Providing Maximum Launchability – A Guide to Defined SmallSat Classification

Carrie O'Quinn
The Aerospace Corporation

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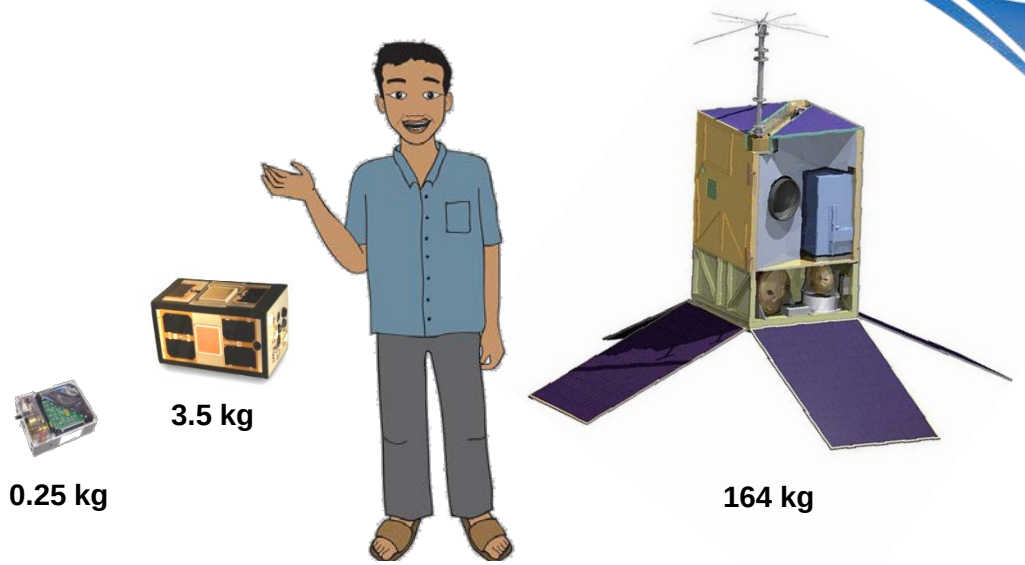
Launch Unit Standard Overview

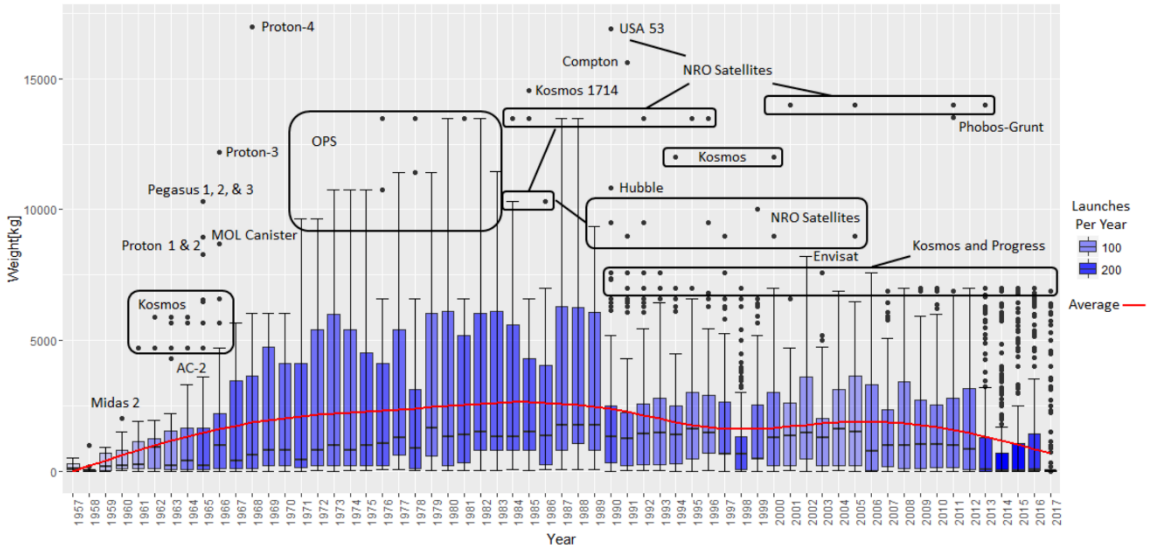
- What is a small satellite?
- What is a rideshare launch?
- How does a small satellite get to space?
- How can we decouple the secondary satellite from the mission?
- Is it time for a new “Launch Unit” standard?

