GPADS Overview Past, Present, and Future

Airborne Days IX

Justin Barber

7 October 2025

Agenda

- Brief GPADS Development History
  - US DoD vs AS IR&D Investment
- GPADS Systems Architecture & Concepts
- Our GPADS Products
- Future GPADS Developments
  - GPS-Denied Operations
  - Avionics Modernization
  - New Mission Planner

Key Personnel

Justin Barber
Airborne Systems
GPADS R&D Manager

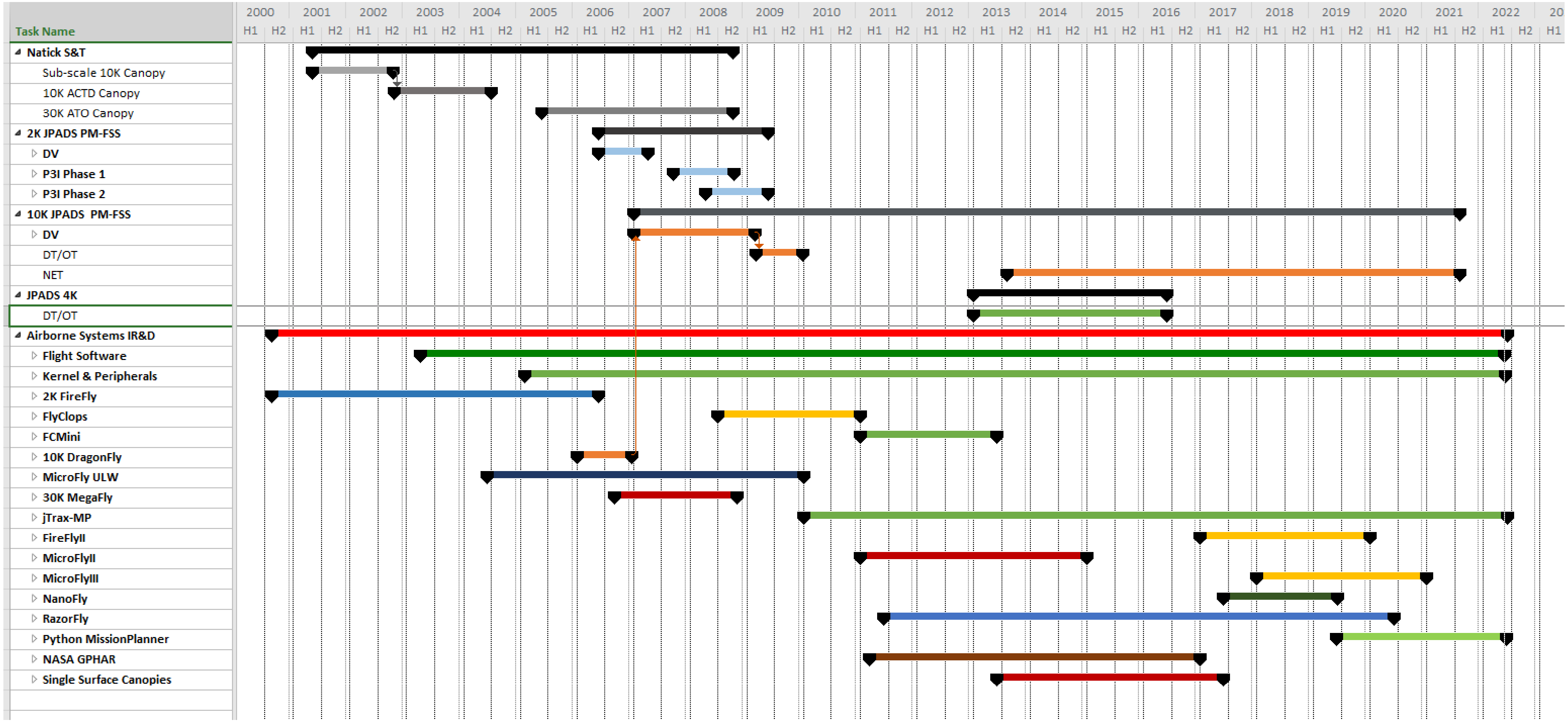
Mick Thorn
Airborne Systems
Senior Instructor & Examiner

GPADS Development History

Terminology

- GPADS – Guided Precision Airdrop System, generic designation of any autonomously
- guided ram air parachute system using GPS and inertial sensors for navigation
- JPADS – Joint Precision Airdrop System, the US DoD designation of their Programs of Record (POR) to field GPADS
- ASNA is the Original Equipment Manufacturer (OEM) to the US DoD JPADS 2K & 10K PORs
  - Won US Army JPADS 2K Program of Record in 2006 (PM-FSS)
    - +3500 systems fielded worldwide. Fielding began 2008 via urgent material release, full rate production began in 2009
  - Won US Army JPADS 10K Program of Record in 2008 (PM-FSS)
    - +500 systems fielded worldwide. Full rate production began in 2014, fielding began in 2016
- Other notable US DoD programs
  - JPADS 10K ACTD 2001
  - JPADS 4K for PM-SOF
  - JPADS 30K Army Technology Objective (42K-lb demonstrated on single ram air canopy)
  - Modular AGU (MAGU) ULW under the guise of JPADS 2K POR

GPADS Development History



GPADS Development History

- ASNJ (Para-Flite) has been actively and continuously developing and testing GPADS since 2001
- Internally funded development of complete GPADS capability began in 2004
  - Large ram air canopy design and deployment system (direct to main, no drogue, no pyrotechnics)
  - Guidance, Navigation, and Control (GN&C) flight software
  - Mission planning software
  - Common avionics architecture (Robot Solutions)
  - Airborne Guidance Units
  - Other Peripherals:
    - Handheld remote controller
    - Pack Frames
    - Navaid
    - Split Confluence Fittings

US Gov't Flight Software

- US Army began developing the US Government-owned FSW in 2003 but it was not sufficiently mature to compete on the JPADS 2K, 10K, and ULW programs at the time of competitive source selection.
  - Funded by US Army Natick S&T office under the 10K ACTD (which ASNA was a part of), not the program office (PM-FSS)
- PM-FSS decided to convert to the gov't owned software on JPADS 2K during the P3I Phase 2 development in 2010-2012
  - Software now demonstrating capabilities that met the program requirements
  - Follow on development and conversion of JPADS 2K, 2KM, and 10K has continued to the present day
- If you procure the US DoD JPADS configuration (via FMS) from Airborne Systems it will have the current version of US Government-own flight software installed
- All commercial sales of GPADS bought directly from Airborne System will have our latest version of flight software installed

