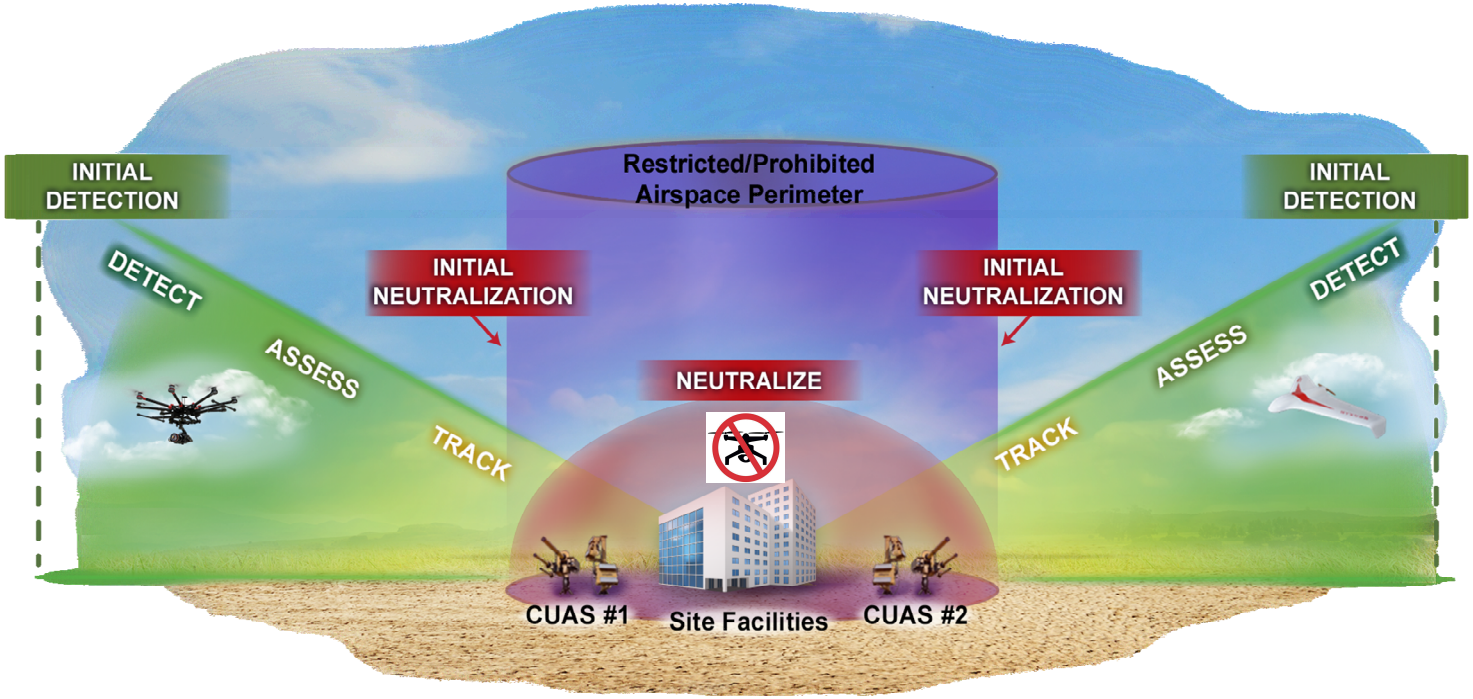


COUNTER UNMANNED AERIAL SYSTEMS TEST PROGRAM

Presented by:

Sandia National Laboratories

Outline

- Problem
- Objective of Test Program
- Test Methodology
- Test Site
- Accomplishment
- Results

Problem: Proliferation of Unmanned Systems

Fast Growing and Constantly Evolving Technology

- UAS are the fastest growth sector within the US aviation industry!
  - Almost 2,000,000 sold in the U.S. in 2015 alone
  - New capabilities (size, payload, autonomy, surveillance, tracking, etc.) are being introduced for commercial purposes at an alarming rate

Airspace Situational Awareness & Control

- Multiple government agencies and agencies from different countries are all struggling with understanding “who/what is in their airspace”.
  - Is it a hobbyist or is it a UAS with malicious intent and with a threatening payload
- Can’t tell who/what’s overflying sites based on eye-witnesses alone
- Need the ability to distinguish friendly from non-friendly assets
  - Establishing “No Fly Zones” to assist in determining intent
  - Need a reliable UAS Detection, Assessment & Tracking Systems
  - Ability to Neutralize UAS identified as a threat

