Tackling Space Sustainability

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SWF – A Quick Primer

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

- **Our vision:** The secure, sustainable, and peaceful uses of outer space that contribute to global stability on Earth

- **Our mission**: Secure World Foundation works 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 people

SWF's Key Focus Areas

- **Space Sustainability:** Ensuring that all of humanity can continue to use outer space for peaceful purposes and socioeconomic benefit over the long term

- **Space Policy and Law Development:** Promoting and assisting in the development of international and national norms, laws, and policies to foster responsible behavior by States and private sector actors

- **Human and Environmental Security:** Promoting improved governance and international cooperation in the delivery of information derived from space systems

PART I: THE PROBLEM

Space Sustainability Challenges

- Lots more stuff happening in space
  - Growing number & diversity of space actors (governments and commercial companies)
  - Growing number & diversity of space activities
- Negative externalities could have widespread impacts for everyone
- Very few hard "rules" about what is and isn't allowed

How can we ensure space is usable for future generations and users??

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Promoting Cooperative Solutions for Space Sustainability

Human-generated space objects

Active Satellites

2,718	Total number of operating satellites: ~~3,372~~ 4,636		
United States: ~~1,897~~	Russia: 176	China: 412	Other: 887
LEO: 2,612	MEO: 139	Elliptical: 59	GEO: 562

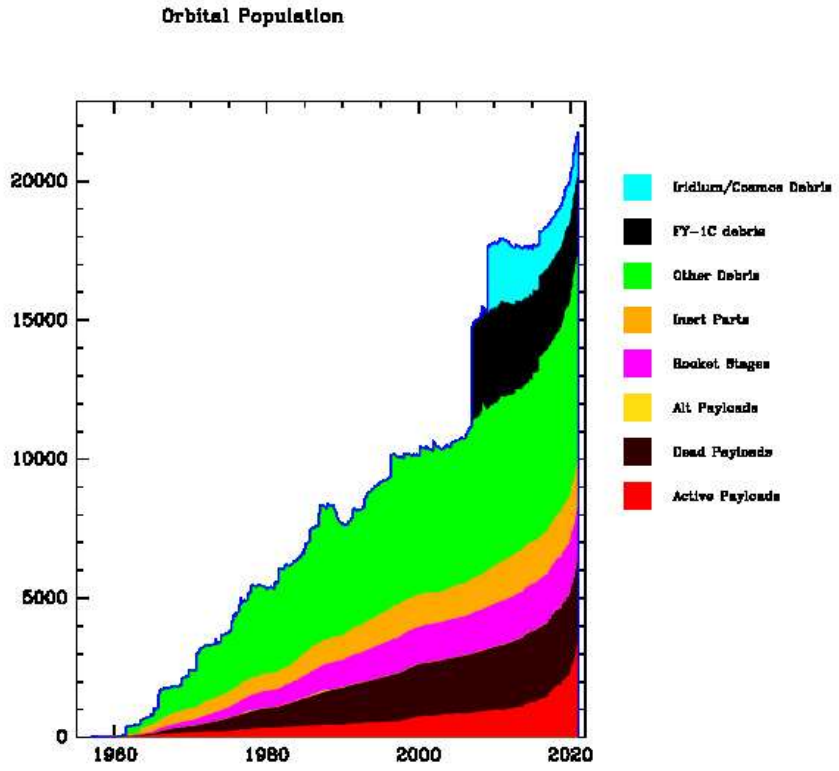
Current through ~~12/31/2020~~ 6/8/2021
Source: Union of Concerned Scientists
Celestrak

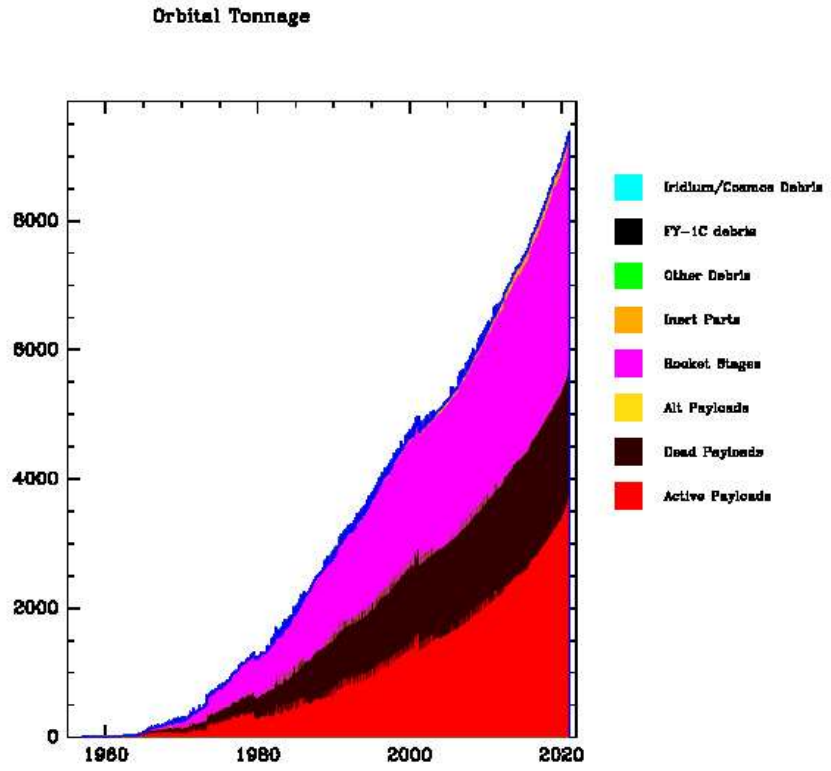
Space Debris

Larger than 10 cm	~30,000	Sources of new debris
Between 1 and 10 cm	~700,000	Can cause major damage
Smaller than 1 cm	Many millions	Can cause minor damage

Source: Data compiled from U.S. Space Command, NASA, and ESA.