GPADS Architecture & Concepts

GPADS Concept of Operations

- GPADS provide an autonomous cargo delivery capability by combining high performance ram air canopies with a GPS enabled guidance system
- Airdrops are possible from as low as 3,500ft (1067 m) AGL up to 24,500ft (7468 m) AMSL with offsets up to 25+ Km in distance achievable
- GPADS offer increased safety for the aircrew and the units on the ground especially when/where there is a need to minimize the risks associated with conventional airdrop such as -
  - Ground to air threats
  - Denied airspace
  - IED and other attacks on convoys
  - Difficulties re-supplying FOB due to terrain, long distance missions and other factors
  - When there is a need for secrecy
  - Re-supplying teams during missions

GPADS Capabilities and Technology

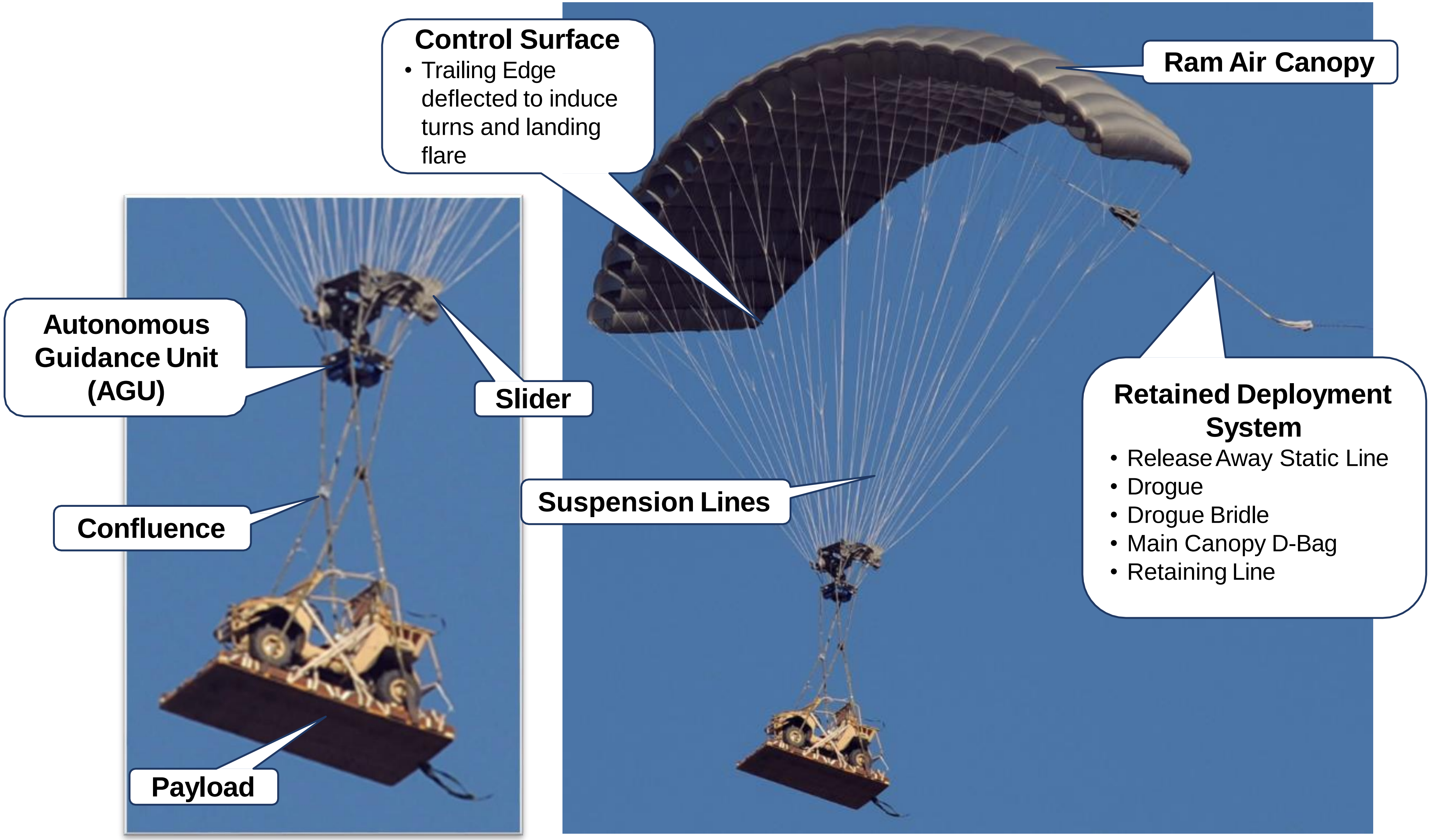
- Airborne Systems offers GPADS capabilities across several platforms spanning a weight range from 25-lbs to 10,000-lbs based on a common systems' architecture.
  - Large Ram Air Canopies
    - All loaded ribs
    - Spectra suspension lines
    - Retained deployment system
    - Multi-grommet slider-controlled deployment, immediately from aircraft
    - Deployment brake cleat
    - "PRO"-packed using a packing frame
- Flight Software
  - Common navigation scheme
  - Canopy collapse after landing to prevent payload dragging in high winds
  - Into-wind or programmed bearing landing modes
  - Vertical Descent Mode at exit and landing

