Shipboard Automated Landing Technology Innovation Program

Presented to
AACUS Workshop

John Kinzer
Aircraft Technology Program Officer, ONR 351
2 November 2011

DISTRIBUTION A: Approved for public release; distribution unlimited.

VISION

All sea based naval aircraft, manned and unmanned, fixed wing and rotary wing, will utilize optimally automated ship launch and recovery to the operating limits of the ship / aircraft system

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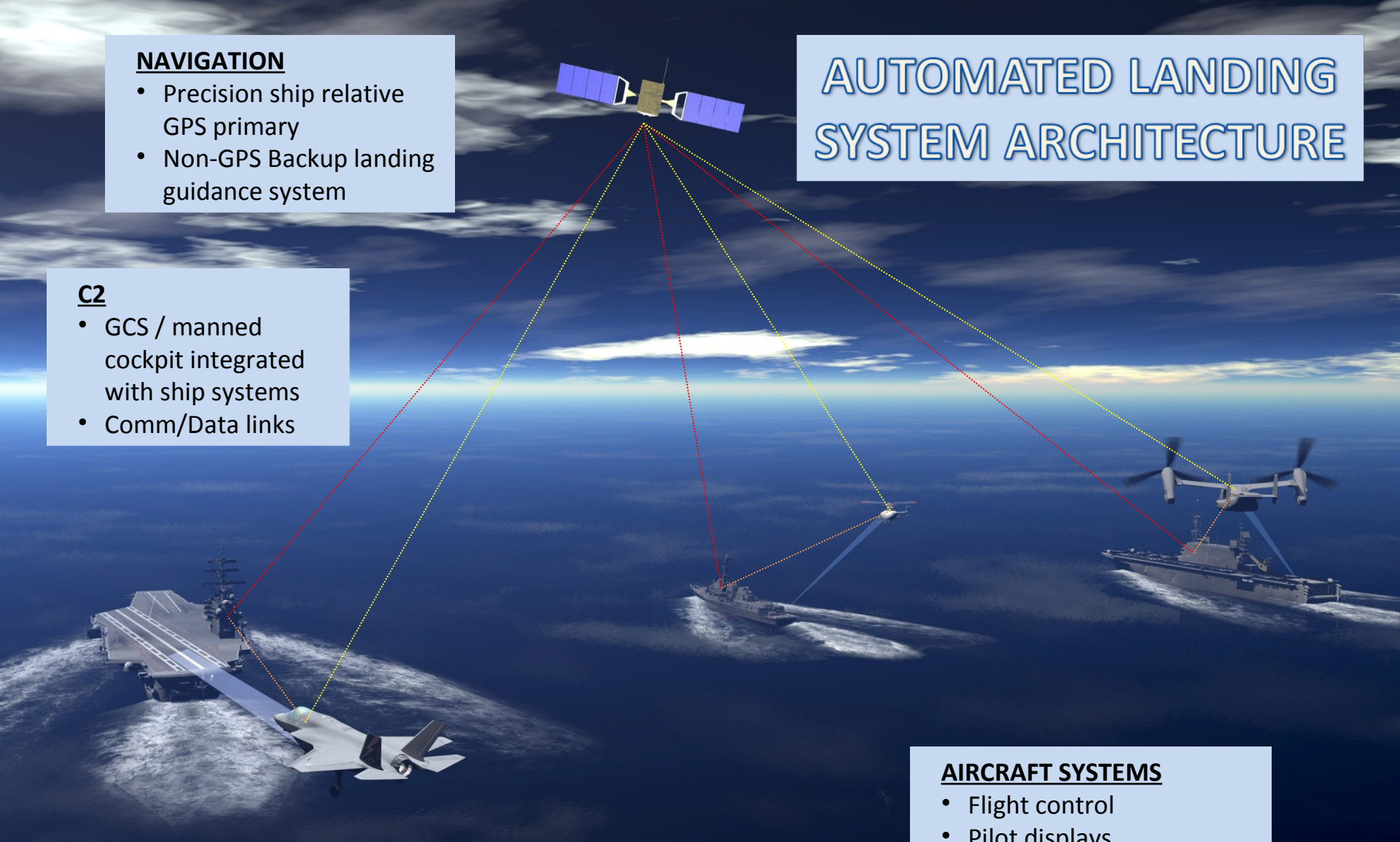
AUTOMATED LANDING SYSTEM ARCHITECTURE



