Committee on Solar and Space Physics

November 13, 2023

Aly Mendoza-Hill – SMD Rideshare Lead
Alan Zide – SMD Heliophysics PE
David Cheney – SMD Heliophysics PE
Katie Nelson – SMD Rideshare Process Analyst

SMD Rideshare Office (SRO) Intro

- **Goal:**
  1) Provide a single POC for SMD Rideshare-related inquiries for both NASA Center and external partners;
  2) Maintain overall knowledge and tracking of Rideshare activities for SMD missions, and ensure best utilization of excess LV performance to obtain maximum science on SMD missions
     - Support **ALL** SMD Divisions
     - Work closely with NASA's Launch Service Program (LSP)
     - Work with NASA Center Rideshare POCs to create unified NASA/SMD Rideshare message; delegates tasks to appropriate Center POCs as required; does not replace Center-level Rideshare Payload development work
- Developing a robust rideshare program to utilize excess mass to orbit and enable additional launch opportunities for the science community
  - Developing key documents: SMD RS policy, SMD RS101, SMD RUG & DNH requirements, & the internal SMD RS Implementation Plan
  - Standardizing Announcement of Opportunity (AO) language and reviewing each AO for consistency
  - Performing top-level payload compatibility analyses of rideshare missions to identify potential impacts to the primary payload or the success of the secondaries
  - Maintaining a list of SMD launch opportunities and tracking potential external launch opportunities

Standard Rideshare Documentation

- Headquarters Level
  - Rideshare Policy
  - Rideshare User Guide or System Interface Specification
  - Announcement of Opportunity Language
- Program Office Level
  - Rideshare Program Office Management Plan
  - Supplemental DNH Requirements
- Launch Services Program
  - Launch Services Information Summary – Acquisitions
  - Launch Services Interface Requirements Document (LSIRD)
  - Interface Control Document

Benefits of Rideshare

Rideshare is the method of getting additional payloads to orbit by connecting them with a primary payload, **a pre-established launch**, that has excess performance capabilities.

Rideshare is akin to using city bus system to get to the office. The bus has specific rules for the passengers, the routes/timelines are planned years in advance, and you may still have an extended walk to your actual destination.

The purpose of rideshare is to decrease the cost of reaching orbit through these joint launches, thus increasing opportunities for space exploration and scientific studies.

If you aren't flexible enough to match up with a Primary's launch parameters, then Rideshare is not for you!

Maturing Rideshare on NASA Missions

2018

Initial SMD Rideshare Policy signed

2019

Rideshare SIS for IMAP

Initial approach for Rideshare developed

2020

NASA SMD Rideshare Office Established

& MOU USAF/NASA Sept'20
Cooperative Area #7 - Rideshare
General Raymond, USSF
Mr. Bridenstein, NASA Adm

CSSP Agile Responses Rideshare Report

2021

LSP Strategic Initiative

Mature Rideshare Process for Customers

2022

VADR Contract

More launch options expanded with implementation of VADR

2023

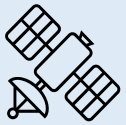
Update Rideshare Policy & RUG

Based on Lessons Learned and industry maturation

Coming 2024! Rideshare Policy update

Highlights of Upcoming SMD Rideshare Policy Update

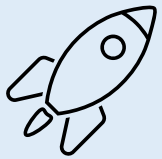
Applicability



- Incorporating VADR, OGA, Intl, SLS/Artemis/CLPS, PI-procured
- Clarifies non-applicability to hosted payloads, and no-greater than Class-D payloads

Types of RS

- NLS-II
- VADR
- Other MDs
- OGA
- Intl Partners
- SLS/Artemis
- PI Procured/CLPS

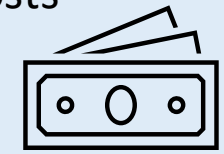


SRO R&R

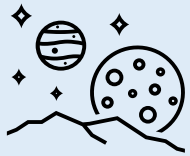
- Explicit responsibilities for SRO and SMD Rideshare Lead
- SSCG vs LSP vs SRO role clarifications

