Space Sustainability and Small Satellites

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CONTEXT

posed for consideration in this afternoon's discussion

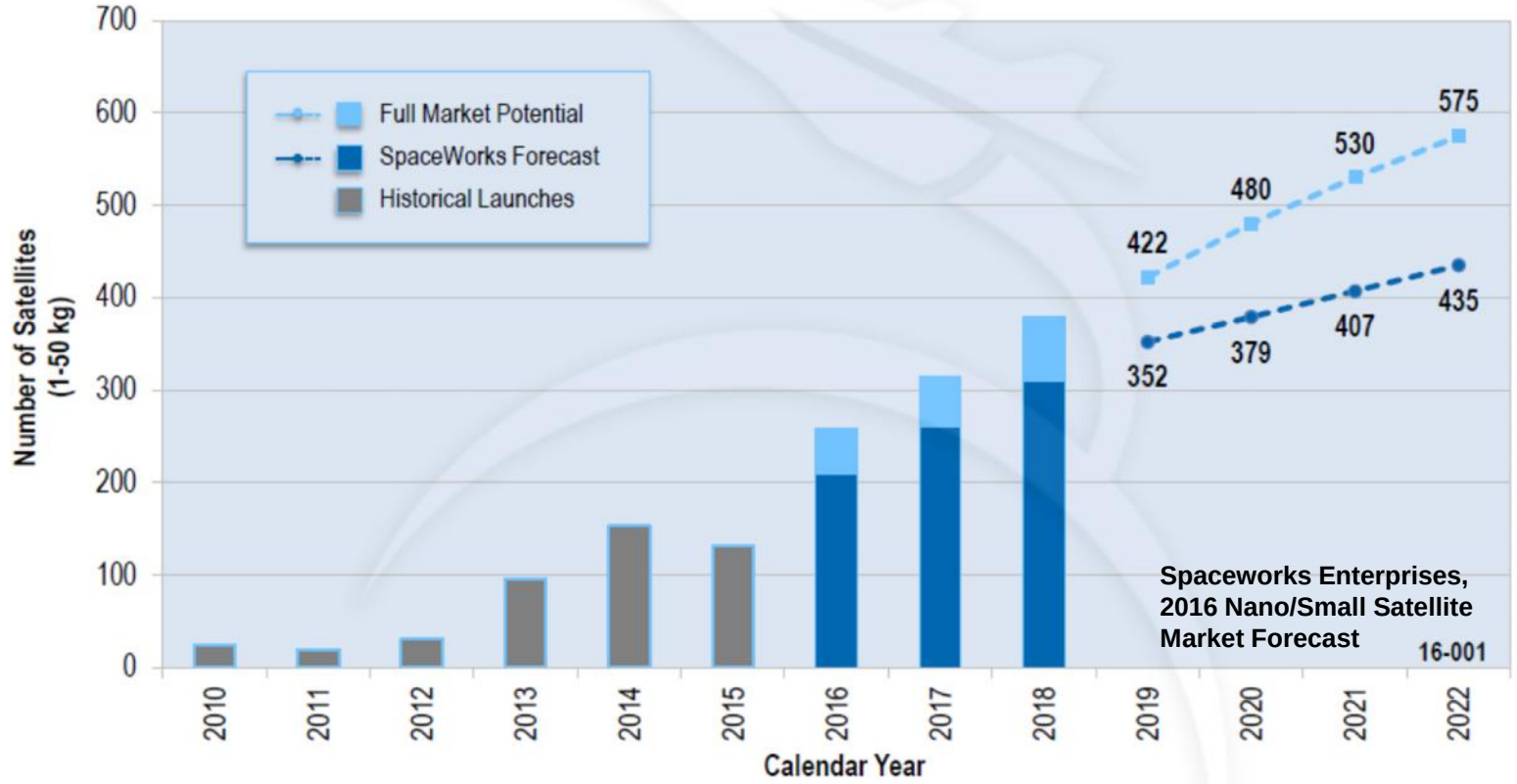
Who We Are

- Secure World Foundation ***is a private operating foundation*** that promotes cooperative solutions for space sustainability

- Why **space sustainability**? Increasing reliance on space assets coupled with potentially destabilizing trends

- **Our mission**: SWF works with governments, industry, international organizations and civil society to develop and promote ideas and actions for international collaboration that achieve the secure, sustainable, and peaceful uses of outer space for the socioeconomic and environmental benefits to Earth

