Space Station Cubesat Deployment Services

NanoRacks Cubesat Deployer (NRCSD)

- 51.6 degree inclination, 385-400 KM
- Orbit lifetime 8-12 months
- Deployment typically 1-3 months after berthing
- Soft stowage internal ride several times per year

Photo credit: NASA

NRCSD

- 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

Photo Credit: NanoRacks LLC

Photo credit: NASA

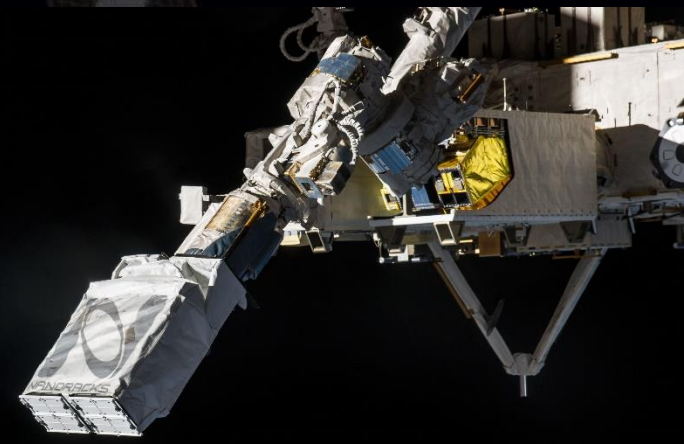
2. Launched by ISS visiting vehicle

3. NRCSDs installed by ISS Crew

5. Grapple by JRMS

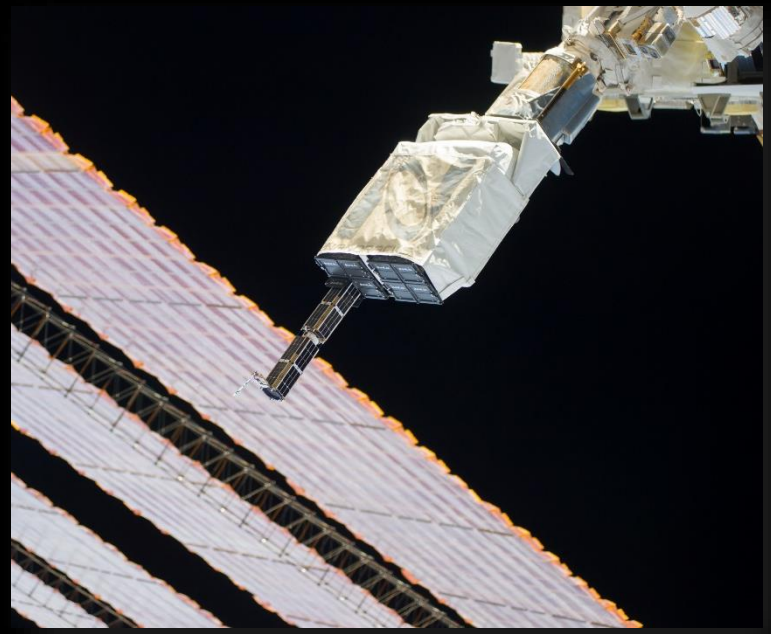
1. NRCSDs transported in CTBs

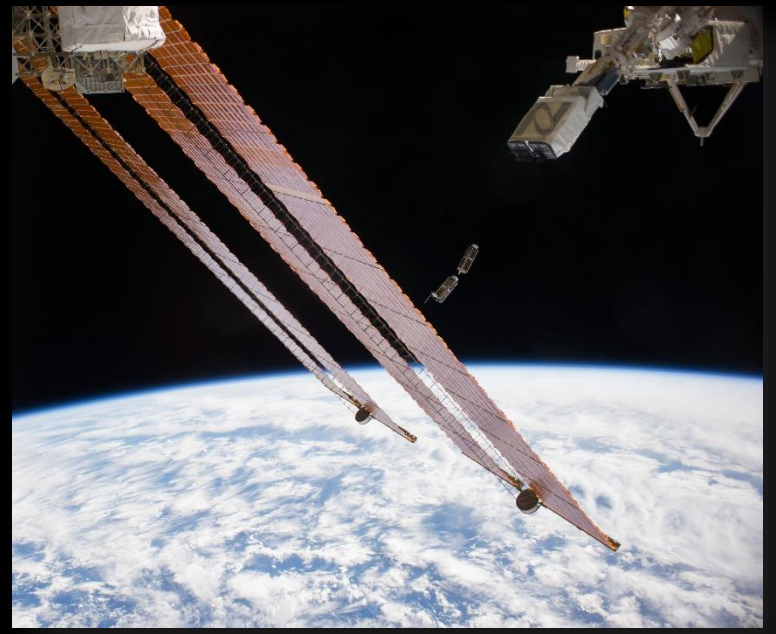
4. JEM Air Lock depress & slide table extension