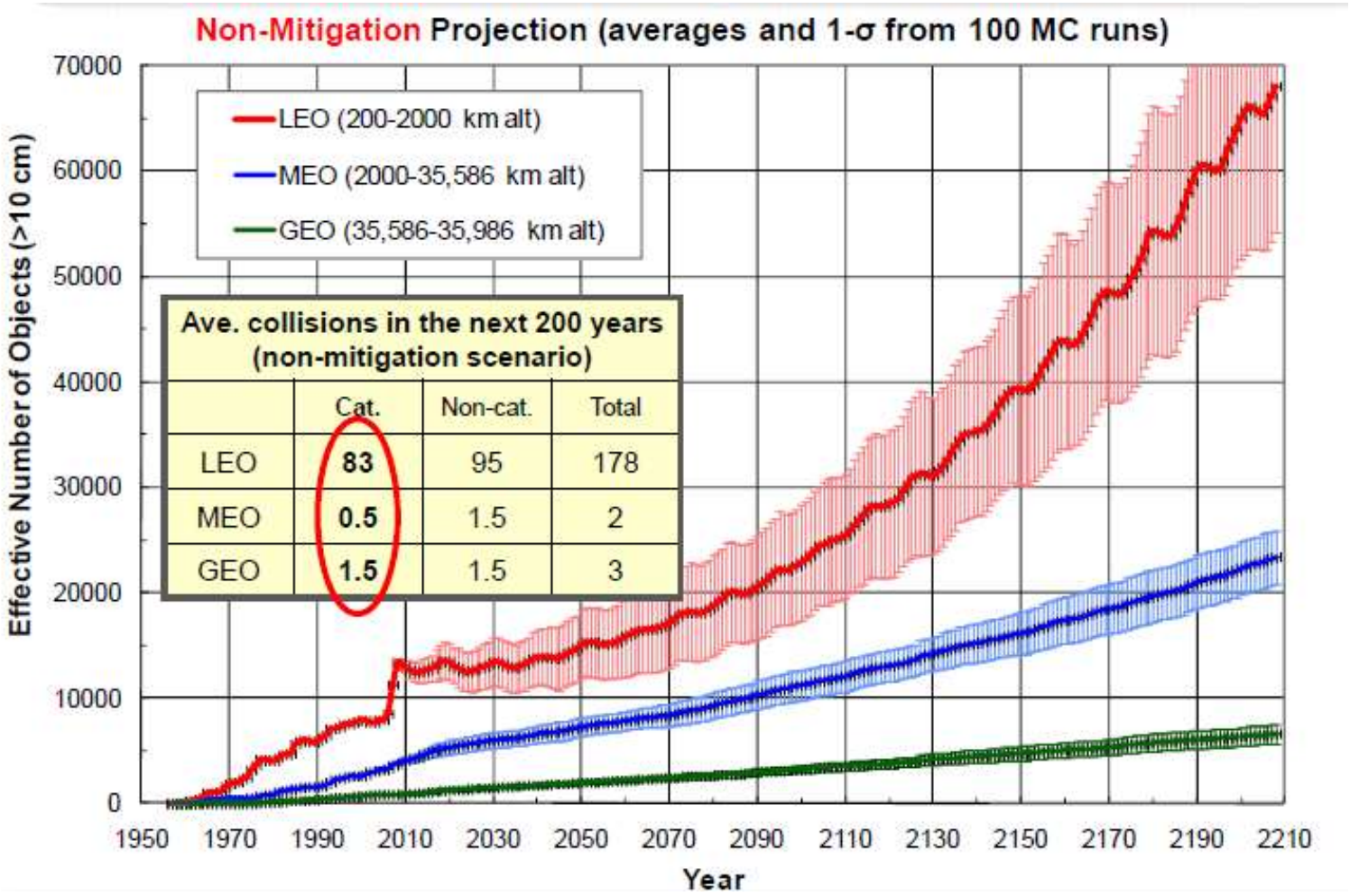
Growth of Orbital Debris





Source: Jonathan's Space Page

The next 200 years, if things stay the same

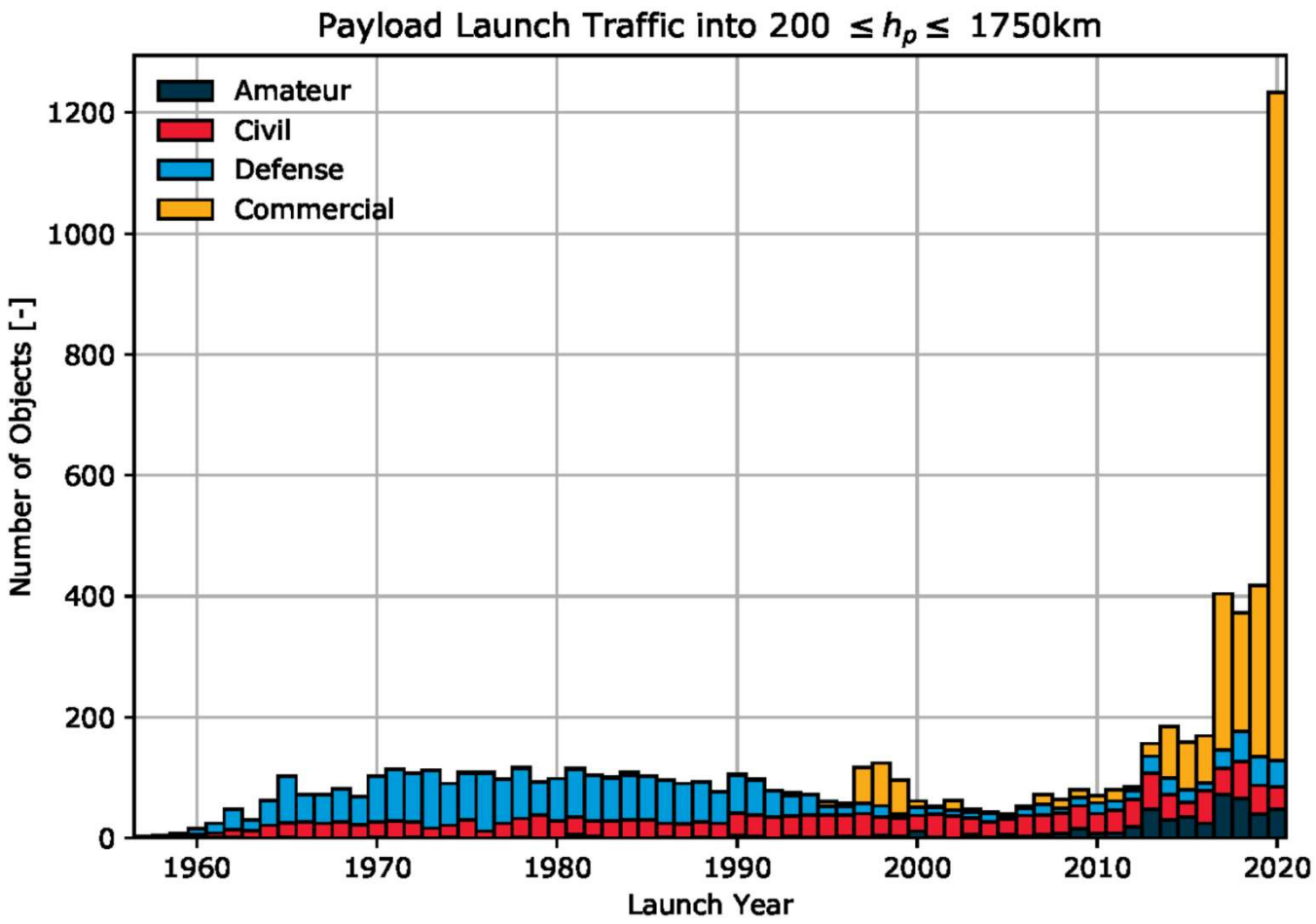


Ave. collisions in the next 200 years (non-mitigation scenario)

	Cat.	Non-cat.	Total
LEO	**83**	95	178
MEO	**0.5**	1.5	2
GEO	**1.5**	1.5	3

Source: J-C Liou, NASA Orbital Debris Program Office (2009)

Number of Payloads Launched Over Time



Source: European Space Agency

Large Constellations

Constellation	Total Satellites	Altitude	Country	Status
OneWeb Gen1	6,372	1,200 km	UK	218 launched
OneWeb Gen2	47,800	1,200 km	UK	Planning
Starlink Gen1	4,408	540 – 570 km	US	1,737 launched (1,011 operational)
Starlink Gen2	30,000	328 – 614 km	US	Planning
Kuiper	3,326	590 – 630 km	US	First launch 2021/2022
Lightspeed	298	1,015 – 1,325 km	Canada	
GW	12,992	590 – 1145 km	China	Planning