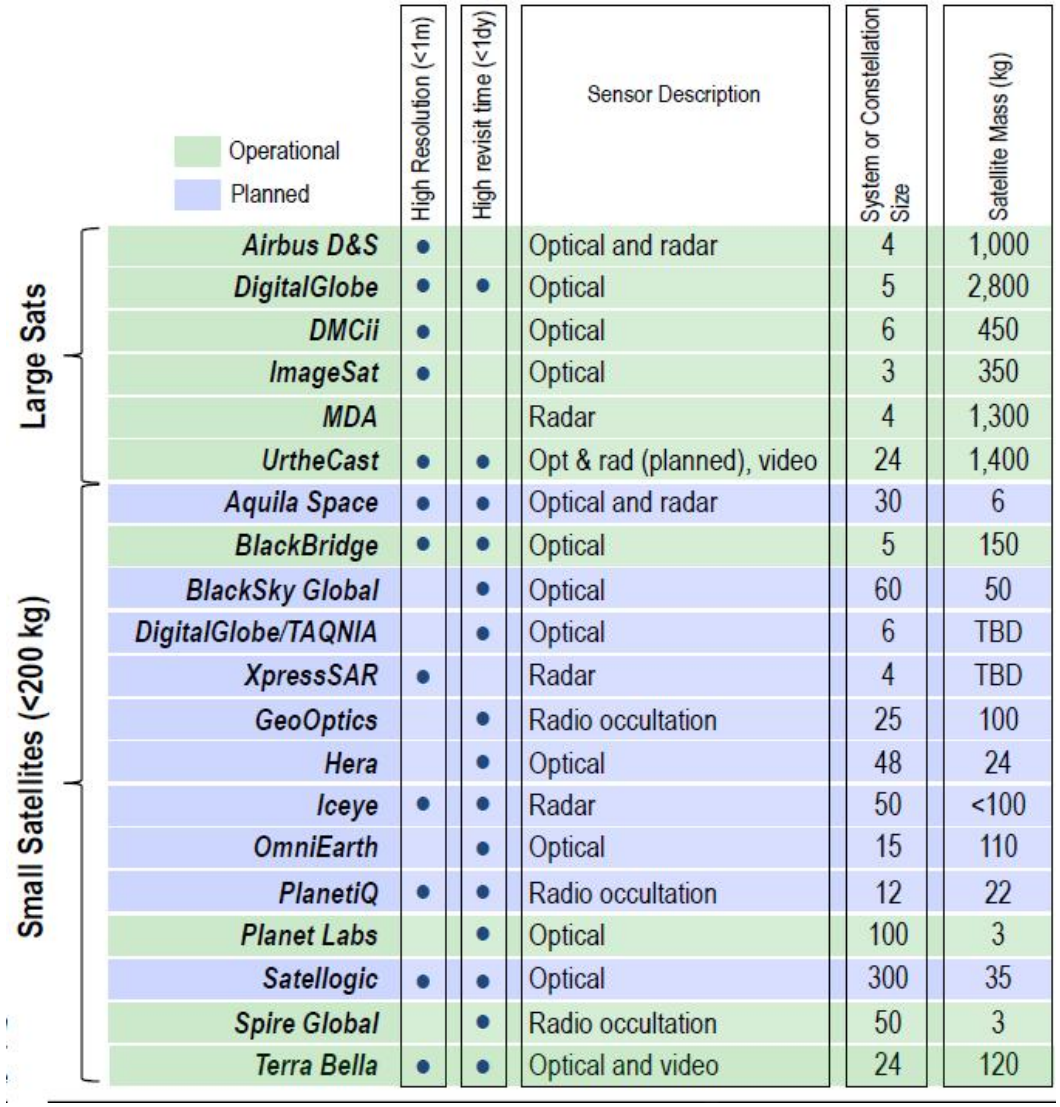
A Fundamental Change?