6. NRCSDs positioned by JRMS

7. Deploy





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

NANORACKS

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

NanoRacks Cubesat Mission (NR-CM$_3$)

- 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

Photo credit: NASA

Mission Highlights

Most CubeSats launched in a single mission

Two countries attain space-faring status

World's largest remote sensing constellation

Kickstarter funding

- 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

Photo credit: NASA

- 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

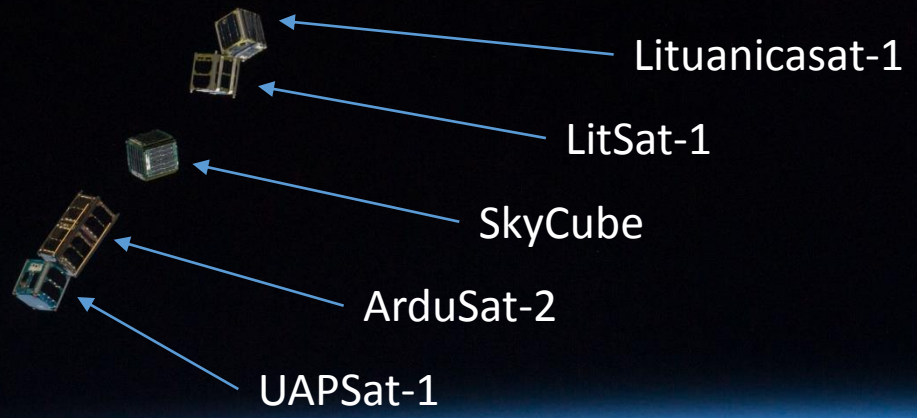
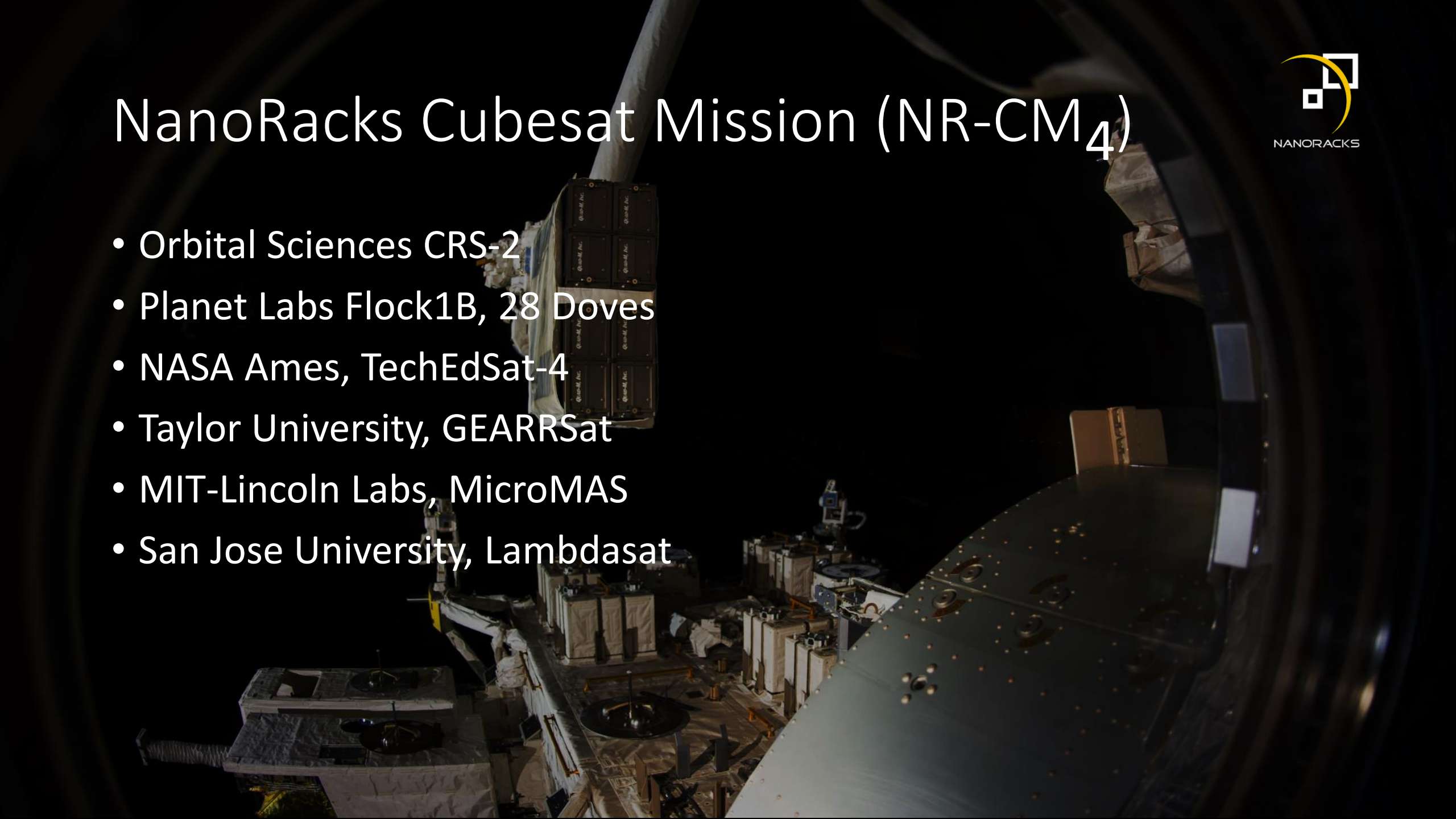


