

The background of the slide is a composite image. On the right side, there is a curved horizon of the Earth, showing continents and clouds. The rest of the background is a dark space filled with numerous small, bright stars and some faint green streaks, possibly representing space debris or meteor trails.

# Addressing Space Traffic Management at Multinational, national and industry levels

Dan Oltrogge

Space Safety Coalition Administrator

22 November 2019

**SSC** SPACE  
SAFETY  
COALITION

## Current safety of flight insufficient

- Spacecraft operators **can't tell which conjunctions are "too close"**
- Spacecraft operators waste staff time and maneuvers due to **false alarms and inaccurate SSA\***
- **Only 60% of spacecraft and 65% upper stages in LEO are successfully disposed\*\***
  - Environmental **stability requires 90-100%** successful disposal rate
- **Safety-of-flight services suffer inaccuracies, omissions, lack of transparency**
  - **LEO and GEO SSA data incomplete, containing only 4% of estimated population > 1 cm**
  - Serious collision risks are being missed
- **246 non-deliberate fragmentations since 1999 (11.5 per year)\*\***
- **... and now the "New Space" era begins**

# Even if only half of New Space applicants actually come to fruition...

- That will be a space population like we've never seen before!
- 57,145 new spacecraft proposed globally

Los Angeles Times

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## SpaceX seeks permission to launch 30,000 more satellites



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IEEE  
SPECTRUM

## Amazon Reports Collision Risk for Mega-Constellation of Kuiper Internet Satellites

By Mark Harris  
Posted 2019-10-16 16:18 GMT

For the first time, we have a complete, representative number for the overall orbital collision risk of a satellite mega-constellation.

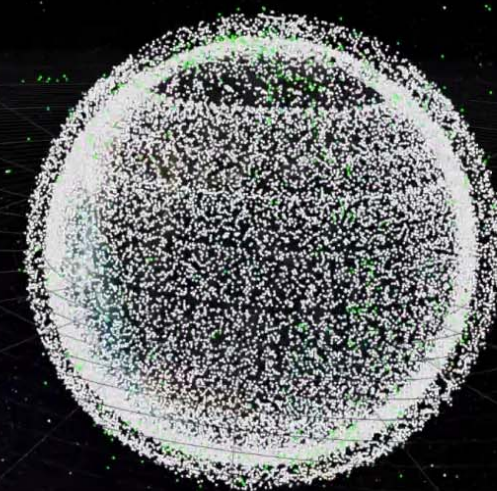
Last month, Amazon provided the U.S. Federal Communications Commission (FCC) with data for its planned fleet of 3,236 Kuiper System broadband Internet satellites.

If one in 10 satellites fails while on orbit, and loses its ability to dodge other spacecraft or space junk, [Amazon's figures](#) (PDF) show that there is a 12 percent chance that one of those failed satellites will suffer a collision with a piece of space debris measuring 10 centimeters or larger. If one in 20 satellites fails—the same proportion as failed in rival SpaceX's first tranche of Starlink satellites—there is a six percent chance of a collision.

More than a third of all the orbital debris being tracked today came from just [two collisions](#) that occurred about a decade ago. Researchers are concerned that more explosions or breakups could accelerate the [Kessler Syndrome](#)—a runaway chain reaction of orbital collisions that could render low earth orbit (LEO) hostile to almost any spacecraft.

SSC SPACE  
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- 2017 GlobalStar
- 2018 ExactView, Iridium
- 2019 HawkEye 360, Helios, PlanetiO, SpaceX, Spire Global
- 2020 ICEYE, Karaousel, OneWeb, Satellogic, SkySat, Space Norway, SpaceX, Spire Global
- 2021 GeoOptics, OneWeb, SpaceX, Spire Global, Umbra, ViaSat
- 2022 AISTech, Amazon, Astrocast, BlackSky, Dauria, Efir, Hongyan, Kepler, LaserFleet, NorthStar, OneWeb, SpaceX, Spire Global, UrTheCast
- 2023 Amazon, Astro Digital, Boeing, Efir, ExactView, Hera Systems, Hiber, O3B, OneWeb, Orora.Tech, Planet, SpaceX, Spire Global, Swarm, Zhuhai
- 2024 Amazon, Boeing, Efir, EightyLEO, Harris, LeoSat, LuckyStar, NSLComm, OneWeb, SpaceX
- 2025 AISTech, Amazon, AprizeSat, Axelspace, Boeing, Capella, CommSat, Earth-I, Efir, Fleet Space, GHGSAT, OneWeb, OrbComm, Reaktor, SpaceX, Technologies, Xingyun, Yaliny
- 2026 Boeing, SpaceX, Spire Global, Telesat
- 2027 Boeing, Canon, Sky and Space Global