As of June 2016: Total number of operating satellites: 1,419

Forecast: Up to 3000 micro/nanosatellites to launch by 2022

A Commercial Driver



Operational
Planned

		High Resolution (<1m)	High revisit time (<1dy)	Sensor Description	System or Constellation Size	Satellite Mass (kg)
Large Sats	*Airbus D&S*	•		Optical and radar	4	1,000
	DigitalGlobe	•	•	Optical	5	2,800
	DMCii	•		Optical	6	450
	ImageSat	•		Optical	3	350
	MDA			Radar	4	1,300
	UrtheCast	•	•	Opt & rad (planned), video	24	1,400
Small Satellites (<200 kg)	*Aquila Space*	•	•	Optical and radar	30	6
	BlackBridge	•	•	Optical	5	150
	BlackSky Global		•	Optical	60	50
	DigitalGlobe/TAQNIA		•	Optical	6	TBD
	XpressSAR	•		Radar	4	TBD
	GeoOptics		•	Radio occultation	25	100
	Hera		•	Optical	48	24
	Iceye	•	•	Radar	50	<100
	OmniEarth		•	Optical	15	110
	PlanetiQ	•	•	Radio occultation	12	22
	Planet Labs		•	Optical	100	3
	Satellogic	•	•	Optical	300	35
	Spire Global		•	Radio occultation	50	3
	Terra Bella	•	•	Optical and video	24	120

Explosive Growth

- Massive expansion in active satellites, e.g.:
  - OneWeb: 648+ smallsats
  - Planet: 100+ 3U cubesats
  - SSG: 200 nanosatellites
  - Spire: 50+ cubesats
- Transformation in launch?
  - 25+ smallsat-class launch vehicles currently proposed or under development

Small Satellites As A Disruptor

Opportunities

- Lower costs of access to space technology
- Lower technical and scientific barriers
- Broaden and diversify actors and users
- Enable new (and innovative?) applications and services
- Provide increase societal benefit

Challenges

- Regulatory fit, efficiency, and scale
- Diverse, heterogenous set of actors
- Few standards for operations
- Spectrum, SSA, and potential space debris implications

QUESTIONS TO CONSIDER

posed for consideration in this afternoon's discussion

Definitions and Distinctions

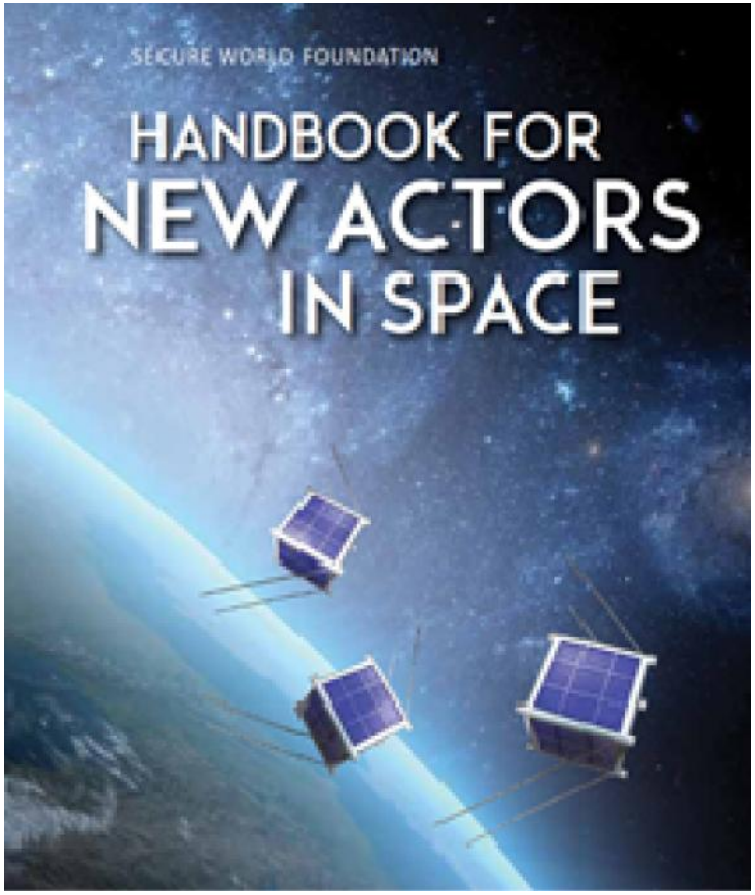
- Not all small satellites are created equal
- NanoSat vs. Cubesat vs. SmallSat: definitional boundaries are unclear, but may be significant
- Differences in constellation architectures vs. single satellite missions
- To what degree does propulsive or maneuverability matter?
- Different operating orbits may also be important
- Operator sophistication may also vary

There is a temptation to talk about "small satellites" as if they are a homogenous group. That is of course, not true.

How important is it for the community to discuss common definitions? What elements should those definitions considers?

New Actors

How does the community help maximize the benefits from new actors entering the space sector by ensuring that there is awareness of the fundamental principles, laws, norms, and best practices for safe, predictable, and responsible activities in space?