NAVIGATION
- Precision ship relative GPS primary
- Non-GPS Backup landing guidance system

C2
- GCS / manned cockpit integrated with ship systems
- Comm/Data links

AIRCRAFT SYSTEMS
- Flight control
- Pilot displays
- Gust sensing / alleviation

SHIP SYSTEMS
- Deck motion prediction and compensation
- Landing aid displays / markings

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Warfighter Payoff

- **Flight operations**
  - Increased safety, reduction in mishaps
  - More operational flexibility through expanded shipboard operating envelopes and flexible flight deck usage
  - Reduced landing intervals, bolter and waveoff rate (shorter recovery periods, reduced fuel consumption)
  - Increased shipboard sortie rates, reduced ship and aircraft fuel consumption, recovery tanker “give” requirements, ship and squadron personnel fatigue, etc.
  - Potential for common capability with DVE and obstructed LZ ops ashore
- **Aircraft / ship design and maintenance**
  - Reduced landing gear and related structure
  - Reduced number of wires / arresting gear engines
  - Reduction in ship support systems (landing aids, displays, etc)
  - Reduction in inspection and repair for hard landings
  - Increased fatigue life
- **Flight training**
  - reduction in training time / cost (decrease in ship landing initial training, qualification, and currency requirements)
  - indirect benefits may include reduced environmental impact and public complaints due to FCLPs (noise), cost of equipping, maintaining, and manning outlaying landing fields, etc.

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SALTI Technical Objectives

- Precise automated approach and glideslope control
  - Reduced susceptibility to wind gusts and turbulence
  - Accommodation of high sea states, higher winds from all directions, degraded visual environment
  - Precise, predictable touchdown: reduced scatter in sink rate, sideloads, touchdown spot, hook-to-ramp distance, centerline deviations
- HCI for manned aircraft for optimal situational awareness, control, and decision making
- Ability to operate under night, degraded visual environment, and emissions control (EMCON) conditions
- High integrity systems for naval seabased operations
  - Excursion: ability to conduct VTOL ops onto ships without specialized modifications
- Optimum commonality among aircraft and ship types, and ship / shore applications

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Areas of Investigation

- Technologies
  - Flight Control
    - » Modified control laws for precision control
    - » Gust sensing and alleviation
  - HCI and ship integration
    - » Ship based pilot displays
    - » Cockpit displays
    - » GCS and ship systems interface
    - » LSE interface
  - Navigation systems
    - » GPS based precision landing algorithms being worked by JPALS, UCAS-D programs
    - » Supporting / alternate systems (ship and/or aircraft mounted)
      - CVN: adapt existing systems/sensors, propose new sensors
      - VTOL: EO/IR, radar, LADAR
  - Deck motion prediction and compensation
    - » CVN, L-class, and small decks – existing algorithms adequate?
    - » Prediction and integration with aircraft control
- CONOPS: adjustments to take advantage of enhanced precision, efficiency, safety, envelope expansion, reduced maintenance

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Related Projects / Transitions

- Related projects
  - PMA-213 (JPALS)
  - PMA-268 (UCAS-D, Air/Ship Integration, PGPS)
  - PMA-266 (Backup Sensor SBIRs, MRMUAS)
  - UCLASS ADPO (AOA in work)
  - AACUS – auto landing to unprepared shore LZ
- Transition potential
  - CVN, L-Class, Small decks
  - Fixed wing: F/A-18, F-35C, UCLASS, F/A-XX
  - Rotary wing: CH-53K, MV-22, UH-1Y, AH-1Z, MH-60R/S, JMR, VTUAV, MRMUAS
  - VTOL: F-35B