GPADS Capabilities and Technology

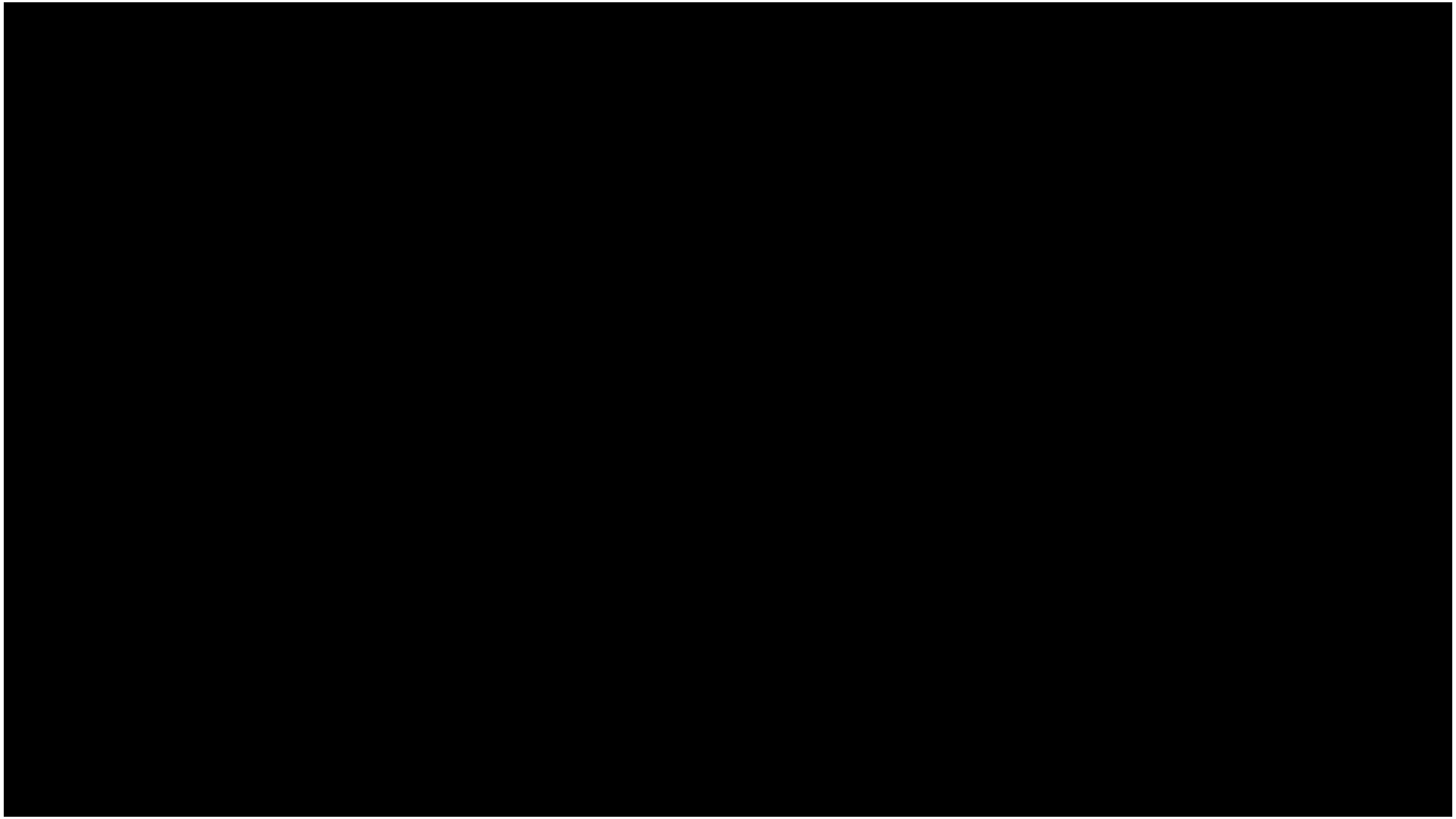
Airborne Systems

- Airborne Guidance Units
  - Suspended between payload and ram air canopy (except NanoFly)
  - LCD Screen/Keypad user interface for rigging, programming, status monitoring
  - Common avionics suite: GPS, 3-axis IMU & magnetometers, barometric sensor
  - Additional actuator to mediate drogue fall to main deployment
  - Auto-power on at exit / Auto-power off after landing
  - Additional actuator to implement Vertical Descent Mode
  - WIFI interface compatible with USAF CAT Software
  - MIL-STD-810G (Environmental), MIL-STD-461F (EMI/EMI) qualified
- Mission Planning Software
  - Supports all ASNA GPADS & MFF products

GPADS Components

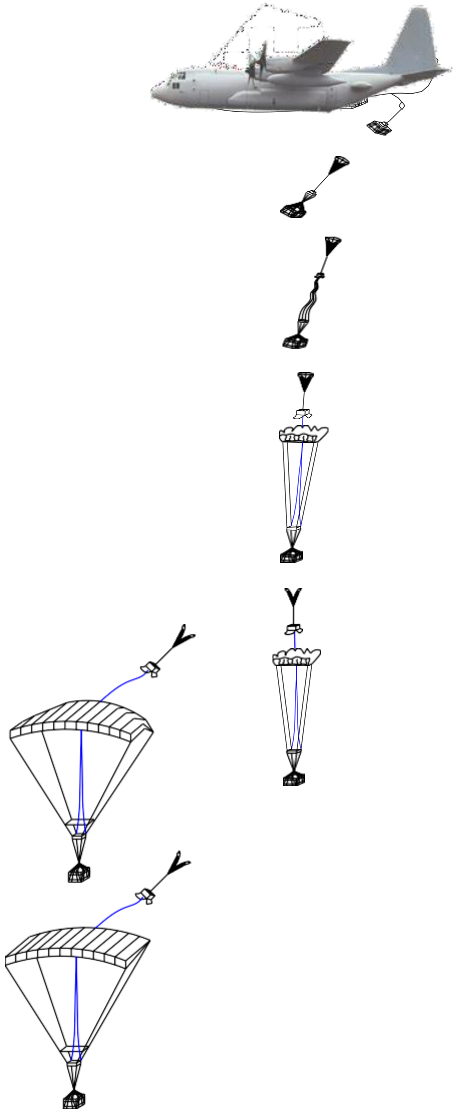


RazorFly Video



GPADS Deployment Sequence

- Gravity exit from the drop aircraft
- Release-Away Static Line (RASL) deploys drogue parachute
- Drogue parachute deploys main ram air canopy (immediately, HAHO, or after programmed time/altitude delay HALO)
- Drogue parachute collapses
- Main canopy begins to pressurize in “slider up” configuration
- Main canopy pressurizes and slider descends down suspension lines
- Main canopy achieves full inflation and stabilized descent
- Deployment brakes automatically released by AGU
- Autonomous navigation begins



