Acquiring Autonomous Systems

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Presented by:

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PEO(U&W) UAS Experience

MQ-4C Triton

MQ-25A

RQ-12A Wasp IV

Wasp

RQ-20A Puma

Aerosonde

RQ-11 B Raven

Scan Eagle

RQ-7B Shadow

RQ-21A Blackjack

MQ-8 Fire Scout

VTUAV

Cargo UAS

K-MAX

MQ-263

PMA-262

PMA-268

PMA-266

PMA-281

Unmanned Air Systems

Common Control System

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Naval Group 4-5 UAS

Group 5
GW> 1320 lbs

Group 4
GW> 1320 lbs
OpAlt < 18 Kft

MQ-4C Triton
MQ-8 Fire Scout
MQ-25

Common Control System (CCS)

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• The “cross-over point” … Artificial Intelligence (AI)
  – DSB 2016 Summer Study on Autonomy:
    • Capabilities of autonomous systems
      – SENSE
      – THINK/DECIDE (AI - unique to autonomous vs. sophisticated deterministic automated systems)
      – ACT
      – TEAM
  – With the introduction of AI, these things change significantly
    • the nature of requirements generation,
    • supporting CONOPS,
    • engineering developmental efforts, and
    • test & evaluation
• Key acquisition community roles in responding to capability needs and the supporting Requirements
  – Evaluating when/where does automation/autonomy provide the best solution
  – Championing “enablers” of automation/autonomy
COOPERATIVE TRACKER
- NTM capability
- Search, detect and target moving target with ownship sensor
- Characterize latency and accuracy, and transmit

COOPERATIVE SHOOTER
- Receive tracks, ID, accuracy, and latency from offboard source
- Transfer control to offboard source

WEAPON CONTROLLER
- Receive track, re-target and abort messages via offboard source
- Transmit track updates, retargeting and abort messages to weapon

WEAPON
- Send and receive in flight target updates
- Weapon to weapon coordination

Mission & Platform Independent Functional Capability
Platforms & Weapons that can Perform Role

Notional Assets
- Space
- Air
- Surface
- Subsurface

TACTICAL CLOUD
- Send and receive in flight target updates
- Weapon to weapon coordination
**PEO(U&W) Third Offset Efforts**

**Third Off-Set**
- Manned/unmanned teaming
- Swarming UAS
- Artificial Intelligence
- Autonomy
- Combining legacy capability with emerging technologies to deal with a broader range of threats

**On-going efforts to put us ahead of the curve**
- APKWS
- SDB II
- Harpoon Block II+ (ER)
- JSOW C-1 (ER)
- Fire Scout / H-60 Composite Det
- Motley Crew
- Surface Domain OASuW initiatives
- IMPAX efforts
- Network Enabled Weapons
- Collaborative Weapons
Technology Needs

**Overarching Needs**

- Cyber Defense & Delivery
- Data Management / Data Fusion
- Open Architectures / Modularity
- Operations in denied environment
  - Assured navigation
  - Communications (LOS & BLOS)
  - Robust networks
  - Precision timing
- Electric Power Generation
  - Solar Cells
  - Additive Manufacturing

**UAS**

- Autonomy
- Ops in urban environment
- Multi-spectral sensors
- Automatic Target Recognition (ATR)
- Mobile target detection and tracking
- Sense And Avoid (SAA)
  - Micro-IFF systems
- Multi-vehicle, multi-sensor planning and control
- Increased range / time airborne
  - Power management
  - Battery technology
- Reducing workload and/or operator

**Weapons**

- Non-Traditional sensors
- Hypersonic (seekers, propulsion, materials, etc)
- Net-enabled / Interoperable
- Multi-mission capability (Modular)
- Expanded engagement envelope
  - Speed / Range / Energetics
- Insensitive munitions improvements
- Additive Manufacturing for energetics
- Alternative weapons (e.g. directed energy, rail gun, etc.)

**Autonomy Related S&T Projects**

- Small Business Innovative Research (SBIR) – 41
- Small business Technology TRansition (STTR) – 4
- ONR Future Naval Capability (FNC) – 4
- OSD Rapid Innovation Fund (RIF) – 3
- DARPA - 5
Technology Push

**Risks**
- Transition Funding
- Requirements lag
- Unique platform architecture
- Size, Weight & Power
- T&E of autonomy
- No technology pull

**Enablers**
- Open Architecture
- Common Interfaces
- Upgradable hardware
- Modeling and Sim
- Low Size Weight And Power
- Testability

Small Business Innovative Research (SBIR) – 41
Small business Technology TRansition (STTR) – 4
ONR Future Naval Capability (FNC) – 4
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DARPA - 5

