Session Agenda

1330  Advanced Undersea Weapons System  Dave Everhart  NSWC-PCD
1400  Advanced Capability – ASTERIA Mine  Fabio Sgarzi  RWM Italia
1415  AUWS Delivery – Air Option  Jeff Feldstein  NSWC-PCD
1430  AUWS Delivery – Undersea Option  Ross Lindman  TCG
1445  Engagement Performance – Algorithms  Victor Newton  ARINC
1500  BREAK
1530  Engagement Performance – Assessment  Victor Newton  ARINC
1545  Sensors/Comms Node – AESOP  Tony Matthews  ITT
1600  Weaponized UW Surveillance Network  Prof Joe Rice  NPS
1615  Mission Planner for Auto UW Sensing  S. Seereeram  SSCI
1630  ADJOURN
Transformation of USW

Transforming USW

ASW
Platform Centric
Distributed Netted Prototypes

MCM
Triad of MCM Platforms
LCS-Based Integrated System

MINING
Single Non-Maneuverable Weapon
Controllable Mobile Weapon

Deter / Delay / Defeat Enemy Maneuver
Compel enemy to invest in MCM

Autonomous Netted USW Systems
Advanced Undersea Weapons & Sensors

Near-Term
Mid-Term
Far-Term

Asymmetric Unmanned Force-Multiplier
Traditional Asymmetric Unmanned USW (Mining)

• Value
  - Low-cost Battle-Space Shaping and Force Protection
    o Keep the enemy where you want him
    o Force the enemy into areas he doesn’t want to go
    o Keep the enemy out of areas he would like to go
  - Diplomatic and Military Leverage
    o Create an A2/AD problem for our Potential Adversaries

• Limitations
  - Delivery Options - Capability, Capacity, Risk
  - Target Discrimination - Enemy, Friendly and Neutral
  - Own Force Maneuverability
  - Command and Control (C2)
  - Dynamic/Flexible Re-tasking or Recoverability
“Stealthy mine-laying platforms capable of penetrating A2/AD systems are preferred” …ASBC
Why AUWS

- Need capability to restrict threat platforms’ ability to maneuver within lethal range of our forces, without putting our platforms at risk.

“Deploying smart mobile mines might prove particularly effective in attriting submarines and/or blocking them from access to their bases” --AirSea Battle Concept

“Advanced, smart mobile mines ... appears particularly attractive, given ... the difficulty and time-consuming nature of countermine operations” ...ASBC

“The Navy should develop ... smart mobile mines capable of autonomous movement to programmed locations over extended distances” --AirSea Battle Concept
AUWS Transit and Launch Options

Enables access to more areas:
- Not reliant on manned platforms
- From very long safe standoffs
- Into higher risk areas
- Clandestinely
- Inside ports
**Value of AUWS**

**Traditional Mining**  
(strategic, autonomous, overt)

- **Quickstrike**
- **SLMM**

<table>
<thead>
<tr>
<th>Depth</th>
<th>Traditional Mines</th>
<th>Transformational AUWS</th>
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<tbody>
<tr>
<td>SHALLOW</td>
<td>400 Traditional Mines</td>
<td>1 Transformational Mine</td>
</tr>
<tr>
<td>INTERMEDIATE</td>
<td></td>
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<tr>
<td>DEEP</td>
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**Transformational AUWS**  
(tactical, controlled, clandestine)

- **LDUUV with Sensor and Weapon Modules**
- **Distributed Sensors**
- **Remote Control w/ Supervised Autonomy**

<table>
<thead>
<tr>
<th>Action</th>
<th>Traditional</th>
<th>Transformational</th>
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<tbody>
<tr>
<td>Deliver</td>
<td>Hours</td>
<td>Hours</td>
</tr>
<tr>
<td>Arm / Engage / Sterilize</td>
<td>Months</td>
<td>Minutes</td>
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<tr>
<td>Clear</td>
<td>Months</td>
<td>Minutes</td>
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- **Risky Delivery & Extensive Clean-up**
- **Eases Delivery & Clean-up; Provides Tactical Flexibility**
AUWS Architecture Vision
Family of Integrated Systems/Modules

**Shallow Water**
- **Delivery Platform**
  - a. Air
  - b. Surface
  - c. Submerged
- **Vehicle**
  - a. UAV
  - b. USV
  - c. UUV
- **Internal Module**
  - a. AESOP
  - b. TDD
  - c. I-TDD
  - d. Acoustic Vector
- **External Module**
- **Gateways**
  - a. Buoy
  - b. Sentinel
  - c. SeaWeb
  - d. UUV
- **Sensors**
  - a. RAP VLA
  - b. HYDRA
  - c. ULTRA
  - d. Acoustic Vector
- **Weapons**
  - a. Archerfish
  - b. Seafox
  - c. I-SLMM
  - d. 19" Mine
  - e. CVLWT
  - f. LCN
- **Delivery Platform**
  - **UxV**
    - a. Range
    - b. Size
    - c. Capacity
  - **Payload Modules**
    - a. Decoys
    - b. Supplies
    - c. Other

**Deep Water**
- **Delivery Platform**
  - a. Air
  - b. Surface
  - c. Submerged
- **Vehicle**
  - a. UAV
  - b. USV
  - c. UUV
- **Sensors**
  - a. RAP VLA
  - b. HYDRA
  - c. ULTRA
  - d. Acoustic Vector
- **Weapons**
  - a. Archerfish
  - b. Seafox
  - c. CVLWT
  - d. Mk 54
  - e. Mk 48
  - f. I-CAPTOR
- **Gateways**
  - a. Buoy
  - b. SeaWeb
  - c. UUV
  - d. Glider

