Unmanned Aircraft Systems
Present & Future Capabilities

Major General Blair Hansen
23 October 2009
Overview

- Why Unmanned Aircraft Systems
- Evolution of Capabilities
- Growing Demand
- Emerging Missions
- Challenges
- Vision
Why Unmanned Aircraft Systems?

- Persistence - ability to loiter over a target for long time periods for ISR and/or opportunity to strike enemy target
- Undetected penetration / operation
- Operations in dangerous environments
- Can be operated remotely, so fewer personnel in combat zones - projects power without projecting vulnerability
- Integrates “find, fix, finish” sensor and shooter capabilities on one platform
## Evolution of Capabilities

<table>
<thead>
<tr>
<th></th>
<th>WWII</th>
<th>Vietnam</th>
<th>Gulf War</th>
<th>OIF/OEF</th>
<th>Near Future</th>
<th>Distant Future</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000 planes</td>
<td>30 planes</td>
<td>1 plane</td>
<td>1 plane</td>
<td>4 planes</td>
<td>Swarm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B-17)</td>
<td>(F-4)</td>
<td>(F-117)</td>
<td>(F-16)</td>
<td>(MQ-X)</td>
<td>(Autonomous UAS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>People</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 crew</td>
<td>1 crew</td>
<td>1 crew</td>
<td>1 crew</td>
<td>1 crew</td>
<td></td>
<td>Mission Commander</td>
<td></td>
</tr>
<tr>
<td><strong>Targets</strong></td>
<td>1 Target</td>
<td>1 Target</td>
<td>2 Targets</td>
<td>6 Targets</td>
<td>32 Targets</td>
<td>??? Targets</td>
<td></td>
</tr>
<tr>
<td><strong>Tech</strong></td>
<td>Mass Aircraft</td>
<td>Tactical Strike</td>
<td>Laser Munitions</td>
<td>GPS Munitions</td>
<td>MAC</td>
<td>Collaboration</td>
<td></td>
</tr>
<tr>
<td><strong>C2</strong></td>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
<td>In-the-Loop</td>
<td>On-the-Loop</td>
<td>Out-of-the-Loop</td>
<td></td>
</tr>
<tr>
<td><strong>Mgmt</strong></td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Active</td>
<td>Responsive</td>
<td>Passive</td>
<td></td>
</tr>
</tbody>
</table>
Family of Systems

Nano
Navigate / communicate inside buildings

Bio-Mechanicals
- Indoor Reconnaissance
- Indoor Lethal/Non-lethal
- Indoor Comm
- Cyber attack
- Swarming

Micro
Close-in reconnaissance & situational awareness

“SUAS Family of Transformers”
- Personal ISR
- Lethal
- SIGINT
- Cyber/EW
- Counter-UAV
- AutoSentries

Wasp III

Man-portable
- ISR
- Time-Sensitive
- Lethal

Irregular Warfare
Increasing across all mission sets

Man-portable
- ISR
- Time-Sensitive
- Lethal

Family of Expendables
- Close-In ISR
- Expendable Jammers
- Lethal
- Counter Air
- Precision Clandestine Resupply
- Cyber attack

Air-Launched
- Close-in ISR
- Lethal
- SIGINT/DF

Next Gen Multi-Mission
- ISR
- Communications Relay
- Lethal / Non-lethal
- Electronic/Cyber Attack/SEAD
- SIGINT/Low Altitude Pseudo-Sats
- = New Mission areas

Multi-Mission
- ISR
- Force protection
- FID

Now

Future
...We must take a joint approach to:

Get the **most** out of UAS to **increase** joint warfighting capability, while promoting service interdependency and the wisest use of tax dollars

**Requires:**
- Optimal joint concept of operations (CONOPS)
- Airspace control resulting in safe / effective UAS operations
- Air defense architecture to achieve security w/o fratricide
- Acquisition effectiveness, efficiency, standardization
Principles of UAS Evolution

- Automation is key
- Modularity = flexibility
- UAS is compelling where the human is a limitation to mission success
- Seamless manned and unmanned systems integration
- “Integrated Systems” approach
- Robust, agile, redundant C2 enables supervisory control (“man on the loop”)
- Solutions are linked and must be synchronized
**Autonomy**

**Conventional Harbor**
- 4 operators per crane
- Manpower-centric system
  - Legacy system
  - Manpower dependant
  - Manual Operation