GPADS Deployment Video

Guidance, Navigation & Control (GN&C) Flight Software

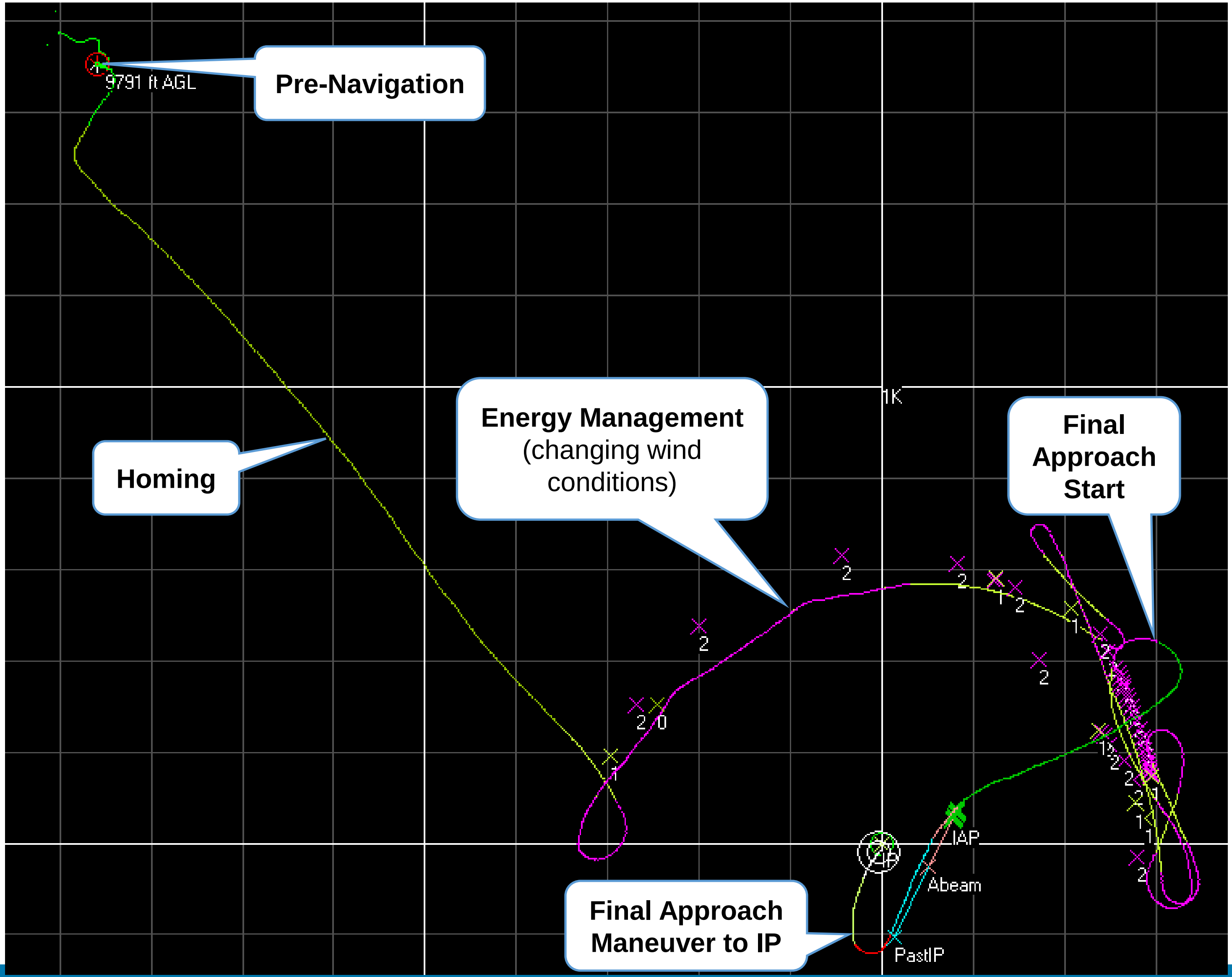
ASNA Flight Software

- ASNA continues to develop and maintain our GN&C software for the US and foreign customers
- The US DoD JPADS 2K and 10K were originally qualified and fielded with ASNA GN&C software
  - The US DoD procured the data rights to the JPADS 10K flight software (which is effectively identical to the final US DoD certified JPADS 2K flight software).
  - SOF units and others continue to commercially procure GPADS systems with ASNA software
- The software is extremely robust and mature
  - Over 5,000 real airdrop tests and operational uses with more than a dozen different parachute configuration in the broadest range of weather conditions

GPADS Typical Flight Profile

- Airborne Systems' family of GPADS products utilize autonomous guidance, navigation and control (GN&C) algorithms that are robust and predictable. A standard GPADS flight profile has 4 primary phases:
  - Pre-Navigation – Approximately 30-45 second period following exit from the drop aircraft during which time the autonomous GN&C logic is waiting for the main canopy deployment to complete and reach a stable flight condition
  - Homing – The system estimates the winds and acquires a bearing to a point upwind of the programmed impact point
  - Energy Management (EM) – If the system reaches the energy management zone upwind of the IP with excess altitude it will execute periodic turning maneuvers to stay upwind of the IP and in the energy management zone until it descends low enough to execute the final approach.
  - Final Approach – Upon exit from EM, the system will set up a downwind leg abeam the IP, and then execute a left or right 180 degree turn onto the final approach bearing. At low altitude the system will command a flare for landing.
- The system continuously monitors the wind conditions and will adjust the location of energy management and the into-wind Auto final approach direction as the winds change.

Typical Flight Profile



Additional GN&C Capabilities

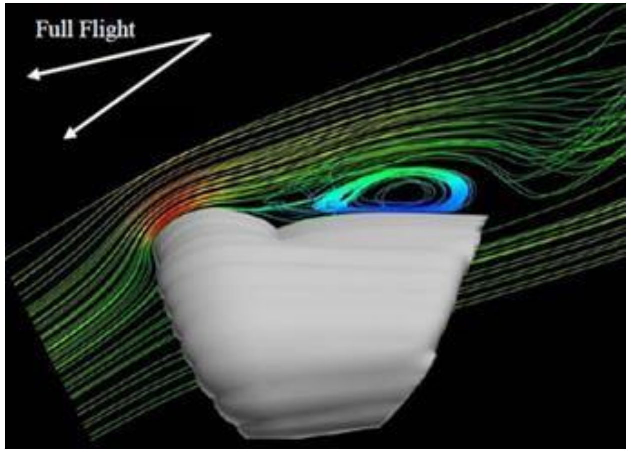
- The Pre-Navigation phase may also include a period of descent under a drogue prior to deployment of the main canopy. The capability is available on NanoFly and MicroFlyII/III
  - Drogue-fall reduces the size of the LAR
  - Drogue-fall does not reduce the size of the failure footprint due to possible premature release of the drogue
- Vertical Descent Mode (VDM) Systems
  - MicroFlyIII, FireFlyII and RazorFly support canopies configured for VDM
  - Systems will deploy in VDM mode and be nearly ballistic if the AGU fails to operate and return the system to normal flight mode
  - The Systems will land in VDM (near ballistic descent) instead of executing a trailing edge flare. Will revert to trailing edge flare if the surfaces are such that the canopy would be tracking backwards
- “Roadway” Landing
  - As an alternative to automatic into-wind landing, the systems can be programmed to land on a specified bearing, independent of the surface wind conditions
  - Into-wind landing is always preferred when possible to maximize payload survivability and landing accuracy