Photo credit: NASA

NanoRacks Cubesat Mission (NR-CM_4)



- Orbital Sciences CRS-2
- Planet Labs Flock1B, 28 Doves
- NASA Ames, TechEdSat-4
- Taylor University, GEARRSat
- MIT-Lincoln Labs, MicroMAS
- San Jose University, Lambdasat

Mission Highlights

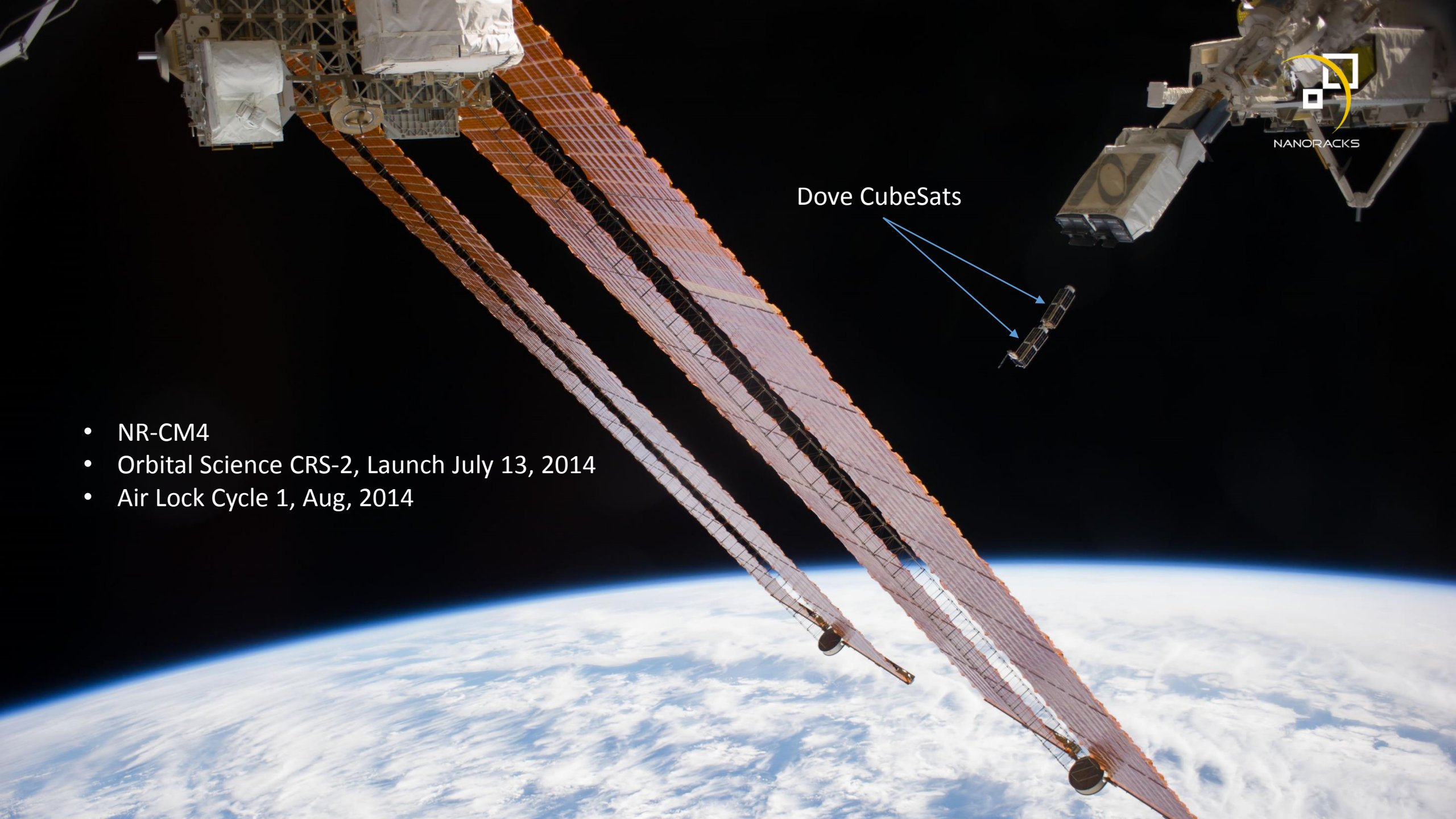
World's largest remote sensing constellation - gets bigger!