Program of Record

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Summary

• Automation enables autonomy
  – Significant changes in requirements generation, CONOPS, develop of systems, and test & evaluation
• Requirements pull focus on automation
  – Technology push leading requirements pull
• Stepping stones
  – Increasingly complex automation
    • Builds trust by users and testers
  – Modelling & Simulation infrastructure
    • Support for both development and test
  – Autonomy of severable functions
• Continue to address risks
  – ONR, DARPA, SBIR
• Planning for success
Questions
Enabling Autonomy

• Open Architecture
  – Future Airborne Capability Environment (FACE) – PMA209 Consortium
  – Sensors Open Systems Architecture (SOSA) – USAF Consortium

• Common Interfaces
  – Navy Interoperability Profiles (NIOPS) – PEO(U&W) CSI
    • Advanced Command and control
    • Track management
    • Motion Imagery
    • WAN Network
    • Common Datalink

• Upgradable hardware
  – Multiple SBIRs, FNCs
  – Hardware Open System Standards (HOST) – PMA209

• Modeling and Sim
  – Multiple SBIRs, FNCs
    • Collaborative Anti-Surface Warfare Engagement (CASE) FNC

• Low Size Weight And Power
  – Multiple SBIRs, FNCs
    • SBIR 142-102 – Micro Identification Friend or Foe (IFF)
    • SBIR 151-026 – Small Non-Cooperative Collision Avoidance System

• Testability
  – Multiple SBIRs, FNCs
    • SBIR 152-084 – Test and Certification Techniques for Autonomous Navigation
### UAS Groups

<table>
<thead>
<tr>
<th>UAS Groups</th>
<th>Max Weight (lbs)</th>
<th>Normal Operating Altitude (ft)</th>
<th>Speed (kts)</th>
<th>Representative DoN UASs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td>0-20</td>
<td>&lt;1200 AGL</td>
<td>100</td>
<td>RQ-11 Wasp</td>
</tr>
<tr>
<td><strong>Group 2</strong></td>
<td>21-55</td>
<td>&lt; 3500 AGL</td>
<td>&lt;250</td>
<td>Scan Eagle</td>
</tr>
<tr>
<td><strong>Group 3</strong></td>
<td>&lt;1320</td>
<td>&lt;FL 180</td>
<td>&lt;250</td>
<td>RQ-21A Blackjack</td>
</tr>
<tr>
<td><strong>Group 4</strong></td>
<td>&gt;1320</td>
<td>&lt;FL 180</td>
<td>Any</td>
<td>MQ-8 Fire Scout</td>
</tr>
<tr>
<td><strong>Group 5</strong></td>
<td>&gt;1320</td>
<td>&gt;FL 180</td>
<td>Any</td>
<td>MQ-4C Triton</td>
</tr>
</tbody>
</table>
Group 3 UAS

RQ-7B Shadow

RQ-21A Blackjack
ScanEagle

Total flight hours (FH): >425,000 (as of February 2016)
Land FH: >391,000 | Ship FH: >33,500
34 ship installs | 30 deployments | 8 classes of ships

Aerosonde
Group 1 UAS

- RQ-20A Puma
- RQ-11B Raven
- InstantEye Nano
- SkyRanger VTOL
- RQ-12A Wasp
Examples of Autonomy S&T

• ONR
  – Collaborative Anti-Surface Warfare Engagement (CASE) Future Naval Capability (FNC)
    • CASE will develop, integrate, and test collaborative autonomy algorithms among like and dissimilar air vehicles
  – Autonomous UAV Collision Avoidance System (ACAS) FNC
    • Develop a light weight, affordable, autonomous capability to recognize and avoid proximity to airborne objects in multi-use airspace

• DARPA
  – Low-Cost UAV Swarming Technology (LOCUST)
    • Use of Small, Inexpensive Unmanned Air Vehicles (UAVs) to Create Swarms
    • Autonomous control of UAV swarms
  – Aircrew Labor In-Cockpit Automation System (ALIAS)
    • Promote the addition of high levels of automation into existing aircraft, enabling operation with reduced onboard crew.

• SBIR / STTR
  – Collision Avoidance Decision Making in the Face of Uncertainty
    • Evaluating tracks, prioritizing perceived threats and deciding whether to maneuver
CNO Guidance

Partnership
Cyber Advantage
Modularity

Requirements
Strengthen Workforce
Ownership of Technical Standards

Align Investments
Product-Oriented Staffing

"Ready to Fight Tonight"

Reduce Cost & Increase Speed to Fleet
Align Resources to Support Today’s Readiness

EXPAND AND STRENGTHEN OUR NETWORK OF PARTNERS

STRENGTHEN OUR NAVY TEAM

ACHIEVE HIGH VELOCITY LEARNING AT EVERY LEVEL

STRENGTHEN NAVAL POWER AT AND FROM SEA

Integrity
Accountability
Initiative
Toughness

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Embracing Unmanned … Yesterday, Today and Tomorrow …