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Shipboard vs Unprepared LZ Landing

Commonality

- Dedicated sensors must be low impact
- Full autonomous capability
- Ideal system requires no surface based cooperative navigation
- GPS denied environment
- Day / night / DVE operations
- Ground user interface needed
- Capability must be certifiable

Ship Differences

- Ship-based cooperative navigation system option
- 6DOF landing surface motion
- Reduced number of obstacle / surface types
- Compliance with standard patterns
- Integration with ship-based systems
- More emphasis on automation of piloted aircraft
- Existing aircraft sensors available

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Program Execution

- Coordinate with AACUS
  - Cargo UAS must be shipboard capable
  - Enabling technologies for shipboard and shore landings should be common to maximum extent practicable
  - Potential for leveraging AACUS development and demonstrations
- Advanced Rotorcraft Recovery System for Shipboard Operations RFI (11-RFI-0008) released Sept 22, 2011
  - Analysis of responses in work
- Rotorcraft automated landing concept study in work for amphibious ships and air combat elements
  - Evaluate benefits, operations, and integration issues
  - NAVAIR Advanced Aircraft Design branch leading
- Limited funding available in FY12 to begin technology development

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Discussion

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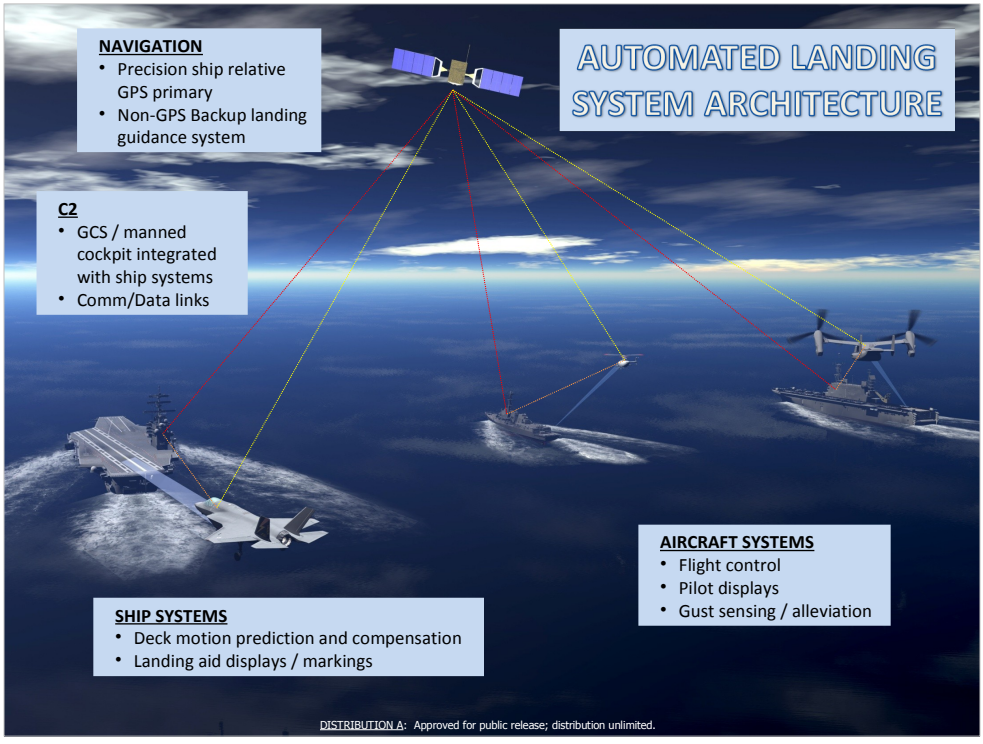
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