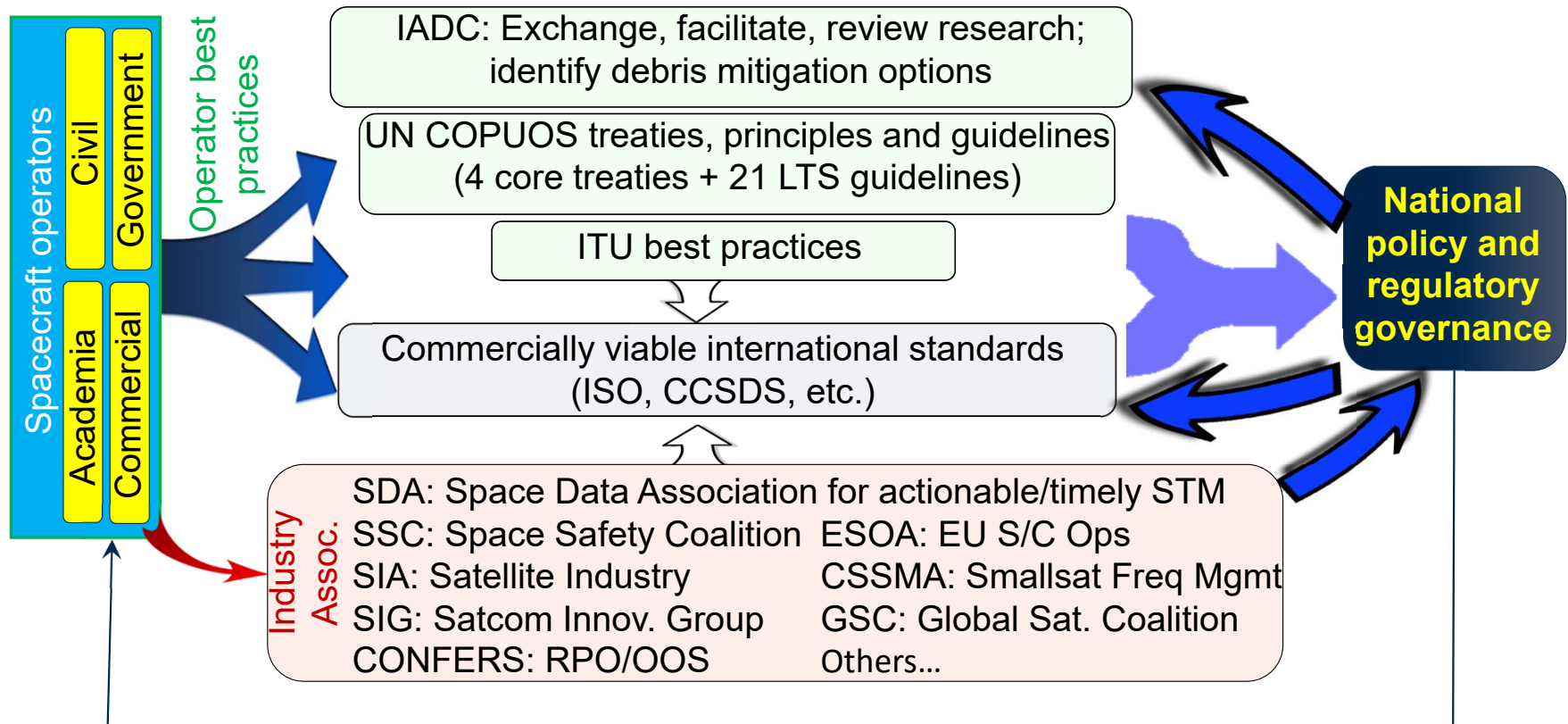
Video Copyright Analytical Graphics Inc. All rights reserved.

## Must address space debris holistically...

- **Must be untiring in our pursuit of mitigating debris**
- **The big picture\* is that we:**
  - Must avoid predictable collisions – this is SSA/STM (necessary but not sufficient).
  - Must minimize the creation of new debris – this is Debris Mitigation (necessary but not sufficient).
  - Must remove massive derelict objects currently in LEO as they are the most likely source of future LNT risk – this is Debris Remediation (necessary but not sufficient).
- **Space governance plays key role in all of these.**
  - It is time we understand it and address the gaps!



