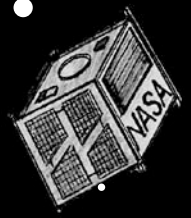
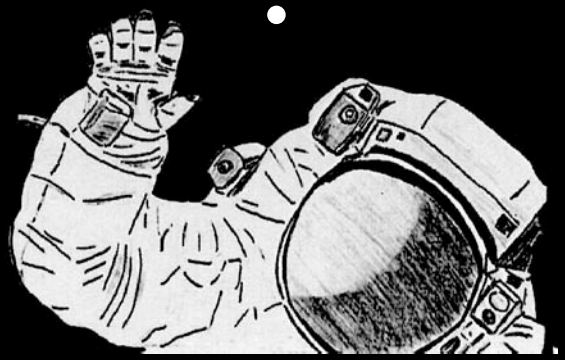
Small Spacecraft Technology Program

NASA Space Technology Mission Directorate



Big ideas in small packages



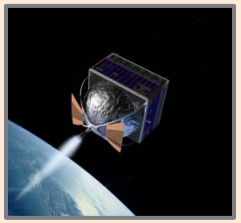
April 2013

Andrew Petro, Program Executive
Bruce Yost, Program Manager

SPACE TECHNOLOGY MISSION DIRECTORATE
NINE PROGRAMS

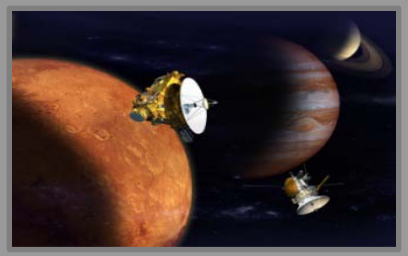
Game Changing Development

Technology Demonstration Missions



Small Spacecraft Technology

Space Technology Research Grants



NASA Innovative Advanced Concepts (NIAC)

Center Innovation Fund

Centennial Challenges

Small Business Innovation Research & Small Business Technology Transfer (SBIR/STTR)

Flight Opportunities

SMALL SPACECRAFT TECHNOLOGY PROGRAM

Franklin and Edison programs combined in 2012 into Small Spacecraft Technology Program.

Program objectives cover TRL range from 3 to 7

Program Executive: Andrew Petro (HQ)
Level 2 Program Office at Ames Research Center
Program Manager: Bruce Yost (ARC)
Deputy Program Manager: John Allmen (ARC)

Please visit: www.nasa.gov/smallsats

PROGRAM OBJECTIVES

Advance the capabilities of small spacecraft to support NASA missions in science, exploration and space operations

- **to perform missions or examine phenomena not possible otherwise**
- **to accelerate the introduction of new technologies and capabilities**
- **to unleash NASA's unique capabilities and assets into the already vibrant small spacecraft community**

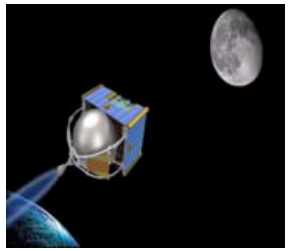
STRATEGIC ELEMENTS

ACTUAL ANNUAL ACTIVITIES WILL VARY BASED ON FUNDING AND OTHER CONSIDERATIONS

	PARTICIPANTS
Focused Technology Development and Demonstrations - technology concept development (TRL 3 to 5) with selective transitions to flight demonstrations (TRL 5 to 7), ~ 3-year cycles, Full and open solicitations.	NASA Other Govt Lg Business Sm Business Academia
Mission Capability Demonstrations - directed formulation phase followed by RFP for mission implementation or NASA-led project with RFP's for mission elements (bus, tracking, etc.), TRL 5 to 7, ~3-year cycles.	NASA Other Govt Lg Business Sm Business Academia
Leveraged Investments - funding for SBIR Phase 2E or Phase 3 projects, CIF follow-on projects, Prize Challenges, and other initiatives – linked to technology focus areas.	Sm Business NASA Others
Smallsat Technology Partnerships (STP) - University-NASA partnerships for technology development and/or demonstration. 1-2 year durations.	Academia NASA Others