**“Multi-Crane Control”**
- 1 operator per 6 cranes
- 24x increase in efficiency
- Tech-centric system
- Multi-crane Control
- Automation (cranes and AGV)
  - DGPS
  - Algorithms
Autonomy – Multi-Aircraft Control
Potential Manpower Savings

- 50 CAPs
  - 50 MQ-9 CAPs
  - + 7 a/c in constant transit
- 10 pilots per CAP
  - 500 pilots required
  - + 70 pilots to transit a/c

570 Total Pilots

2011
(Current system)

2012
(MAC)

- 50 CAPs
  - 50 MQ-9 CAPs
  - 2 CAPs per MAC GCS
  - 1 transit per MAC GCS
- 5 pilots per CAP
  - 250 Pilots required
  - + 0 to transit aircraft

250 Total Pilots

56% Manpower Savings

MAC = 1 pilot can fly up to 4 a/c

- 50 CAPs
  - 50 MQ-9 CAPs on orbit
  - 25 CAPs automated
  - 25 CAPs in MAC (5 pilots/CAP)
    - 125 pilots required
    - + 25 auto-msn monitor pilots
    - + 0 to transit aircraft

150 Total Pilots

64% Manpower Savings

TBD
(MAC + 50% auto)
Unmanned Aerial Systems Growth

- Overwhelming demand for persistent ISR has driven significant DoD investment in UAS
  - Over 2,000 UAS aircraft deployed to Iraq and Afghanistan
  - $3.5B investment in PB10
  - Over 450K flight hours in FY09
  - Light-weight, low altitude UAS account for preponderance of growth

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**UAS Investment**

<table>
<thead>
<tr>
<th>Year</th>
<th>Investment ($)</th>
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<tbody>
<tr>
<td>PB07</td>
<td>$0.00</td>
</tr>
<tr>
<td>PB08</td>
<td>$1.50</td>
</tr>
<tr>
<td>PB09</td>
<td>$2.50</td>
</tr>
<tr>
<td>PB10</td>
<td>$3.50</td>
</tr>
</tbody>
</table>

*Does not include Overseas Contingency Operations funding*

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**DoD UAS Flight Hours**

<table>
<thead>
<tr>
<th>Year</th>
<th>Flight Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>50,000</td>
</tr>
<tr>
<td>2006</td>
<td>150,000</td>
</tr>
<tr>
<td>2007</td>
<td>250,000</td>
</tr>
<tr>
<td>2008</td>
<td>350,000</td>
</tr>
<tr>
<td>As of 7/31/2009</td>
<td>450,000</td>
</tr>
</tbody>
</table>

*Does not include man-portable UAS*
Anticipated growth within CONUS

Planned 2013 DOD UAS bed down

- **113 CONUS locations**
- **1.1 million UAS flight hrs for initial/continuation training**
- **91% of airspace is Class E&G**

<table>
<thead>
<tr>
<th>Service</th>
<th># Base/Posts</th>
<th># UA</th>
<th># Troops</th>
<th>Airspace Class (1000 Hrs/Yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Army</td>
<td>84</td>
<td>4066</td>
<td>3521</td>
<td>0</td>
</tr>
<tr>
<td>Air Force</td>
<td>9</td>
<td>96</td>
<td>1149</td>
<td>51.8</td>
</tr>
<tr>
<td>Navy*</td>
<td>0</td>
<td>9</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Marine Corps</td>
<td>18</td>
<td>1401</td>
<td>1134</td>
<td>0</td>
</tr>
<tr>
<td>SOCOM</td>
<td>41</td>
<td>1364</td>
<td>4465</td>
<td>9.9</td>
</tr>
<tr>
<td>Total:</td>
<td>152</td>
<td>6936</td>
<td>10284</td>
<td>61.7</td>
</tr>
<tr>
<td>% of Use:</td>
<td></td>
<td></td>
<td></td>
<td>5%</td>
</tr>
</tbody>
</table>

* Navy Programs of Record still in Development and Test phases in 2013

Manned Aircraft Annual Training Hours (Worldwide in FY07):

- Army…………………………………………………………………………….. 405K Hrs
- Air Force………………………………………………………………………... 1,700K Hrs
- Navy / Marine Corps………………………………………………………….. 1,167K Hrs
- SOCOM………………………………………………………………………….. 193K Hrs
- TOTAL…………………………………………………………………………… 3.3M Hrs
Emerging UAS Missions - Advanced ISR Capabilities