First passive microwave radiometer in a CubeSat

Innovative Re-entry technology

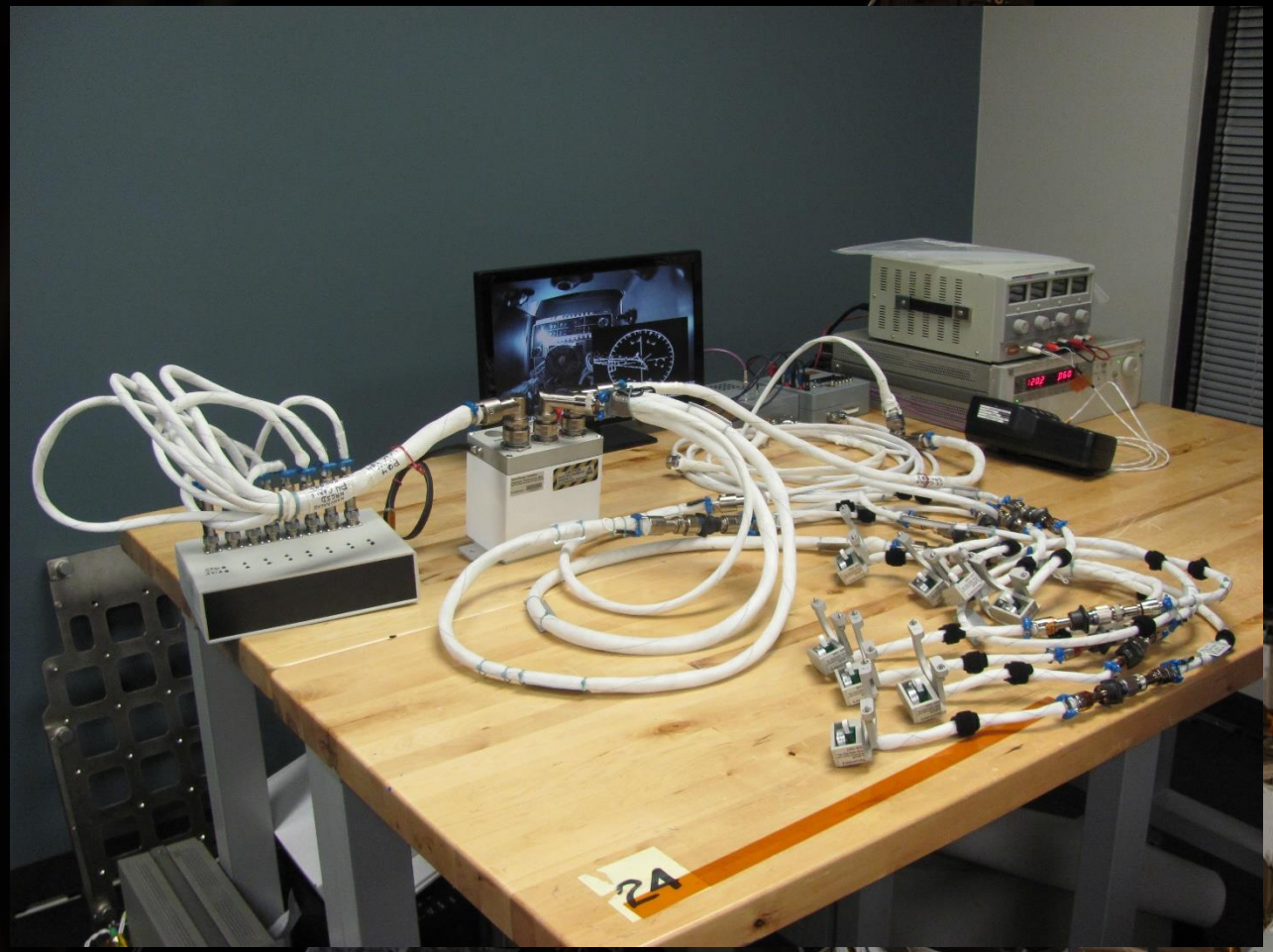
First space-based graphene experiment

