Sea-based Automated Launch and Recovery System (SALRS) Sensor Performance in Degraded Conditions

John Kinzer
Aircraft Technology Program Officer, ONR 351
October 4, 2012

Sea-based UAS Are a Major Component of Future Naval Capability

- Navy 2025: Forward Warfighters, By Admiral Jonathan Greenert (Naval Institute Proceedings, Dec 2011)
  - Expanded (Unmanned) Reach
    - » The future Fleet will deploy a larger and improved force of rotary wing unmanned aerial vehicles (UAVs).....
    - » Even more significant, the Fleet of 2025 will include UAVs deploying from aircraft carrier decks
  - Over the next 10 to 15 years, the Navy will continue to … exploit the reach and persistence of unmanned vehicles…
- Department of the Navy Objectives for FY12 and Beyond

  "5. Dominate in Unmanned Systems

  a. Integrate Unmanned Systems into the DON Culture

  b. Develop Unmanned Systems in the Air

  c. Deploy and Establish Unmanned Systems On / Under Sea

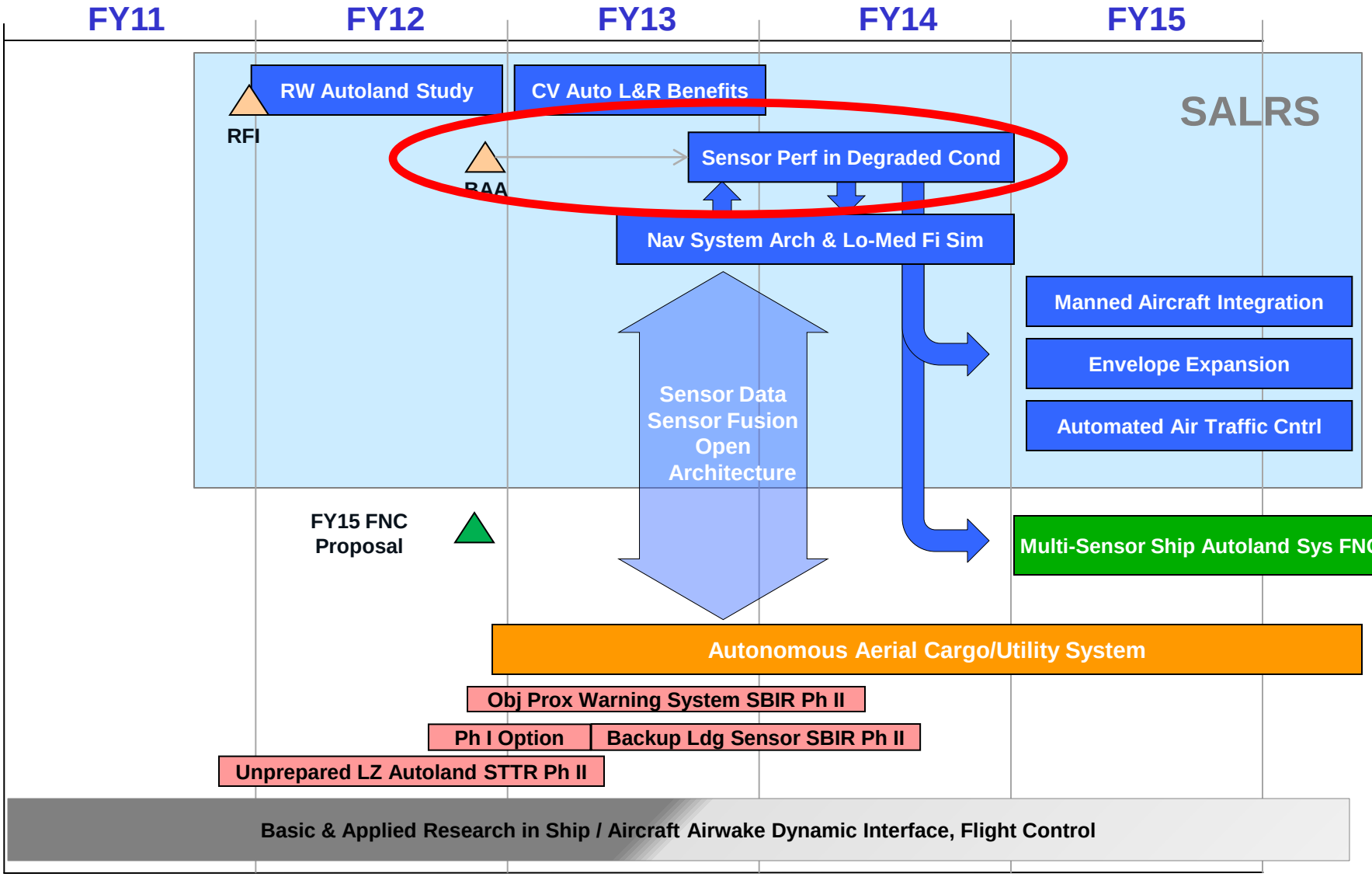
  d. Field Unmanned Systems on the Ground"

