Opportunities & Challenges for New Actors in Space

Krystal Wilson, Director of Space Applications Programs
Secure World Foundation
15th Annual CubeSat Developers Conference
San Luis Obispo, California
May 2, 2018

Secure World Foundation

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**: To work with governments, industry, international organizations, and civil society to develop and promote ideas and actions to achieve the secure, sustainable, and peaceful uses of outer space benefiting Earth and all its peoples

What We Do

- The Foundation acts as a **research body, convener and facilitator** to examine key space policy topics
  - To promote **international cooperative governance** for increased space sustainability
  - To increase **human and environmental security** by promoting improved governance of the delivery of information gathered from space systems in ways that promote its utility
  - To assist in the **development of effective national and international space policies and laws** both in established and emerging space nations

- Offices located in Broomfield, CO & Washington, DC with 10 staff members

Activities and Partners

UNIDIR

WMO

esri

UNITED NATIONS
Office for Outer Space Affairs

INTERNATIONAL ASTRONAUTICAL FEDERATION

GEO GROUP ON EARTH OBSERVATIONS

Publications

Events

Outreach

CSSMA

ORF OBSERVER RESEARCH FOUNDATION

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

CEOS

SPACE GENERATION ADVISORY COUNCIL

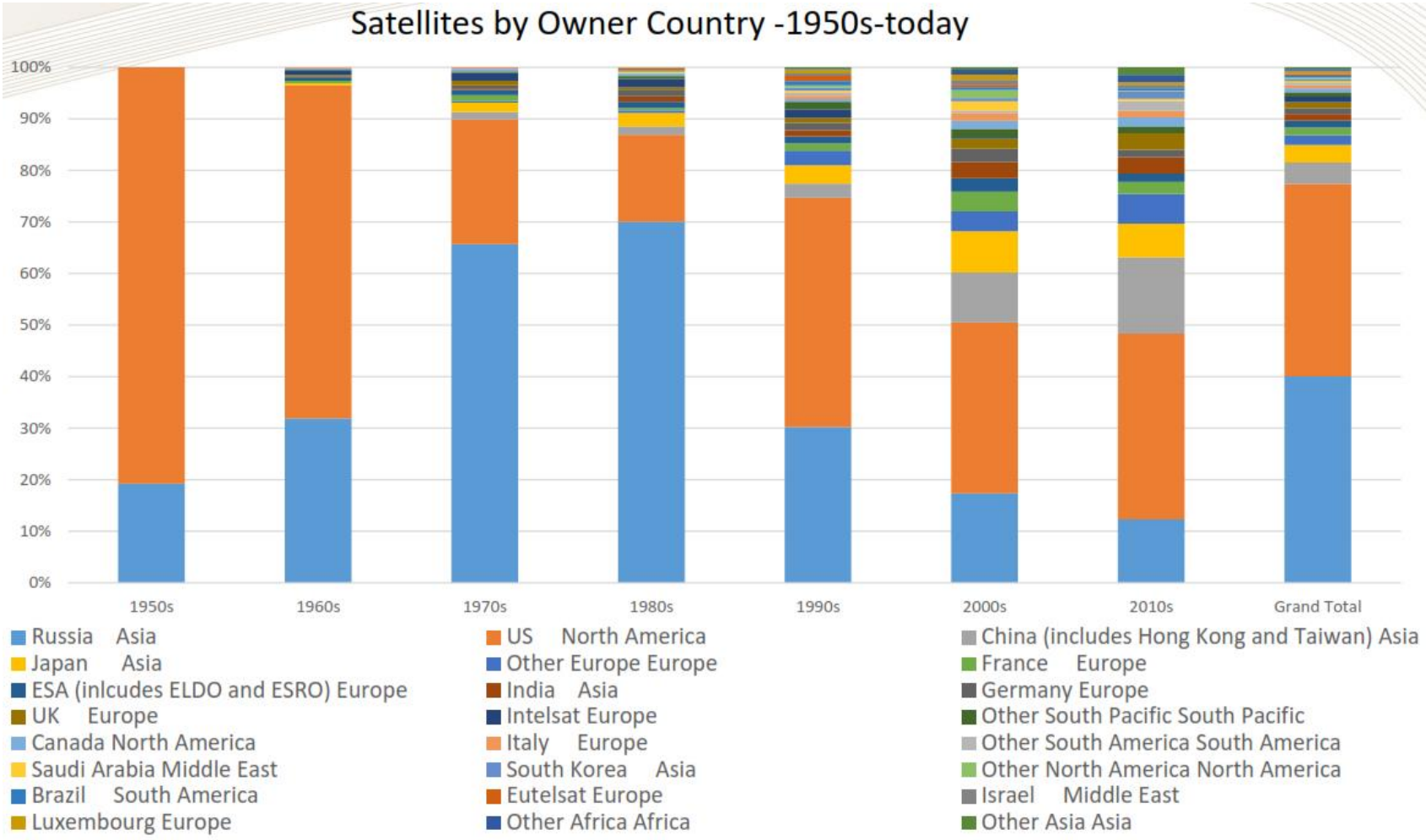
Trends in space

- Space is becoming more ***globalized***
  - Growing access to space technology
  - Growing interest by many countries in utilizing space for national benefits (socioeconomic development, prestige, national security)

- Space is becoming more ***commercialized***
  - Space began as part of competition between governments (US and USSR)
  - Influx of technology, talent, and capital from other sectors (IT, analytics, etc)

How do we manage the influx of new actors and growth in space activities to ensure long-term sustainability of space?