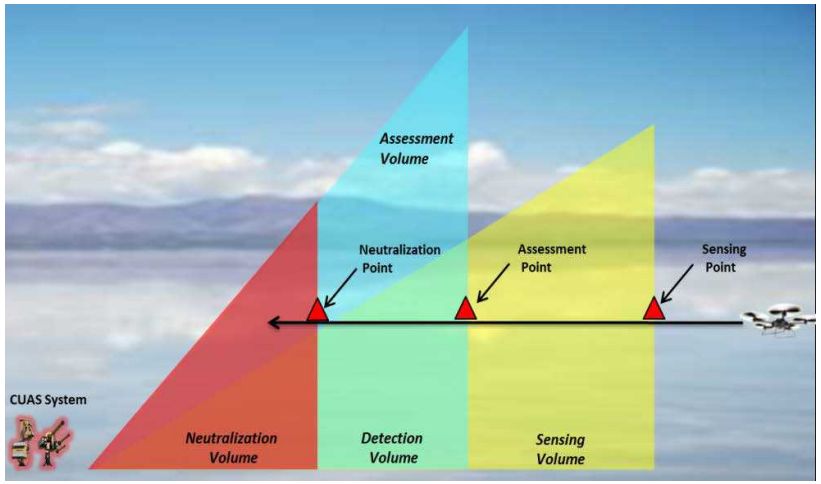
CUAS Test Program

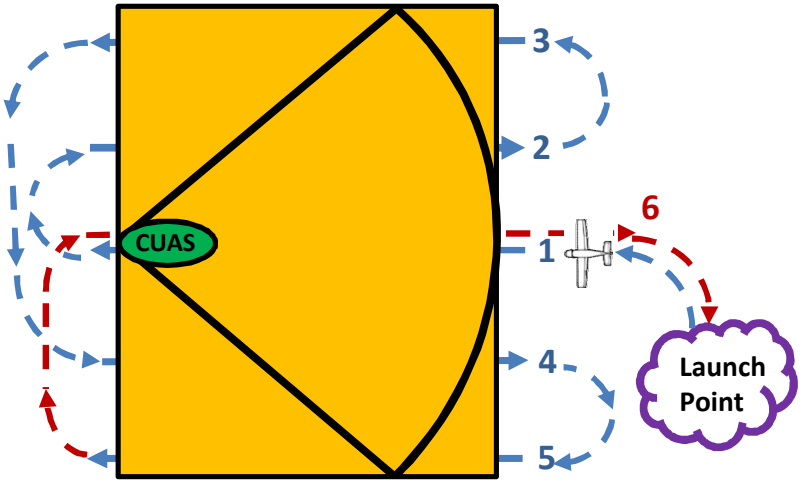
Objectives: Evaluate the performance characteristics of COTS Counter-Unmanned Aerial Systems (CUAS) in order to inform executive decisions for acquisition, deployment, and operations:

- Establish a test site and methodology dedicated at providing credible, consistent, and comparable testing
- Identify capability gaps that require further technology development to meet the security needs for critical infrastructure.
- Establish a dedicated test site and methodology for repeatable quantitative testing and allow other agencies to leverage their technology needs in a collaborative manner.

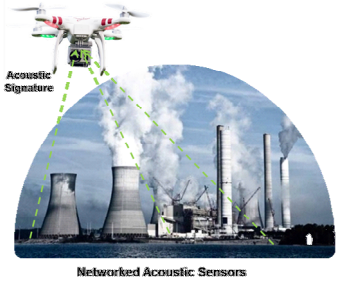
Technology Methodology

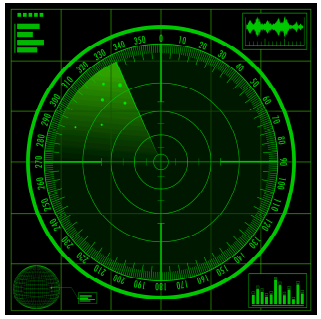
- Performance Metrics for Counter Unmanned Aerial Systems (CUAS)
  - Characterize system performance from the first point of sensing & through to Neutralization (Sensing, Assessment, Detection, & Neutralization)
  - Define the Volume:
    - Fly multiple paths throughout the entire volume
    - Fly at multiple altitudes
  - Target UAS
    - Fly different types of platforms (Fixed wing, multi-rotor, etc.)
      - All commercial off the shelf (COTS), Group 1 & 2 (<55lbs)
    - Multiple paths & at multiple altitudes
    - Multiple aircraft at the same time





CUAS Technologies





- **Detection**
  - Radar – integrated COTS systems
  - Passive acoustic/seismic
  - Passive RF – spectrum analyzer
  - Imaging
  - Human ears and eyes

- **Assessment**
  - Imaging cameras
  - Library matching (Passive RF, acoustic)
  - Human eye

- **Neutralization**
  - RF techniques
  - High power lasers
  - Projectiles
  - Net capture (from air or ground)
  - Guided missiles
  - Passive barriers (hardened / buried structures)

