Secondary & Hosted Payloads Market Characterization

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Motivation

- Results of research roadmapping work for Theme 4:

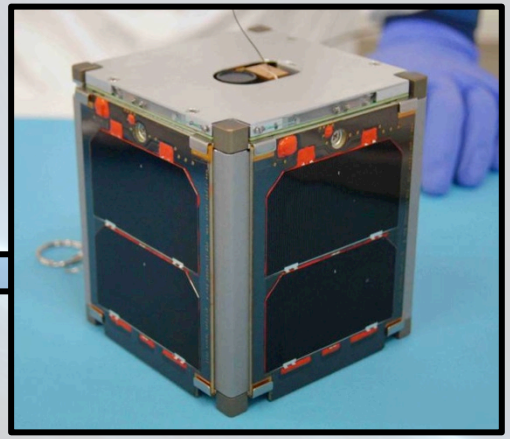
  "What is the market?" remains an open question to the CST industries. Identifying and verifying the suborbital and orbital microgravity commerce and research opportunities is of prime importance.

- Focusing on secondary and hosted orbital payloads represents a tractable portion of this task
  - Topic was strongly suggested by several industry partners during roadmap workshop

Secondary & Hosted Payloads

- Terminology:
  - **Secondary Payloads:** also known as rideshare, independent satellites that are carried into orbit on the same vehicle as the primary, utilizing any excess capability of the launch vehicle
  - **Hosted Payloads:** small payloads that are directly affixed to the primary satellite, using its bus for power and communications

Title	Payload Size
Mini	100kg-500kg
Micro	10kg-100kg
Nano	1kg-10kg
Pico	100g-1kg



ZACUBE-01 (CPUT, South Africa)

The Opportunity

- Nearly every launch has some unused vehicle capacity
- Secondary and hosted payloads can use this resource
  - Low cost access to space for a small payload has many appealing applications and missions
  - Missions can be enabled by having distributed architectures across numerous small satellites or hosted payloads
    - e.g. communications networks, space situational awareness, earth observation, navigation

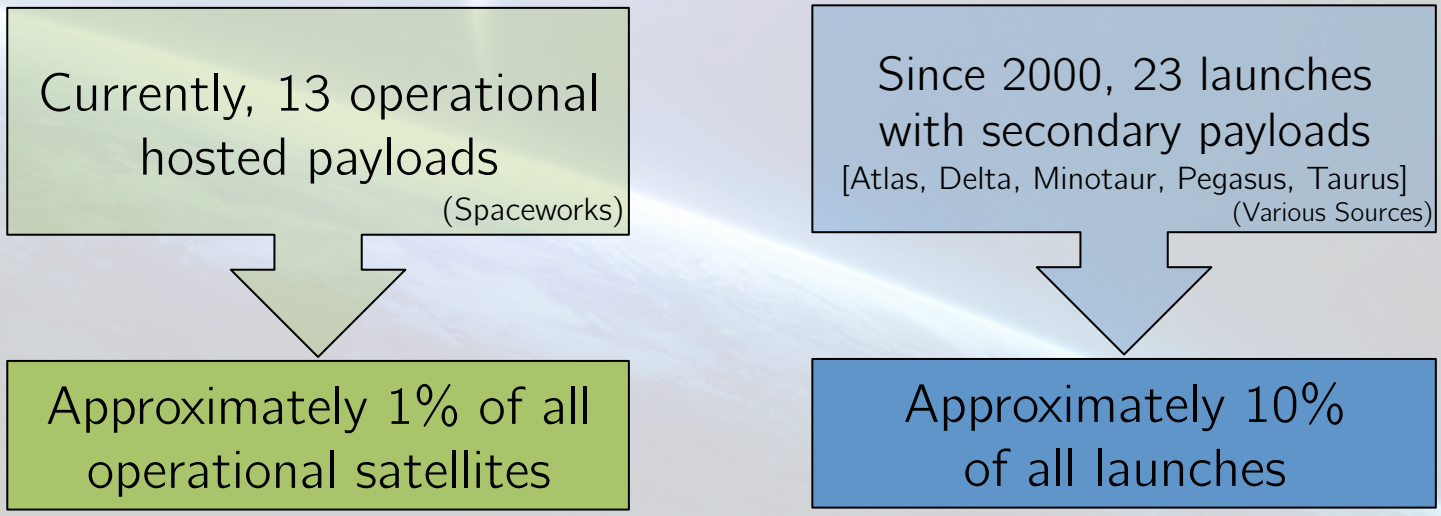
Commercially Hosted Infrared Payload (CHIRP)
USAF tech demo (SAIC) on SES-2 (Orbital)