Naval UAS Operations Need to Be Routine and Reliable
Sea-based Automated Launch & Recovery is a Critical Component

SALRS Goal and Program Objectives

- Overall goal: develop non-GPS dependent precision ship-relative navigation (PS-RN) capability to support automated aircraft launch and recovery in conditions of degraded weather, high deck motion, and electromagnetic interference
- Program objectives
  - Characterize and model sensors for use across range of expected sea-based UAV operating conditions
  - Develop integrated PS-RN system to fuse sensor data and provide accurate, continuous, high integrity input to aircraft flight control system

SALRS Program Plan



SALRS Sensor Performance in Degraded Conditions

- Objective: characterize and model sensor performance in demanding naval environments
  - Sensors suitable for incorporation in a multi-sensor precision ship-relative navigation (PS-RN) system that enables air vehicles to autonomously launch from and recover onto vessels at sea
  - Includes both fixed wing aircraft operating from aircraft carriers, and rotary wing aircraft operating from small-deck surface ships (e.g. destroyers, frigates)

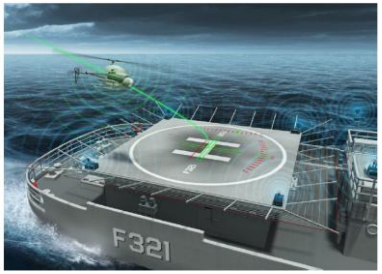
PS-RN Primary System Attributes

- Capable of providing final approach guidance for either (specify)
  - fixed wing aircraft carrier (CVN) based aircraft out to 3 nmi approaching from stern
  - rotary wing aircraft out to 1.5 nmi in all directions
- Sensor input accuracy at touchdown of 10 cm spherical error probability (SEP)
- Compliance with electromagnetic emissions control so that risk of ship detection is not increased during aircraft recovery operations.
- Fully operable with high degree of deck motion
- Fully operable with deck marking degradations experienced during the course of an extended deployment (snow, ice, spilled liquids, wear and tear)
- Fully operable in complete darkness
- Compatible with shipboard eye-safety requirements
- Fully capable, at reduced range, in heavy rain, snow, sleet, smoke, haze and fog.
- Not dependent on GPS
- High reliability
- Low impact to aircraft and ship in terms of size, weight, power and cost, even factoring in redundancy needed to meet reliability

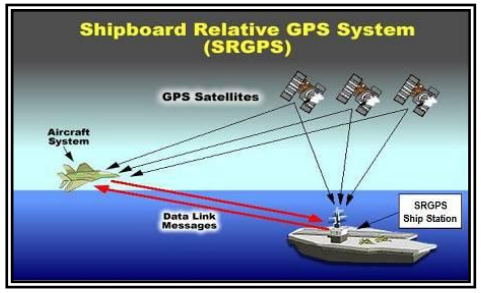
PS-RN Secondary System Attributes

- Capable of detecting obstructions to safe landing (i.e. self-determination of landing safety)
- Using the PS-RN sensor(s) as a data link transmitter and/or receiver
- Potential for supporting other missions (e.g. surveillance)
- Potential for use in shore-based automated landings
- Potential for landing on unsurveyed ships with no special equipment