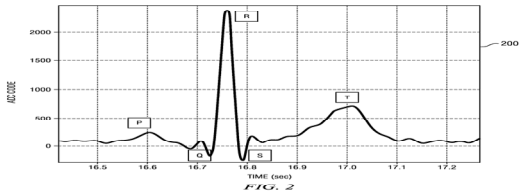
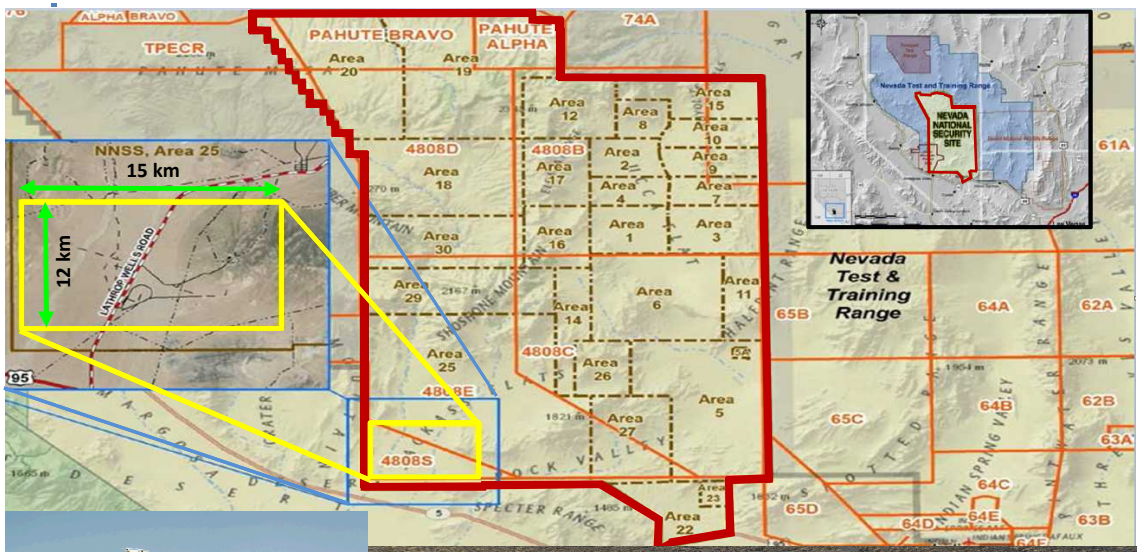


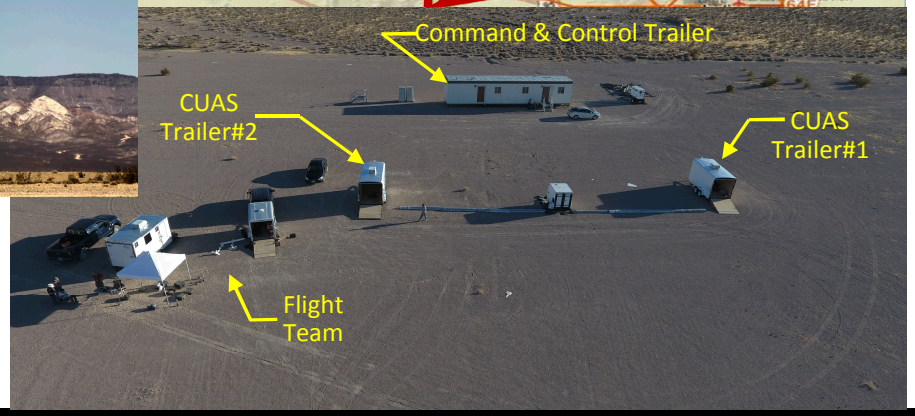
FIG. 2

CUAS Considerations

- Counter Systems must Co-exist and complement existing systems (Security, Operations, Communications, etc.)
- Neutralization methods CAN NOT interfere or disrupt current security operations
- No “Silver Bullet” currently exists.
  - Requires Differing technologies
    - There are Pros/Cons of various Technologies and site specific considerations
  - Technology Maturity Level: Be aware that Manufacturer’s claimed capabilities may not represent the actual capabilities
    - Most systems require additional maturation
    - Must test these systems to understand the full range of a CUAS capabilities
- Operational Considerations
  - Emerging Capabilities – Requires continuous re-evaluation of capabilities

Test Site





Current Capabilities:

- Operational area: 12km x 15km
- Restricted Air Space
- Ability to fly aircraft 3500ft AGL, 10,000ft AGL with approval
- Elevation: 2880ft ASL
- Terrain: Desert (canyons, flat valley beds & mountainous)
  - Total Elevation Change ~ 1690ft
- Counter Measure Capabilities
  - Open air jamming
  - Munitions base neutralization
- Group1&2 UAS Capabilities
  - (6) Certified Pilots
  - Fleet of 13 different aircraft frames (Fixed Wing & Multi-rotors)
  - Total Feet Size = 36 aircraft