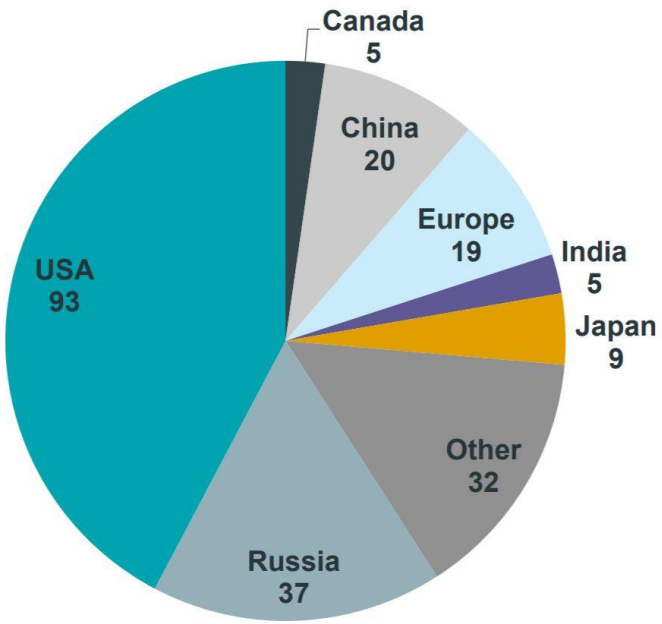
More International



Source: Adapted from IDA Global Trends in Civil and Commercial Space Study

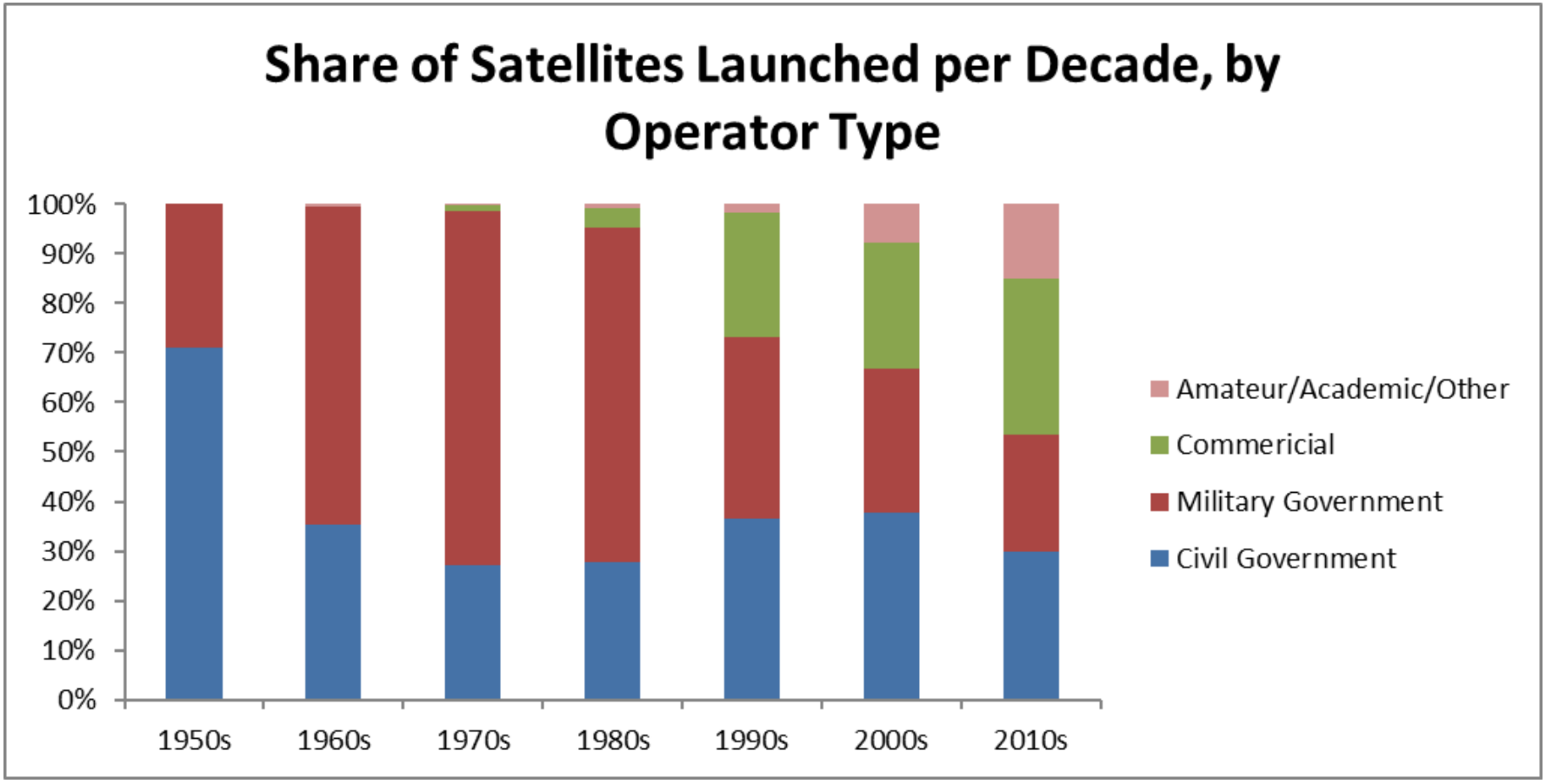
