

# Orbital Debris Mitigation

AIAA Small Satellite Technical Committee

# Agenda

- ▾ Motivation
- ▾ Strategies
  - ▾ Policy Solution
  - ▾ Next Step
- ▾ Next Step
  - ▾ What
  - ▾ When
  - ▾ Where
  - ▾ How

# Motivation

- Proliferation of small sats pose a threat to high value assets (percieved threat most are in LEO)
- Mitigate the threat that governments will curtail the launch of small sats (Over reaction of government may curtail the licensing of small sat)
  - Over saturation within LEO
- No enforceable limits on orbital lifetime
  - UN limits it to 25 years post mission

# Motivation

- ↓ SmSTC notes that
  - ↓ Increased discussion of and concerning space debris hazards
  - ↓ Some actors noting the limited control of launching and operations of small sats (government threat)
  - ↓ No broadly-accepted practices or formal policies
  - ↓ Pre-emptive in developing our own formal policy
- ↓ FCC
  - ↓ Frequency allocation (SP)
  - ↓ New cost rules

# Goal

- Recognizing the critical nature of protecting the space environment - critical infrastructure
  - We want to draft best practices
  - Uniquely situated to develop long-term strategies around reducing orbital debris that might be caused by small sats
  - Evolve from discussion to implementation best practices
  - Establish a AIAA Small Satellite Debris Mitigation Working Group
  - IAA Space Debris Working Group (NFC)

# Discussion (10 min)

- ▾ FCC Proposed Rulemaking
  - ▾ Scott Palo

# Discussion (10 min)

- ↳ Lessons Learned from Other Sectors
  - ↳ Norman Fitz-Coy

# Sectors

- All are global phenomena closely intertwined in our daily lives; have significant societal implications
- Long term sustainability of each depends on existence of appropriate rules, protocols, and operational procedures to guard against overuse and/or abuse
- Due to their global influence, each sector is represented at the United Nations (UN)

## **Space:**

as pertaining to outer space in particular the region within the Earth's sphere of influence

## **Financial:**

as pertaining to institutions, instruments, and the regulatory framework that provide financial services to its customers



# Space Sector

Year	Particulars of Relevant Space Debris Events
1959	UN COPUOS established
1967	UN Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies
1972	UN Convention on International Liability for Damage Caused by Space Objects
1976	UN Convention on Registration of Objects Launched into Outer Space
1978	Don Kessler published “Collision Frequency of Artificial Satellites: The Creation of a Debris Belt” in <i>Journal of Geophysical Research</i>
1993	IADC formed by Japan, Russia, US space agencies and the European Space Agency
1995	NASA issues first mitigation guidelines
2001	U.S Government Orbital Debris Mitigation Standard Practices
2002	IADC Space Debris Mitigation Guidelines
2007	UN General Assembly endorsed the UNCOPUOS Space Debris Mitigation Guidelines
2010	ISO Space Debris Mitigation Requirements

