PEO Aviation, PM Aviation Systems
PM Aviation Mission Equipment (AME)
Redstone Arsenal, AL

2009 CNS/ATM Conference, 8-12 June

Joint Precision Approach and Landing System (JPALS)
Avionics Risk Reduction (JARR)
PURPOSE

- To update the CNS/ATM community on status to integrate JPALS capability in Army rotary wing platforms
  - Army intent to integrate and field current and future civil airspace requirements as part the JPALS program
  - Risk reduction activities for Modernized GPS User Equipment (MGUE) and GPS interference protecting antennas integration through JPALS Avionics Risk Reduction (JARR)
JPALS Overview

- Differential GPS based system intended to support joint service, civil, and multi-national interoperability
- JPALS Increment 1A is a ship station development program
  - Inc 1A Airborne System (AS) development is limited to proof of concept prototype system only
  - Army Inc 1B airborne system development program will integrate common JPALS capable avionics
- There will be two types of JPALS ground stations
  - Shipboard Relative GPS (SRGPS) Sea-based JPALS
    - Differential corrections over data link
  - Local Differential GPS (LDGPS) Land-based JPALS
    - Two modes
      - Civil: Local Area Augmentation System (LAAS)
        - Single frequency GPS processing
        - Differential corrections over VHF data link
      - Military (LAAS like)
        - Dual frequency GPS processing
        - Differential corrections over data link
Army JPALS Program Update

- PEO Aviation Organization
- Army JPALS Fielding Plan
- JPALS Avionics Risk Reduction (JARR) Program
- JPALS Enablers
- Summary
Army JPALS Fielding Plan

- Army JPALS Aircraft and Air Traffic Control Fielding Plan

  - Increment 1
    - 2018 initial fielding of JPALS capability in Blackhawks
    - Fielding schedule accommodates MGUE integration to offset cost of requalification and retrofit
    - Developing and fielding JPALS and MGUE concurrently saves non-recurring engineering and retrofit cost of separate programs

  - Increment 2
    - 2017 initial fielding of JPALS Fixed Based Local Differential GPS (LDGPS) at Army airfields
    - Aligns with Army aircraft JPALS capability with Ship Board Relative GPS (SRGPS) waveform integration and testing
    - Ground infrastructure consistent with aircraft capability
JPALS Avionics Risk Reduction (JARR) Program
Army JPALS Avionics Risk Reduction (JARR) efforts have been under contract since 2006 with Honeywell, Clearwater, FL

Phase 1 (2006-2007)

JPALS Data Link and Legacy NAVAID Suite Integration Feasibility within Embedded GPS Inertial (EGI) Multimode Receiver (MMR) form factor
- There are positive indications that the existing MMR will be able to provide:
  - VOR / ILS (Localizer, Glideslope, Marker Beacon)
  - LAAS Datalink
  - JPALS Datalink
  - DME

DO-178B Level A and B EGI Certification
- Evaluated requirements and implementation cost to EGI software/firmware components for obtaining the appropriate DO-178B certification
JPALS Avionics Risk Reduction

- Phase 2 (2007-2008)
  - Prototype of EGI system processor 2 card configuration to single card configuration
  - Category 1 Feasibility Study without the need of Augmentation (non-DGPS)
    - Determined that the implementation of error model updates for multipath, receiver, and atmospheric effects provides a significant improvement of accuracy and availability of navigation solution
  - Evaluated improved GPS interference protecting antenna technologies and aircraft antenna placements for good performance
JPALS Avionics Risk Reduction

- **Phase 3 (2009-2010) Awarded Feb 09**
  - Multimode Receiver (MMR) prototype based on JPALS/Distance Measuring Equipment (DME) Study
  - Prototype autonomous landing capability
  - Evaluate GPS Wing Small Antenna System (SAS) alternatives
  - EGI HW/SW Failure Modes, Effects, and Criticality Analysis (FMECA) development to allocate DO-178B levels of criticality
  - SRGPS Aircraft Integration Guide (AIG) Support

