Naval Precision Weapons Session
PMA-201/OPNAV N98/JHUAPL
Net Enabled Weapons (NEW)
Support to ASuW

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Precision Strike Weapons
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Net Enabled Weapons are critical to supporting the ASuW mission and the Navy’s strategic vision
- Allow for the receipt of In-Flight Target Updates (IFTUs) that improve the targeting and engagement of Moving Maritime Targets
- In-flight Retargeting/Reallocation
- In-flight Abort

PMA201 is taking a leading role in the ASuW mission
- Net Enabled Weapon portfolio
- Sensor to Weapon 3PS Targeting (S2W 3PS)
- Weapon to Weapon Coordination (Cooperative Attack)
PMA201 is Meeting the Challenge!

**Supporting the Strategic Vision**

**SEA POWER 21**

- **Sea Strike**
  - **FORCEnet**
  - **Sea Basing**
  - **Sea Trial**
  - **Sea Warrior**
  - **Sea Shield**

**INFORMATION DOMINANCE:**

- Connecting sensors, networks, weapons, command & control, platforms, and warriors.
- Integrating warriors, sensors, networks, weapons, and platforms to dominate the battlespace.

**EMPHASIZE:**

- Development of long-range, high-speed attack systems.
- Ability to attack fleeting targets and conduct time sensitive strike.

**NEW Standardization**

- **FY 13**
  - **JSOW C-1**
- **FY 17**
  - **HARPOON BLOCK II+**
- **POM 14**
  - **OASuW**
- **FY 20**
  - **SDB II**
- **POM 14**
  - **COOPERATIVE ATTACK FNC**

**PMA201 is Meeting the Challenge!**
Network Enabled Weapon (NEW)
Joint Standoff Weapon (JSOW) C-1

Program Description

• ACAT 1C // Navy Program

• Contractor: Raytheon Missile Systems

• Requirement: Adverse weather standoff outside point/area defenses against fixed/re-locatable stationary land targets (area, point, and hardened targets with blast/frag and penetration).

• First free flight test completed July 2011

• JSOW C-1 will be the 1st Network Enabled Weapon (NEW) deployed

JSOW Unitary (AGM-154C-1)

- Uncooled Commercial IR Sensor with ATA
- GPS/INS Guidance for flyout
- Terminal Seeker, Increased P_K, Precision Accuracy
- Broach Warhead, Blast / Fragmentation / Penetrator
- Link-16 Strike Common Weapon Data Link (SCWDL)
- Stationary Land & Maritime Moving Targets

In Development - 2013 IOC

Key Performance Parameters

<table>
<thead>
<tr>
<th>Legacy</th>
<th>C-1 Unique</th>
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<tr>
<td>Survivability</td>
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<td>Air Vehicle CEP</td>
<td>WDL</td>
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<td>Range at Low Alt.</td>
<td>WDL</td>
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<td>Range at High Alt.</td>
<td>Net Ready</td>
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<td>Launch Speed Min.</td>
<td>WDL Range</td>
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<td>Launch Speed Max.</td>
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<td>Off Axis Launch</td>
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<td>Interoperability</td>
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<td>Unitary CEP</td>
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Network Enabled Weapon (NEW)
Harpoon Block II+

**Platforms**
- Threshold: F/A-18 E/F
- Objective: add P-8A

**Program Description**
- Designated an Abbreviated Acquisition Program (AAP)
- Sales Exchange Agreement with Boeing
- Provides a Navigational Update to the Harpoon Blk 1C
  - Includes GPS/INS & SCWDL
  - Network Enabled Weapon
- IOC/Fleet Release FY17

**Upgrade Kit – H/W only**
- H12E SCS: Net Enabled Weapons (NEW) Msgs
- JMPS: GPS/Data Link Keys

**1760 I/F**
- SCWDL Kit (Already Developed)

**Harpoon Block II +**
- Data Link
- D/L Antenna
- Guidance
- Shell
- GPS Antenna
- Guidance
- Control Unit

**Common Data Link**
- GCU with GPS
- OFS NEW Msgs

**Platforms**
- Threshold: F/A-18 E/F
- Objective: add P-8A

**GPS Satellite**
- F/A-18E/F
- NEW msg
- Sensor
- Target

**Air-Launch OV-1**

**Mission**
- GPS
- Harpoon Block II+
- Data Link
- D/L Antenna
- Guidance
- Shell
- GPS Antenna
- Guidance
- Control Unit