Primary Precision Ship-Relative Navigation Sensor Categories

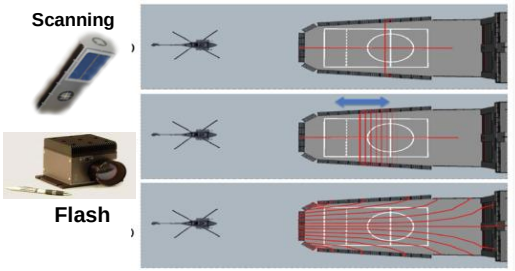


Local Navigation / Pseudolites



GPS

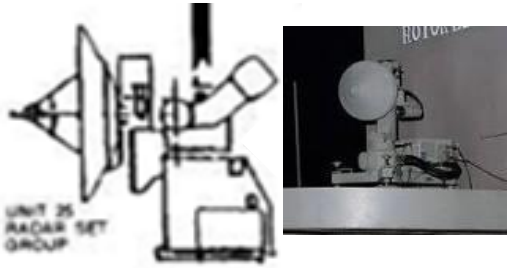
EO / IR (SW, MW, LW)



LIDAR

Laser ILS or Tracker

RF Time / Direction of Arrival



RADAR (SPN-46 / UCARS, also passive / active MMW)

- Ship or aircraft installation
- Standalone or augmented

Technical Objectives

1) Characterize candidate PS-RN sensor performance variation in demanding conditions representative of the Naval operating environment
   - Obscuration
   - Deck Motion
   - Distance from zero out to 1.5 nmi for helicopter systems and 3 nmi for fixed wing systems.
2) Test multiple candidate PS-RN sensors simultaneously and/or under identical conditions
   - performance comparison
   - support sensor fusion development.
3) Conduct and analyze tests of sensor signal propagation across a range of degraded conditions combined with high ship motion.
   - Degraded conditions include fog, rain, snow, smoke, haze, varied lighting conditions, electromagnetic interference from other ship/aircraft systems, and jamming.
   - Tests are desired in as high a fidelity environment as is possible within the time and budget constraints.
4) Baseline stand-alone sensor capability + augmentation
5) Develop physics based models of sensor performance and operating characteristics to support:
   - Simulations and development of multi-sensor fusion algorithms, and a multi-sensor PS-RN system to provide inputs to aircraft flight control system
   - Determination of sensor contribution to system accuracy, integrity, and continuity
   - Development of a plug-and-play sensor interface with a multi-sensor fusion system

Data Rights

- Intent is to share developed models with companies interested in developing a navigation fusion capability for the Navy
- If model source code is proprietary, model executable must available along with interface and model design information to allow integration with other models and simulations

Special Notice Overview

- Special Notice 12-SN-0020, “Sea-Based Automated Launch and Recovery System (SALRS) Sensor Performance in Degraded Conditions,” as amended from time to time
- Not a solicitation in itself – all white papers and proposals to be submitted under ONR Long Range Broad Agency Announcement for Navy and Marine Corps S&T (BAA 13-001)
  - SN takes precedence if conflicting
- Nominal award
  - Single award
  - Estimated period of performance – 18 months
  - Estimated funding - $2M
  - Flexibility on all the above – will use white papers to evaluate best approach

White Papers

- Expected NLT Monday, 5 November
- See BAA 13-001 and 12-SN-0020 for detailed requirements
- 5 pages or less (excluding cover page and PI resume)
- White paper content (note: different from BAA)
  1) Technical approach
  2) Specific sensors to be tested and rationale
  3) Test Plan and Schedule
  4) Brief description of ongoing or prior programs that will be leveraged
  5) Funding plan