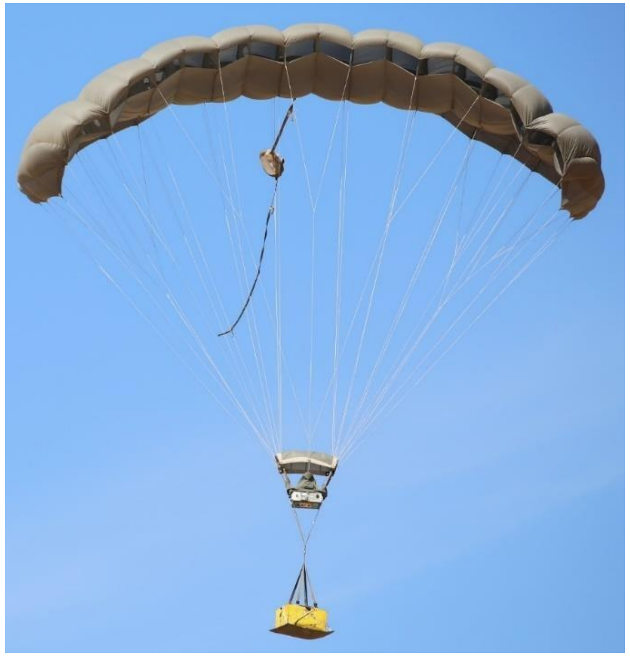
Additional GN&C Capabilities

- GPS Denied (Current Capability)
  - If the system loses GPS lock during the flight it will continue to navigation via dead-reckoning using the inertial, barometric sensors and the most recent wind estimate. Note accuracy may degrade quickly due to changing wind conditions
  - If the system loses lock prior to exit from the aircraft and does not gain it upon starting navigation, it will enter a left-hand turn and wait for GPS lock to be achieved
- Manual Override Mode
  - When the system is being manually controlled by a jumper in the air or operator on the ground, it continues to run the GN&C algorithms in the background. If communications with the handheld is lost for more than 3 seconds, it will revert back to autonomous mode and resume navigation on its own.
- There are multiple “abort” scenarios when the system is experiencing an anomalous condition
  - For example, dropping outside of the LAR – if the system runs out of altitude enroute to the impact point, it will turn into the wind and flare for landing

Vertical Descent Mode

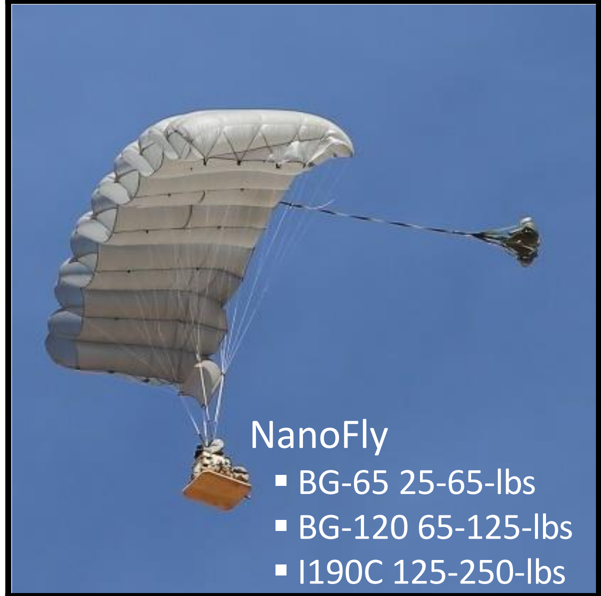
- The Vertical Descent Mode (VDM) is a new addition to the Airborne Systems GPADS family of systems
- Implemented to the MicroFlyIII, 2K FireFlyII, and 4K RazorFly (in development)
- The profile section of the canopy is distort to alter the aerodynamic flow around the canopy
- The glide ratio of the canopy is decreased when activated (~1:1)
- Note that the canopy is not stalling. It is still flying and is still controllable
- Requires additional motor in the front of the AGU
- On final approach the VDM motor of the AGU releasing the Center “A Lines” to reduce forward airspeed and increase descent rate to approximately 25-ft/s and a very low glide ratio (wind dependent)
- System will do a normal flare if the AGU calculates that the ground speed will be backwards in VDM
- VDM on exit from the aircraft dramatically reduces failure footprint if the AGU fails to navigate