**Harpoon Block 1C**
- Upgrade Kit (Already fielded)

**Harpoon Block II**
- Upgrade Kit – H/W only

**Designated an Abbreviated Acquisition Program (AAP)**
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**GPS/INS**
- accuracy
- reduced search area
- 7x Pattern Size Reduction Over Blk 1C
- Attack boundary collapses to search area
- IPTU accuracy further reduces search area
- 10x Pattern Size Reduction Over Blk 1C
- Attack boundary collapses to search area
Requirements

- Network enabled / not network dependent
- Perform at extended ranges under a wide range of targeting conditions (weather, jamming, etc.)
- Surface/Air launched
- Survivable
- Near 2018 long 2024 solution
- Near 2018 ECP to existing Program of Record
- Harpoon, SM6, Tomahawk, LRASM, JSOW, SLAM-ER

Schedule

- CBA Approved May 2010
- JROC Approved ICD – Nov 2010
- MDD ADM – Jan 2011
- MPCR 0-7 Pre-Brief – 14 Mar 2011
- MPCR R3B – 16 Mar 2011
- AoA ESC/AAG out brief – 09 Mar 2011
- AoA Quick Look – Jul 2011
- *MS A – Jun 2012
- *MS B – 2017
- *MS C - 2020
- *IOC – NLT 2024
* Dependent on results of AoA that concludes in CY11

Issues

- Affordability
- Kill Chain Wholeness
- Schedule
Sensor to Weapon 3PS (S2W 3PS)

- Enables Shooter to engage target from sanctuary
  - Increases Shooter Survivability
  - Allows for a “launch and leave” capability
- ISR and/or C2 platform provide IFTUs directly to weapon
  - Improved targeting accuracy
  - Increased Pk
Weapon to Weapon (Cooperative Attack)

- Enables Semi-autonomous communications/coordination between multiple weapons
  - Dynamic In-flight Retargeting/Reallocation
  - Synergistic use of Sensors
  - Reduced Salvo Size
- Currently pursued via ONR sponsored POM14 FNC
  - Common solution, weapon agnostic
  - Targeted Demonstration in JSOW C-1, Harpoon Block II+
Near Term Challenges

- **Development of a NEW CDD/KPP that defines roles and responsibilities of platform participants (shooters, weapons, 3PS)**
  - Currently in development

- **Definition of future Network Architecture, i.e. L16, TTnT, etc.**
  - Awaiting direction from N2/N6

- **Identification of potential NEW platforms and weapons**
  - E-2D, BAMS, P-8

- **Funding for J11 message set incorporation in 3PS ISR platforms (N88/N89 seam issue)**
  - LSRS: POM 13 Issue Sheet submitted, **currently below the line**
    - $10M in FY13, $5M in FY14
    - JTIC certification, Chg 4 to MIL-STD-6016D ICP, Training materials, enhanced operator displays and controls
  - JSTARS
Precision Strike Annual Review

20 March 2012

Major Craig “Pebbles” McDermott
OPNAV N98
Air-to-Ground Requirements Officer
AIR TO GROUND WEAPONS ROADMAP

- 2.75” Rockets
- 5” Rockets
- 20MM/25MM
- 50 Cal

Direct Attack
- GP Bombs
- LGB/DMLGB
- JDAM/LJDAM
- Hellfire (RW)
- Maverick
- GBU-24/J109

Stand Off
- Land Attack
- JSOW A/C
- SLAM ER

Rockets/
MG Ammo

HARPOON 1-C
SLAM ER

Stand Off
ASuW

APKWS II
LOGIR
20/25MM

LJDAM
GP Bombs
BLU-129
DMLGB
GBU-24/J109

JSOW C-1
HARPOON II+
OASuW AoA
AARGM

Precision
Counter EA
Moving Target
Stand Off
All Weather

SDB II
AARGM
JSOW C/C-1
Strike Stand Off Weapons

**JSOW Unitary (AGM-154C-1)**

- Adds Weapon Data Link/ Network Enabled Weapon (NEW), Maritime Moving Target Capability to the existing capabilities of the JSOW C

**Small Diameter Bomb II**

- Provides precision tactical standoff capability against mobile/stationary targets in all weather conditions using GPS/INS Enhanced Accuracy
- Tri-mode seeker (SAL/IIR/MMW) provides pinpoint accuracy and minimum collateral damage.
- Network Enabled Weapon

**Advanced Anti-Radiation Guided Missile (AARGM AGM-88E)**

- Destruction of Enemy Air Defenses (DEAD)
- Expanded Threat Coverage
- Enhanced Anti-Radiation Homing (ARH) receiver against heat generating high value targets.