New National Entrants

Government Smallsats by Country of Operator, 2012 – 2017



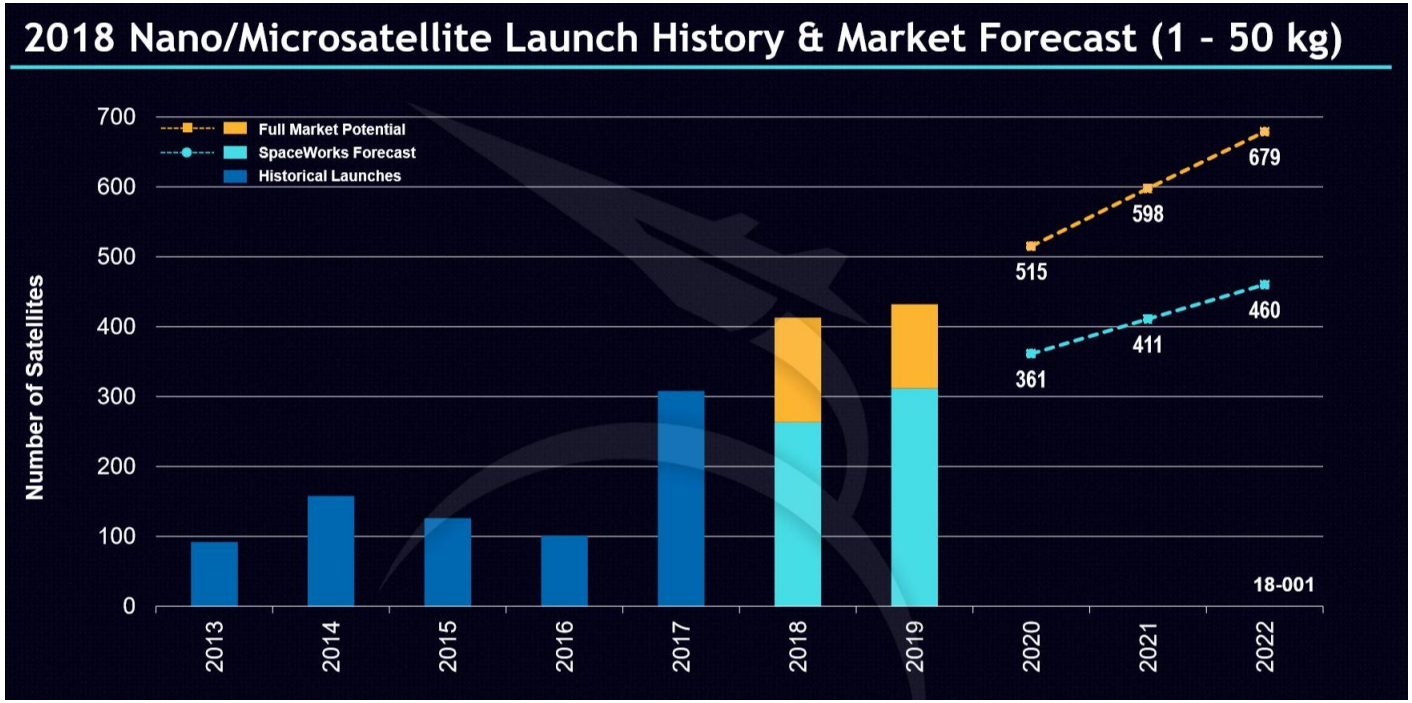
Source: Bryce Space and Technology "Small Satellites By the Numbers 2018"

