

NANORACKS

**Rapid, Reliable, Flexible and Affordable Access
to the International Space Station and Beyond**



HOW WE OPERATE

- NanoRacks operates principally under a Space Act Agreement (SAA, #6355)
- SAA enables streamlined commercial processes and procedures
- Low cost and rapid access to ISS orbit...initially.

We started with internal pressurized services, and have been investing private capital to expand our offerings

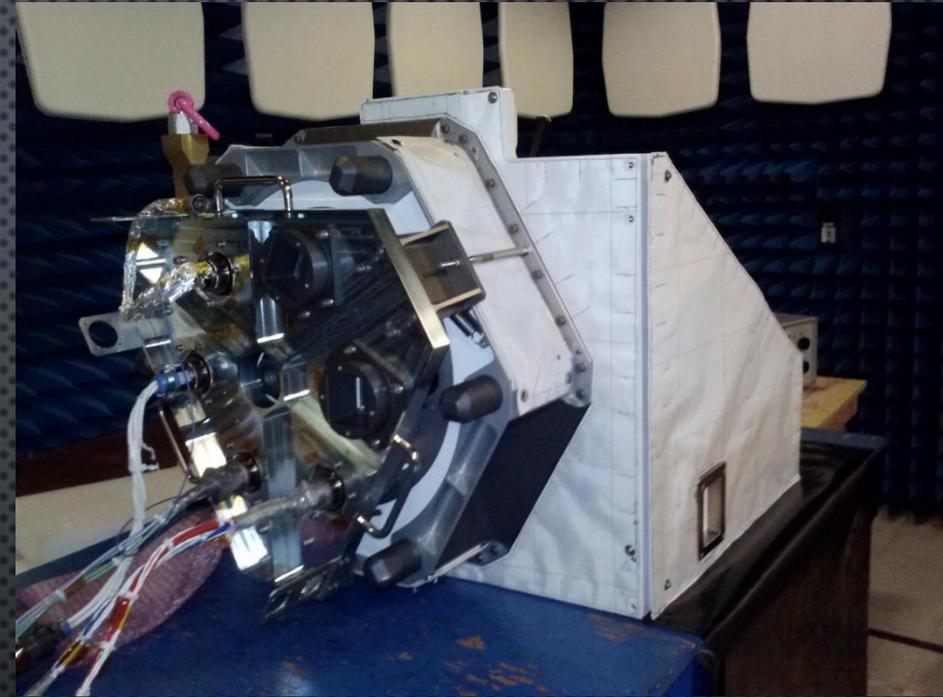
OUR NASAS SAA ALLOWS US TO:

- Directly access ISS manifest
- Access NASA crew time
- Manage payload integration
- Work directly w/ DoD and IC
- Streamline access to manifest
- Independently own hardware on ISS
- To negotiate new agreements, such as recent agreement with USG to supply ISS cubesat dispensers from SpaceX-3 onwards for both govt & commercial missions



CATEGORIES OF SERVICE

- External Platform: For sensors, technology, and materials testing
- Small Satellite Launches: Currently focused on cubesats, but go up to 180kg
- Internal: 4 internal platforms, including plate reader, two microscopes, and centrifuge
- Return to Earth: Using either Soyuz or Dragon
- Data Return: Near real-time
- High security processes



External Platform During
NASA Testing



INITIAL CUSTOMERS

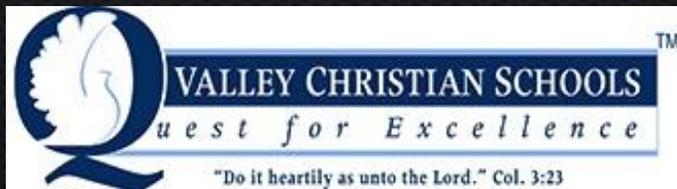
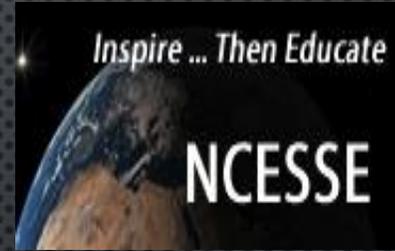
- Federal Agencies
- Basic and Applied Researchers Universities
- Israeli, German, Saudi and other international
- All Commercial Contracts

DELIVERIES TO DATE

- Over 150 payloads to ISS
- 12 payloads returned to Earth
- 100% success thru NASA safety

PIPELINE (UNDER CONTRACT)