Selection Process

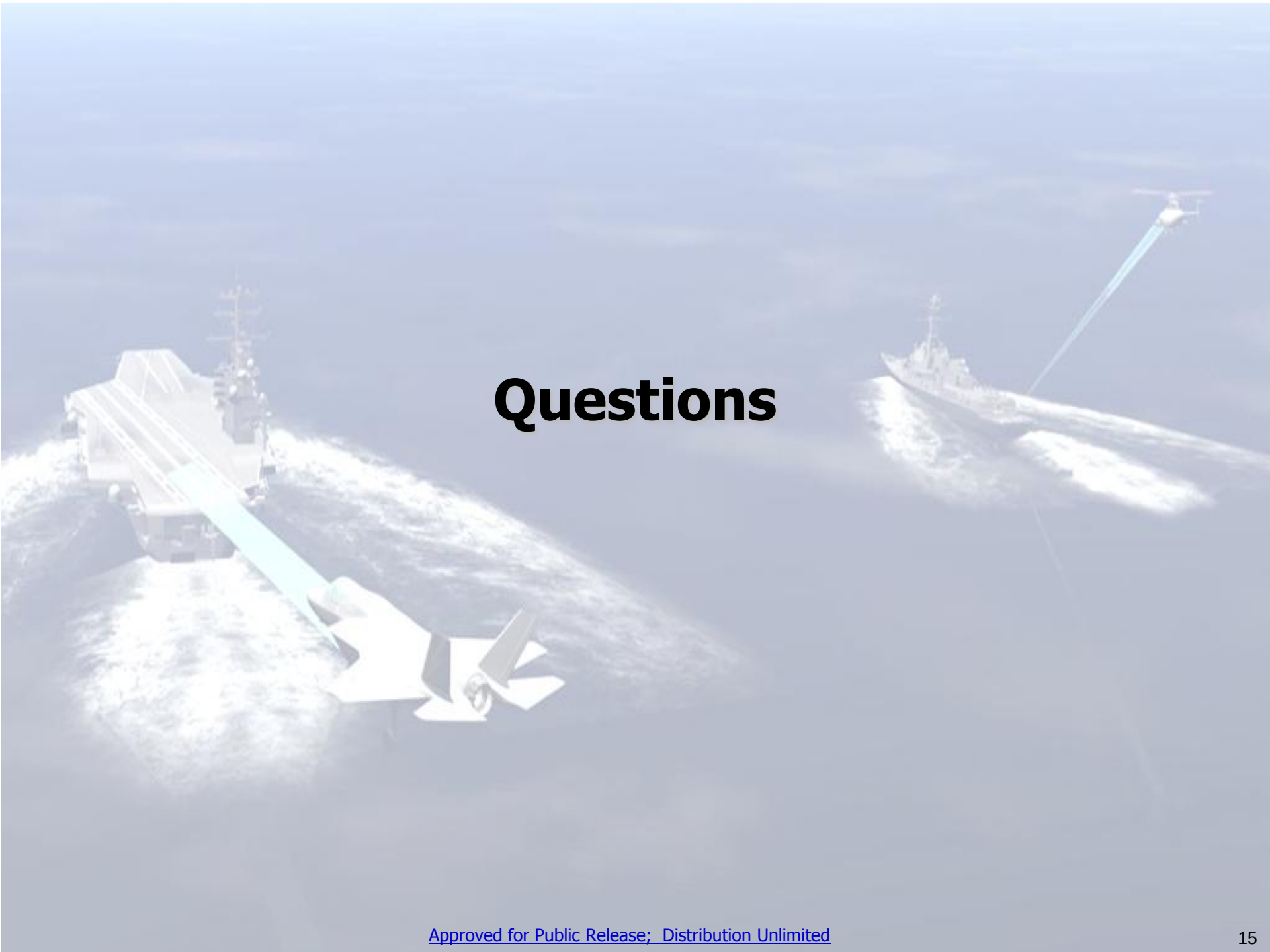
- Submissions evaluated against BAA objectives
- Criteria:
  1) Scientific and technical merits
  2) Potential Naval relevance
  3) Offeror capabilities, experience, facilities, techniques
  4) Qualifications, capabilities, experience of PI and team
  5) Cost realism and funds availability

Criteria 1-4 of equal value, significantly greater than Criterion 5

- Evaluations by Navy and other Government Subject Matter Experts

Full Proposal and Award

- **Encouragement to propose:**
  - Based on white paper
  - Does not ensure award
  - See BAA 13-001 and 12-SN-0020 for detailed requirements
  - Expected NLT 19 December
- **Evaluation process similar to white papers**
- **Selection notification expected 18 January 2013**
- **Award – May-July 2013**



Questions