ACTIVITIES FOR 2013

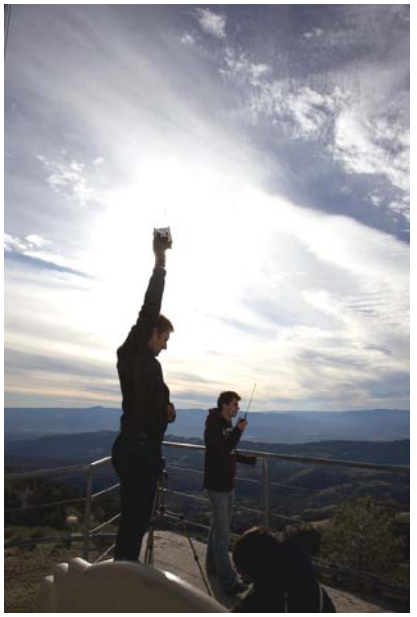
- PhoneSat mission – Spring
- EDSN mission – Fall
- Continuing development of OCSD, ISARA and CPOD for missions in 2014-16
- Smallsat Technology Partnerships – proposals due June 5, projects to start in Fall
- Micro-electrospray propulsion development solicitation in partnership with Game Changing Development Program – proposals in review
- Flight Opportunities Solicitation – proposals due June 17
  - Propulsion technology development
  - Small Earth Return Vehicle development
- Tentative “Smallsat Flight Software Workshop”
- Study and formulation of future initiatives



SMALLSAT TECHNOLOGY PARTNERSHIPS

Cooperative agreements with US colleges and universities to develop and/or demonstrate new technologies and capabilities for small spacecraft in collaboration with NASA.

- Technology development
- Development of spacecraft or payloads for suborbital, balloon or orbital space flights.



Objectives:

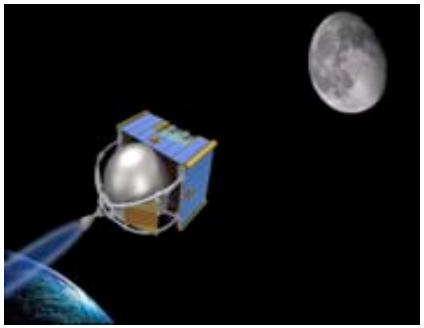
- Develop new technologies and capabilities for small spacecraft by engaging the university community
- Share NASA experience and expertise in relevant university projects
- Increase support to university student efforts in small spacecraft technology through funding and collaboration with NASA,
- Engage NASA personnel across the agency in rapid, agile, and cost-conscious small spacecraft development

Proposals due June 5

One to two year projects
Up to $100,000 per year, per university (up to $150,000 if more than one university)
Up to 1.0 FTE in NASA labor per year, per project
Anticipate up to 10 awards

R&D Opportunities

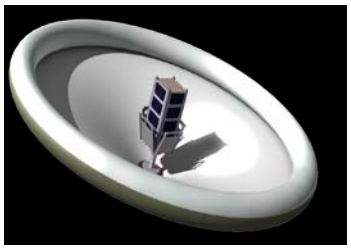
Game Changing Opportunities In Technology Development - 2012
NASA Research Announcement: NNL12A3001N
Appendix E
Technology Development For Suborbital Flight Opportunities



Full and open competition
Proposals Due: June 17, 2013

Small Spacecraft Propulsion Technology Development
Advancement of propulsion system concepts for use by small spacecraft
Selected projects could be considered for future flight demonstrations

- Offer performance advantage over existing cold-gas thrusters or other features
- Starting TRL of 3 to7
- Desirable features:
    - Low cost or short time to develop
    - Low cost to procure flight units
    - Small system volume or low mass
    - Low power consumption in operation
    - Suitable for rideshare launch opportunities (minimum hazards)

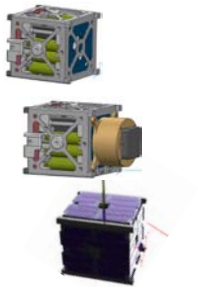


One year projects
Up to 10 awards - $100k-$250k each

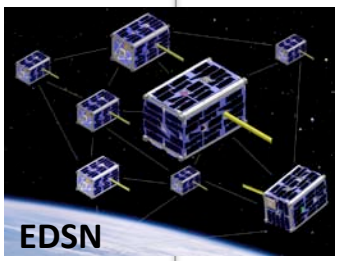
Entry, Descent and Landing Technology Demonstrations for Small Earth Return Vehicles
Payload concepts to demonstrate technology advancement for descent and landing
One year projects
Small number of awards - $50k-$250k each (there are additional topics for this category)