- 13% of the cost of a dedicated mission
- 80% of the mission objectives accomplished

(Office of Space Commercialization)

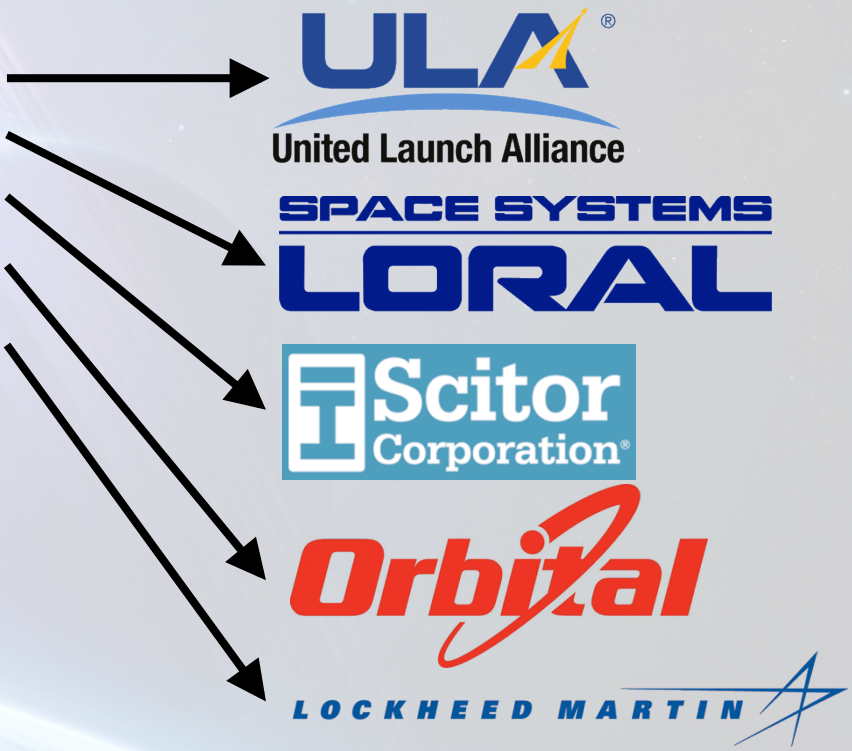
The Problem

- An opportunity that hasn't been extensively utilized
  - No real technical issues
    - Aerospace Corp.: 43 nanosatellites launched by 1975
    - The first US intelligence satellite (GRAB-1) was a SP for the launch of a navigation satellite (Transit-2A) in 1960
  - Programmatic issues are abundant



How to Solve the Problem

1. Reach out to industry partners to gain an understanding of the landscape
2. With their help, identify specific areas that our analyses and studies can address
3. Perform specific analyses and studies – especially in expanding the opportunity
4. Disseminate results