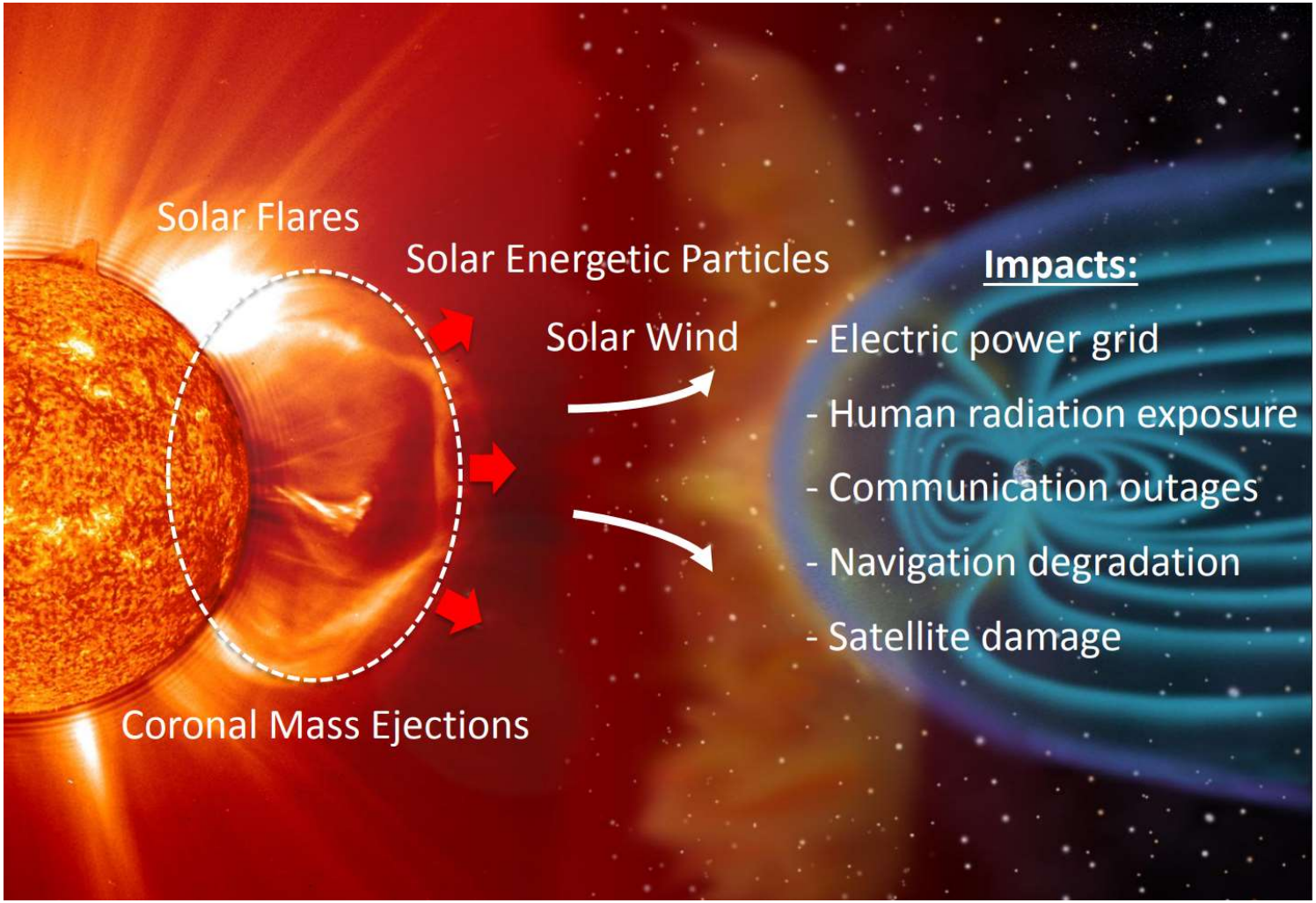
Source: Jonathan McDowell

EU must 'move at speed' on space broadband network

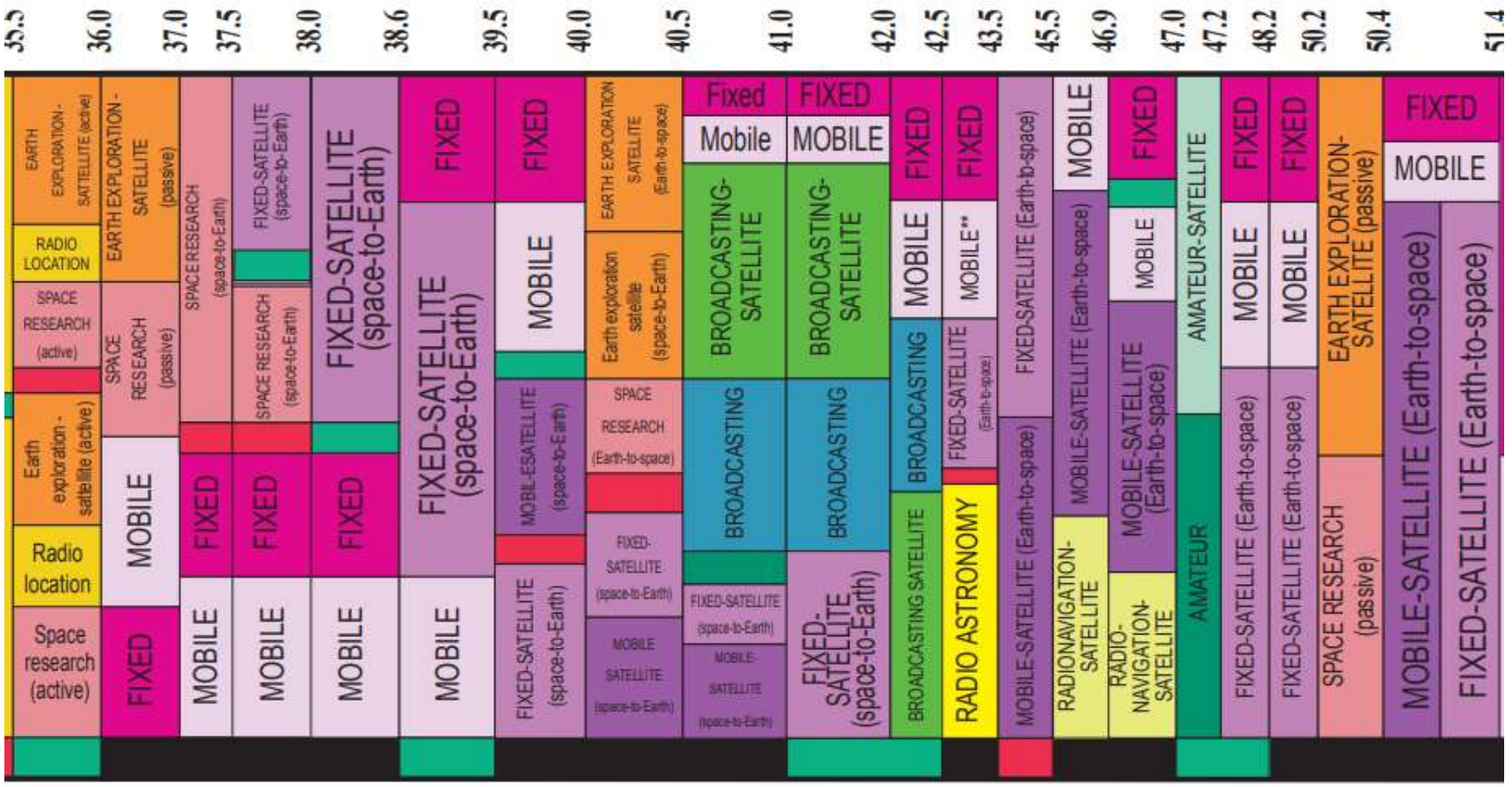
Jonathan Amos
Science correspondent
@BBCAmos

