Proximity Operations Nano-Satellite Flight Demonstration (PONSFD) Overview

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Scott MacGillivray, President
Tyvak Nano-Satellite Systems LLC
15265 Alton Parkway, Suite 200
Irvine, CA 92618-2606
(714) 392-9095 | scott@tyvak.com
Tyvak Company Background and Overview

• **Tyvak was Formed to Address Unfulfilled and Growing CubeSat Needs**
  – Needed spacecraft performance and complete system solutions were not supported by existing component and kit-focused suppliers
  – Need for advanced “next generation” CubeSat components and complete vehicles to support operational and scientifically relevant missions
  – Provide complete program life-cycle expertise and mission development

• **Founded by Scott MacGillivray, Dr. Jordi Puig-Suari, and Other CubeSat Experienced Engineers**

• **Provide Range of NanoSat Products and Services**
  – Complete CubeSat bus and vehicles for advanced missions
  – Direct sales of select components and product suites to support other organization’s in-house projects
  – Research and development of advanced “next generation” CubeSat products
  – Launch integration services
PONSFD Mission Goals

• **Design, Develop, and Demonstrate Rendezvous and Proximity Operations to a Support Inspection Mission Utilizing a CubeSat**
  – Utilize a Nano-Satellite Class (< 10 kg) Space Vehicle
  – Validate use of completely new set of low power miniature components and software approach
    • Demonstrate technology and operations applicable to future operational nano-satellite capabilities and operations
  – Demonstrate Proximity Operations from various distances, approach scenarios, and lighting conditions
    • Nominal operating distances: 50m to 2km
    • Full Range of Distances: 0.5m to 25km
  – Demonstrate docking between two vehicles
    • Safely approach and make contact between test vehicles

• **Program Represents a 10x Reduction in Space Vehicle Size and Program Cost for a Proximity Operations Flight Experiment**

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PONSFD Funded by the Small Spacecraft Technology Program within the NASA Space Technology Mission Directorate
Baseline Operations Concept

Launch

Simultaneous P-POD Releases

Initial State of Health Checkout

Orbit Maneuvering to Initial Proximity Distance and Maintain (Formation Flight)

Main Rendezvous and Proximity Operations (RPO) Flight Demonstration Phases

CubeSat A Performs RPO Relative to CubeSat B

CubeSat B Performs RPO Relative to CubeSat A

Increased Range RPO Scenarios

Decreased Range RPO and Docking Scenarios

Disposal
Key CubeSat Vehicle Features and Capabilities

- **Leverages Tyvak’s High Performance Endeavour Components**

  - **C&DH** (Leverages Tyvak’s Intrepid System)
    - Atmel Based Main S/C Processor
    - Linux Software Libraries
  
  - **EPS**
    - Power Management and Distribution (PMAD) Electronics Based on Flight Proven Designs
    - Deployable & Body Solar Panels
    - High Capacity Li-ion Battery Module
  
  - **ADCNS**
    - Multiple 1GHz ARM Processors
    - Next Generation Star Trackers
    - Next Generation Miniature Reaction Wheels
    - Multi-Thruster Propulsion Module
    - GPS Receiver and Antennas
  
  - **TT&C**
    - UHF for main communications
    - S-Band Downlink for mission data
    - Inter-Satellite Link
  
  - **RPOD Module**
    - Imager Based System
    - Maneuver and Trajectory Planning
    - Universal Docking Mechanism
Key Mission and Technology Elements Demonstrated

NanoSat Proximity Operations
- Sensors and software for range & range rate determination
- Cooperative sensors

NanoSat Docking
- Close-in co-op aids and sensors
- Universal Docking mechanism

NanoSat S-Band Comm
- TT&C and Mission Data (e.g., RPO sensor and images)

Miniature, Low Power Inter-Satellite Link

GN&C Algorithms
- GN&C algorithms running on high performance, low power processors

Advanced Capability CubeSat
- Fully functional Space Vehicle
- On-Board Processing and Storage

ADCNS Sensors and Actuators
- Precision Star Trackers and Reaction Wheels
- Miniature, Low Power GPS Receiver & Antennas

Precision Control Propulsion System
- Highly integrated miniature propulsion system for proximity maneuvering
Thank You