Budgeting

- Updated lists of standard vs non-standard items & responsibility for costs

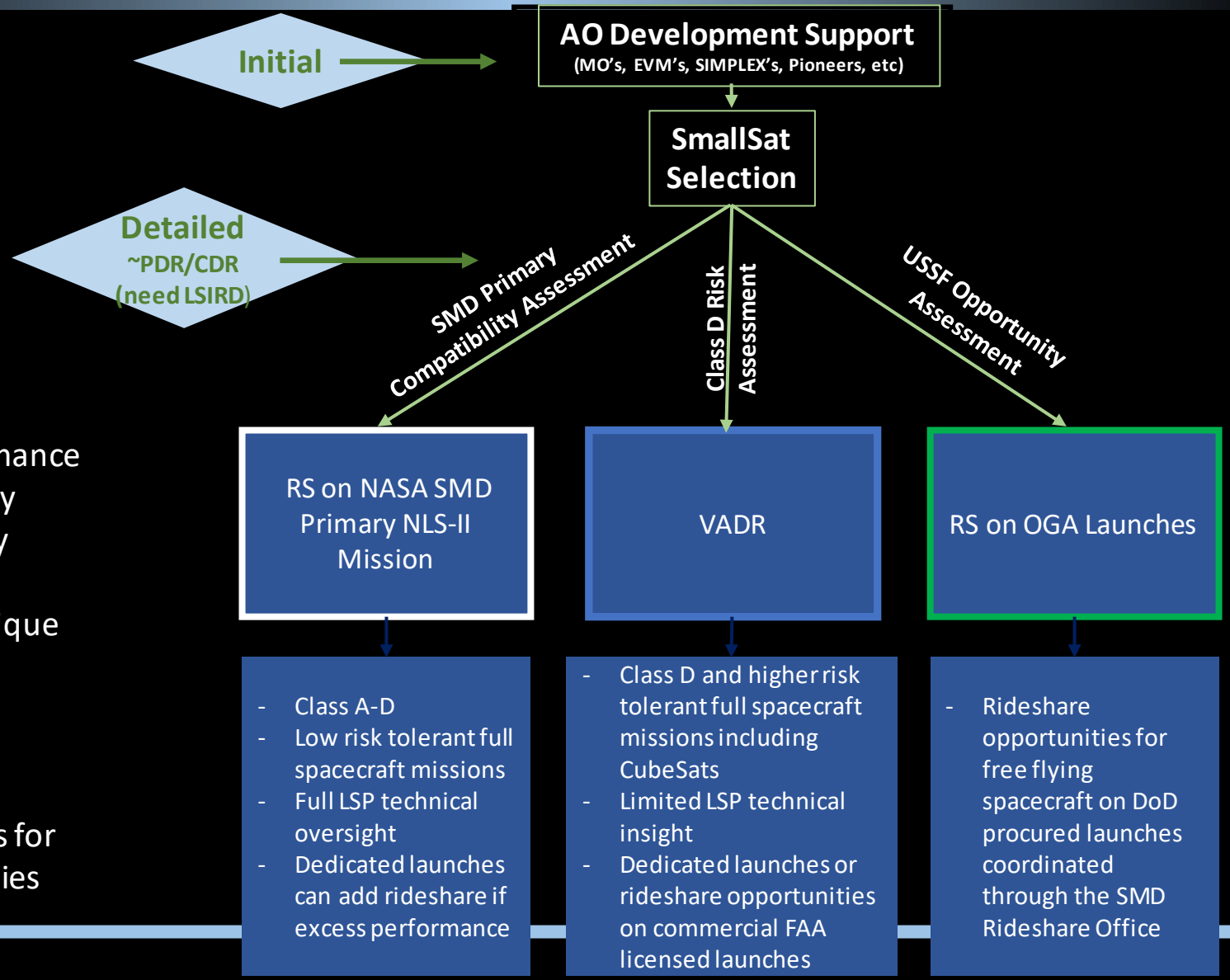


Lessons Learned



- Incorporates lessons learned from NLS-II rideshare experiences

SMD Rideshare Office Compatibility Assessments



Launch Options:

- Utilize excess performance on NASA SMD Primary launches => RS Policy
- For NASA Science-unique orbits => VADR
- Partnering with government and commercial providers for increased opportunities