12 January

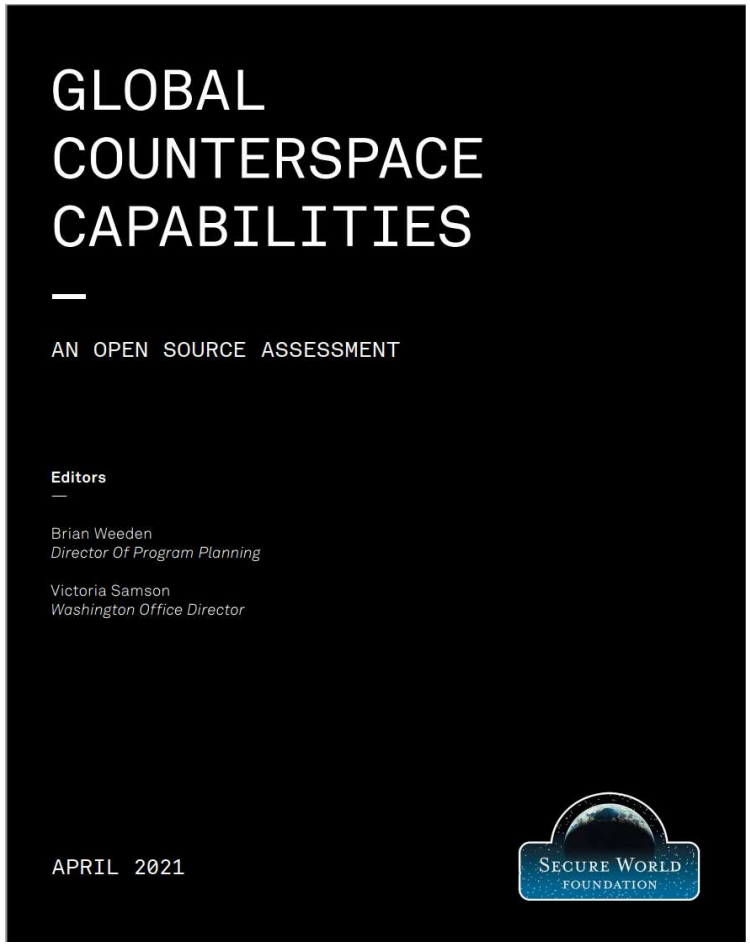
Space weather challenges



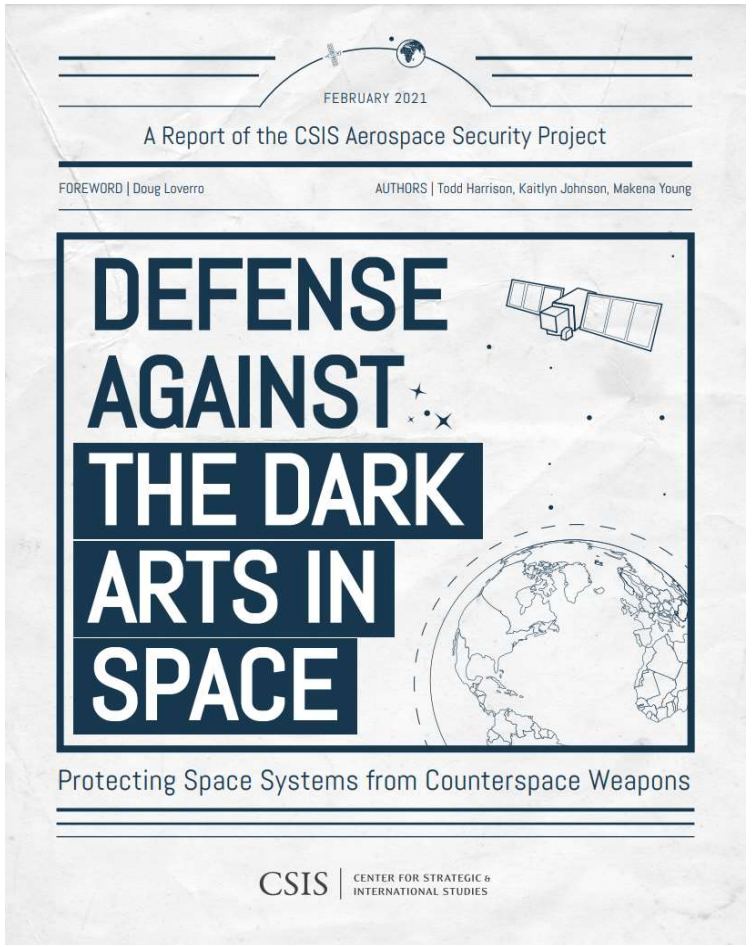
RF spectrum congestion



Proliferation of counterspace threats



Secure World Foundation (2021)