More Commercial



Source: McDowell, Jonathan C, 2017—Satellite Statistics http://www.planet4589.org/space/log/stats2/own_categ.txt

Industry Predictions



Source: Spaceworks Enterprises, 2018 Nano/MicroSatellite Market Forecast

Launched in 2017: More than 300

Forecast: Up to 2600 micro/nanosatellites to launch in the next 5 years

Mega-constellations: 16,000+ planned satellites, many not included in above

A Commercial Driver

Operational
Planned

		High Res (<1m)	High revisit (<1dy)	Sensor Description	System Size	Sat Mass (kg)
Large Sats	Airbus D&S	•		Optical and radar	4	1,000
	DigitalGlobe	•	•	Optical	5	2,800
	MDA	•	•	Radar	1	2,300
	DMCii	•		Optical	6	450
	ImageSat	•		Optical	3	350
	UrtheCast	•	•	Optical and radar	24	1,400
Small Satellites (<200 kg)	Astro Digital	•	•	Optical	30	20
	Axelspace	•	•	Optical	50	95
	BlackBridge (Planet)	•	•	Optical	5	150
	BlackSky Global		•	Optical	60	50
	Capella Space		•	Radar	30	TBD
	XpressSAR	•		Radar	4	TBD
	GeoOptics		•	Radio occultation	24	115
	HawkEye360		•	RF mapping	21+	TBD
	Hera Systems		•	Optical	48	24
	ICEYE	•	•	Radar	50	<100
	PlanetiQ		•	Radio occultation	12	22
	Planetary Resources	•	•	Optical	10	TBD
	Planet		•	Optical	100+	3
	Satellogic	•	•	Optical	25+	35
	Spire Global			Radio occultation	50	3
	Terra Bella (Planet)		•	Optical	24	120

SIA
The Voice of the Satellite Industry

Source: Satellite Industry Association "State of the Satellite Industry Report" https://www.sia.org/wp-content/uploads/2017/07/SIA-SSIR-2017.pdf

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

Congested, Competitive and Invested

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

How can industry 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

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 applications and services
- Provide increased societal benefit

Challenges

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

What can industry be doing now to address these challenges?

