MEDAL Objectives**
- **TEAM Spiral 1 Display Features**
- **Plan TEAM Assets for Entire Mission**
- **Plan TEAM Assets for Single Region**
- **Deploy Plan to Assets**
- **Mission Execution – Search**
- **Plan Neutralization Mission**
- **TEAM Alternate Scheduler**
- **TEAM More Complicated Plans**



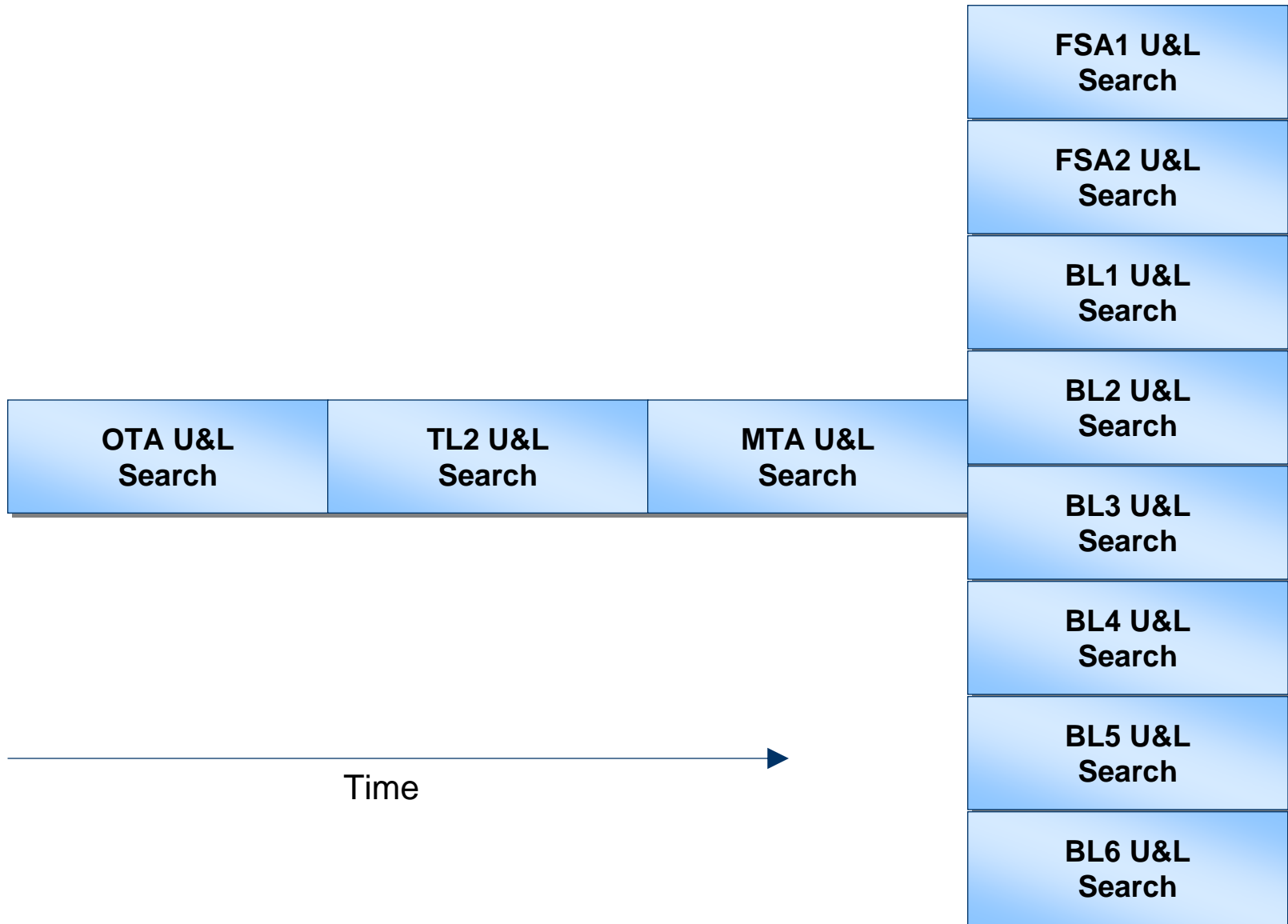
- The BPAUV asset is scheduled to scan the boat lanes.
- The BPAUV tasks are executed prior to the planning and execution of MCM search tasks

Schedule	Zone	Contact	VehicleStatus	Alerts
Area Name	Type	Percent Cleared	Confidence	Vehicles
	Search	0	0	None
	Search	0	0	None

0 Warnings 0 Alerts Routes approved. Ready for execution. GMT Time: 13:39:34



Update MEDAL Objectives





Map features

- Zoom, pan, scale
- Lat/Long
- Map layers
 - Digital Nautical Chart (DNC)
 - Bathymetry data
 - Bottom type
 - Restore default layers
 - Legend