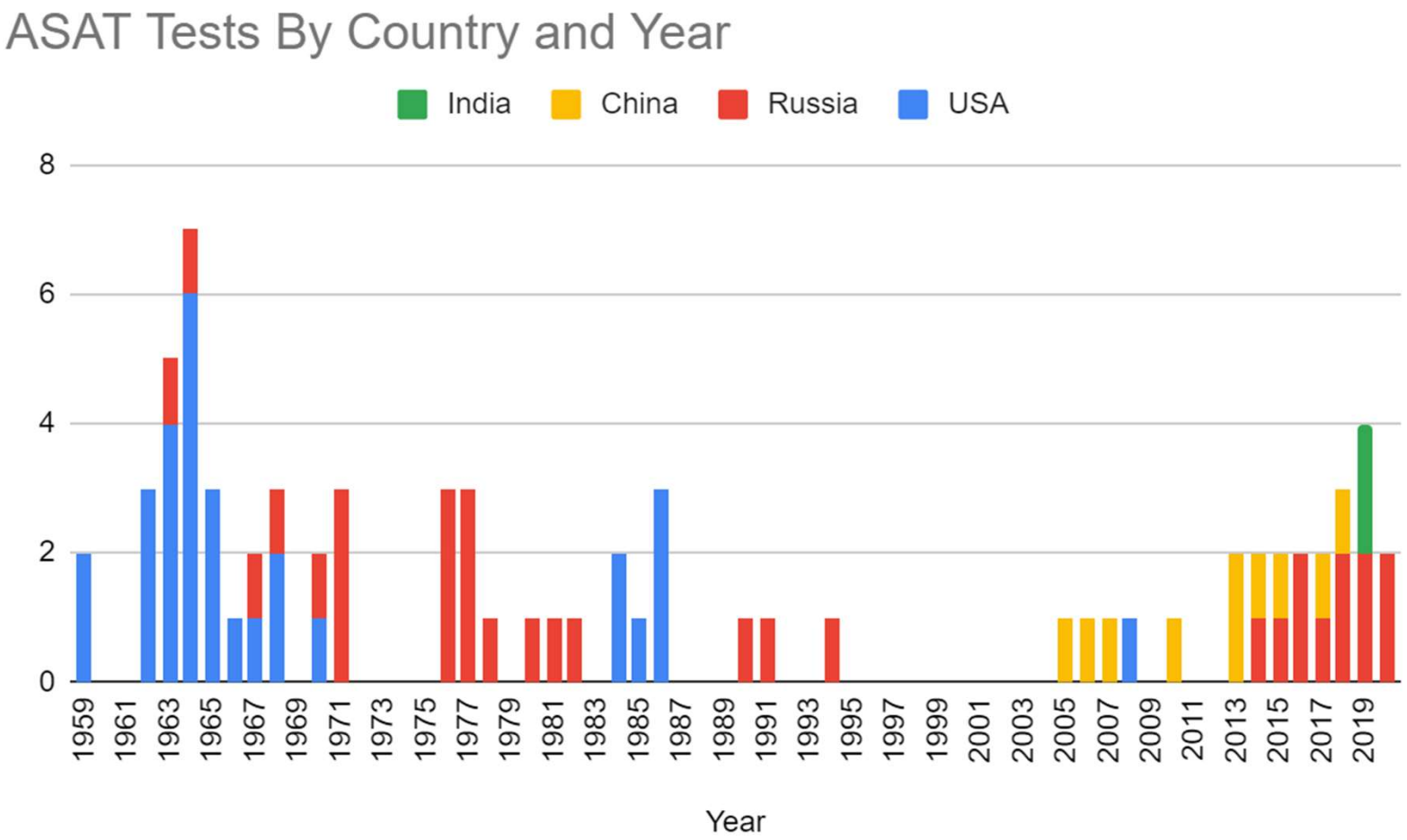
Center for Strategic and International Studies (2021)

Global Assessment of Counterspace Capabilities

	China	Russia	U.S.	France	India	Iran	Japan	North Korea
LEO Co-Orbital	Y	G	Y	R	R	R	R	R
MEO/GEO Co-Orbital	Y	Y	Y	R	R	R	R	R
LEO Direct Ascent	G	Y	Y	R	Y	R	R	R
MEO/GEO Direct Ascent	Y	Y	Y	R	R	R	R	R
Directed Energy	Y	Y	Y	Y	R	R	R	R
Electronic Warfare	G	G	G	Y	Y	Y	R	Y
Space Situational Awareness	G	G	G	Y	Y	Y	Y	R

Legend: none R some Y significant G

Historical ASAT tests



Source: *History of ASAT Tests in Space (SWF)*

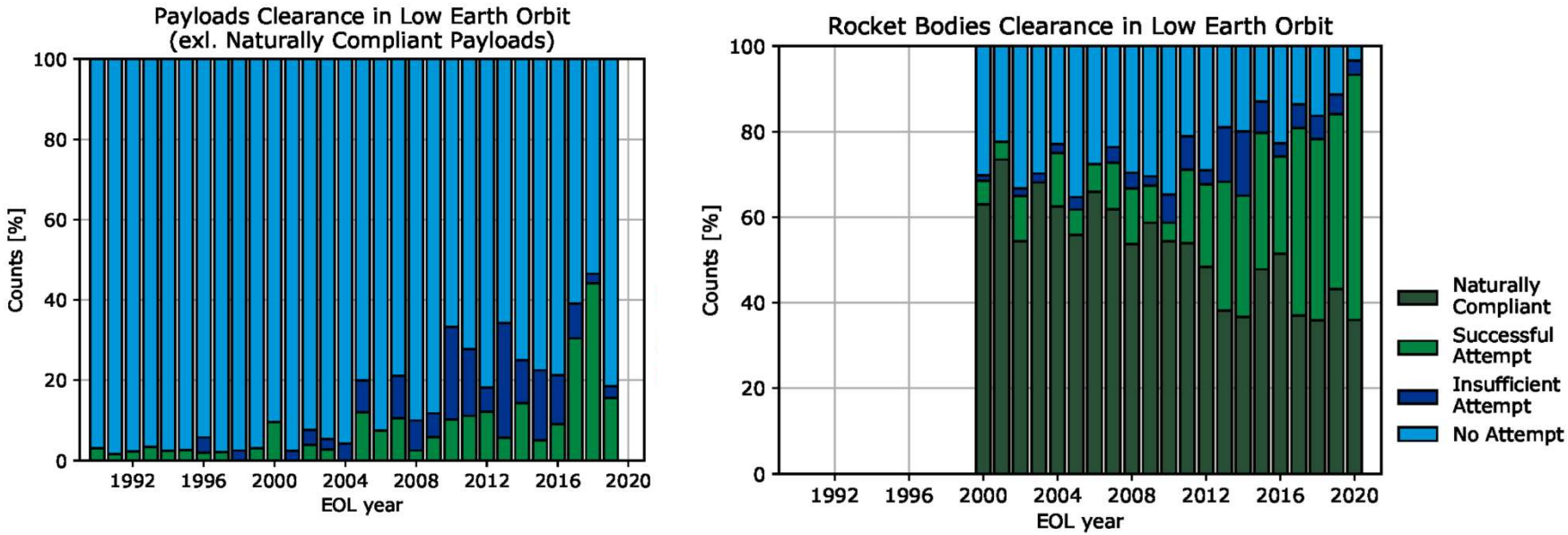
PART II: THE SOLUTION (?)