Concept to flight hardware- 92 days



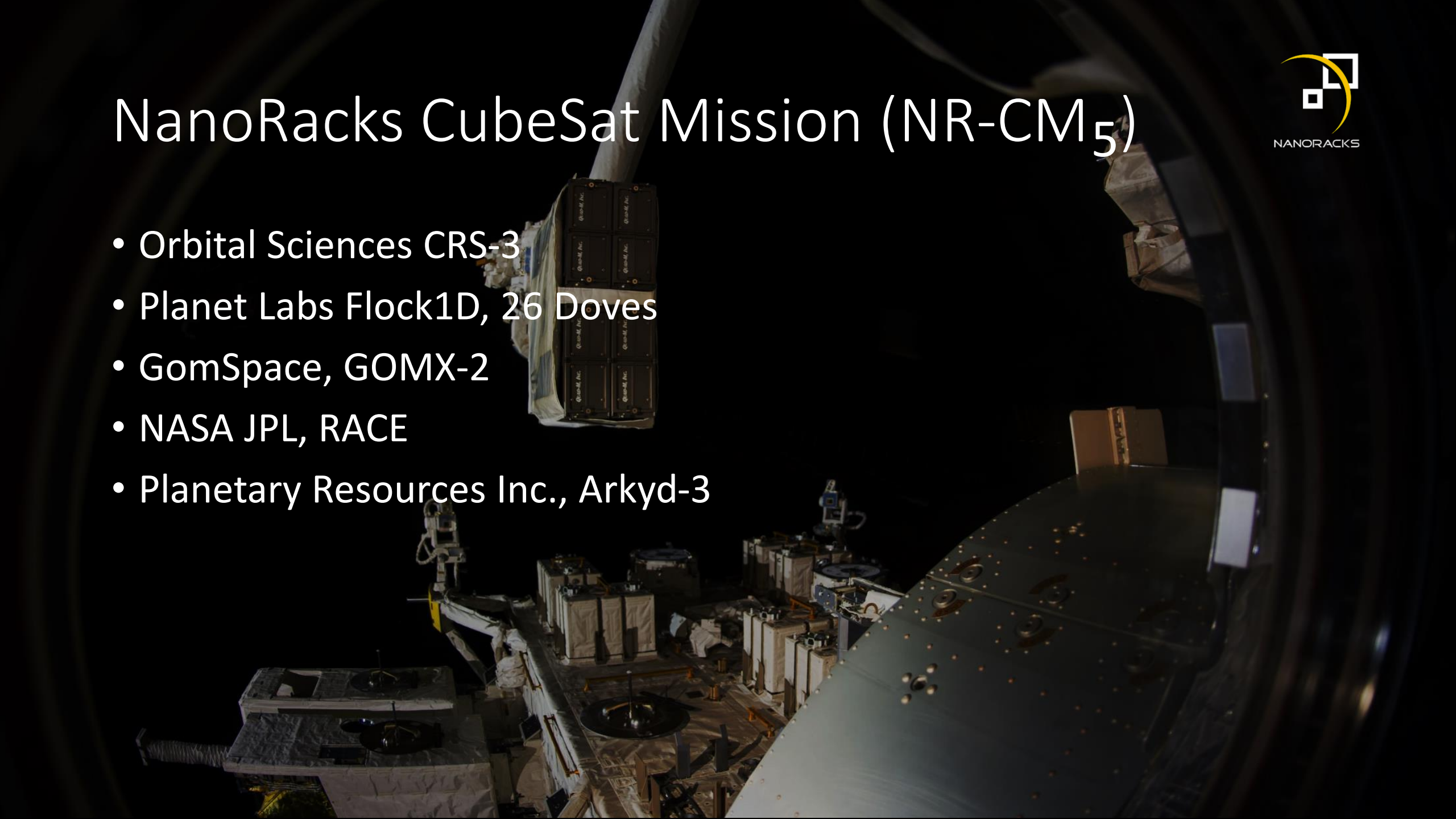
- NR-CM4
- Orbital Science CRS-2, Launch July 13, 2014
- Air Lock Cycle 1, Aug, 2014