- 70 internal payloads
- >60 smallsat payloads
 - 100 more under MOU
- 4 External Platform payloads





THE NANORACKS CUBESAT DEPLOYER

- Each NRCSD can deploy up to 6U of cubesats
- 8 NRCSD's per airlock cycle for a total of 48U deployment capability
- 2 air lock cycles per mission





NANORACKS CUBESAT MISSION (NR-CM₃)

CUBESATS

- Affordable small/cubesat constellations are now realistically achievable
- Real-time/near-real time global applications, demonstrations, risk reduction include:
 - signals collection, communications, weather data, remote sensing, space weather, space situational awareness
- Addresses portion of Affordable Access Problem
 - Rapid, reliable, affordable, and flexible access to LEO
 - Simple, safe, non-toxic in-space propulsion coming soon

Orbital Sciences CRS-1 (Launched
Jan 9,2014)

Planet Labs Flock1A, 28 Doves

Lithuanian Space Assoc., LitSat-1

Vilnius University & NPO IEP,

LituanicaSat-1

Nanosatisfi, ArduSat-2

Southern Stars, SkyCube

University of Peru, UAPSat-1

NR-CM₃ HIGHLIGHTS

- World's largest remote sensing constellation
- Most CubeSats launched in a single mission
- Two countries attain space faring status
- Innovative on-orbit sensor lease model
- Kickstarter