**Harpoon II+ ()**

- Harpoon II+ provides a navigation upgrade to allow for increased reliability and improved target selectivity / survivability
- Network Enabled Weapon

**Pacing the Threat**
N98 Future Outlook

• Increased Range
  – AARGM
  – JSOW ER
  – JDAM ER / LJDAM ER

• Hard Target Munitions

• JSOW A Conversion
  – Cluster Munition to Unitary Warhead

• NCEA
  – Replacement of Live with Heavy Inert
  – Increases in Training Requirements (20mm, Hellfire, etc)
  – Constrained Weapons (SLAM ER, Harpoon, LMAV, GBU-24, etc)

• Science and Technology
Precision Strike Annual Review
Capabilities Based Acquisition

March 20, 2012
Weapon Acquisition Challenge

• DoD faces an austere fiscal environment
• DoD plans to reduce/limit new-start MDAPS
• New capabilities must be achieved through the modification and integration of existing systems
Capabilities Based Acquisition

• JCIDS – ICD, CBA identified GAPs, AoA in context of kill chain
  – Identifies requirements for capabilities

• CDD/CPD – Capability requirement documents
  – Focused on system acquisition

• System-of-system (SoS) = Design Options = Greater Opportunity
  – Capabilities may be achieved through one or more combinations of systems in an existing/new portfolio of programs
  – “Non-traditional” allocation of functions (e.g., find, fix, track, ID) to constituent systems is part of the SoS solution space…

• SoS solutions offer efficiency and optimization across mission areas; “more for less”

• SoS resource allocation ties investment to warfighting capability

How can DoD acquire capability?
Integrated Chain of Capability
Example: Anti-Surface Warfare

Pre-Launch Nodes

- If Pre-launch and Post-launch capabilities are acquired and “optimized” without specific knowledge of prioritized overarching warfighting capabilities it is likely the integrated system will not be optimal

Post-Launch Nodes
Understanding the complex nature of the integrated chain of capability helps determine the overall capability effectiveness.
Assume the size the link above is equivalent to system performance, and that when summed the areas within each “link” will add up to a required overall capability effectiveness determination.

- EX: Overall Effectiveness = Salvo size needed for enemy SAG takedown
Integrated Chain of Capability
Example: Anti-Surface Warfare

- Highly survivable/lethal ... Less weapons
- Great sensor ... Good data link ... Average seeker
- Poor data link ... Good seeker
- Etc...

Pre-Launch Nodes

Post-Launch Nodes

- Different combinations of performance may “sum” to the same overall effectiveness, as each node’s system performance has an effect on the performance requirements of the other nodes
Integrated Chain of Capability
Example: Anti-Surface Warfare
Capability Performance Requirements Traceability

Where Simulation Can Help

- Man/Hardware-in-the-Loop

- Constructive
  - AMOS, CFAM, LCOM, THUNDER
  - EADSIM, JIMM, SCOPES, SEAS, SPAAT, SUPPRESSOR
  - BRAWLER, ESAMS, GIANT, GTSIMS, JSEM, JTEAM, MIL-AASPEM 11, MOSAIC, RADGUNS, SHAZAM

- Virtual

- Resolution

- Aggregation

- Campaign

- Mission

- Engagement

- Specialty

- Hundreds of engineering models

Live Virtual Constructive (LVC)
Optimizing the Integrated Chain of Capability to meet a warfighting need is based on performance metrics of feasible combinations that are linked to desired IOC (TRL), and costs (affordability).
Challenges to *Capabilities* Based Acquisition

• Orchestrating acquisition for asynchronous programs
• Authority for requirements and funding across multiple programs
• Program baseline thresholds may not support new capability
  • Characterize above-threshold performance & update documents
  • Identify “delta requirements” and institute modifications
• The need for accurate program models for capability-based mission analysis
• Capabilities achieved through SoS solutions can only be developed in collaboration. Teaming is paramount…Industry data sharing and GFI together offer potential teaming solutions
Distributed Development
Executed through / by asynchronous MDAPs

Concept Development
Tech. Development
Eng & Mfg Develop.
Eng & Mfg Develop.