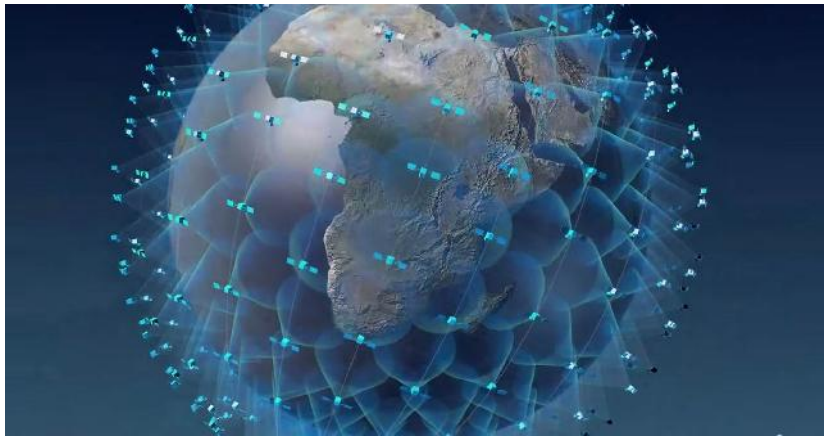


Soon to be released!

Congested, Competitive and Invested

In an increasingly competitive orbital environment, how can operators cooperate to develop norms of operations?

How can operators work with government(s) to ensure safety of operations for all users of the space environment?



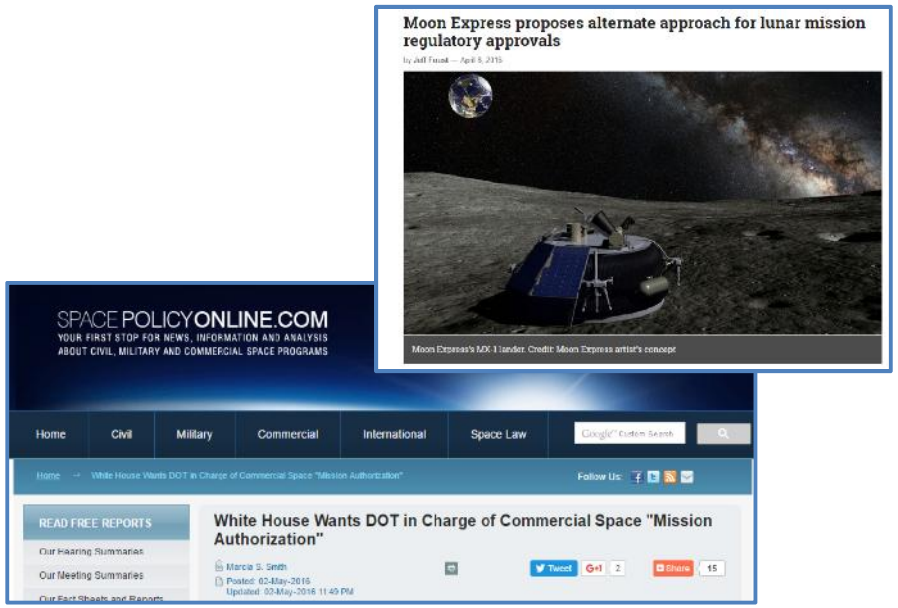
* Satellites not to scale

- Satellite tracking capabilities
- Satellite "transponders" or beacons
- Adequacy of space debris guidelines
- Spectrum management & coordination
- Information sharing and transparency
- Norms / best practices for operations

Regulatory Fit & Efficiency

What is the proper governmental posture & policy context for small satellite driven applications?

How can industry and government collaborate to provide an appropriate & effective regulatory context?



- Pace of innovation vs. pace of government
- Government's role as a customer
- Regulatory authority and knowledge base
- Industry awareness of regulatory requirements
- Balance of national security & economic development objectives

These issues are not unique to small satellites, but the small satellite community may have unique viewpoints on them

Conclusions

- Emergence of smallsats as a key driver in a rapidly diversifying and growing space domain
- Smallsats turning into go-to technology for actors within the public, academic, and private sectors
- As that occurs – increasing diversity in small satellite applications, architectures and approaches, presenting policy challenges
- Questions about real market opportunities/ response – *Is this another bubble? Are there enough non-government customers?*
- Space sustainability challenge – how to take advantage of the positive while meeting regulatory/oversight and responsibility operator requirements
- International implications to decisions taken at national & corporate levels