Regulatory Fit & Efficiency

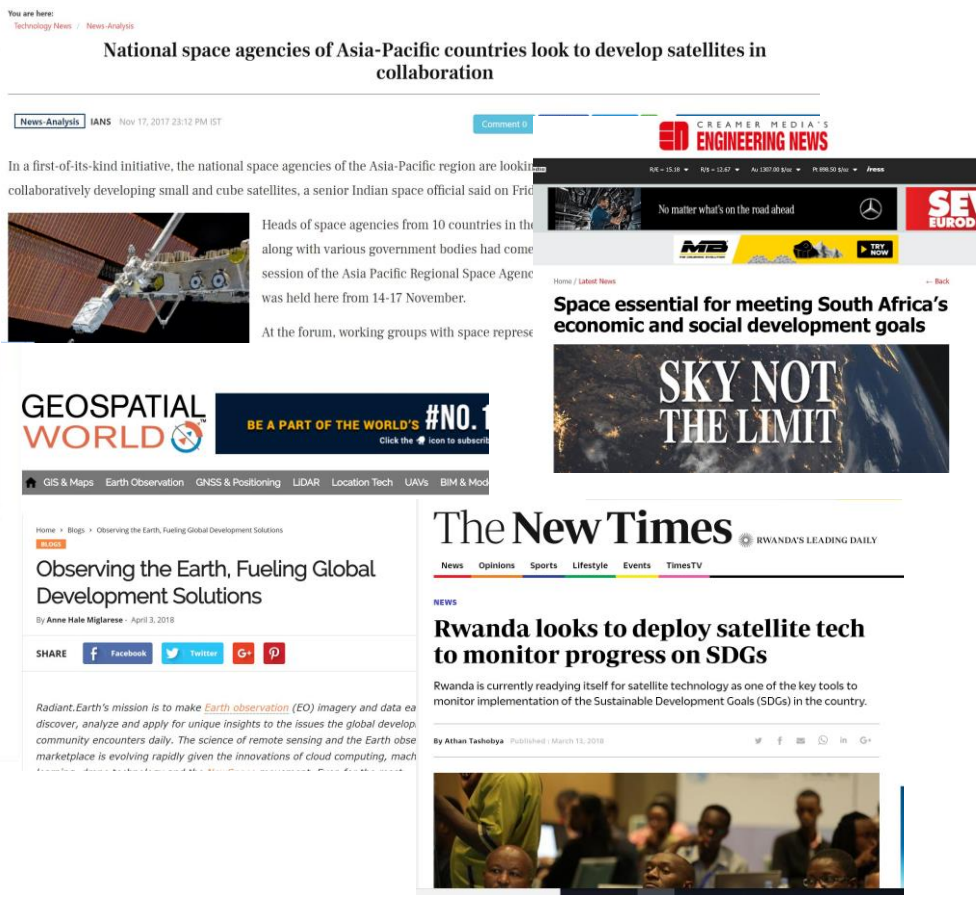
What is the proper governmental posture & policy context for small satellite driven applications?

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
- Propulsion/maneuverability

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

Societal Benefit



How do small satellites fit into a variety of humanitarian and international development efforts?

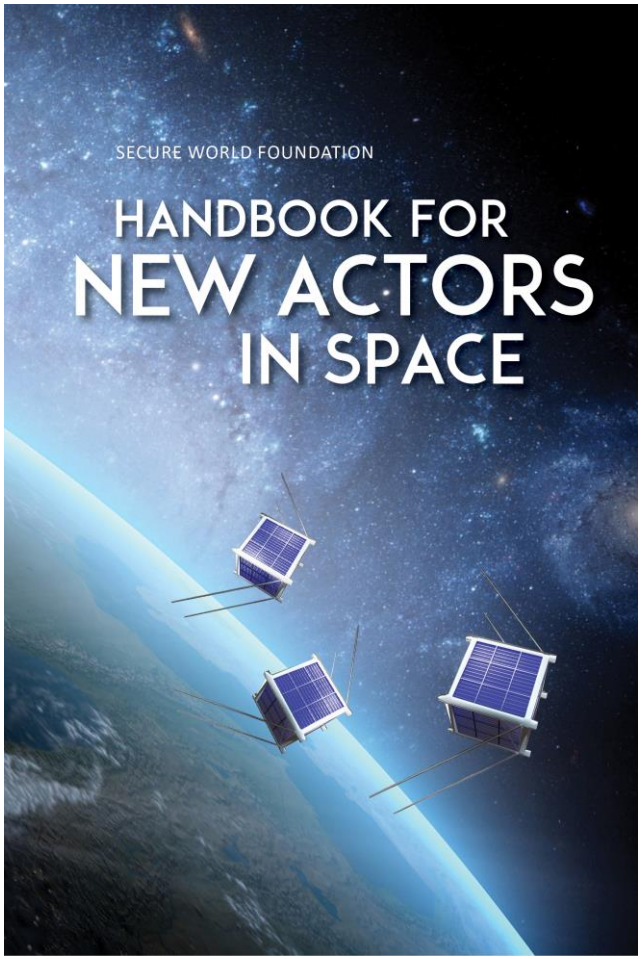
How to Address Changing Environment?