1. NRCSDs transported in CTBs



3. NRCSDs installed by ISS Crew



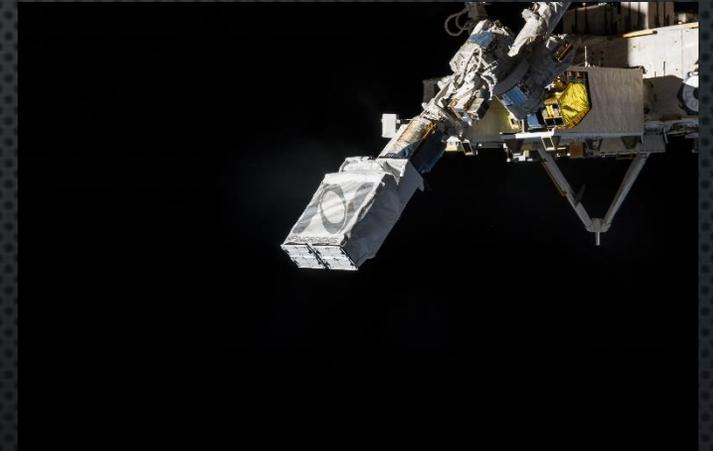
5. Grapple by JRMS



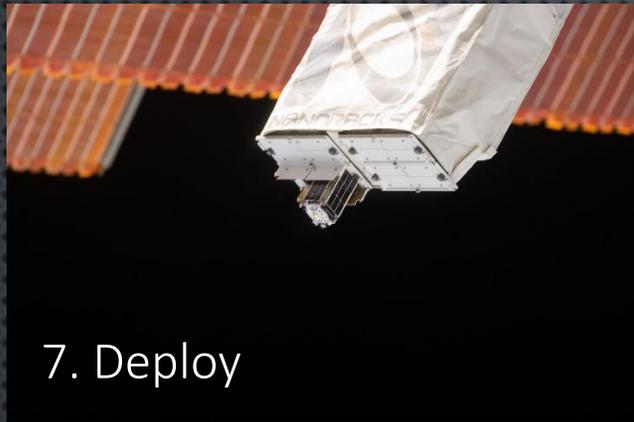
2. Launched by ISS visiting vehicle



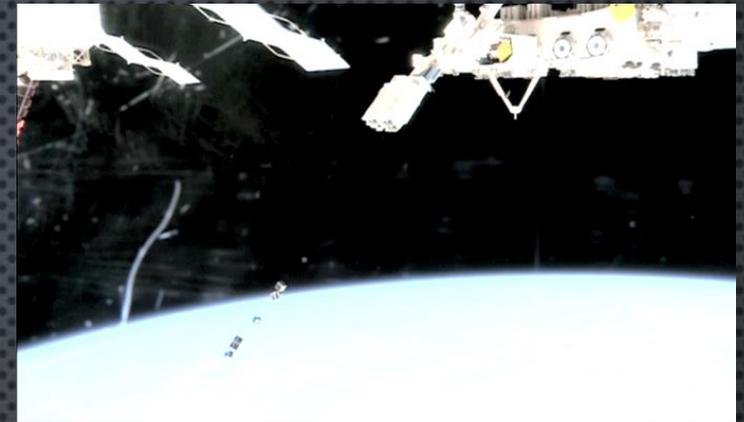
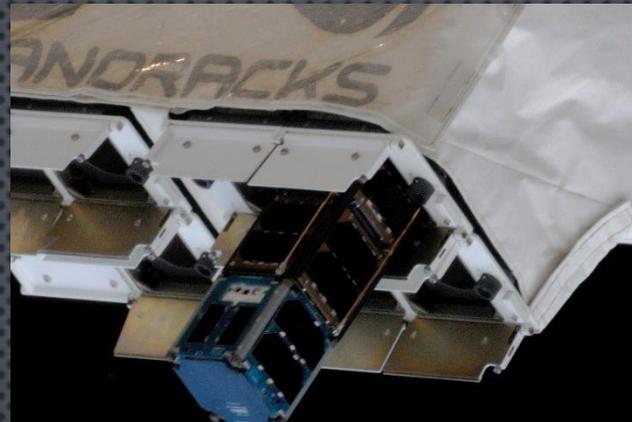
4. JEM air lock depress & slide table extension



6. NRCSDs positioned by JRMS



7. Deploy



8. JRMS return NRCSD-MPEP stack to slide table; Slide table retracts and pressurize JEM air lock



9. ISS crew un-install first 8 NRCSDs; repeat install/deploy for second set of NRCSDs



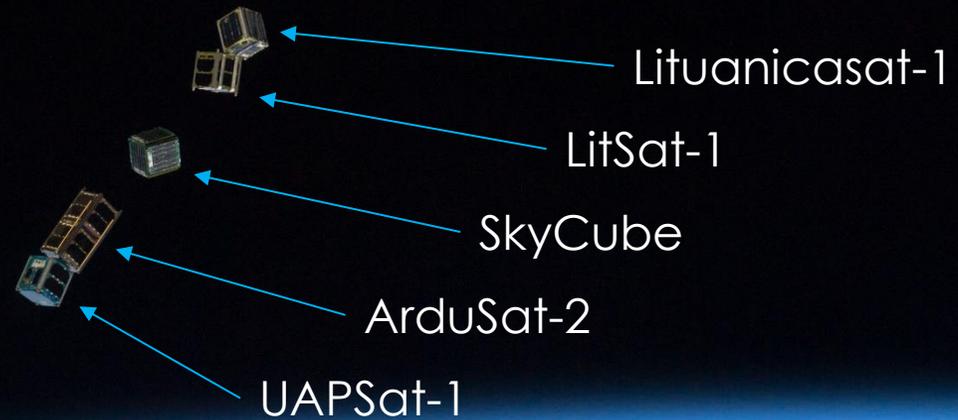
- NR-CM3
- Orbital Science CRS-1, Launch Jan 9, 2014
- Air Lock Cycle 1, Feb 11-15, 2014
- Deployers 1-8 (all Planet Labs Doves)

Dove CubeSats



- NR-CM3
- Orbital Science CRS-1, Launch Jan 9, 2014
- Air Lock Cycle 2, Feb 25-28, 2014
- Deployers 9-14 (Planet Labs Doves)

- Deployer 15

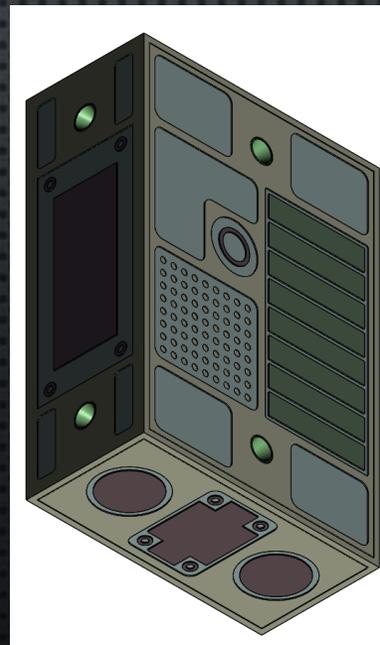
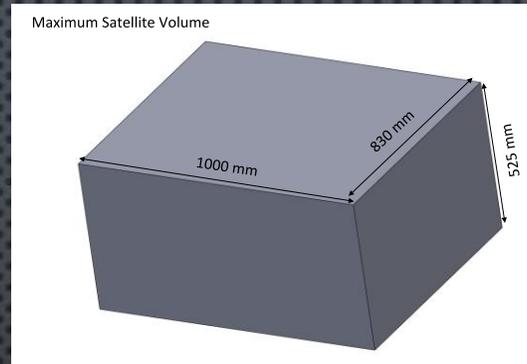