**Environment**:
- Ports, Harbors
- SLOCs, Sea Base

**Targets**:
- FAC, SPSS, Mini-Sub, UUV
- Ships, Subs, Gliders

**Mission Objectives**:
- ISR, SOF, Deter, Control, Project, Protect
Notional AUWS Family of Systems

Transit
- B-52
- Wing
- P3

Delivery
- LOS, OTH, SAT
- Command & Control via mobile or stationary Gateways
- UAV
- USV

Components
- Quickstrike
- USS 688
- Torpedo Tubes & DDS
- UUV w/ Sensors/Comms
- LCS
- DDG
- VA Class (D5 VLS Tubes)
- USS w/ SLMM warheads
- Moored Torpedoes
- Weaponized LD-UUV
- Effectors (Wide Area Coverage)
- Effectors (Explode-in-Place)

Effectors
- AESOP
- N-AVS
- TDD-N

Sensors
- (Distributed Network)
- Sensors

Shore base

Phase 0 - Shape Operations (ISR)

**Components**
- LOS, OTH, SAT
- Command & Control via mobile or stationary Gateways

**Effectors**
- (Wide Area Coverage)

**Transit**
- SSN 688I Torpedo Tubes & DDS
- VA Class (D5 VLS Tubes)
- UUV w/ Sensors/Comms
- UUV w/ SLMM warheads

**Delivery**
- Sensors (Distributed Network)
- AESOP
- N-AVS
- TDD-N

Clandestine Battlespace Preparation; ISR
Phase I - Deter Operations (insert weapons)

Components
- LOS, OTH, SAT
- Command & Control via mobile or stationary Gateways

Effectors
- (Wide Area Coverage)
- (Explode-in-Place)

Sensors
- (Distributed Network)
- N-AVS
- TDD-N

Effectors
- Weaponized LD-UUV

Transit
- Moored Torpedoes
- UUV w/ SLMM warheads

Delivery
- UUV w/ Sensors/Comms
- Weaponized LD-UUV

Components
- SLMM
- UDM

UAV Class
(D5 VLS Tubes)

SSN 688I
Torpedo Tubes & DDS

DDG

LCS

Shore base

DDG

LCS

SSN 688I
Torpedo Tubes & DDS

VA Class
(D5 VLS Tubes)

UAV w/ Sensors/Comms

UUV w/ SLMM warheads

Moored Torpedoes

Hold-at-risk; Early Warning; Show of force
Phase II - Seize Operations (weapons enable)

**Transit**
- B-52
- P3

**Delivery**
- Wing
- UAV
- USV

**Components**
- LOS, OTH, SAT
- Command & Control via mobile or stationary Gateways

**Effectors**
- Wide Area Coverage
- Explode-in-Place

**Sensors**
- Distributed Network
- N-AVS
- TDD-N

**Engage Hostile Targets; Area Denial**

- Shore base
- DDG
- LCS
- P3
- USV
- UUV w/ Sensors/Comms
- UUV w/ SLMM warheads
- SSN 688I Torpedo Tubes & DDS
- VA Class (D5 VLS Tubes)
- Weaponized LD-UUV
- AESOP
- UDM
- Quickstrike
- Moored Torpedoes
- SLMM
AUWS Roadmap

Now
Manned delivery,
Estimated emplacement,
Ambiguous engagement

Next
Unmanned delivery,
Precision emplacement,
Controlled engagement

Future
Autonomous delivery,
Precision positioning,
Cooperative engagement

Quickstrike
Limited
Standoff / Precision

SLMM
Improved
Standoff / Precision

TDDs / Distributed Sensors
CDV
DMUV
LD-UUV
SLMM
LWT
Next Gen Weapon

Transition to Smart Mobile USW Systems
Summary

• Let’s defend our forces by stopping threat forces in their waters with our asymmetric systems

• Let’s integrate the mining mission into the ASW and ASuW construct for a true USW asymmetric capability

• This AUWS surprise just may DETER their aggression!
Back-Ups
Technical Description

• Unmanned sensors, communications, & weapons nodes delivered by an LDUUV
• Key elements include:
  • Tactical Positioning and Fire Control
  • Remote Command and Control (RECO)
  • Autonomous Threat Discrimination & Localization

S&T Focus

• Mission planning, Tactical Decision Aid, autonomy, and fire control algorithms.
• LDUUV sensor and weapon deployment modules.
• Communications packages for undersea and gateway nodes, including processing and encryption algorithms
• Low-power, acoustic/ magnetic/ pressure/ seismic sensors and processing to detect and localize targets

Warfighter Payoff

• This EC provides operational commanders with clandestinely delivered, autonomous and remotely controlled, cost effective minefields. It will provide a tactically flexible asymmetric capability to deter and restrict the mobility and access of adversary forces that threaten our ability to maneuver at sea.

Pillar: SHD
EC Manager: Dr. Tom Swean
Contact info: tom.swean@navy.mil
Value of Wide-Area-Coverage

The Field is the capability – Not the individual weapon

- Field performance is a function of the individual weapon’s performance and the number weapons in the Field

  *Weapon performance in defined by the size of its kill volume*

- Military Utility favors weapons that ease:
  - Delivery
  - Control
  - Removal

  Lowest Total Ownership Cost

High-performance weapons reduce Total Ownership Cost
Value of Networking Weapons

- Autonomous Distributed Systems without networking
  - Prob of 1st Kill = 0.55
  - Cumulative Kills = 2

- Marginal Effectiveness
  - Robust effectiveness would require twice as many weapons in UDNS field

- Autonomous Distributed Systems with networking
  - Prob of 1st Kill = 0.88
  - Cumulative Kills = 4

- Robust Effectiveness

Networking Improves both the Initial and Sustained Threat
Value of Autonomy vs Control

Control improves Utility, but Autonomy improves Performance; Let the warfighter decide based on the situation.