Opportunities & Challenges for New Actors in Space

Krystal Wilson, Director of Space Applications Programs
Secure World Foundation
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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

- UNITED NATIONS Office for Outer Space Affairs
- INTERNATIONAL ASTRONAUTICAL FEDERATION
- GEO GROUP ON EARTH OBSERVATIONS
- WMO
- esri
- ORF OBSERVER RESEARCH FOUNDATION
- NOAA
- CEOS
- SPACE GENERATION ADVISORY COUNCIL

Outreach
Events
Publications

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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 *diverse*
  – 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

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Source: Bryce Space and Technology “Small Satellites By the Numbers 2018”
More Diverse

Share of Satellites Launched per Decade, by Operator Type

Nano/Microsatellite Launch Predictions

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

Source: Spaceworks Enterprises, 2018 Nano/MicroSatellite Market Forecast
**Earth Observation Services Growth**

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<tr>
<th>Large Sats</th>
<th>Small Satellites (&lt;200 kg)</th>
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<tr>
<td><strong>Airbus D&amp;S</strong></td>
<td><strong>Operational</strong></td>
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<td><strong>DigitalGlobe</strong></td>
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<td><strong>UrtheCast</strong></td>
<td><strong>Optical and radar</strong></td>
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<td><strong>Optical</strong></td>
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<td><strong>Axelspace</strong></td>
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<td><strong>BlackBridge (Planet)</strong></td>
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<td><strong>BlackSky Global</strong></td>
<td><strong>Optical</strong></td>
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<td><strong>Capella Space</strong></td>
<td><strong>Radar</strong></td>
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<td><strong>GeoOptics</strong></td>
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<td><strong>HawkEye360</strong></td>
<td><strong>RF mapping</strong></td>
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<td><strong>Hera Systems</strong></td>
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<td><strong>PlanetIQ</strong></td>
<td><strong>Radio occultation</strong></td>
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<td><strong>Planetary Resources</strong></td>
<td><strong>Optical</strong></td>
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<td><strong>Planet</strong></td>
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<td><strong>Satellogic</strong></td>
<td><strong>Optical</strong></td>
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<td><strong>Spire Global</strong></td>
<td><strong>Radio occultation</strong></td>
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<td><strong>Terra Bella (Planet)</strong></td>
<td><strong>Optical</strong></td>
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- Massive expansion in active satellites:
  - 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 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 and academia be doing now to address these challenges?
In an increasingly competitive orbital environment, how can industry and academia cooperate to develop norms of operations?

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

- Satellite tracking capabilities
- Satellite “transponders” or beacons
- Adequacy of space debris guidelines

- Spectrum management & coordination
- Information sharing and transparency
- Norms / best practices for operations

* Satellites not to scale
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.
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
• **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

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

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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 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 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

• 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
• 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

www.swfound.org
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