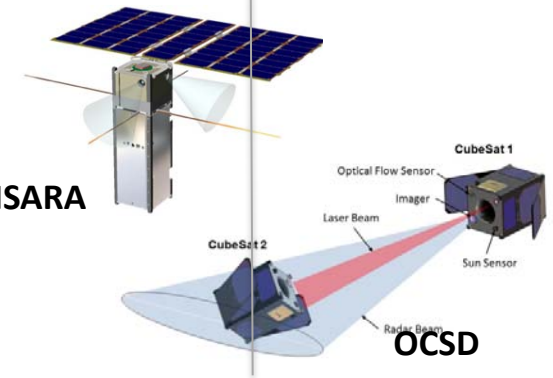
FLIGHT PROJECTS

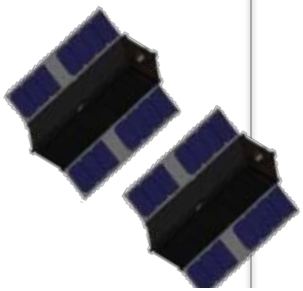
2013	2014	2015



PhoneSat 1/2b







CPOD

PhoneSat
Demonstrating use of smartphones as the spacecraft control and data handling system - yielding extremely low cost satellites for many uses.

Led by NASA Ames Research Center

Launch: April 21, 2013

EDSN (Edison Demonstration of SmallSat Networks
Demonstrating a small spacecraft swarm (8 cubesats) operating as a network for distributed sensing & communication

Led by NASA Ames Research Center

Launch: Fall 2013

ISARA (Integrated Solar Array & Reflectarray Antenna)
Demonstrating increased bandwidth for Ka-band radio communications by using the back of a deployed solar array as a radio antenna reflector

Led by JPL with Pumpkin, Inc.

Launch: 2014

OCSD (Optical Communication & Sensor Demonstration)
Demonstrating space-to-ground laser communications, low-cost navigation sensors, and proximity operations with two 1.5U cubesats

Led by Aerospace Corp.

Launch: 2014

CPOD (Cubesat Proximity Operations Demonstration)
Proximity operations and docking demonstration with two 3U cubesats

Led by Tyvak, LLC

Launch: 2015

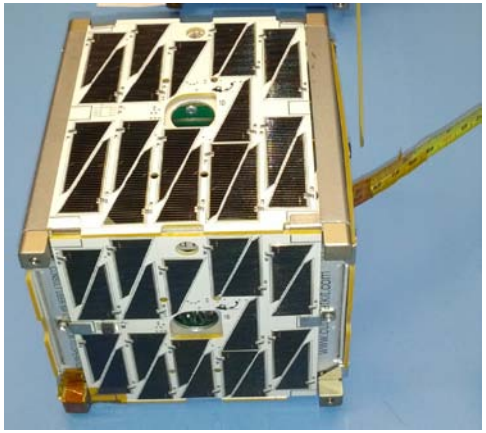
PHONESAT 1.0/2.0B MISSION

Demonstration of very low cost satellite bus based on smartphone electronics. Each is a 1U cubesat. 2nd generation PhoneSat has solar panels.

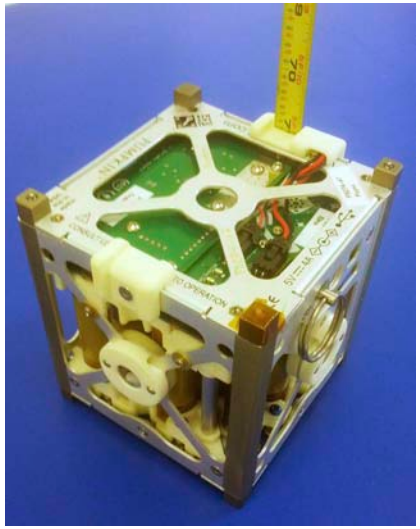
Launch:
Antares A-1: April 21, 2013
with PhoneSat 1.0/2.0b
(3 satellites)