SMD Primary NLS-II Rideshare Examples

Landsat-9

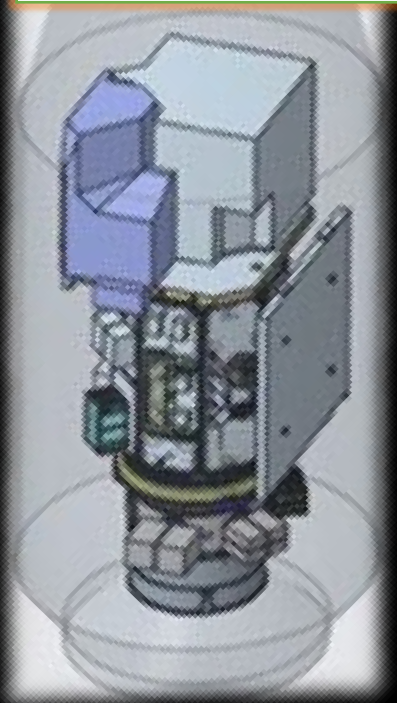
-Earth Science Division

-LV: AtlasV-401

-ESPA Standard

-Rideshare Payloads: 4 CubeSats

Launched September 27, 2021



JPSS-2

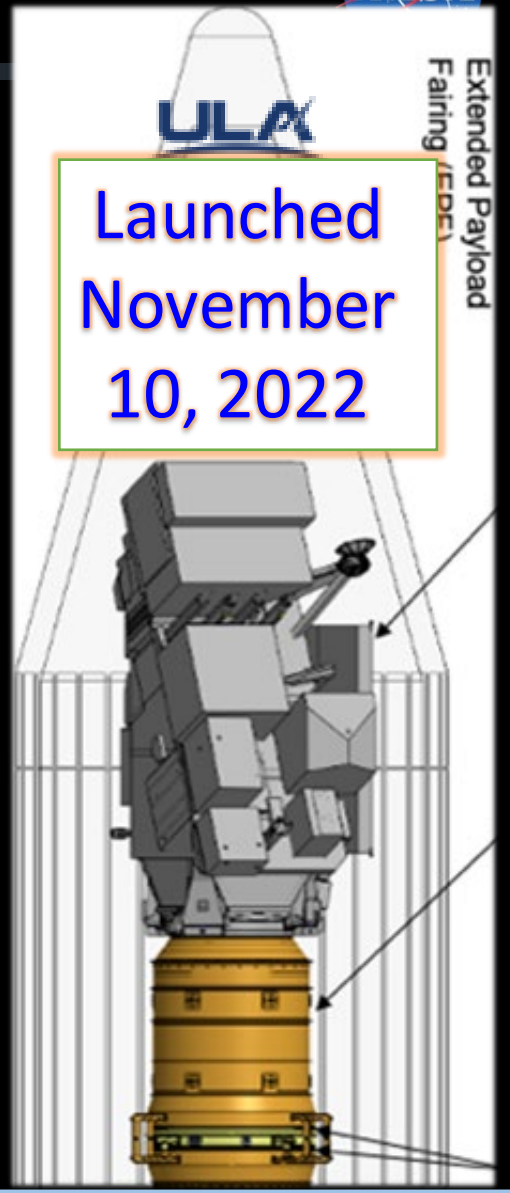
-Joint Agency Satellite Division

-LV: AtlasV-401

-ULA C-Adapters

-Rideshare Payload: LOFTID

Launched November 10, 2022



Majority of excess performance utilized

SMD Primary NLS-II Rideshare Examples

IMAP

-Heliophysics Division

-LV: Falcon

-ESPA Grande

-Rideshare Payloads:

  -SWFO L1

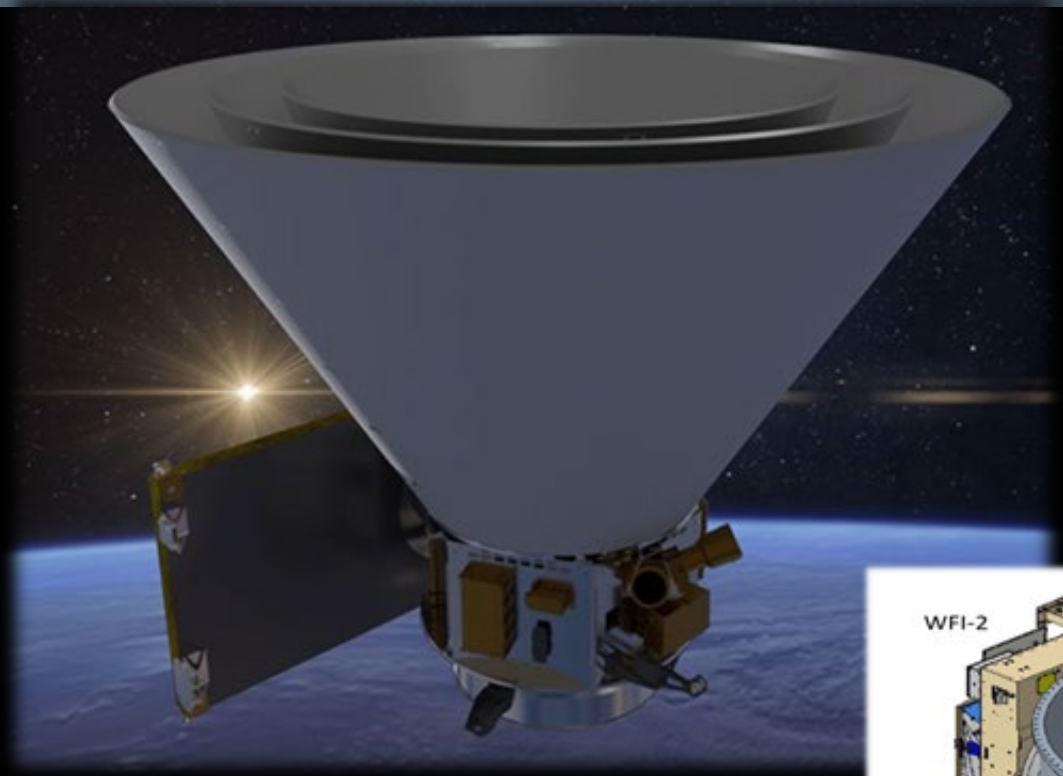
  -HPD Carruthers Geocorona Observatory

Launching
February 1, 2025

Majority of excess performance utilized

Images not to exact scale

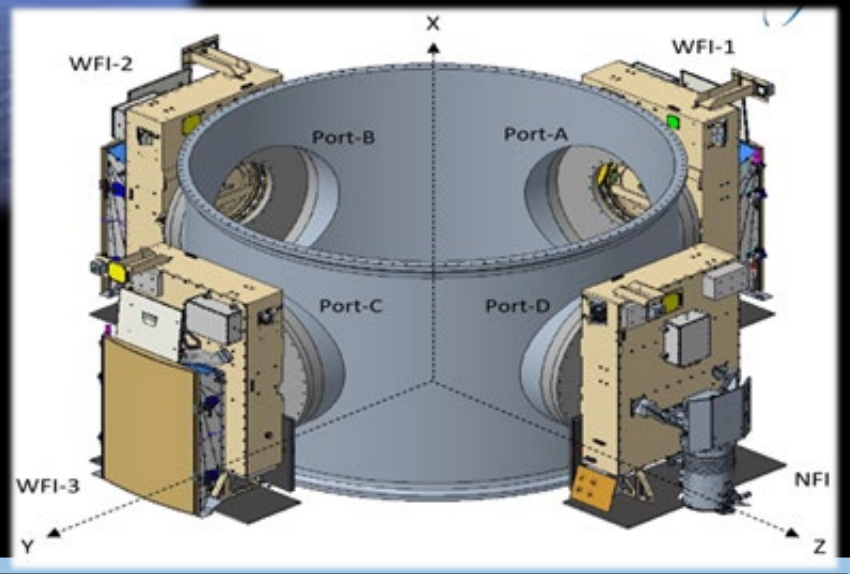
SMD Primary NLS-II Rideshare Examples - continued



Images not to scale

SPHEREx
-Astrophysics Division
-LV: Falcon 9
-ESPA Grande
-Rideshare Payload:
-PUNCH
-Heliophysics Division
-4 Spacecraft

Launching
February 28, 2025



The Rideshare ”Balance"

SMD Challenges to be Operationally Routine Rideshare

- NASA SMD launches one-of-a-kind SCIENCE missions based on direction from Decadal Surveys and open competitions (Not routinely replenished missions)
- The rideshare configuration is different from a “Transporter” mission as there is a NASA primary mission so therefore extra emphasis on Do No Harm.
- Science instruments are state of the art and highly sensitive to loads, contamination, magnetic cleanliness, RF emissions
- Non-standard orbits
- Extended duration before deployment for lunar, planetary, etc
- Secondary Payload interface to LV payload carrier is defined very late in the secondary mission timeline
- Secondaries don’t have “Go/No Go” privilege on launch day

NASA SMD RS & SmallSat – Top Implementation Challenges

- Contamination Control - every SC has a different set of requirements. (Instrument GN2 flowrate & humidity, **magnetic cleanliness**, silicone sensitivity, hydrocarbon, surface cleanliness, etc)
- Rideshare payload powered off
  - Affects thermal control of propulsion systems for extended coast phases
- Primary trajectory may drive changes to RPL systems (thermal, power, propulsion).
- On-board propulsion for NASA 'unique' orbits
  - vs relying on LV delta-v
  - Reliability and TRL of propulsion systems for deep space
- DSN coverage post SC separations – L1 vs LEO
- Class D or 7120.8 mission assurance…. If you plan on taking advantage of RS, you need to meet workmanship and safety requirements to ensure no harm to the primary.
- Primary coupled loads analyses…
  - 50-75Hz fundamental frequencies to minimize potential coupling risks with NASA primary missions
  - Random Vibe – High frequencies
  - Mass simulator vs multiple CLA's
- Secondary schedule flexibility to adjust to the Primary LV Analyses cycle timelines.