ISS SMALL & MICRO SAT LAUNCHES (1-180 KG)

Larger S/C launches possible

- JEM airlock, and ballistics requirement for orbital deployment create constraints in volume & mass
- 1000 mm x 830 mm x 525 mm
- 180 kg
 - Min Ballistics No = 91.24 kg/m² is less than ISS BN (100 kg/m²)
 - Assume Cd = 2
 - Meets ISS safety criteria



CHALLENGE: Safe & Nontoxic Smallsat Propulsion

- Spacecraft propulsion is last major barrier to smallsat launch revolution
- ISS safety is a new requirement
- Must be safe & non-toxic
- Propulsion options include:
 - Electrodynamic tethers
 - Electro-spray thrusters
 - Micro-RF ion thrusters
 - Resistojets
 - Micro-pulsed plasma thrusters
 - Electrically-controlled non-toxic solid propellants
 - Green non-toxic monopropellants



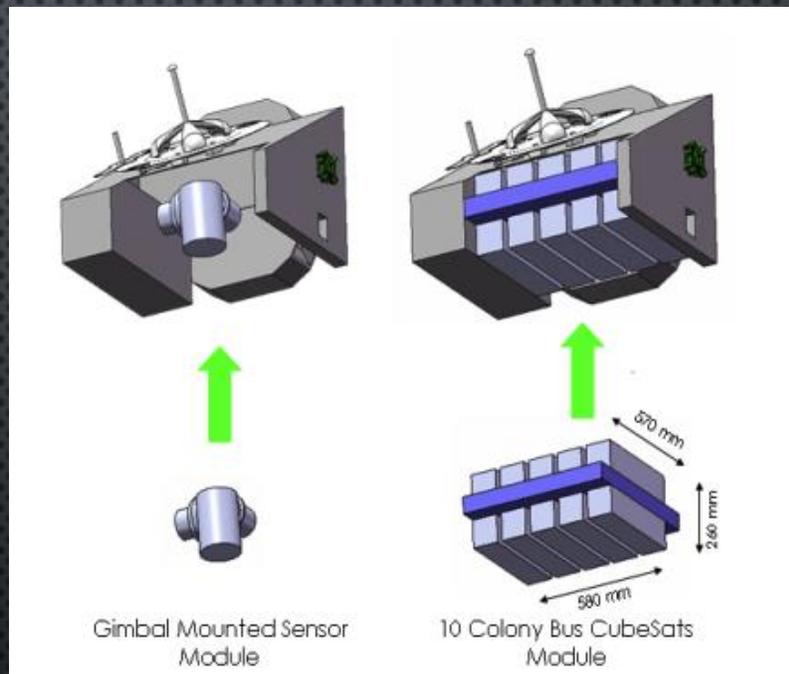
EXTERNAL PLATFORM PROGRAM

EPP Service Details

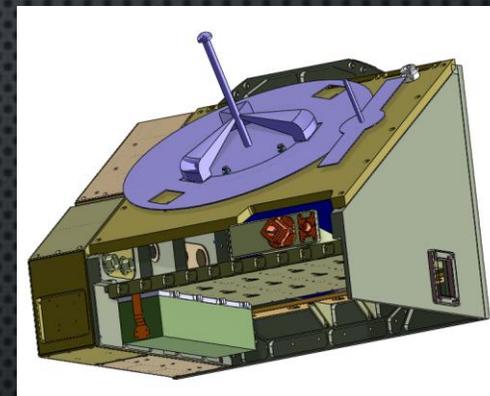
Payload size can be 4U (10 by 10 by 40 cm) in the Cubesat form factor or the full volume at 580 x 570 x 260 mm

Services Provided Include:

- NASA interface
- Launch Manifesting
- NASA Safety Review
- Payload integration
- Launch to the ISS
- Astronaut Services
- Power if Required
- Data Flow if Required
- customer and manifest
- Possible return of Payload