# Space governance framework *virtuous cycle*



# AIAA global space governance characterization



## United Nations

## International NGOs

## National Regulatory

## Industry Consortia

	UN COPUOS (Treaties)	UN COPUOS (Excl. Treaties, SDM & LTS Guidelines)	United Nations Space Debris Mitigation Guidelines	United Nations Long Term Sustainability Guidelines	Committee on Space Research (COSPAR)	Consultative Committee for Space Data Stds	Inter-Agency Debris Coordination Committee	Intl Assoc for Adv of Space Safety (IAASS)	Intl Organization for Standardization (TC20/SC14)	International Telecommunications Union (ITU)	Canada	EU	France	Japan	South Africa	UK	USA Commercial	USA NASA	USA USAF	AIAA	Association of Space Explorers (ASE)	CubeSat Standard (Cal Poly)	Consortium for Execution of RPO & OOS (CONFERS)	Satellite Industry Association (SIA)	Space Data Association (SDA)	Space Safety Coalition (SSC)	World Economic Forum
Normative? (●=Y ○=N ●=Mix)	●	○	○	○	○	●	○	○	●	○	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	○	○
Capacity building																											
Casualty risk																											
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Jurisdiction & ownership																											
Moon & celestial bodies																											
Registration																											
Responsibility/Liability																											
RPO/OOS																											
Safety																											
Security																											
Space law																											
Space weather effects																											
SSA																											
Standardization																											
TCBMs																											

# How can we ensure the benefits of space for future generations?

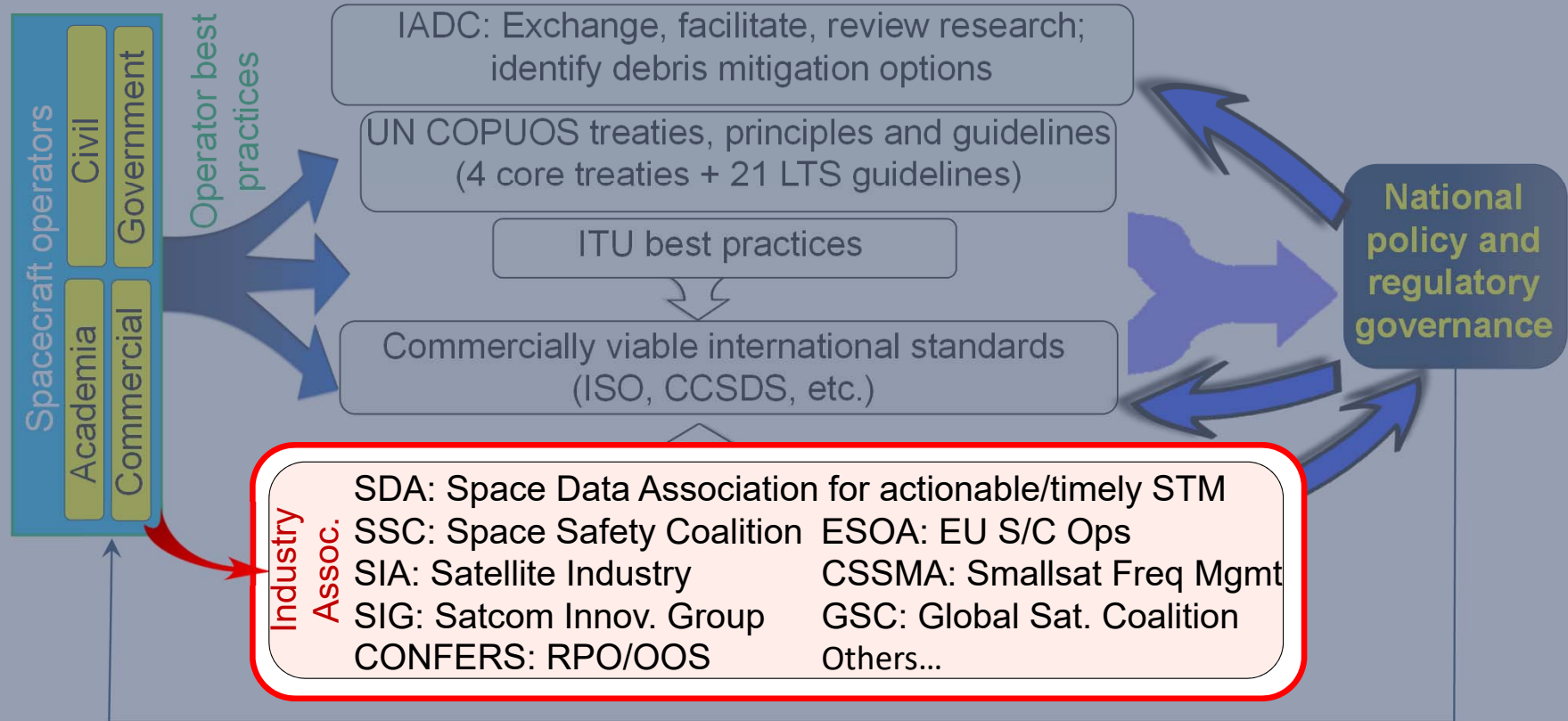
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# Space governance framework *virtuous cycle*