What Secure World Foundation is Doing

SWF Handbook for New Actors in Space

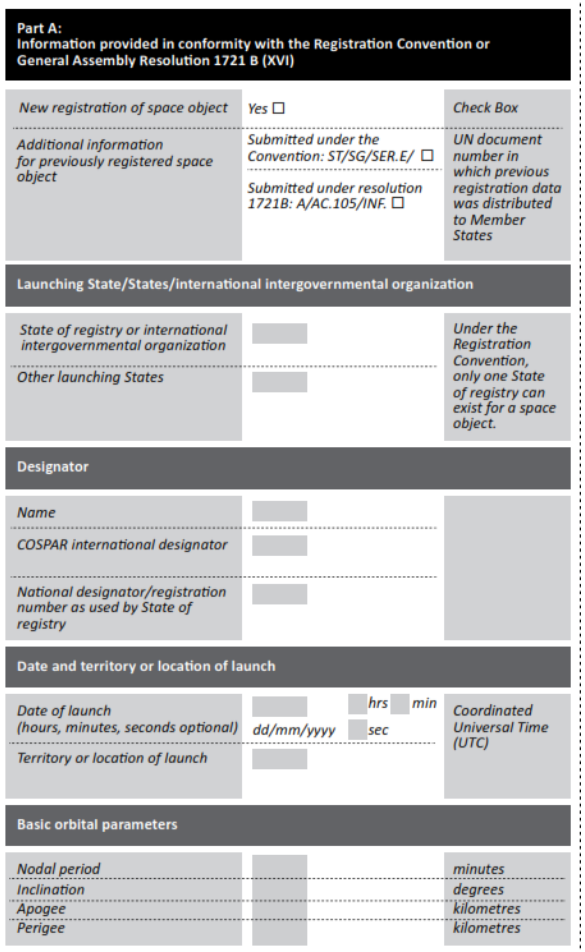
- **Goal:** Create a publication that provides an overview fundamental principles, laws, norms, and best practices for safe, predictable, and responsible activities in space

- **Two specific audiences:**
  - Countries developing space programs and/or having to oversee and regulate their first satellites
  - Universities and start-up companies that are developing/operating satellites



Chapter 1 – International framework

- Freedom and Responsibility
- Registration of Space Objects
- International Frequency Management
- Remote Sensing
- International Standards
- International Export Control
- International Liability
- Dispute Settlement
- Environmental Issues
- Advanced Issues
- International Organizations



Part A:
Information provided in conformity with the Registration Convention or General Assembly Resolution 1721 B (XVI)

New registration of space object	*Yes* ☐	*Check Box*
Additional information for previously registered space object	*Submitted under the Convention: ST/SG/SER.E/* ☐ *Submitted under resolution 1721B: A/AC.105/INF.* ☐	*UN document number in which previous registration data was distributed to Member States*

Launching State/States/international intergovernmental organization

State of registry or international intergovernmental organization		*Under the Registration Convention, only one State of registry can exist for a space object.*
Other launching States		

Designator

Name		
COSPAR international designator		
National designator/registration number as used by State of registry		

Date and territory or location of launch

Date of launch (hours, minutes, seconds optional)	*dd/mm/yyyy* *hrs* *min* *sec*	*Coordinated Universal Time (UTC)*
Territory or location of launch		

Basic orbital parameters

Nodal period		*minutes*
Inclination		*degrees*
Apogee		*kilometres*
Perigee		*kilometres*

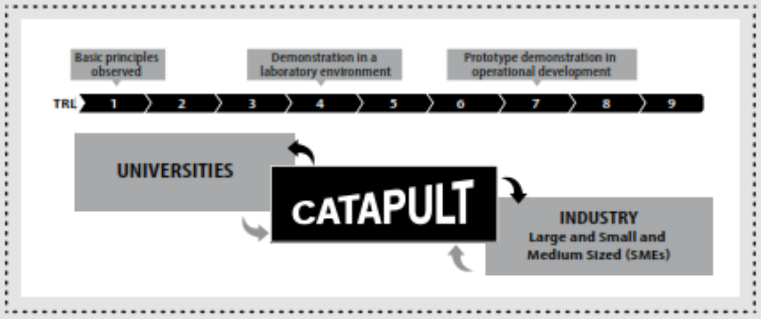
UNOOSA International Registry Form

Chapter 2 – National policy and administration

- Public Policy
  - Rationales, objectives, principles
  - Government roles and responsibilities
- Public Administration and National Oversight
  - National regulators and licensing
  - National frequency administration
  - Export controls
- Case Study: Remote Sensing Policy and Administration