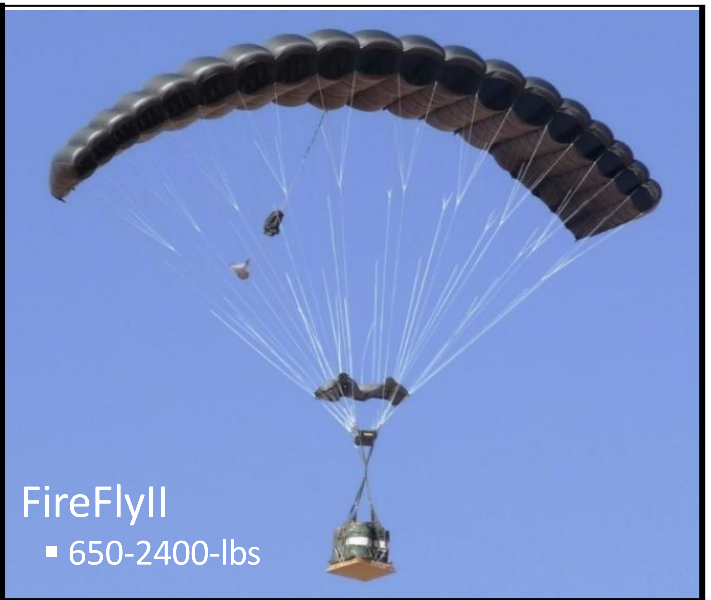


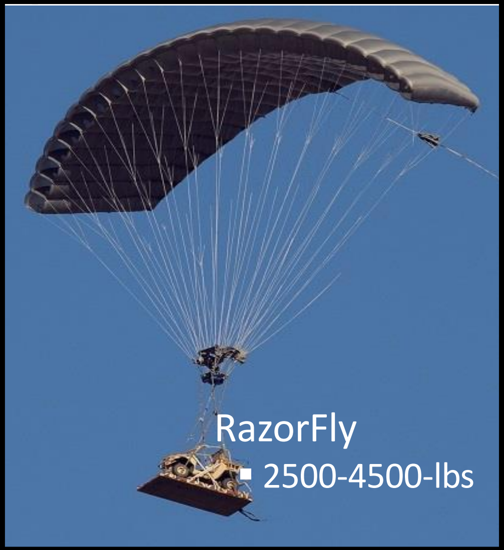


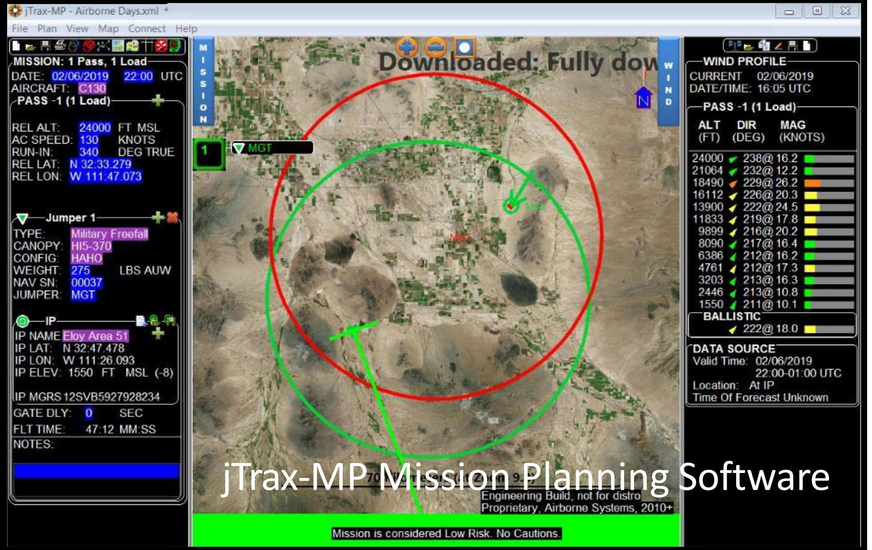
Our GPADS Products

Existing GPADS Product Range









GPADS Training & Services

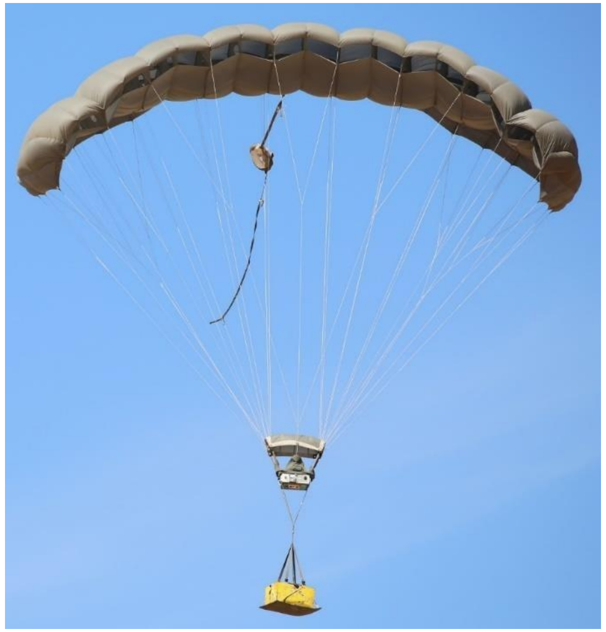
- New equipment and refresher/ continuation training for the complete GPADS range of systems, inclusive of mission planning software
  - Customer location
  - At our Eloy training facility
- GPADS combo drop training courses
- In-servicing and packing
- Inspection, maintenance, and repacking
- Full technical & drop support

NanoFly

- JPADS for 25-250 lbs.
  - 65-sqft 25-75 lbs. (BG-65)
  - 120-sqft 75-125 lbs. (BG-120)
  - 190-sqft 125-250 lbs. (INT-190)
- Hand-deployed drogue
- System weight: approximately 25lbs. (11.3 Kg)
  - Varies dependent on canopy size selected
- AGU mediated drogue fall (altitude or time)
- Includes harness to strap AGU to rucksack (or similar) payload

MicroFlyII & MicroFlyIII

- The MicroFlyII remains an available product in its existing configuration
- Universal deployment system and rigging for AGU mediated Drogue Fall or HAHO operation
  - Drogue Fall, program AGU for main canopy deployment altitude (3,550 ft. AGL up to 24,500 AMSL) or drogue fall time (0 to 120 seconds)
  - HAHO, drogue fall time is set to 0 seconds
  - Main canopy deployment triggered by 3rd actuator on the AGU
- MicroFlyIII has the following new capabilities:
  - RA-530C for 500 - 1000 –lbs. payload capacity
  - Vertical Descent Mode for RA-530C and RA-360C
  - MAR-360C (Marauder) with and without VDM
  - Silent Slider
  - Redesigned Kevlar drogue bridle and larger drogue for RA-530C
  - Revised drogue pouch flaps
  - Support for VDM or non-VDM capable canopies



Combo Drops

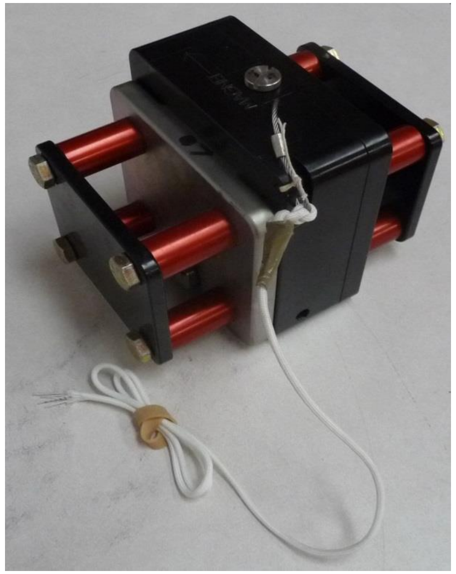
- MicroFlyII exit aircraft first either in HAHO or HALO mode
  - In HALO delay is set by both altitude & time
    - 24,500 ft AGL to 3,500 ft AGL
    - 0 to 120 seconds
- Team exits aircraft and follows MicroFlyII, to Impact Point (IP)
  - The MicroFly can either be in autonomous mode or be controlled by the team leader using remote control
- Can manually change IP if required
- Equivalent canopy performance means team stays with equipment
- Safest and most flexible method of inserting with equipment
- Safe alternative to Tandem Bundle

FireFly II

- Completely redesigned AGU for VDM
  - LCD/Keypad on same side of AGU as actuators for easier rigging
  - LiFePo4 battery technology for extended shelf life and reduced maintenance
  - A-Line VDM actuator
  - Drogue fall actuator (future capability)
- FireFly Canopy Design
  - 1,025-sqft
  - 650-2400 lbs. GRW
  - 19 cells
  - Glide Ratio: 3.25:1
  - Gravity drop CDS (A-22) typical
  - Release away static line (RASL)
  - 24,500-ft MSL from C-17 and C-130
- Accuracy: 100-m Average, 150-m 80% CEP

RazorFly

- New AGU based on 2K AGU design
- RazorFly Canopy Design
  - 1,740-sqft
  - 2,500-4,500 lbs. GRW
  - 23 cells
  - Glide Ratio: ~3.5-3.75:1
  - Uses 2K drogue
  - Packing/Rigging similar to 2K
- Specifically designed for SOCEP and MRZR ATV
  - Split confluence align vehicle with the direction of flight to avoid tip-over on landing
- Also compatible with other standard resupply payloads (Type V, double CDS etc.)
- Accuracy: 121-m Average, 177-m 80% CEP



DragonFly

- ASNA is the prime contractor for the complete system on US Army PM-FSS JPADS 10K Program of Record
  - Primary system development 2007-2017
  - NET Training for US DoD 2015-2022
- Canopy Design
  - 3,500-sqft
  - 4,900-10,000 lbs. GRW
  - 35 cells
  - Glide Ratio: 3:1
  - Gravity and Extracted configuration
  - Quad CDS, CEP, Type V 8 & 12-ft
  - Release away static line (RASL)
  - 24,500-ft MSL from C-130, 17,500-ft MSL from C-17

DragonFly

- Accuracy: 145-m Average, 204-m 80% CEP
- Hundreds of test and operational drops
- Hundreds of systems fielded
- When rigged for extraction, the extraction parachute is not retained to the rest of the system