# Space flight safety via industry-formed Space Data Association (10 years)

The screenshot shows the Space Data Center website interface. The top navigation bar includes the logo "space data center" with the tagline "Serving the satellite operator community" and the "SPACE DATA ASSOCIATION" logo. Below the navigation bar, there are buttons for "Ephemeris Data", "Maneuver Reporting", "Conjunction Reports" (highlighted in green), and "RFI Events". The main content area displays "conjunction reports for SES" with a dropdown menu. Below this, there is a section titled "Conjunction Reports" with a link to view more items. A table lists several reports with columns for ID, Source, Analysis Start Date (UTC), Analysis Stop Date (UTC), Status, and # of Satellites.

ID	Source	Analysis Start Date (UTC)	Analysis Stop Date (UTC)	Status	# of Satellites
47081	Scheduled Run	2019-08-16 02:00:00.000	2019-08-23 02:00:00.000	Estimated start time: 2019-08-16 02:00:00	0
47080	Scheduled Run	2019-08-16 00:00:00.000	2019-08-23 00:00:00.000	Completed: 9 min 41 sec	19013
47078	Scheduled Run	2019-08-15 22:00:00.000	2019-08-22 22:00:00.000	Completed: 9 min 40 sec	19013
47076	Scheduled Run	2019-08-15 20:00:00.000	2019-08-22 20:00:00.000	Completed: 9 min 39 sec	19013
47073	Scheduled Run	2019-08-15 18:00:00.000	2019-08-22 18:00:00.000	Completed: 9 min 40 sec	19013
47072	Scheduled Run	2019-08-15 16:00:00.000	2019-08-22 16:00:00.000	Completed: 9 min 39 sec	19013



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# Space Safety Coalition (SSC)

- <https://spacesafety.org>
- Most operators support space sustainability
  - “It’s just good business sense”
  - Especially important for new large constellations
- SSC is a new ad hoc coalition of willing space operators and relevant industry stakeholders
  - Formed to assemble aspirational best space operations practices
  - Not a legal entity
- SSC can make a difference, in *advance* of:
  - Space governance treaties and consensus guidelines
  - Standards
  - National regulations
- Signatories endorse and agree to strive to implement best practices
  - To ensure safety and commercial viability of space activities

# 37 endorsing space organizations so far.



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## SSC's “Best Practices for the Sustainability of Space Operations”

- **A ground-breaking “living” best practices document:**
  - **Part 1:** Endorses existing international guidelines and standards ([IADC](#), [UN](#), [ISO](#))
  - **Part 2:** Contains **over forty additional specific best practices** to further enhance and secure the long-term sustainability of space operations
  - Spans all phases of design and spaceflight, orbit regimes, spacecraft form factors, life cycle phases, and mission types



## SSC's best practices address majority of UN 2019 LTS guidelines

- [A/AC.105/C.1/L.366](#) “Guidelines for the Long-term Sustainability of Outer Space Activities”

Guideline	Guideline Title	SSC Endorsement Doc
<b>Safety of space operations</b>		
B.1	Provide updated contact information and share information on space objects and orbital events	Endorses data sharing relevant to orbital debris mitigation and collision avoidance
B.2	Improve accuracy of orbital data on space objects and enhance the practice and utility of sharing orbital information on space objects	Endorses accurate orbit solutions and data sharing
B.3	Promote the collection, sharing and dissemination of space debris monitoring information	Encourages use of SSA and STM entities to share safety of flight data
B.4	Perform conjunction assessment during all orbital phases of controlled flight	Endorses Active Collision Avoidance when feasible
B.5	Develop practical approaches for pre-launch conjunction assessment	Endorses use of launch providers who take steps to preclude collisions between spacecraft, stages of the launch vehicle, active space and debris throughout deployment phase
B.6	Share operational space weather data and forecasts	
B.7	Develop space weather models and tools and collect established practices on the mitigation of space weather effects	
B.8	Design and operation of space objects regardless of their physical and operational characteristics	Endorsed practices are agnostic of size/form factor/function.
B.9	Take measures to address risks associated with the uncontrolled re-entry of space objects	Advocates for design for demise and 1.e-4 casualty risk per spacecraft
B.10	Observe measures of precaution when using sources of laser beams passing through outer space	