Team
NASA Ames Research Center
- Project Manager: James Cockrell

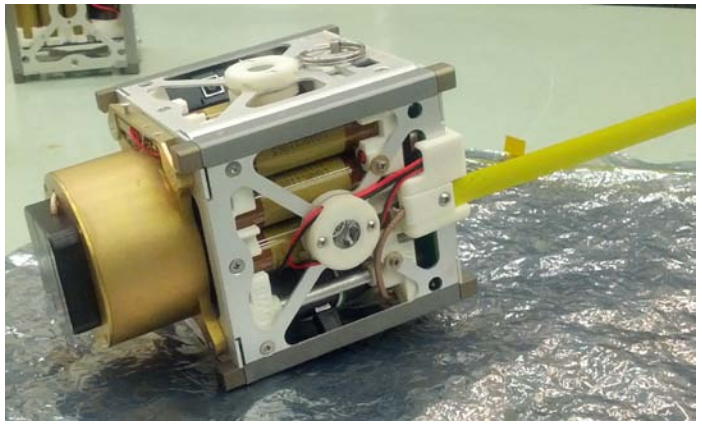
Popular Science –
2012 Best of What's New Award



"Alexander"
PhoneSat 2.0b



"Graham"
PhoneSat 1.0



"Bell"
PhoneSat 1.0
with Iridium experiment

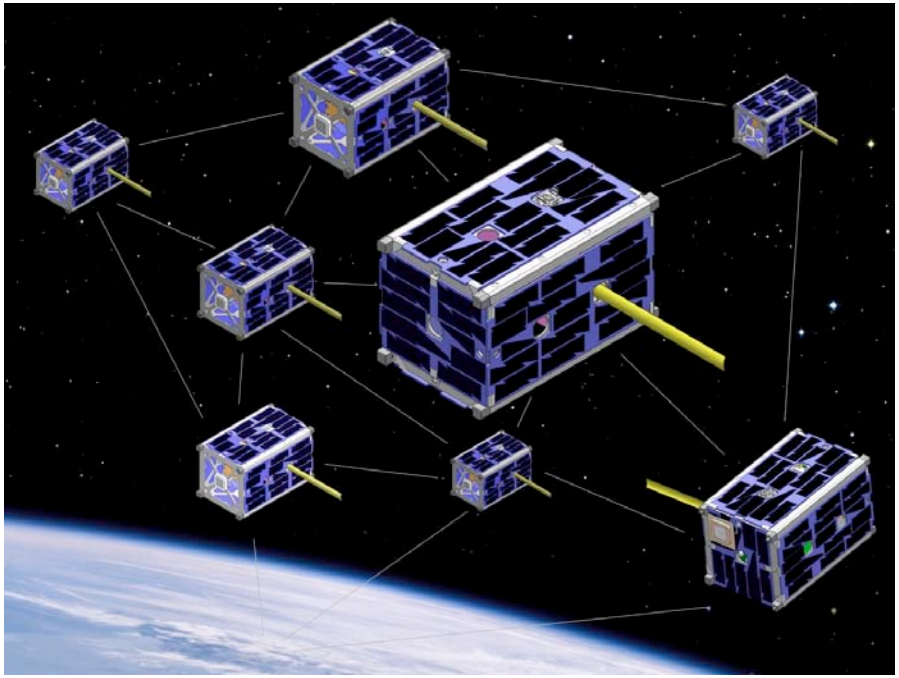
EDISON DEMONSTRATION OF SMALLSAT NETWORKS (EDSN)

Eight low-cost 1.5U cubesats to demonstrate the operation of an intra-swarm communications and coordinated multi-point science observations.