- **Phase 4 - In Process**
  - Architectural description to standardize the JPALS capable EGI for single hardware and software configuration
  - SBAS (WAAS) capability assessment IAW Military Standard Order MSO-C145
  - Continuation of MMR prototype and FMECA efforts
  - Provide support for SRGPS and LDGPS AIG developments
  - JPALS requirements support to MGUE Phases A and B
JPALS Avionics Risk Reduction

- Planned Efforts for Risk Reduction
  - SAS assessment with aircraft specific installations with JPALS requirements
  - Support GPS Wing MGUE program for including new GPS receiver in JPALS
  - LDGPS and SRGPS test support using prototype JPALS avionics with MGUE and SAS
  - Initiate prototyping of "standardized" EGI+JPALS
  - Digital Aeronautical Flight Information File (DAFIF) database precision approach assessment for JPALS/LAAS environment
  - JPALS datalink Analysis of Alternatives (AoA)
JPALS Enablers
CNS/ATM Synchronization

- JPALS will include future Communication, Navigation, and Surveillance/Air Traffic Management (CNS/ATM) Navigation requirements
  - Basic Area Navigation (B-RNAV)
  - Precision Area Navigation (P-RNAV)
  - Required Navigation Performance Area Navigation (RNP-RNAV)
  - Vertical Navigation (VNAV)
  - Space Based Augmentation System (SBAS) and Ground Based Augmentation System (GBAS) interoperability
  - GPS Primary Means Certification IAW MSO-C145
  - Possibly Terrestrial RNAV (rho-rho DME) due to VHF Omni-directional Range (VOR) decommissioning in Europe (Objective)
    - Scanning Distance Measuring Equipment (DME) capability now included in the JARR prototype effort
- Leverage current EGI+ integrations and TSO-C129 equivalent level of certification
Purpose

- The AIG will provide a recommended approach to integrate JPALS functionality in Inc1B aircraft with maximum possible reuse and minimal impact on existing aircraft avionics.

AIG documentation focuses on:

- Identify avionics and flight management systems requiring modification
- Integration of JPALS requirements and capabilities within existing avionics equipment and platform architecture through hardware and software modification
- I/O Connectivity

Level of Detail

- Integrated Architecture
  - JPALS minimum performance requirements
  - Existing aircraft platform constraints
- Functional Allocation
  - Hardware
  - Software
- Assumption Identification
JPALS Datalink Challenges

- Combat Net Radio (CNR) Centric
  - Single Channel Multiband radios
    - Update for LAAS waveform
    - Update for new JPALS SRGPS and LDGPS waveforms
    - Mobile User Objective System (MUOS) satellite communications upgrade
    - Communication Suite simultaneity matrix inclusive of JPALS mission requirements
  - GATM use for VHF 8.33 kHz Channel Spacing
  - Surrogate JPALS radio
JPALS Datalink Challenges

- EGI w/MMR form factor
  - Maintain Legacy NAVAID Suite
  - DME Capability (Objective GATM Requirement)
  - VHF/UHF antenna plumbing
- Distributed LAAS/JPALS datalink implementation between Nav and Comm suite avionics
- SRGPS and LDGPS interoperability definition through AIG
  - Independent of hardware architecture
  - Datalink ICD – Over-the-Air, Ship/Ground to Platform
  - Waveform development
- Waveform instantiation IAW Ship/Land operational concepts
Summary

- Overall synchronization of schedule and requirements with GPS Wing MGUE and SAS, JPALS Increment IA and Increment 2 programs
- LAAS and JPALS LDGPS and SRGPS datalink waveform definitions and overall JPALS datalink AoA
- Conclusion of current Army rotary wing EGI+ integrations IAW TSO-C129 (area navigation using GPS as supplemental means for en route, terminal, and non-precision approach) as JPALS baseline