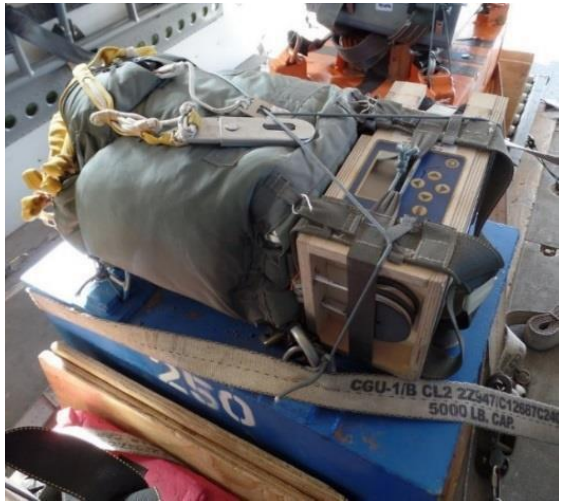
FlyClops/FCMini

The objective of FlyClops is to reduce the total ownership costs of JPADS to the point that it becomes a viable and preferred aerial delivery solution for mass resupply airdrop missions.

- This objective results in the following key performance requirements:
  - Minimized unit procurement cost – without reducing reliability or performance.
  - The system is 100% disposable after one use. The retrograde and refurbishment cost/burden is driven to zero.
  - Deliver the system packed and ready for rigging onto a payload. Drive cost/burden of parachute packing training, proficiency, maintenance, and facility infrastructure to near zero.
- The result is a system with nearly *60% unit cost reduction* and notionally *95% sustainment cost reduction*. Sustainment is essentially reduced to storage space and periodic battery maintenance.

FlyClops/FCMini

- AGU structure made completely of birch plywood
  - Lower cost than a reusable metal structure
  - Less material to be potentially repurposed as an improvised explosive device (IED)
- Single actuator for canopy control. Canopy flies in half brakes and does not flare at landing
- Removable Lithium Iron-Phosphate battery pack
  - Longer shelf life and extended battery maintenance schedule
- Payload harness integrated into parachute container and riser assembly
- AGU renders itself unusable upon landing
- Parachute is packed and assembled to AGU, ready for rigging onto the payload and mission programming
- FlyClops AGU weighs just 24-lbs (standard 2K AGU is 85-lbs)
- FCMini AGU weighs just 6-lbs (MicroFlyII is 28-lbs)
- FlyClops uses 1T2K canopy, packed by ASNA
  - Includes deployment system and upper harness to confluence point
  - Accuracy: 91-m Average, 150-m 80% CEP
- FCMini uses 1TMC-4 canopy packed by ASNA
  - Includes deployment systems and harness to payload
  - Accuracy: 62-m Average, 89-m 80% CEP



FlyClops Development History

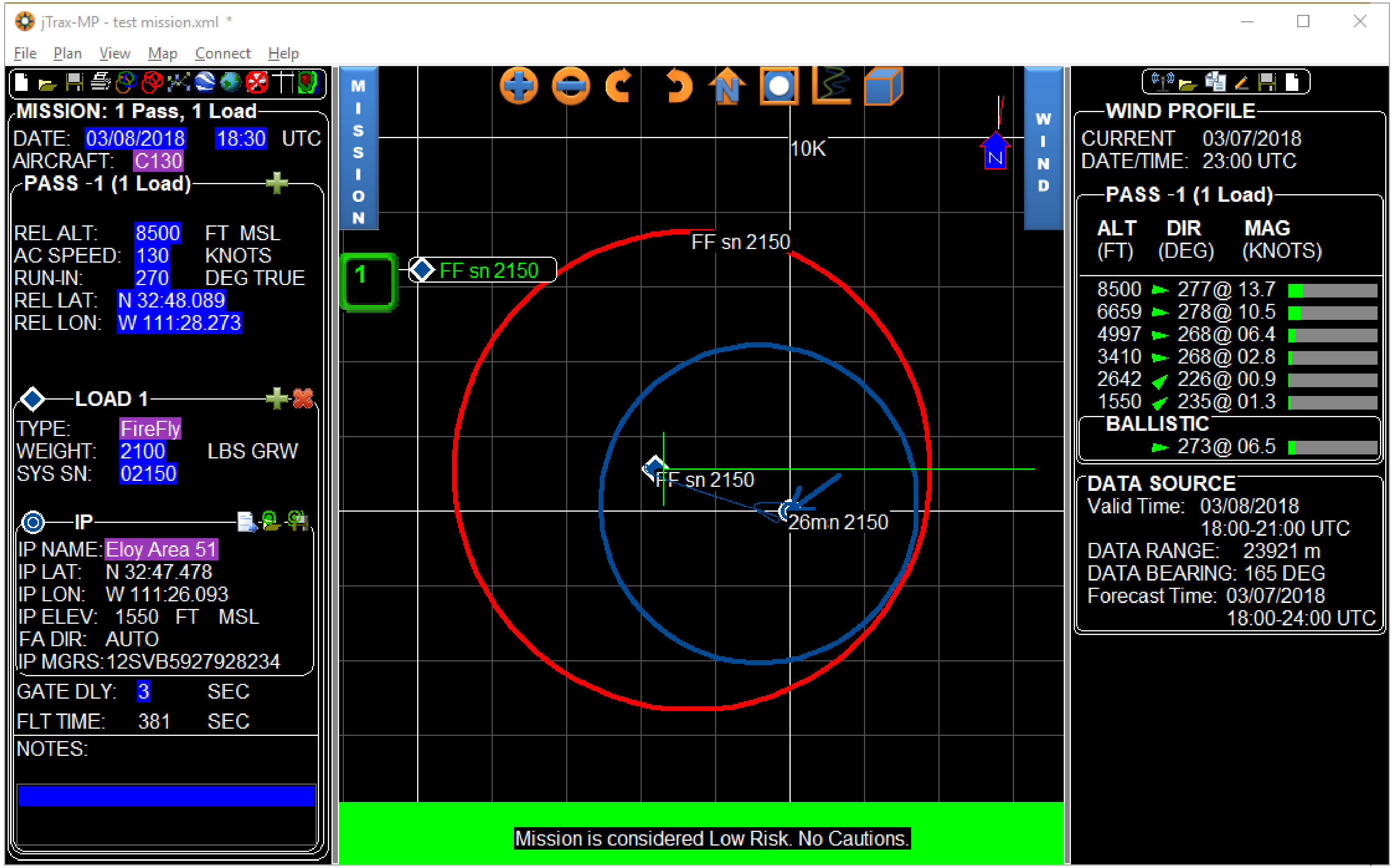
- 1T2K canopy development began in 2009 as an internal development program and then transitioned into the JPADS 2K Program of Record in late 2010
  - Qualified to 17,500-ft MSL initially, later to 25,000-ft MSL
  - In production since 2012, hundreds delivered to US DoD and foreign militaries
- Development of FlyClops AGU began in mid 2011 with initial sales in 2012
- Development of the FCMini and 1TMC-4 began in 2013
- Over 600 operational and test drops of the two systems to date
- Environmental Certifications:
  - MIL-STD-461E RE 102 and RS 103
  - MIL-STD-810G 511.5 Explosive Atmosphere
  - MIL-STD-810G 500.5 Rapid Decompression