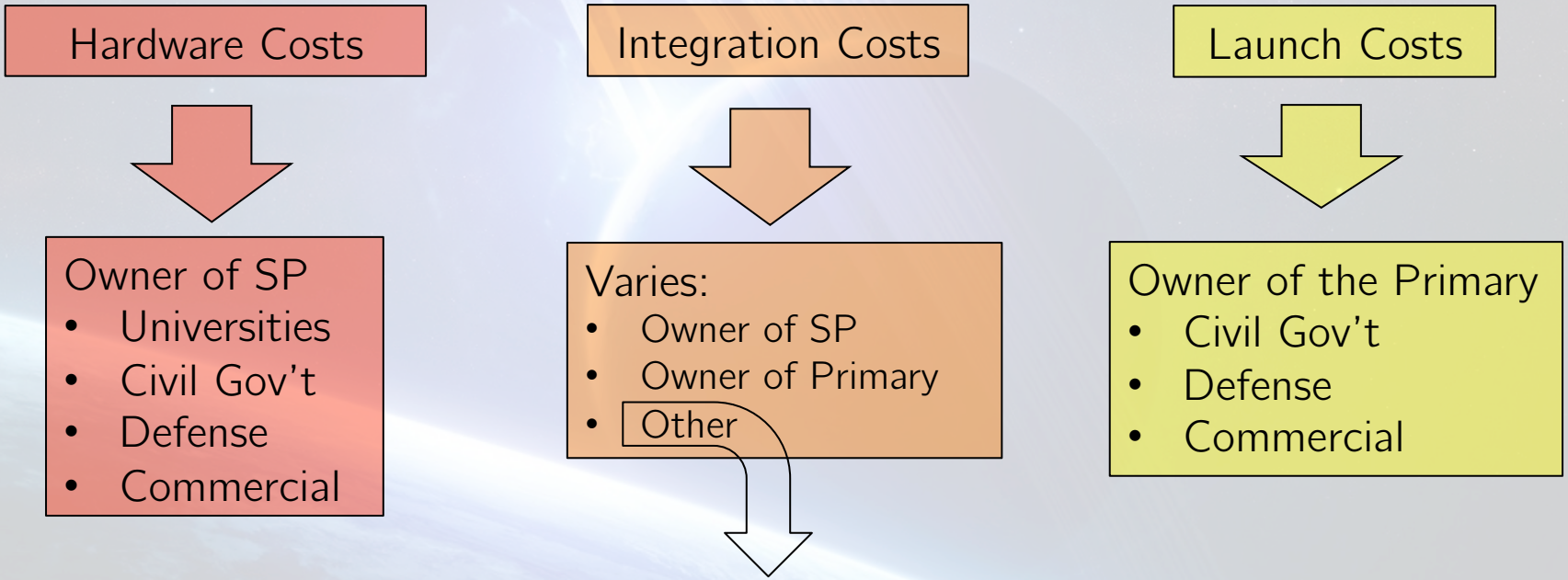
An Important Distinction

	Commercial Primary	**Government Primary**
Commercial SHP	Commercial on Commercial	Commercial on Government
Government SHP	Government on Commercial	Government on Government

The Hot Topic

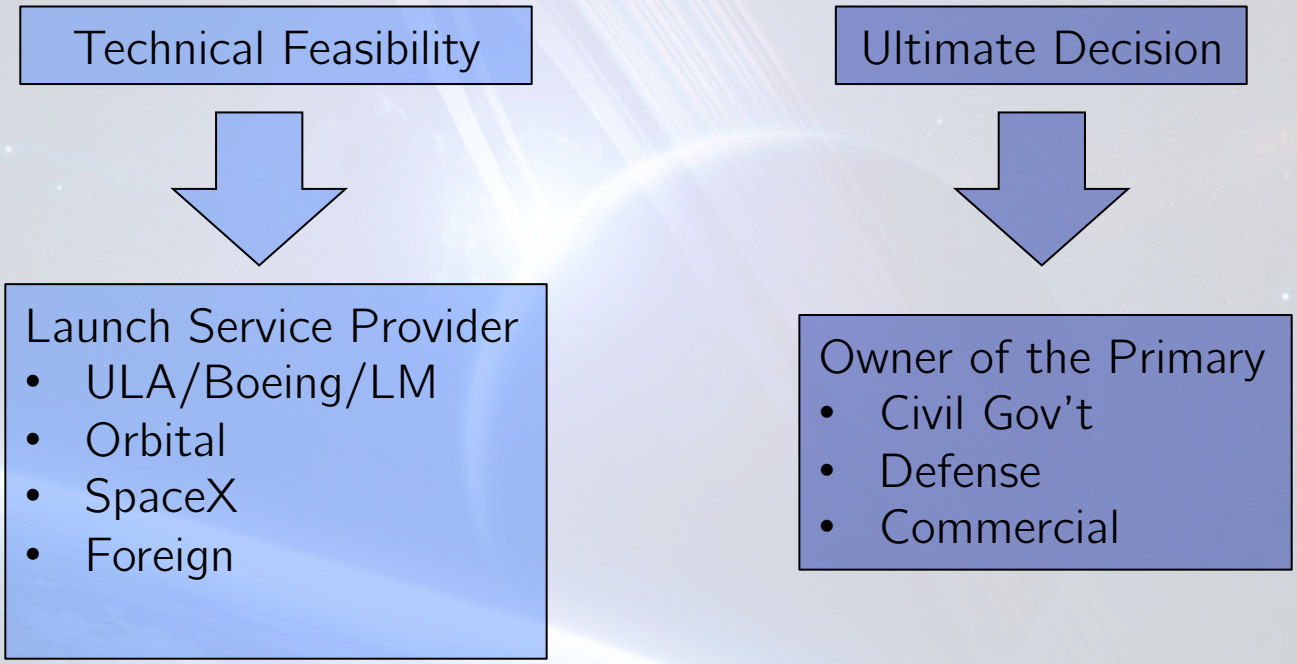
Tauri Group: 4% of satellites <15kg on the books are commercial
Spaceworks: 23% of operational HP's are commercial