Launch planned for October 2013

Team
NASA Ames Research Center
- Stephan Ord

Partners:
Montana State University – Payload
Santa Clara University – Ground Station
NASA Marshall Space Flight Center



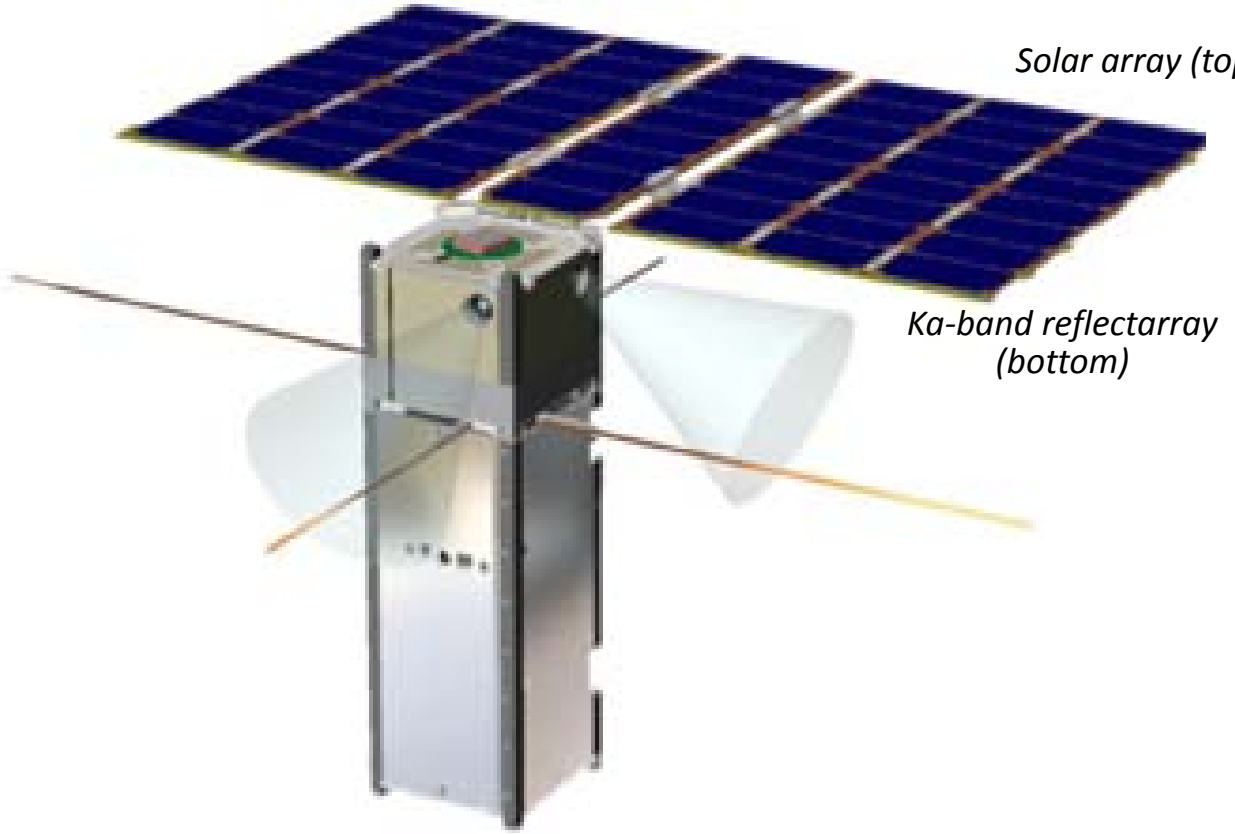
Integrated Solar Array and Reflectarray Antenna (ISARA)

One 3U cubesat with a large, deployable solar array that doubles as a Ka-band reflectarray providing 100 Mbps of data downlink capability.

Launch is planned for 2014

Team
Jet Propulsion Laboratory
- Richard Hodges

Partners: Pumpkin, Inc. (spacecraft bus)
Naval Research Lab (software)



Solar array (top)