Tabular Data

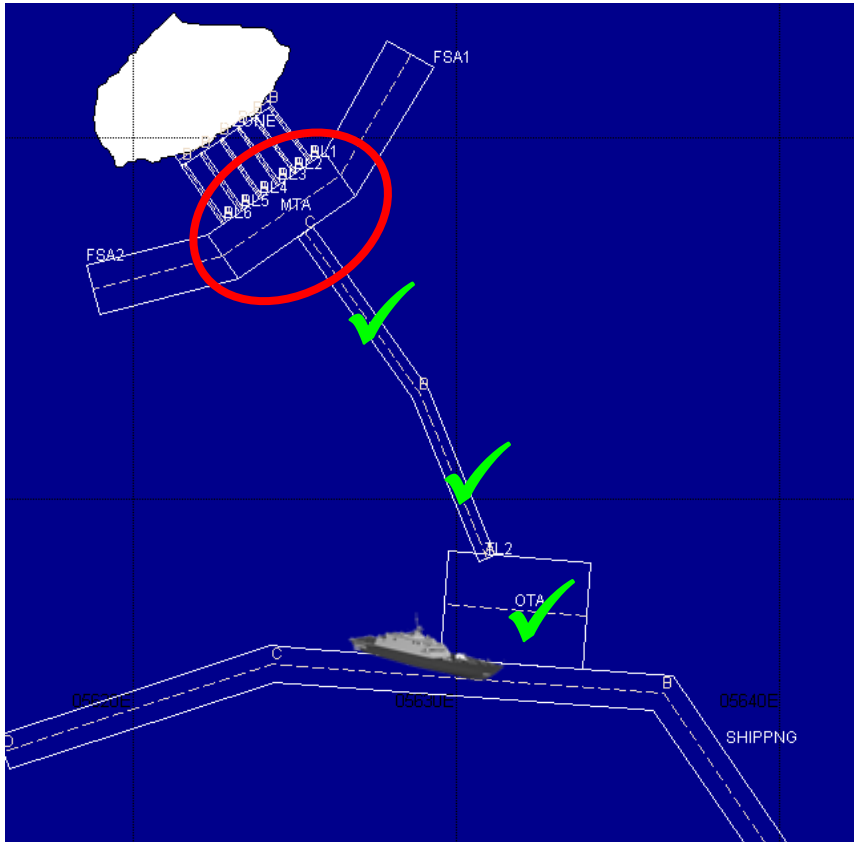
- Schedule
- Zones
- Contacts
- Asset Status
- Alerts

Plan Details

- Vehicle health
- Route
- Preferences



- **Import MEDAL objectives**
- **Zone details**
- **Callouts for MTA and boat lanes**
- **Schedule and plan mission**
- **View schedule**
 - Tabular data
 - Gantt chart
- **Display layers**
 - All scheduled routes
 - Declutter tasks
 - Declutter all routes on map
 - Use preferences to display plans for single asset



- Load only MTA objective
- LCS remains in OTA
- Generate schedule and plan
- Detailed map features
 - Ingress / egress
 - Turns
 - Tracks
 - Track spacing
 - Track extensions



Search mission execution in progress:

- **MH-60S with ALMDS in MTA**
- **RMMV with AQS-20 at start of first track of MTA**
- **View false detects on ALMDS sensor display**
- **RMMV detects a contact**
- **View contact details**



- **Load neutralization objective**
- **Generate schedule and plan**
- **Plan features**
 - Ingress / egress
 - Contact to reacquire



Original TEAM scheduling algorithm plan

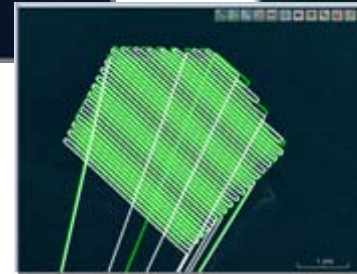
- **Alternate Scheduler**

- Daniel H. Wagner Associates, Inc.
 - MVMP
 - Developed under SBIR
- MTA only
- Original assets:
 - MH-60S
 - 2 RMMVs)



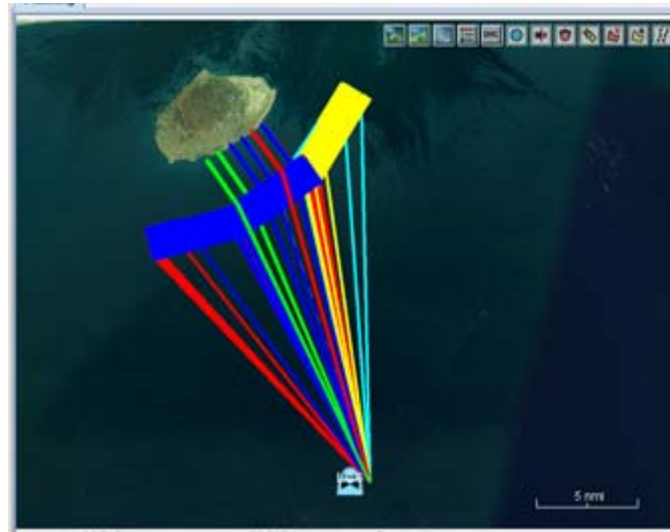
- **Alternate Geometries**

- Non-rectangular regions
- More areas
- Transit loop



- **Additional Assets**

- Areas:
 - MTA
 - 2 FSA regions
- Assets
 - 3 MH-60S
 - 6 RMMVs



<u>Performance Data</u>	
All Areas	18.8 sec
MTA	2.4 sec
Alt Geom	18.1 sec
Wagner All Areas	21.3 sec
Wagner MTA	2.9 sec
Wagner Alt Geom	20.7 sec



- ✓ **Infrastructure Foundation**
- ✓ **Built on that Foundation with Automated Manned-Unmanned, Team-Based Planning**
- ✓ **Built on that with a Consistent, Unified Operator Interface to Facilitate Operator-System Interaction**

Beyond that

- Further Built Up that Structure by Interoperation with
 - Legacy Systems
 - Existing Internal Investment Systems
 - System Developed by a Third Party under a Separate Effort
- Demonstrated the Structure in an Execution Vignette

Ready to Perform on Spiral 2 and Phase 2