Secondary Payloads (1/2)



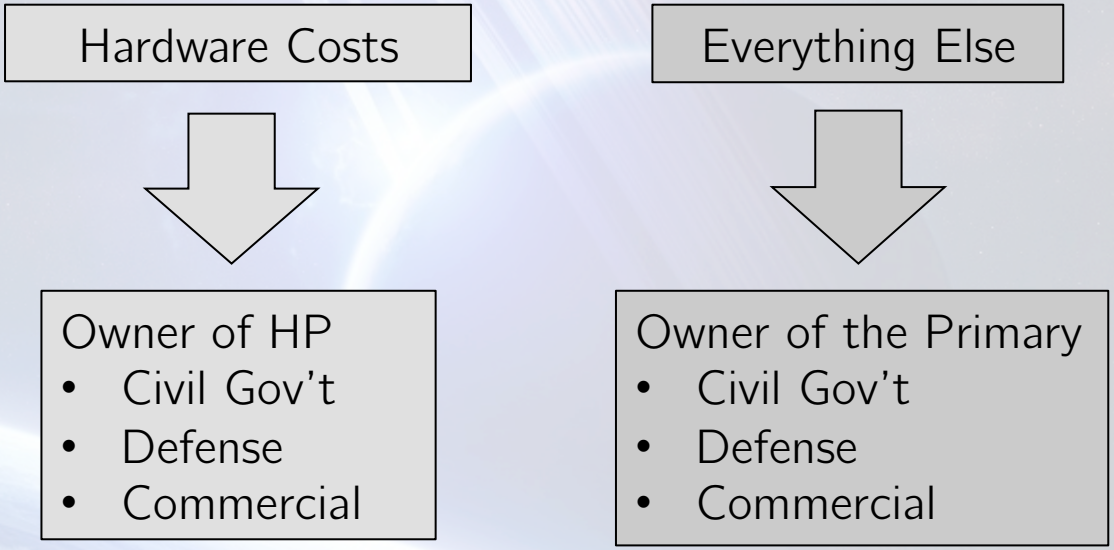
- Government Programs
  - STP, ELaNa
- Brokers
  - ISIS, Spaceflight Services, Cal Poly, UTIAS
  - Can deliver many secondaries as a single integrated payload to the LSP (e.g. ESPA, P-POD)

Secondary Payloads (2/2)



- Note that typically LSP does not make the decision to put SP's on because they don't own the manifest
- Exceptions:
  - SpaceX reserves the right to add SP whenever 20% excess vehicle capability
  - Supply missions to ISS: SpaceX and Orbital are selling a service

Hosted Payloads



- For some missions HP's are the only possible architecture:
  - Small payloads and high orbits do not comply with 25 year rule for orbital debris
- Much more variability amongst satellites than launch vehicles
  - Few standardized systems or infrastructure

Programmatic Issues

Manufacturing a commercial satellite: approx. 2 years

+

Developing new hardware for SP or HP: approx. 4 years

+

Low revenue (commercial) or Low importance mission (gov't) from SP or HP

=

Primary will not wait around for the SP or HP

But...

Satellite constellations: GPS, Iridium, RapidEye, Globalstar, Galileo, etc.