What is a Small Satellite?

- Small satellites have a mass less than 500 kg
  - *CubeSats are a special subset of small satellites which conform to the "CubeSat Standard"*
  - *The "ESPA class" is an informal standard for a satellite with a mass of approximately 180 kg*

- Small satellites are on the rise!
  - *Fewer than 700 small satellites were launched between 2006 and 2015*
  - *Over the next 10 years, estimates are an additional 3,500 to 10,000 satellites will be launched*[1]





Source: J. McDowell, June 2017, "Satellite Catalog," http://planet4589.org/space/log/satcat.txt.
Note: Shading represents the number of satellites launched in that year.[2]

1. Euroconsult, "Prospects for the Small Satellite Market," (Jul. 2017)
2. B. Lal et al., "Global Trends in Small Satellites," IDA Paper P-8638 (Jul. 2017)

What is a Rideshare Launch?

- Launches with excess capacity sell to small satellites that can “piggyback” or “hitchhike” to space
- Growth in rideshare missions
  - *In 1967, the Department of Defense Space Test Program launched their first mission, consisting of two satellites*
  - *In 2013, 57% of launch vehicles were launched with excess capacity*[1]
  - *Large launch vehicle rideshare missions are becoming more common*
    - In February 2017, PSLV-C37 carried 104 satellites into orbit[2]
    - The second Falcon Heavy mission will carry 25 satellites into orbit[3]
  - *Small launch vehicle rideshare missions are the norm*
    - Rocket Lab launched a rideshare mission on their second launch and plans to launch a rideshare mission for NASA[4,5]
    - Virgin Orbit plans to launch rideshare missions for NASA and GOMSpace[5,6]

1. A. Snow et al., “Global Launch vehicle market assessment: A study of launch services for nana/microsatellites in 2013,” SpaceWorks (Jul. 2014) http://www.spaceworkscommercial.com/wp-content/uploads/2018/01/SpaceWorks_Global_Launch_Vehicle_Market_Assessment_2013.pdf
2. Bonnema, A., “Launch Service 101: Managing a 101 CubeSat Launch Manifest on PSLV-C37,” SmallSat Conference (2017)
3. S. Clark, “Rideshare mission for U.S. military confirmed as second Falcon Heavy launch,” SpaceFlightNow (March 2018); https://spaceflightnow.com/2018/03/01/rideshare-mission-for-u-s-military-confirmed-as-second-falcon-heavy-launch/
4. https://www.rocketlabusa.com/news/updates/rocket-lab-to-fly-planet-and-spire-satellites-on-second-test-flight/
5. https://www.nasa.gov/press-release/nasa-awards-venture-class-launch-services-contracts-for-cubesat-satellites
6. https://virginorbit.com/press/2018/1/22/gomspace-signs-contract-for-low-inclination-launch-on-virgin-orbits-launcherone