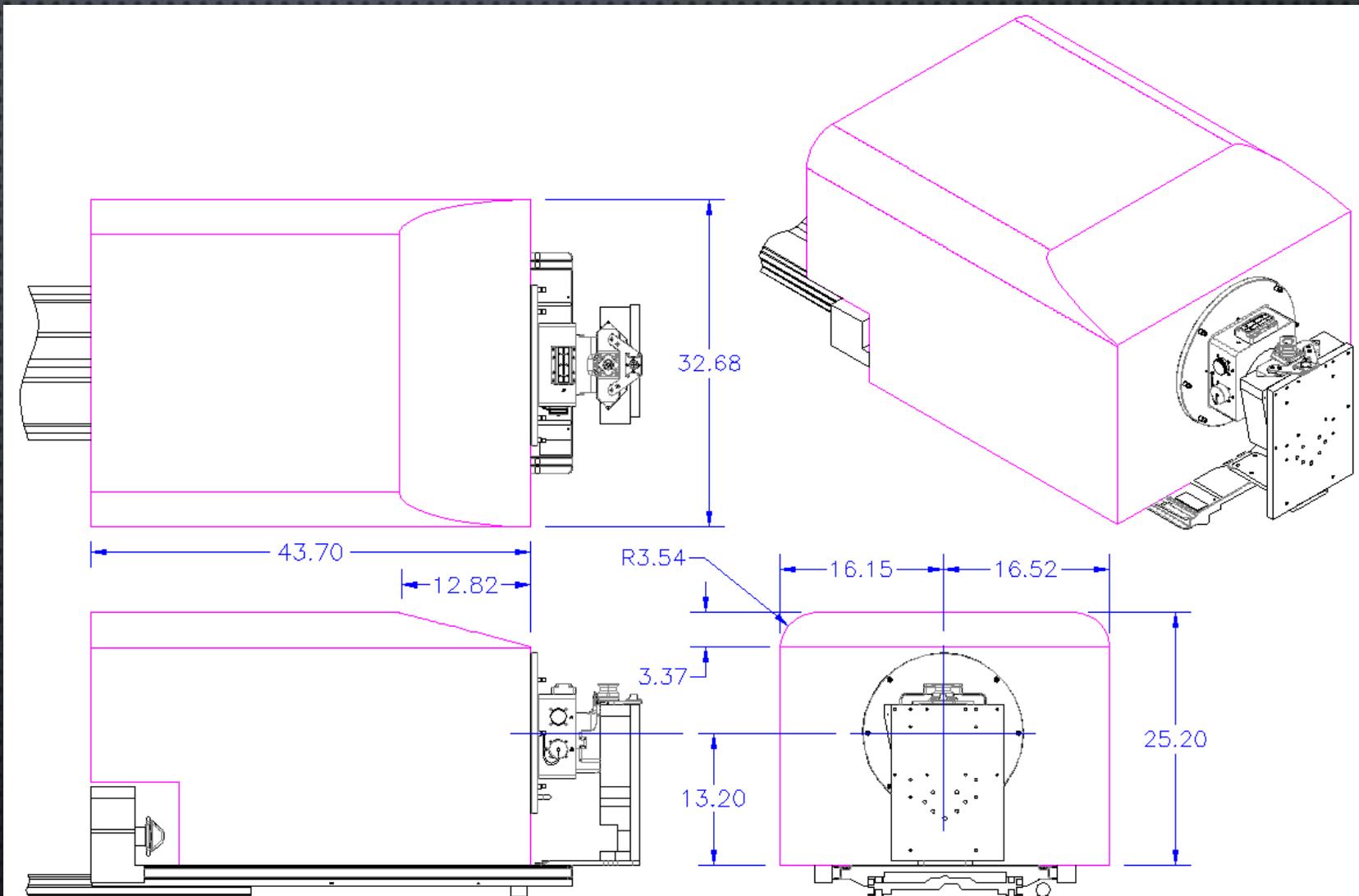
Two Possible Configuration Based on Payload Type





BENEFITS

- Private & Secure
- Speeds Technology Development
- Predictable & Frequent Service
- Turnkey Pricing
- Pointable & Moveable
- High data rates from Payload to Customer
- Human Payload Interface
- Payload Return Available
- Facility has access to 1KW of power
- MISSE-X Compatible



KABER PAYLOAD ENVELOPE (JCAP EXTENSION)



BUSINESS MODEL

Proving utilization in low earth Orbit;

Proving demand exists when Customer needs can be met

Proving viability of space Station platform

Now—looking to stimulate Other markets, such as Earth Observation from station And then moving beyond Station

We are working every day to manage the end-to-end service to make it easier on our customers.

Our customers can focus their energy and time on their payloads