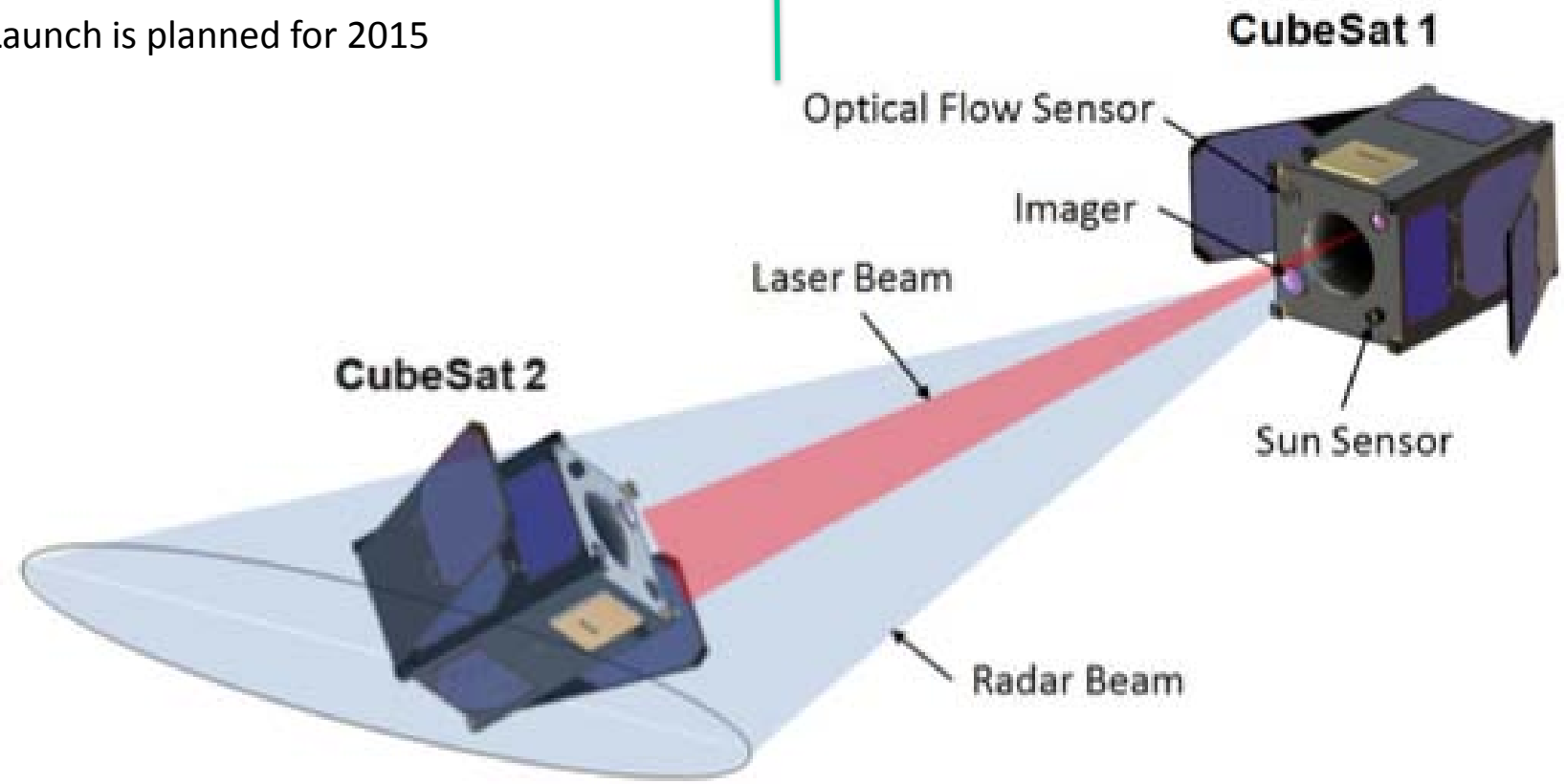
Ka-band reflectarray (bottom)

Optical Communication and Sensor Demonstration (OCSD)

Demonstrate radar ranging, optical downlink, cold gas propulsion, and cross-track motion sensing with two 1.5U cubesats executing formation flying and rendezvous operations.