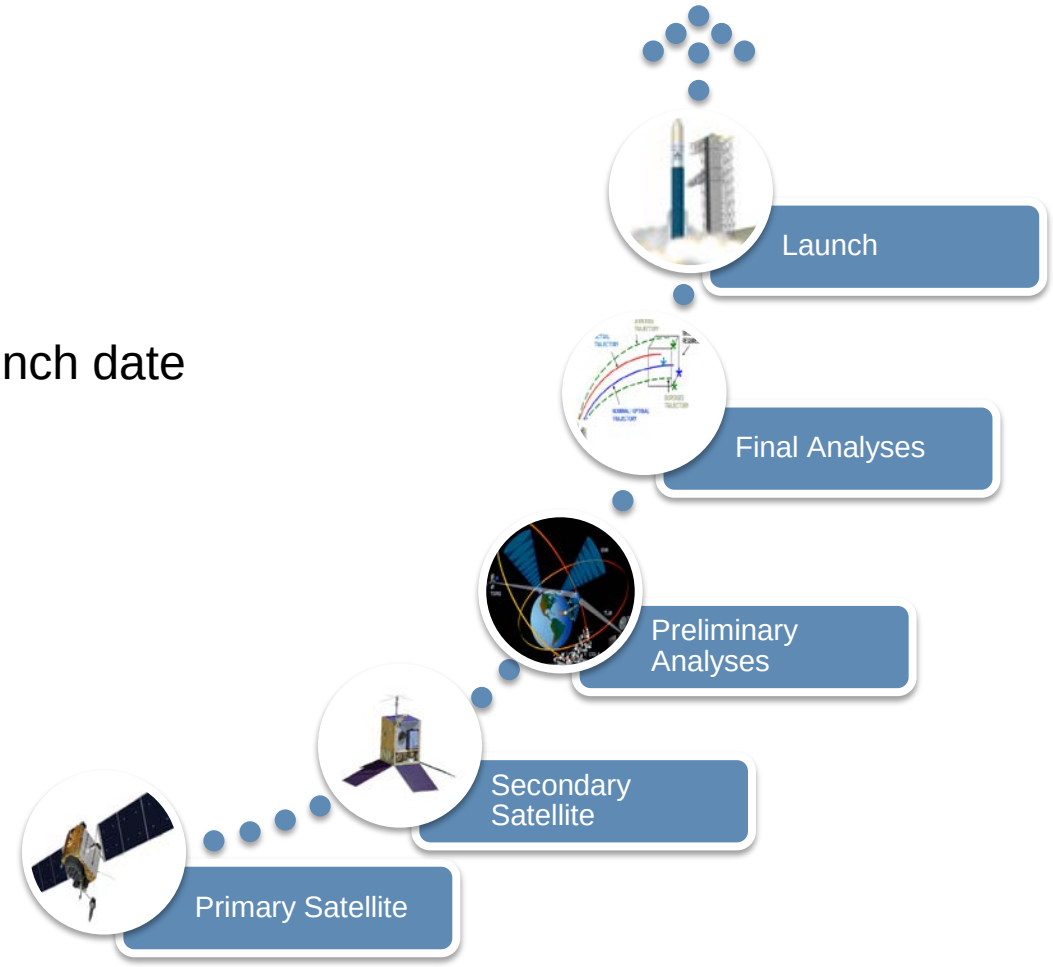
How Does a Small Satellite Get to Space?

Dedicated Launch

- Custom solution is created for the small satellite
- Very expensive

Traditional Rideshare

- Compatible launch must be identified far in advance of launch date
  - *Compatible orbit (altitude and inclination)*
  - *Excess mass and mission performance*
  - *Compatible timeline*
- Mission unique analyses must be performed
  - *Mass properties*
  - *Coupled Loads*
- What happens if the launch vehicle is delayed?
- What happens if the primary satellite is delayed?
- What happens if the secondary satellite is delayed?