NanoRacks Cubesat Mission (NR-CM$_4$)



- On-orbit deployment issues observed during ALC1
- NRCSDs returned safely to JEM
- Problem identified and replicated on the ground
- Coordinated path forward with NASA and JAXA
- Deployments planned to resume end of February

NanoRacks CubeSat Mission (NR-CM$_5$)



- Orbital Sciences CRS-3
- Planet Labs Flock1D, 26 Doves
- GomSpace, GOMX-2
- NASA JPL, RACE
- Planetary Resources Inc., Arkyd-3

Mission Highlights

Majority of CubeSats lost due to launch failure on Oct 28, 2014

5/16 Deployers Recovered! Multiple Doves recovered, along with GOMX-2

Arkyd-3 Re-flight being delivered at the end of the month for SpX-6 mission

NanoRacks CubeSat Mission (NR-CM5’)

- SpaceX CRS-5
- Planet Labs Flock 1D’ – 2 Doves

Astronaut Terry Virts swaps in Flock1D’ Doves

Mission Highlights

Rapid Re-flight

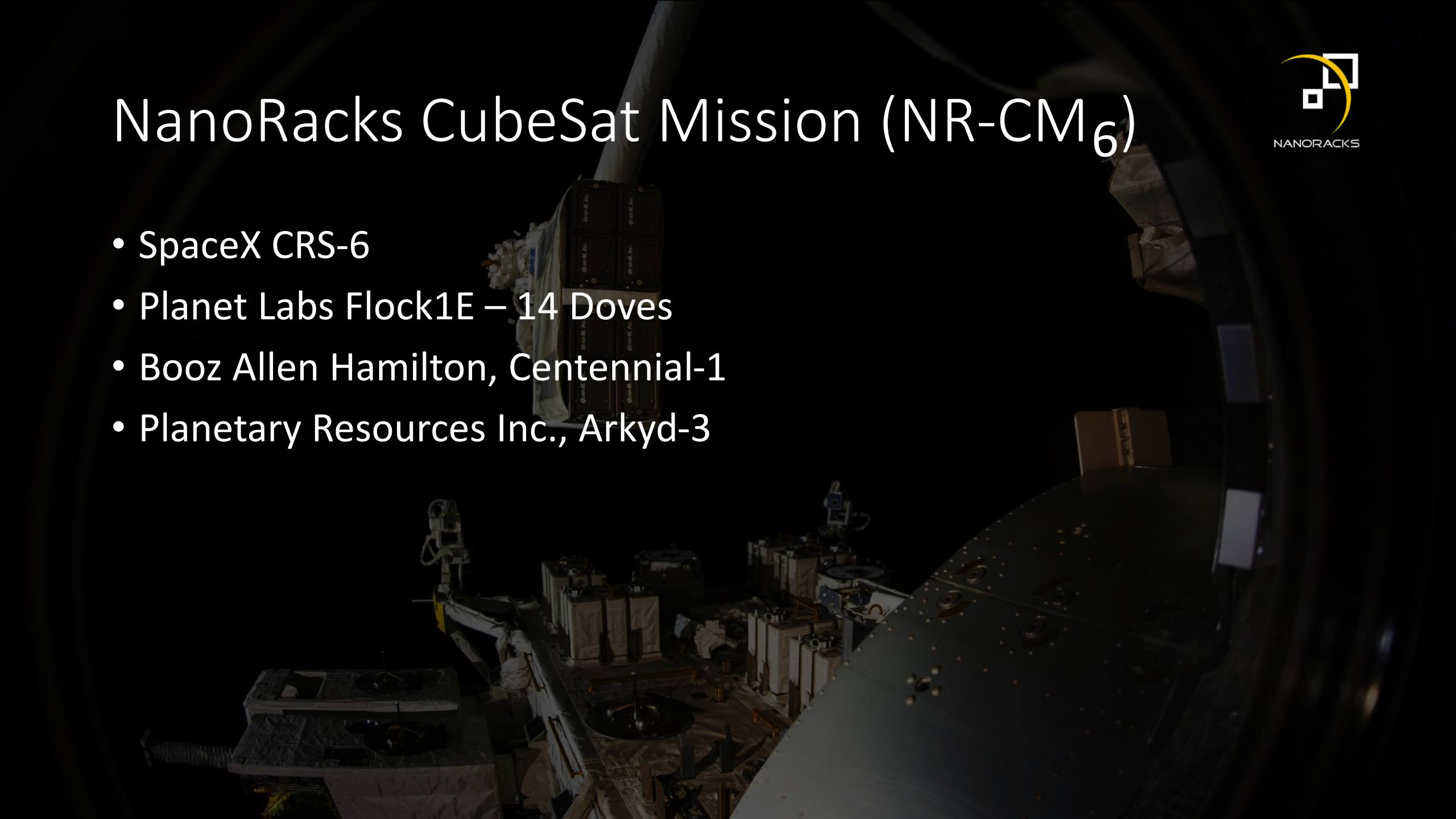
Less than two weeks between Orb-3 failure and delivery of flight hardware to NASA