Launch is planned for 2015

Team
Aerospace Corp.
- Siegfried Janson



CubeSat Proximity Operations Demonstration (CPOD)

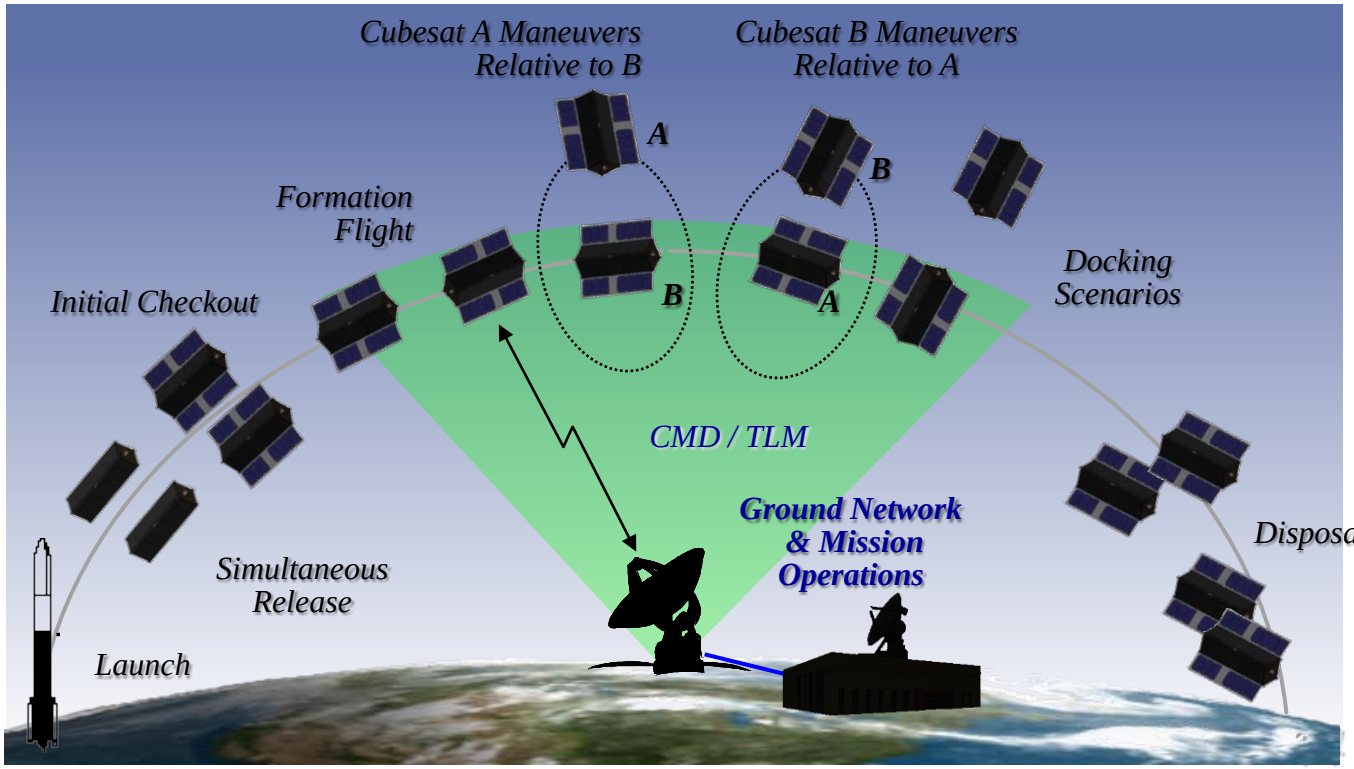
Two 3U cubesats demonstrate rendezvous, proximity operations, docking, and formation flight over a 1-year mission.

Launch planned for 2015

Team

Tyvak Nano-Satellite Systems LLC
- Scott MacGillivray

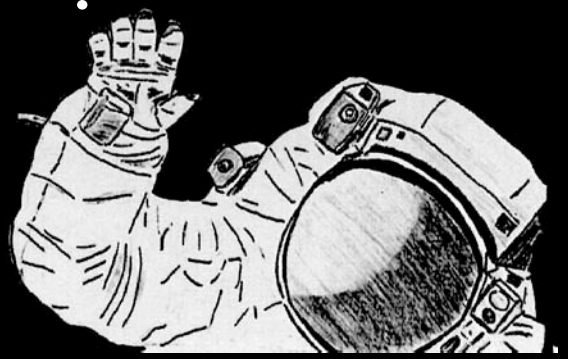
Partners: California Polytechnic State University, 406 Aerospace, Applied Defense Solutions, Analytical Graphics Inc.



SMALL SPACECRAFT TECHNOLOGY PROGRAM

NASA SPACE TECHNOLOGY MISSION DIRECTORATE

Big ideas in small packages



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