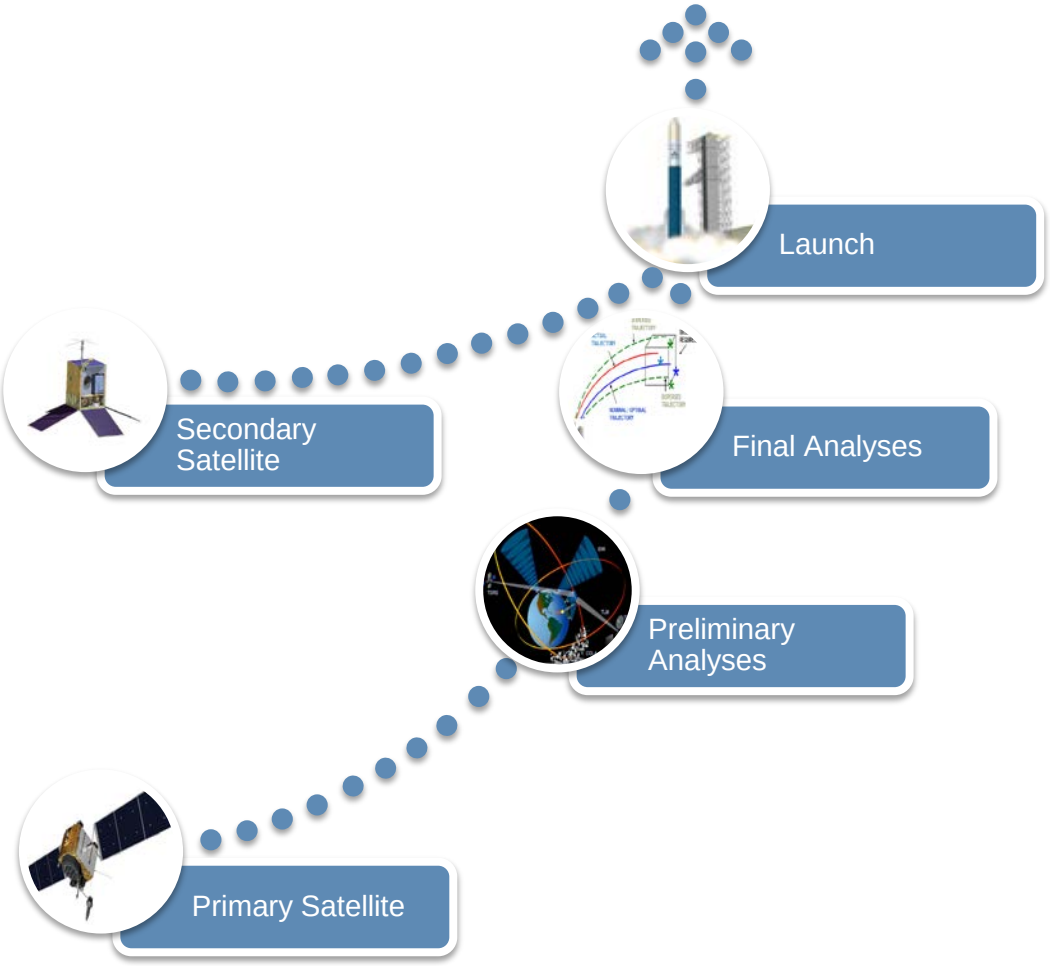


Typical process is not conducive to "buying a bus ticket to space"

How Can We De-Couple the Secondary Satellite from the Mission?

- CubeSat standard revolutionized access to space for small space experiments
  - *Defines requirements for CubeSat developers to design and build their satellites*
  - *CubeSat developers can develop their system without a predetermined launch*
  - *Launch providers can design missions for CubeSats without knowing which satellites will be launched*

- Key features of the CubeSat standard
  - *Defines mass, volume, and center of gravity requirements for the satellite*
  - *Defines mechanical and electrical interface requirements for the satellite*



Is it Time for a New Launch Unit Standard?

Benefits of a Launch Unit Standard

- Efficiently fill out cargo volume in launch vehicle fairings
- Increase launch availability by maximizing SmallSat compatibility
- Swap satellites into pre-defined launch configurations
- Reduces integration costs
- Decrease time to launch
- A “rising tide lifts all boats,” and straightforward access to launch vehicles, cargo, and satellites benefits launchers, satellite manufacturers and end users alike.

Next Steps

- Consortium formed in August 2017
  - *Includes industry, academia, government*
  - *Regularly meeting to define requirements*
- Recommendations to be presented at SmallSat 2018 in Logan, Utah

Stay tuned! Recommendations coming in August 2018

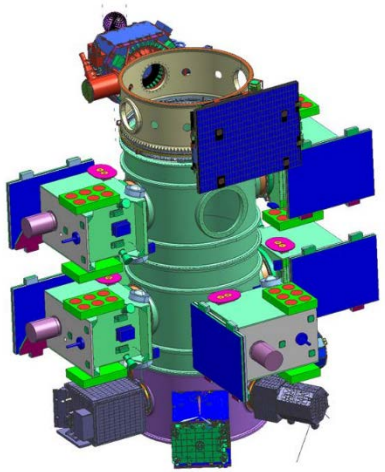


Photo courtesy of SpaceX

STP-2 Stack