Open architecture allowing modular sensors to be integrated quickly and inexpensively

- WAAS
- LADAR
- Hyperspectral
- SIGINT
- SAR
- DAS

Situational Awareness

Hyperspectral

Multi-stream Wide Area Sensor
Wide Area Airborne Surveillance (WAAS)

- As new capabilities are developed, warfighters innovate to meet mission needs
- New and developing payloads create opportunities and challenges

<table>
<thead>
<tr>
<th>Type</th>
<th>Coverage Area</th>
<th>ROVER Queries</th>
<th>IOC Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMV</td>
<td>4x4 km</td>
<td>12</td>
<td>2nd Qtr FY10</td>
<td>Observe single target, single ROVER / OSRVT</td>
</tr>
<tr>
<td>MQ-9</td>
<td>10x10 km</td>
<td>30</td>
<td>4th Qtr FY11</td>
<td>10x10 km coverage area, as many as 30 ROVER queries and potentially 65 clips to the Tactical Operations Center</td>
</tr>
</tbody>
</table>

Gorgon Stare + ARGUS

- Gorgon Stare – 2 fps
- FMV – 30 fps
Analytical Challenges – Data ≠ Knowledge

- Tasking Processing, Exploitation and Dissemination (TPED)
  - Capabilities have not kept pace with platform growth

- Data Standards and Interoperability
  - Sufficient interoperability does not exist between platforms and TPED architectures

- Communications Architectures
  - Growth of UAS platforms and intelligence capabilities has driven significant frequency spectrum demand
Vision for an unmanned future

- Automated control and modular “plug-and-play” payloads
- Airspace integration/deconfliction – addressing both cultural and technical challenges
- Joint UAS solutions and teaming
- Automated exploitation capabilities
- Technology to address bandwidth concerns
- An informed industry and academia – knowing where we are going and what technologies to invest in ….
Today's UAS deliver a game-changing capability
A single air vehicle provides the ability to find, fix, and finish targets!
Back up slides
The Operational Demand by Airspace Class

Percent of 1.1M Hours

- Class G -- 76%
- Class A -- 5%
- Class B -- 0%
- Class C -- 0%
- Class D -- 2%
- Class E -- 15%

- Restricted -- 2%

Class G
- SFC-700' or 1,200' AGL

Class B
- SFC-10,000' MSL
- Raven-B
- Shadow

Class C
- SFC-4,000' AGL
- Hunter
- Predator

Class D
- SFC-2,500' MSL

Class E
- SFC-14,500' MSL
- Global Observer

Jet Routes

60,000' MSL
- Global Hawk

45,000' MSL
- Global Observer
- Predator

18,000' MSL
- Global Observer
- Predator

10,000' MSL
- Global Observer
- Predator
UAS Classification

- Joint Classification scheme developed to facilitate consensus on regulations, standards and certification
- Utilized at all echelons and levels within combat theaters

<table>
<thead>
<tr>
<th>UAS Category</th>
<th>Maximum Weight (lbs) (MGTOW)</th>
<th>Normal Operating Altitude</th>
<th>Speed (KIAS)</th>
<th>Current/Future Representative UAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>0-20</td>
<td>&lt;1,200 AGL</td>
<td></td>
<td>WASP III, BATCAM, Raven, Dragon Eye</td>
</tr>
<tr>
<td>Group 2</td>
<td>21-55</td>
<td>&lt;3,500 AGL</td>
<td>&lt;250</td>
<td>Scan Eagle</td>
</tr>
<tr>
<td>Group 3</td>
<td>&lt;1320</td>
<td></td>
<td></td>
<td>Silver Fox, Shadow, Neptune,</td>
</tr>
<tr>
<td>Group 4</td>
<td>&gt;1320</td>
<td>&lt;18,000 MSL</td>
<td>Any Airspeed</td>
<td>Predator, Sky Warrior, Hunter, Fire Scout</td>
</tr>
<tr>
<td>Group 5</td>
<td>&gt;1320</td>
<td>&gt;18,000 MSL</td>
<td></td>
<td>Global Hawk, Reaper, BAMS, Global Observer, N-UCAS</td>
</tr>
</tbody>
</table>
UAS – an alternative to a range of traditionally manned systems

- Deeply modular and upgradable
  - Support future roles and mission needs

- Size, Weight and Power
  - Maximize sensor & weapons flexibility

- High subsonic dash
  - Force packaging and responsiveness

- Target area persistence
- Survivable in contested environment