Orbital Debris Mitigation

- Steps taken to minimize the creation of orbital debris through space activities
  - Limit debris released during normal operations
  - Minimize the potential for break-ups during operational phases
  - Limit the probability of accidental collision in orbit
  - Avoid intentional destruction and other harmful activities
  - Minimize potential for post-mission break-ups resulting from stored energy
  - Limit the long-term presence of spacecraft and launch vehicle orbital stages in the LEO region after the end of their mission
  - Limit the long-term interference of spacecraft and launch vehicle orbital stages with the GEO region after the end of their mission

- **Voluntary at the international level, but implemented in some countries via policy and regulations**

Compliance with 25-year rule (LEO)



Source: ESA Space Environment Report (2021)

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Promoting Cooperative Solutions for Space Sustainability

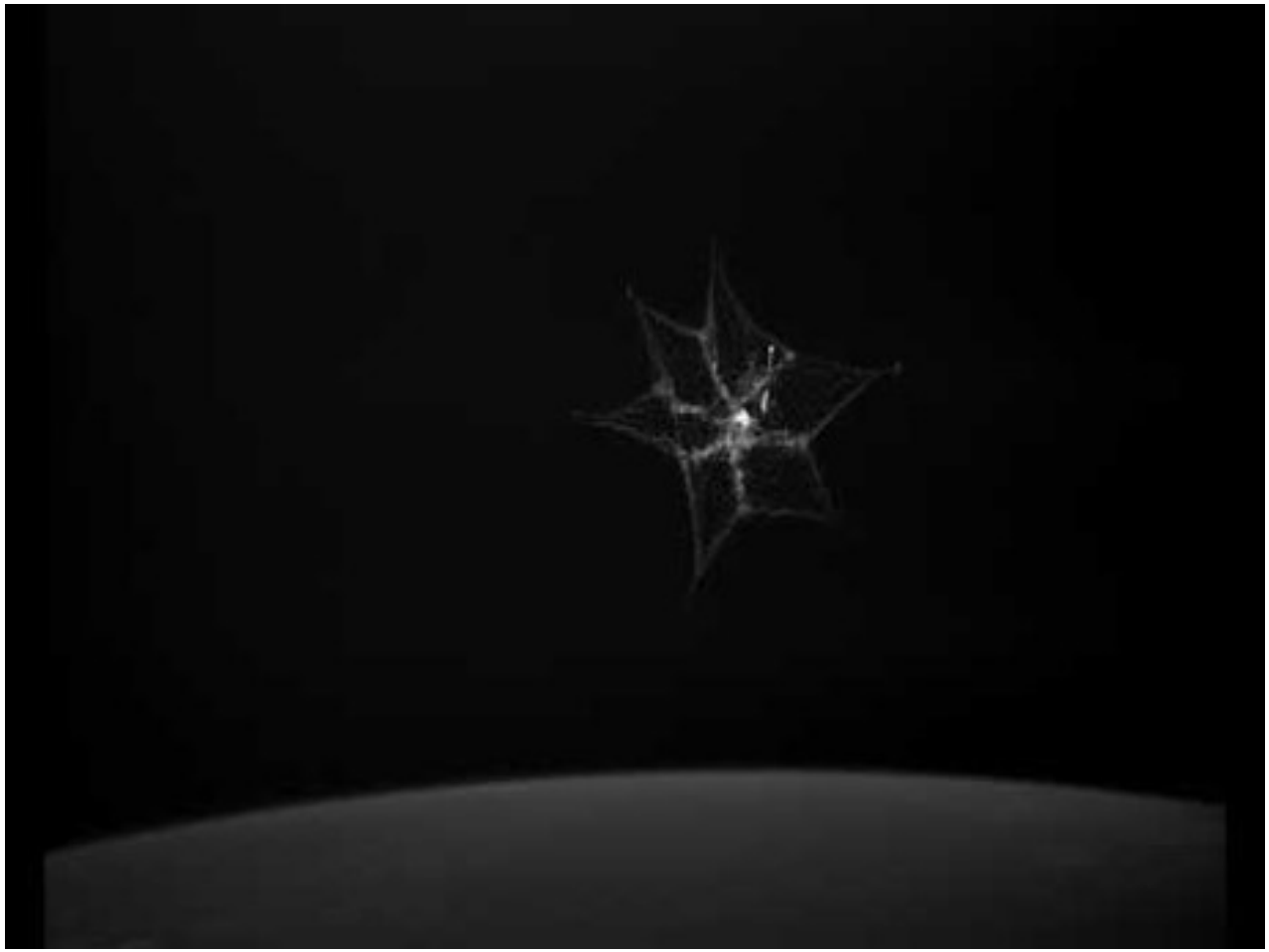
US National Policy on Orbital Debris

Year	President	Policy Directive	Implementation
1988	Ronald Reagan	Minimize creation of space debris in tests, experiments, and systems	
1989	George HW Bush	+ Encourage other countries to adopt space debris minimization policies	
1996	Bill Clinton	++ Develop design guidelines for space debris minimization, and take a leadership role in promoting international adoption	
2006	George W Bush	+++ Follow national orbital debris mitigation standards, and incorporate into licensing of commercial satellites	
2010	Barack Obama	++++ Preserve the space environment, foster development of space collision warning measures, and research debris removal technology	
2020	Donald Trump	++++ Evaluate and pursue active debris removal	?