Accomplishments

- CUAS Test Program
  - Defined performance requirements and test metrics?
  - Used BAA to solicit potential COTS systems
  - Developed a test methodology that allows analysis for all types of systems in a comparable and quantifiable manner
  - Currently Two Test Windows
    - Testing :
      - (3) Radar/Camera Based Detection/Assessment Systems with RF Jamming
      - (2) RF Triangulating Detection Systems with RF Jamming
      - (2) Acoustic Detection and Classification Systems
      - (2) Net-Capture Systems
    - Hosted multiple Visitor Days for US Agencies and Foreign Governments
    - Supported multiple R&D days for Commercial Companies to improve their capabilities

Lessons Learned

- Need Airspace Situational awareness
- There is no Counter UAS silver bullet – will require more technology development & testing
- Policy is struggling to keep up with the fast pace of these technologies
- Use of countering UAS is a long term commitment
- Create a consistent & repeatable test approach to understand the capabilities and limitations of your CUAS technologies.
- Recommend & seek partnerships with multiple stakeholders to leverage resources and lessons learned in the pursuit of a solution.

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QUESTIONS?

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Backup Slides

UAS Use Cases

- UAS are the fastest growth sector within the US aviation industry!
  - Almost 2,000,000 sold in the U.S. in 2015 alone

Delivery


Policing


Safety/Monitoring


Farming


Security

Movie Production


Wildlife Management


R&D and Aerial Photography


Tourism


Disaster Response


Search and Rescue

Illicit Uses
•
•
•

Evolving Threat

- Increase in UAS populations, ease of acquiring, and new capabilities has lead to many instances of concern toward potential illicit uses
  - Near misses happening regularly
    - Dozens > 9,000 ft. AGL (hobbyist ceiling is 400 ft.)
    - First unconfirmed mid-air collision with manned aircraft

Hexacopter:

- 4 lb payload
  - 10-12 minutes
- 10 lb
  - 5 min

Speed = 60-80 mph!

Fixed wing can carry >> payload for >> distances

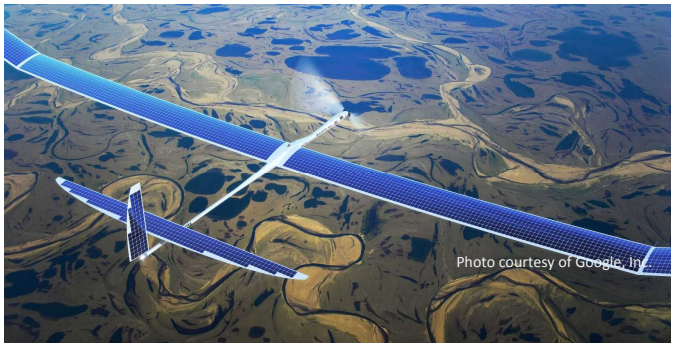
Octocopter:

- 12 lb payload
  - 10-12 minutes
- 20 lb
  - 5 min

Future Direction for Unmanned Systems

- Autonomy – rapid technology evolution
  - No comm link
    - No signal to sense or manipulate
    - Attribution?
  - Rapid, reactive control
    - Low and fast
    - Autonomous Sense and Avoid
    - Randomizes behavior from blue perspective
  - Push button swarms
    - One person controlling many platforms
    - Tactical speeds and objectives are achievable today (DJI4)
  - Machine speed detect/assess/respond
- Commercial payload and component integration
  - Advanced, one-off payload development (additive mfg.)
- Multi-purpose platforms (UMS – unmanned systems, ground, sea, and air)

Google: Internet from the Sky



Issues with Small/Unmanned

Policy, Legal, and Technical Challenges

Policy

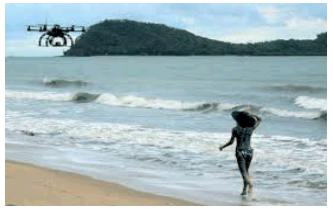
- Current UAS Technologies were not developed to comply with existing FAA airworthiness standards

Legal

- What is trespassing with small UAS?
- Delicate balancing act: public/privacy concerns vs. national security?
- What are the legal issues associated with interfering with an unmanned system?

Technical

- Technology revolution has moved development from graduate laboratories to high school student basements
  - Additive manufacturing
  - Open source software
  - Ubiquitous, advanced, cheap, miniaturized and integrated control hardware/firmware
- Current research is poised to continue transforming this threat (rapid evolution!)
- Detection and timely assessment of small UAS at range is challenging with no silver bullet solution
- Neutralization is problematic due to policy and collateral damage
  - Operations within the USA may limit availability/use of some technologies
  - Swarm threat?
- Not just a UAS issue
  - Multi-modal, advanced autonomy, no RF link to exploit…



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