Case Study:
The United Kingdom Satellite Applications Catapult

The United Kingdom Satellite Applications Catapult was established by the government of the United Kingdom (UK) in May 2013 with the goal of creating economic growth in the UK through supporting the development, commercialization, and use of satellite applications. According to its Delivery Plan 2015–2020, the Catapult (Figure 8) aims to promote satellite application and technology development and to help domestic industry "bring new products and services more rapidly to market." The Satellite Applications Catapult is one of 11 "Catapults" operating in the UK, each focusing on different technologies and application areas. The Catapult operates as a private, not-for-profit research organization. It is governed by a board, which includes representation from the United Kingdom Space Agency (UKSA) and from Innovate UK—a government agency focused on fostering technology and economic development.



UK Satellite Applications Catapult

Chapter 3 – Responsible space operations

- Pre-launch
  - Licensing
  - Launch vehicle selection and integration
  - Insurance
- Launch
  - Safety considerations
- On-orbit
  - Orbit determination, propagation, and tracking
  - Conjunction assessment and collision avoidance
  - Anomaly response
- End-of-life

Examples of CA Screening Volumes

Orbit Regime	Orbit Regime Criteria/Definition	Predict/ Propagate/ Time	Radial Miss (km)	In-Track Miss (km)	Cross-Track Miss (km)
GEO	1300min < Period < 1800 min Eccentricity < 0.25 & Inclination < 35°	10 days	12	364	30
HEO 1	Perigee < 2000 km & Eccentricity > 0.25	10 days	40	77	107
MEO	600 min < Period < 800 min Eccentricity < 0.25	10 days	2.2	17	21
LEO 4	1200 km < Perigee ≤ 2000 km Eccentricity < 0.25	7 days	0.5	2	2
LEO 3	750 km < Perigee ≤ 1200 km Eccentricity < 0.25	7 days	0.5	12	10
LEO 2	500 km < Perigee ≤ 750 km Eccentricity < 0.25	7 days	0.5	28	29
LEO 1	Perigee ≤ 500 km Eccentricity < 0.25	7 days	2	44	51

Examples of close approach screening volumes

Handbook Next Steps

- The Handbook was officially released in February 2017
- Electronic copies are available through the SWF website, free of charge: www.swfound.org/handbook
- Printed copies are also be available today
- Feedback is welcome!
- SWF plans to curate an electronic library of resources to accompany the Handbook and is looking for interested partners to help with sponsorship or contributions
    - Companies
    - Governments
    - NGOs
    - Universities

Previous Events and Materials

Events

- Hosted "Cubesat Launch and Deployment Best Practices Side Event" and "Dialogue on Practices for Post Mission Disposal at 2017 SmallSat Conference in Logan, Utah
- Held workshop on "Space Sustainability and Small Satellites" during the 12th Annual Ilan Ramon Conference in Herzliya, Israel in January 2017.
- Participated in Small Satellites Tech, Business & Regulatory Industry Workshop in Noordwijk, Netherlands in April 2017
- Presented on "Small Satellite Technology and Space Capability" at the United Nations/United Arab Emirates High Level Forum in November 2016
- Held side event on SSA challenges and small satellites at the Advanced Maui Optical and Space Surveillance Technologies Conference in Maui, Hawaii in September 2016
- Held side event on Small Satellite Operator Best Practices for SSA and Conjunction Assessment at 2016 SmallSat Conference in Logan, Utah

Publications

- Insight - Small Satellites for the Global South – March 2017
- Insight- Small Satellites and Space Situational Awareness – September 2016
- Legal and Regulatory Considerations of Small Satellite Projects – April 2014

Upcoming Events

Currently Planned:

- **Global Space Applications Conference 2018** in May in Montevideo, Uruguay
- **2018 UNIDIR Space Security Conference** in May in Geneva, Switzerland
- **Space Situational Awareness: Strategic Challenges for India** in June in Bengaluru, India
- **SmallSat Conference** in August in Logan, Utah
- **Student Generation Advisory Council Space Generation Congress** in October in Bremen, Germany

Lots more in development! Topics include space weather, citizen science, on-orbit servicing, spectrum.

Questions?

Thanks.

kwilson@swfound.org

1.202.568.6215