Guideline	Guideline Title	SSC Endorsement Doc
<b>Scientific and technical research and development</b>		
D.1	Promote and support research into and the development of ways to support sustainable exploration and use of outer space	Incorporates by reference and promotes IADC guidelines which are based upon such research
D.2	Investigate and consider new measures to manage the space debris population in the long term	Incorporates by reference and promotes IADC guidelines which are based upon such investigations

## SSC's best practices address majority of UN 2019 LTS guidelines

Guideline	Guideline Title	SSC Endorsement Doc
<b>Policy and regulatory framework for space activities</b>		
A.1	Adopt, revise and amend, as necessary, national regulatory frameworks for outer space activities	
A.2	Consider a number of elements when developing, revising or amending, as necessary, national regulatory frameworks for outer space activities	
A.3	Supervise national space activities	
A.4	Ensure the equitable, rational and efficient use of the radio frequency spectrum and the various orbital regions used by satellites	
A.5	Enhance the practice of registering space objects	Endorses spacecraft owner, operator and stakeholder exchange of information relevant to safety-of-flight and collision avoidance with other space operators and stakeholders

Guideline	Guideline Title	SSC Endorsement Doc
<b>International cooperation, capacity-building and awareness</b>		
C.1	Promote and facilitate international cooperation in support of the long-term sustainability of outer space activities	Incorporates by reference IADC, UN COPUOS and ISO/CCSDS guidelines and standards which promote international cooperation
C.2	Share experience related to the long-term sustainability of outer space activities and develop new procedures, as appropriate, for information exchange	Spacecraft owners, operators and stakeholders should exchange information relevant to safety-of-flight and collision avoidance via intra-operator coordination and SSA and STM service entities
C.3	Promote and support capacity-building	Incorporates by reference IADC, UN COPUOS and ISO/CCSDS guidelines and standards which promote capacity building
C.4	Raise awareness of space activities	Incorporates by reference IADC, UN COPUOS and ISO/CCSDS guidelines and standards which promote space activities

# AIAA global space governance characterization

	United Nations	International NGOs	National Regulatory	Industry Consortia
	<ul style="list-style-type: none"> <li>UN COPUOS (Treaties)</li> <li>UN COPUOS (Excl. Treaties, SDM &amp; LTS Guidelines)</li> <li>United Nations Space Debris Mitigation Guidelines</li> <li>United Nations Long Term Sustainability Guidelines</li> </ul>	<ul style="list-style-type: none"> <li>Committee on Space Research (COSPAR)</li> <li>Consultative Committee for Space Data Stds</li> <li>Inter-Agency Debris Coordination Committee</li> <li>Intl Assoc for Adv of Space Safety (IAASS)</li> <li>Intl Organization for Standardization (TC20/SC14)</li> <li>International Telecommunications Union (ITU)</li> </ul>	<ul style="list-style-type: none"> <li>Canada</li> <li>EU</li> <li>France</li> <li>Japan</li> </ul>	<ul style="list-style-type: none"> <li>Space Explorers (ASE)</li> <li>Space Data Association (SDA)</li> <li>Space Safety Coalition (SSC)</li> <li>World Economic Forum</li> <li>Space Safety Association (SSA)</li> <li>Space Safety Coalition (SSC)</li> <li>World Economic Forum</li> <li>Space Safety Association (SSA)</li> <li>Space Safety Coalition (SSC)</li> </ul>
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Casualty risk	●	○	○	○
Contamination (physical)	●	○	○	○
Contamination (radiation)	●	○	○	○
Contamination (RFI)	●	○	○	○
Cooperation, inclusiveness	●	○	○	○
Exchange of space data	●	○	○	○
Health & status	●	○	○	○
Jurisdiction & ownership	●	○	○	○
Moon & celestial bodies	●	○	○	○
Registration	●	○	○	○
Responsibility/Liability	●	○	○	○
RPO/OOS	●	○	○	○
Safety	●	○	○	○
Security	●	○	○	○
Space law	●	○	○	○
Space weather effects	●	○	○	○
SSA	●	○	○	○
Standardization	●	○	○	○
TCBMs	●	○	○	○

Legal entities that have a direct and material interest in space safety and sustainability can learn more about the space safety coalition at: <https://spacesafety.org> or email us at [info@spacesafety.org](mailto:info@spacesafety.org)

## Best Practices for the Sustainability of Space Operations