Active Debris Removal (Remediation)

- ADR involves removing existing orbital debris objects from orbit
- Lots of potential technologies
  - Space tugs
  - Robotic arms, nets, harpoons
  - Ground-based or space-based lasers
- But technologies still in their infancy and not a lot of serious investment to date
  - The European Union and JAXA have both funded ADR missions to remove one piece of orbital debris each
  - Some private sector interest, but hard to build business without government customers/funding

ESA RemoveDebris Net Test

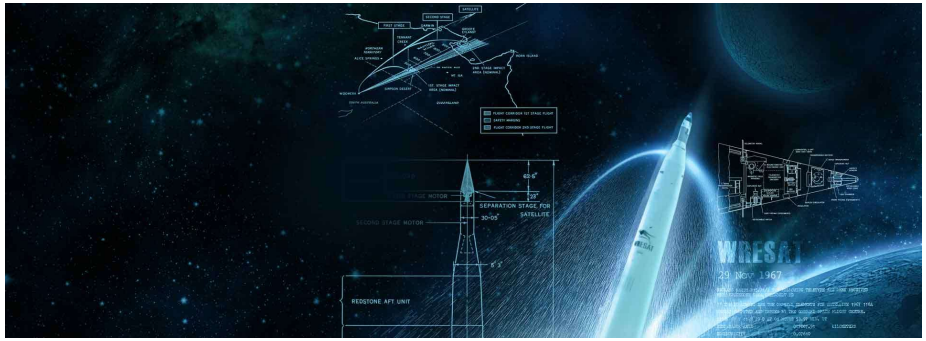


Existing Legal Framework

- 1967 Outer Space Treaty
- 1968 Rescue Agreement
- 1972 Liability Convention
- 1975 Registration Convention

Woomera and MILAMOS Manuals

- Woomera Manual on the International Law of Military Space Operations



McGill | Manual on International Law Applicable to Military Uses of Outer Space

- MILAMOS

Norms in Space Governance

- Much of the existing space governance framework is based on norms
  - Example: Freedom of overflight for satellite reconnaissance
    - Launch of Sputnik in 1957 helped set the norm that satellite overflight did not breach territorial sovereignty
    - By mid-1960s, freedom of overflight was a generally accepted norm
    - Was not codified into "hard law" until Outer Space Treaty of 1967
- Norms are likely going to be the main mechanism to address future challenges
  - Far more space actors than ever before, with diverse interests and goals
  - Increasingly challenging to get global consensus on new "hard law"

What are the LTS guidelines?

- In 2010, the United Nations Committee on the Peaceful Uses of Outer Space (UN COPUOS) established the Working Group on the Long-Term Sustainability (LTS) of Outer Space Activities
- The Working Group was tasked with producing a set of voluntary, non-binding guidelines for all space actors to help ensure the long-term sustainable use of outer space
- The Working Group's mandate ended in June 2018, at which point the UN COPUOS member States reached consensus on 21 guidelines and a context-setting preambular tet.
- In June 2019, the COPUOS plenary officially adopted these 21 guidelines, and agreed to create a working group under the agenda item of on the long-term sustainability of outer space activities of the Scientific and Technical Subcommittee

The 21 LTS guidelines

- The 21 agreed guidelines comprise a collection of internationally recognized measures for ensuring the long-term sustainability of outer space activities and for enhancing the safety of space operations

- **92 Member States agreed on these guidelines**

- Full text of agreed guidelines available in UN document A/AC.105/2018/CRP.20. The four major sections:
  - Policy and regulatory
  - Safety of space operations
  - Cooperation and capacity-building
  - Scientific and technical R&D

Multilateral Discussions on Security

- Challenging to accurately include all stakeholders because very state-centric
- Limitations of the way the UN is set up to discuss space issues
- COPUOS space debris mitigation guidelines
- Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT) / No First Placement
- EU Draft Code of Conduct
- 2013 Group of Governmental Experts (GGE) on TCBMs

Possible Progress for Space Security Talks

- Space security discussions have been stymied at the multilateral level
  - Subsidiary Body 3 of the UN Conference on Disarmament
  - GGE on further practical measures for the prevention of an armed race in outer space (PAROS)
  - UN Disarmament Commission Working Group 2

- UK resolution "Reducing Space Threats through Norms, Rules and Principles of Responsible Behaviours" A/RES/75/36, Dec. 2020
  - Submit national views to UNSG by May 3: https://www.un.org/disarmament/topics/outerspace-sg-report-outer-space-2021/
  - UNSG report in time for fall 2021 UNGA

Identifying Responsible Behavior

- Focus should be on behaviors, not technologies
- Important to develop a shared understanding of responsible vs irresponsible behavior
- Examples of responsible behavior
  - Operating with due regard to other space objects
  - Increase transparency for plans/intentions of activities on orbit, including military ones
  - No non-consensual close approaches
  - Registering space objects in a timely manner
  - Following existing best practices for orbital debris mitigation
  - Avoiding deliberate creation of long-lived debris

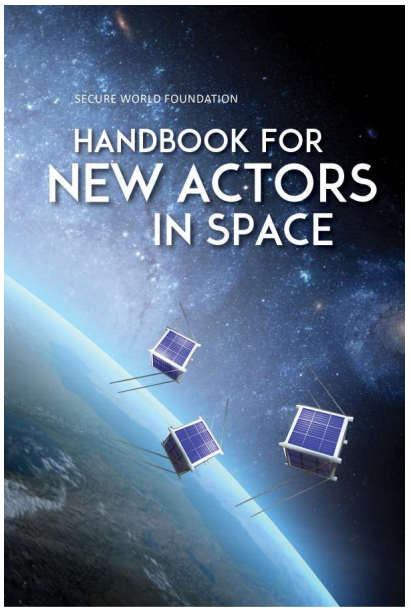
Role of the Commercial Sector

- Space Safety Coalition
- Satellite Industry Association's "Principles of Space Safety for the Commercial Satellite Industry"
- Space Data Association
- CONFERS

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



www.swfound.org/handbook

Moving Forward

- Question: which fora will be used for this? Will the discussions be bilateral, trilateral, multilateral?
- IncSea – for space?
- Improve general verification capabilities (SSA)
- Enhance communications
- Debris-creating ASAT test ban
- In general, need for US leadership in these discussions

Thank you. Questions?

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