Flock1D’ ready to deploy at the end of the month

Unprecedented coordination between Planet Labs, NASA, and NanoRacks

NanoRacks CubeSat Mission (NR-CM$_6$)

- SpaceX CRS-6
- Planet Labs Flock1E – 14 Doves
- Booz Allen Hamilton, Centennial-1
- Planetary Resources Inc., Arkyd-3



Mission Highlights

PRI achieving re-flight

Planet Labs launches next generation of Doves

Tech demo of photon detector for ground based tracking and imaging of 1U size space crafts

Upcoming CubeSats in 2015

- Planet Labs Doves
- St. Thomas More Cathedral School, STMSat-1
- GomSpace, GOMX-3
- Aalborg University – AAUSat-5
- University of Colorado Boulder, MinXSS
- NASA Ames Research Center, NODeS

Schedule and Program Requirements

- Scheduling (L-/+ months)
  - L-9 Initial data call
  - L-3 Safety Review
  - L-1.5 Customer delivery
  - L-1 NanoRacks deliver to NASA
  - L+1.5 Deployment (typical)

- NanoRacks Requirements
  - Battery flight acceptance test
  - Electrical: 3 inhibits minimum
  - Customer responsible for spectrum & remote sensing licensing
  - Fault-tolerance for deployables
  - Non/low toxicity materials
  - Secondary locking features

Availability and Pricing

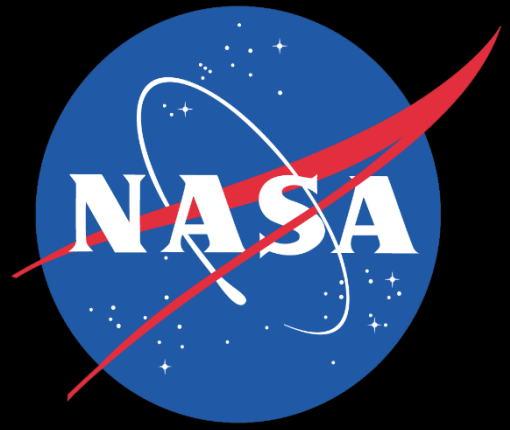
- **Availability**
  - Orbital ATK
  - SpaceX
  - HTV

Eligibility

NanoRacks' Space Act Agreement with NASA allows participation from ISS member organizations and also non-ISS partner customers with approval

- **Pricing**
  - Roughly $85,000 (USD) per Unit dependent on program.
  - Inclusive: safety, integration, launch, on-orbit ops
  - Volume discounts available

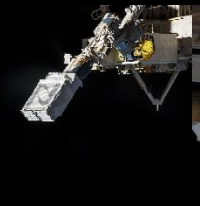
Acknowledgement



Customers!

NanoRacks

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