Do No Harm Considerations

- DNH requirements need to be proactively considered, communicated, and documented in all phases of a mission
  - **Pre-phase A and Phase A (Acquisition/Procurement)**
    - Consistent DNH language included in all procurements
    - Proposals should discuss how reserves (mass, cost, schedule) will be used to manage the RS unknowns
  - **Phase B (Development)**
    - DNH Risks should be a standard item tracked, mitigated, and statused on a regular basis like any other risk
    - Confirmation Review and Decision Memo should document potential costs and reserves required for the DNH risks and mission unique implementations
    - Analyses should be performed (additional funding could be required) to figure out potential solutions depending on LV selection [Trajectory, Coupled Loads, Clearance, Separation, Thermal, and Airflow Impingement, etc.]
  - **Phase C/D (Implementation)**
    - DNH requirements verification responsibilities should be called out early
    - Funding organization risk posture must be clearly communicated to launch services contractor to aid in technical trade decisions
  - **Commissioning**
    - The LVC contractor doesn't perform collision avoidance and ground contact analysis after first maneuvers.

Conflicting Development Schedules

- LV Integration and analyses schedules are driven by the Primary mission schedule.
  - Secondary must adjust to the Primary LV analyses cycle timelines.
  - SC development schedules don’t always line up with the primary and may require LV analysis products prior to the primary’s schedule.
    - Drives the need for flexibility in secondary payload designs to be able to handle conservative RUG environments and deconflict from specific LV analysis results where possible

Conflicting Development Schedules (cont'd)

- Secondary payloads need to plan for up to a two-year hibernation period
  - Verbiage is now included in some AO solicitations (ex. Helio SMEX)

    - Pro's
      - Allows for more potential launch opportunities
      - Creates extra schedule margin if a mission in development falls behind

    - Con's
      - Increases risk of losing key personnel
      - Increases mission cost for known period of hibernation
      - Increases cost for unplanned slip in development/implementation
      - Additional wear-time on key components

Rideshare Launch Site Processing (Not routine processing)

- Secondary payload will need a processing facility, potentially shared with other secondaries.
- Secondary payload may require a debris shield during primary payload integration. If needed, must be provided by SC, not touch LV H/W, and be removed prior to encapsulation. Will not be provided by LV.
- Secondary payload SHOULD NOT plan for post encapsulation access. (Introduces contamination risk to other payloads)

Q & A's?

NASA HQ Science Mission Directorate Rideshare Office

Aly Mendoza-Hill

Alan Zide

David Cheney

Katie Nelson

BACKUP SLIDES

Current Opportunities & S3VI Resources:

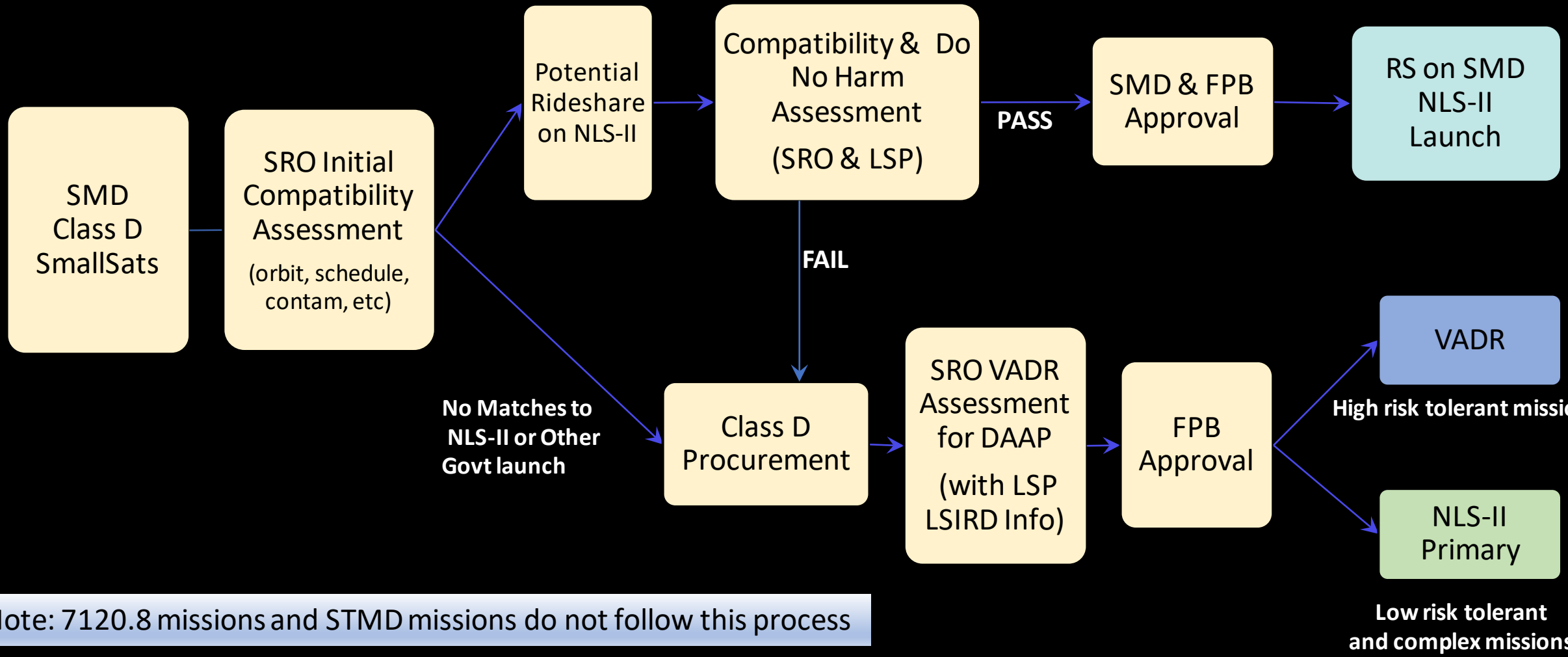
- **NASA Launch Portal:**
  https://s3vi.ndc.nasa.gov/launchportal/
- **Upcoming SmallSat Mission solicitations:**
  https://www.nasa.gov/smallsat-institute/nasa-smallsat-opportunities
- **NASA SMD Rideshare Guide:**
  https://www.nasa.gov/sites/default/files/atoms/files/smd_spa_rug_with_dnh_generic_july2023.pdf

SMD Missions: Potential Rideshare Opportunities

Note: Dates are estimates and subject to change, excess launch capacity on most flights still TBD

Mission Name	Launch Date (NET)	Launch Trajectory	Apogee (km)	Inclination (deg)	Insertion	Rideshare Adapter
IMAP	2/1/2025	L1		28	C3 max <= -0.5 km2/s2	ESPA Grande (no RS opportunities available)
SPHEREx	2/28/2025	SSO	650		06:00 MLTAN	Full SPA (no additional RS opportunities available)
Sentinel 6B	11/24/25	LEO	1336	66		TBD
MUSE	1/1/2027	SSO	620	97.9	06:00 MLTAN	TBD
COSI	4/1/2027	LEO	550	5		TBD
JPSS-4	9/1/2027	SSO	833km (TBD)	polar (TBD)	13:30 MLTAN (TBD)	TBD
NEO Surveyor	9/13/27	L1			C3 = TBD	TBD
SBG	4/30/2028	SSO	626	97.9	TBD MLTAN	TBD
AOS-I (AOS-Storm)	07/01/2028	LEO	430	55		TBD
SWFO-FollowOn	12/15/2028	L1			C3 = TBD	TBD
Astro 2021 MIDEX AO	12/31/28	TBD				TBD
HelioSwarm	01/01/2029	C3 = - 2.75 km2/s2			C3 = - 2.75 km2/s2	TBD
GDC	8/1/2029	LEO	400	81-82		TBD
DAVINCI+	8/1/2029	Venus			C3 = 18 km2/s2	TBD
AOS-P (AOS-Sky)	12/01/2030	SSO	450	97.2	13:30 LTAN	TBD
VERITAS	6/1/2031	Venus			C3 = 17 km2/s2	TBD
JPSS-3	9/1/2032	SSO	833km (TBD)	polar (TBD)	13:30 MLTAN (TBD)	TBD

Rideshare on NLS-II vs. VADR Procurement for SMD Class D



Note: 7120.8 missions and STMD missions do not follow this process