→

Many launches to same orbit with same hardware

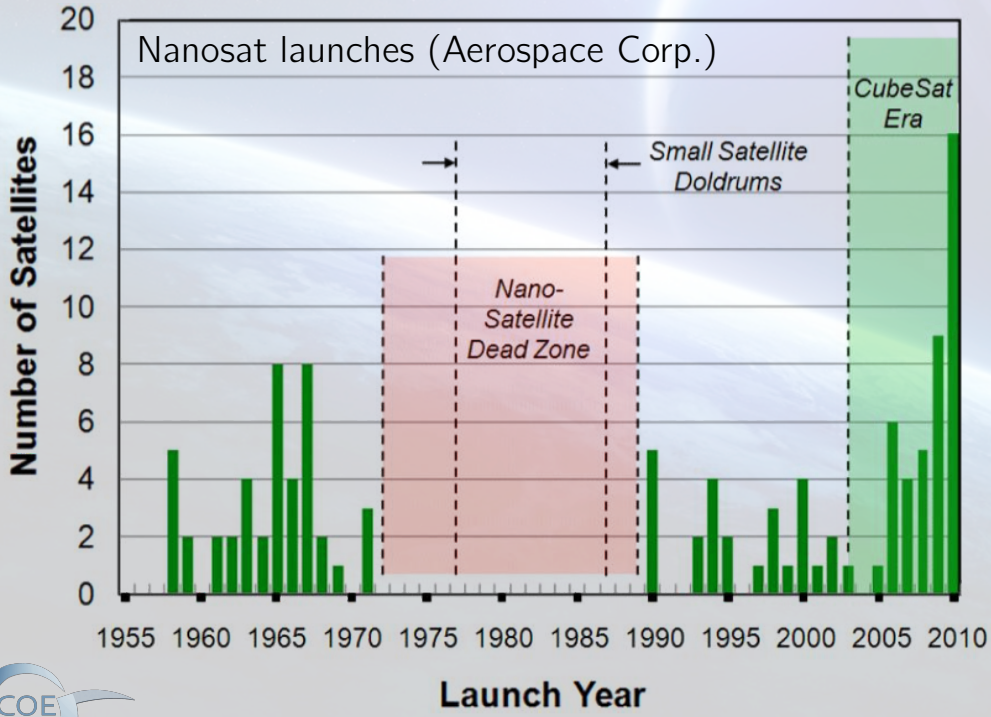
→

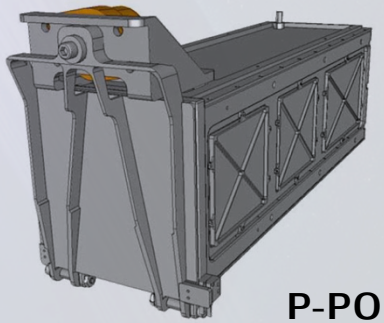
Perfect opportunity for secondary or hosted payloads

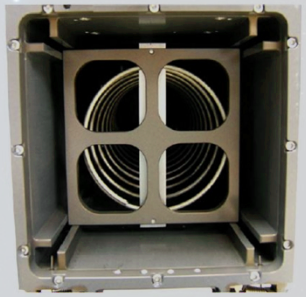
EG: Iridium NEXT, 72 satellites going to LEO in 2015-2017 on Falcon 9's

CubeSats

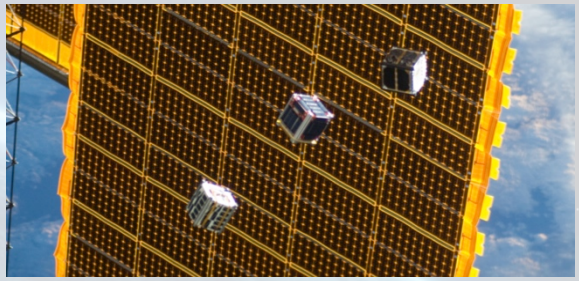
- Standard developed in 2000 by Stanford University and Cal Poly
- Satellites constructed from 10x10x10 cm cubes, each having mass of 1 kg
- Poly Picosatellite Orbital Deployers (P-POD's) have deployed approx. 90% of all CubeSats







P-POD



Cubesats Deployed from a P-POD on ISS

Future Work

- Continue work with industry partners to identify the best focus area for our work
  - How to monetize, assess growth areas
  - Consider a different paradigm, such as an "Airline Model"
- Perform analyses and studies
- Coming Soon:
  - Stanford Institute for Economic Policy Research and Stanford COE CST *Forum on Space Entrepreneurship*, Feb 7-8, 2013
  - *New Space*: a new quarterly peer-reviewed journal published Spring 2013. Hubbard Editor-in-Chief.

Acronyms

EELV	Evolved Expendable Launch Vehicle
ELaNa	Educational Launch of Nanosatellites
ESPA	EELV Secondary Payload Adapter
HP	Hosted Payload
ISIS	Innovative Solutions In Space
LSP	Launch Service Provider
P-POD	Poly-Picosatellite Orbital Deployer
SHP	Secondary and Hosted Payloads
SP	Secondary Payload
STP	Space Test Program
UTIAS	University of Toronto Institute for Aerospace Studies