Maturing SoS-based Capability

SoS Process / Documents Must Guide Simultaneous and Distributed
Concept Development (CD), Technology Development (TD),
Engineering & Manufacturing Development (EMD)
AND
Collaborative Test & Evaluation (T&E)
SoS-based Capability Development
Systems Engineering Rigor...reflected in documentation

Multiple MDAPs
(SoS Constituents)

- Concept
  (CONOPS)
- Requirements
  (CDD)
- T&E
  (TEMP)

Composite Capability
(SoS-based)

- Concept
  Objective + Strategy
  (OCD)
- “Delta Rqmts”
  (CA)
- Characterization
  (CCP)

Compatible with and augments DoD acquisition processes, as it is dependent upon MDAPs for execution!

Developed via Multiple MDAPs
(coalition of program offices)

Operational Concept Document

Capability Annex

Capability Characterization Plan
SoS-based Capability Development Documentation

- **Operational Concept Document**
  - Adjunct to acquisition and Fleet “CONOPS”
  - Shapes the collaborative development environment (cross-MDAP scope)
  - Context & process for identifying *capability-specific* “delta requirements”

- **Capability Annex**
  - Documents SoS-based Capability
  - Augments constituent CDDs / CPDs
    - Derived / delta requirements

- **Capability Characterization Plan**
  - *Integrated schedule* for research, analysis, test and experimentation
    - Live / Virtual / Constructive

Documents are *interdependent* & must remain aligned
May inform employment concepts for new, complex capabilities

“Adds” capability-specific “delta requirements” to existing JCIDS documents

Leverages existing T&E activities and results...

May influence changes to constituent MDAP TEMPs for system-level T&E
Shaping the collaborative environment

Step #1: Agree on the concept

➢ Operational Concept Document
  - Derives from:
    • Handbook of Systems Engineering and Management (definition)
    • ANSI / AIAA G-043-1992
  - Incorporates relevant content from:
    • Concept Proposals
    • Operational Concept Descriptions
    • DoD Acquisition CONOPS
    • USN Fleet CONOPS
    • Design Reference Mission Profiles
    • Test & Evaluation Strategies

Scope transcends constituent systems and MDAP offices
Implementing the SoS via MDAPs

Capability-specific “Delta Requirements”

➢ Capability Annex
  - High-level / SoS-focused perspective
  - Captures capability-specific “delta requirements” for constituent systems
    • Informed by the OCD
  - *May* include an “Interoperability Viewpoint” that incorporates one or more of the following:
    • Functional Decomposition
    • Physical Allocation
    • Mission Task Sequences
    • Information Exchanges

CA intended to augment the CDD for each constituent system
Capability-Verification
With useful and consistent performance metrics…

Composite Capability (SoS-based)

Integrated Function (2+ Systems)

Fire Control
  “Network”
  Shooter

Integrated Function (2+ Systems)

“Network”
Shooter
Weapon D/L
Weapon

Measure(s) of Effectiveness - AND / OR - Measure(s) of Performance

Integrated Function Performance Measure (IFPM)

Critical Technical Parameters
Capability Characterization
The role of T&E in the context of SoS Development

➢ Capability Characterization Plan
  - Predictive performance analyses
    • Constructive
      o Computer based / parametric
  - System-Level & Integration Tests
    • Virtual
      o Hardware & Operator in the Loop
    • Live
      o Demo / Prototype
      o Fleet Battle Experiments

Capability assessment is continuous and progressive. Findings from all activities support Observations of Operational Capability and inform fleet introduction processes.
Concluding Thoughts

- Capabilities based acquisition offers potentially significant **efficiencies and affordability** in procuring warfighting capability

- SoS development requires modifications to the traditional MDAP acquisition processes

- Front end SoS and system engineering that includes a robust Modeling and Simulation tool set can identify optimal “Integrated Chains of Capability”

- Government and Industry can work together in a collaborative environment to support this analysis

- Methods exist in system engineering best practices to guide the acquisition community in SoS based development