Mission Planner –jTrax-MP

Mission Planning

- Independent of the software tool used, effective mission planning is essential in the effective use of GPADS
- Mission planning mistakes are the #1 cause of GPADS mission failures.
- The USAF CAT software has had a number of issues over the past decade which directly, or indirectly caused GPADS mission failures, to the point that GPADS use was temporarily grounded by the US DoD.
- ASNA has worked closely with the US Army and Air Force to address these problems, to the point of developing software that complements (and sometimes over-rides) the USAF CAT software
  - This software (CAT MPA) has been handed off to the USAF program office and integrated into the latest release of CAT (3.2.3).
  - CAT MPA is a FalconView-centric derivative of the our jTrax-MP software
- jTrax-MP is a robust and validated GPADS mission planning solution which ASNA has developed in-house and continues to maintain and develop for several GPADS customers.

Sample Screenshot



Ongoing/Future GPADS Developments

New Development

- Robust GN&C Strategy for GPS-denied/compromised mission scenario
  - Support for simultaneous GPS tracking of GPS, GALILEO, and GLONASS constellations
  - Support for India NavIC navigation System
- Iridium-based Navigation Solution for GPS-denied situations
  - Planning initial capability release in FY2026
  - Receiver provider: www.nalresearch.com
- Avionics Modernization
  - Color/Touchscreen LCD interface
  - Upgraded inertial sensors and filtering
- Next generation high performance large ram air canopies
  - Hi-Glide 2K derived from Hi-5 and Marauder

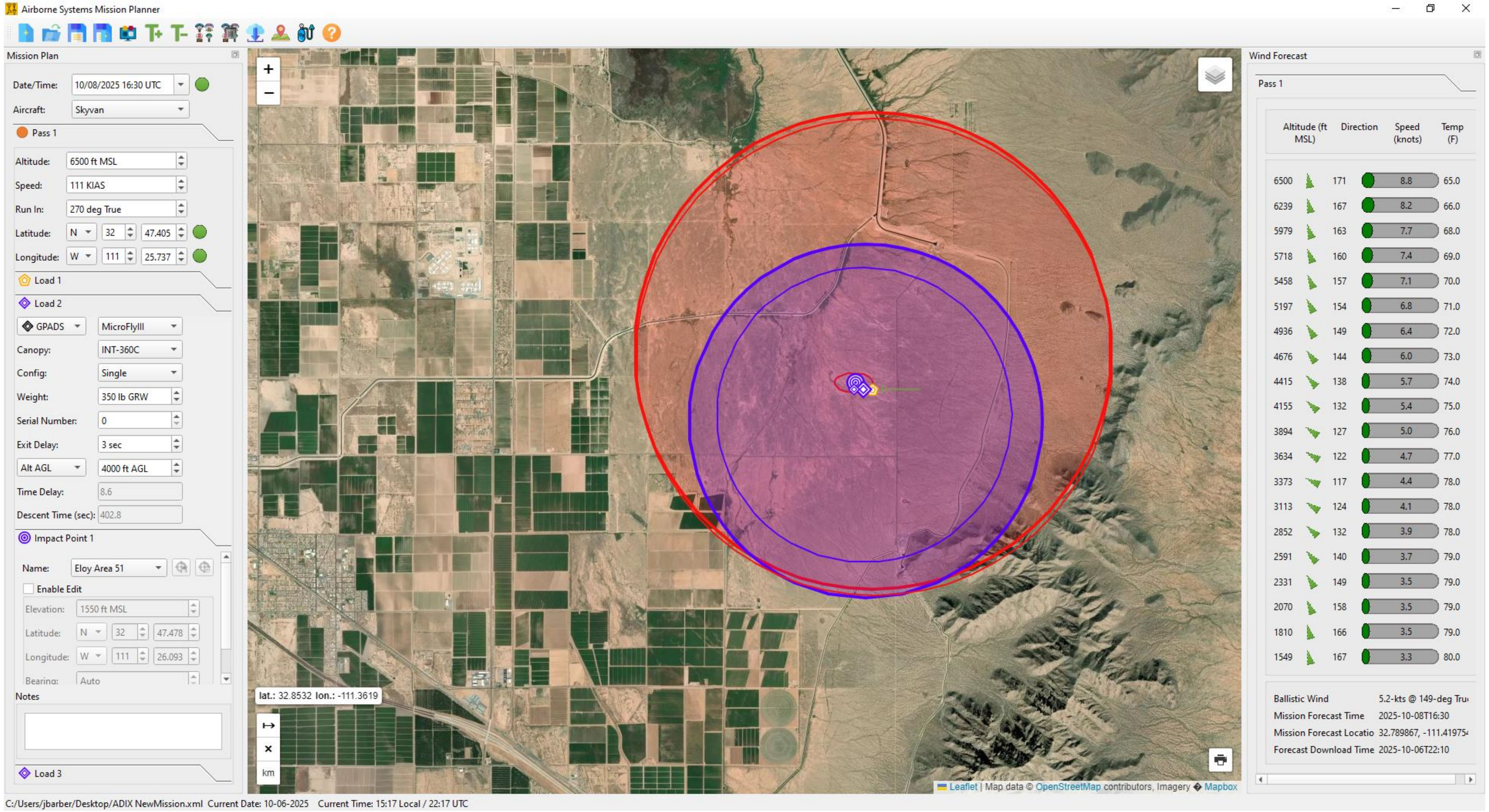
Iridium GPS Alternative

- Completely independent of the all of the GNSS constellations
- Much higher power signal at frequency outside the GNSS bands. Highly resistant to jamming
- Requires subscription service with Iridium and agreements with US DoD for international use
  - Availability is RAPIDLY evolving (think of GPS 20 years ago)
- Accuracy varies widely based on time and location
- 1st Gen: Supplement our existing dead reckoning with Iridium navigation solution to greatly improve navigation over longer periods of GPS loss
- 2nd Gen: Enhanced avionics suite with sensor fused Kalman filtered position solution: Will improve landing accuracy in all conditions
- Existing AGUs will be upgrade-able to add new capability.

New Development

- Completely redesigned Mission Planner
  - Added support for AS-2000 drogue fall, clusters, T-11, Octo-11, MC-6
  - Integrated 3D and 2D terrain display
  - Advanced wind and weather depiction
  - Continued support for all GPADS and MFF products
  - Integrated support of our O2 products
  - Support for Android/iOS, handheld devices

Mission Planner



Mission Planner 3D