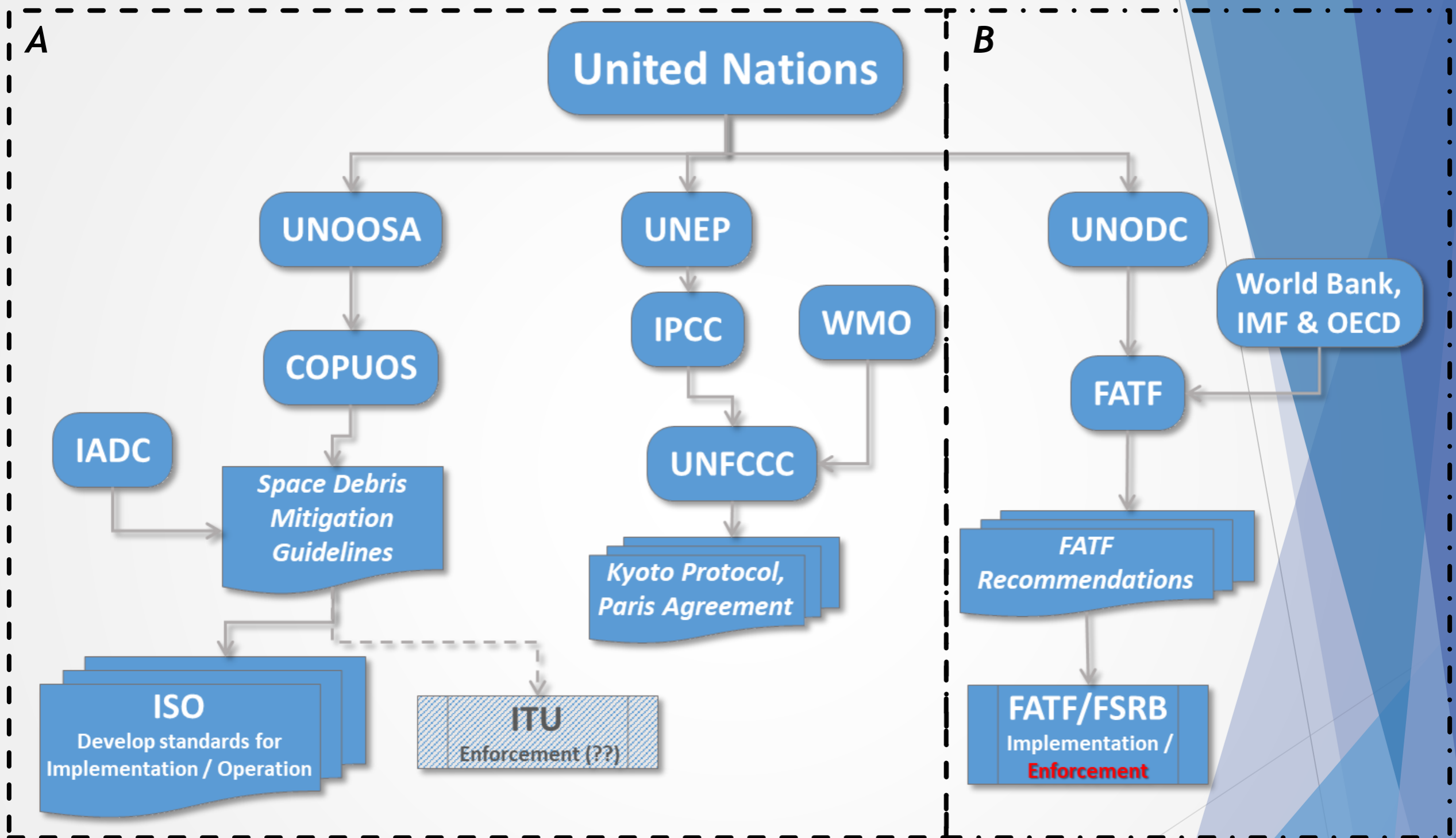
# Terrestrial Sector

Year	Particulars of Relevant Climate Change Events
1979	First World Climate Conference
1988	Intergovernmental Panel on Climate Change (IPCC) established
1990	Second World Climate Conference calls for a global treaty on climate change; UN begins discussions on a framework convention
1991	First meeting of the Intergovernmental Negotiating Committee (INC)
1992	UNFCCC text adopted by the INC at the Earth Summit in Rio
1994	UNFCCC entered into full force
1994	First Conference of the Parties (COP 1) in Berlin
1997	Adaptation of Kyoto Protocol at COP 3
2005	Kyoto Protocol entered into force
2007	IPCC's 4 <sup>th</sup> Assessment Report; climate science enters social consciousness
2012	Doha Amendment to the Kyoto Protocol is adopted
2016	Paris Agreement entered into force in November with signing by 143 of 197 parties

# Financial Sector

Year	Particulars of Relevant Financial (FATF) Events
1990	First set of Forty Recommendations on money laundering was issued
1996	The 40 Recommendations were revised and a series of Interpretative Notes issued to clarify the application of the Recommendations
2000	The first list of Non-Compliant Countries and Territories (NCCT) was published (15 countries)
2001	<ul style="list-style-type: none"> <li>• The 9 Special Recommendations on terrorist financing were issued</li> <li>• Second list of NCCT countries published (8 countries)</li> </ul>
2003	Significant amendments were made to the scope of the Recommendations, expanded to include designated non-financial businesses and professionals (DNFBP) in the customer due diligence (CDD) requirements
2005	Addressed threat posed by cash couriers and measures to detect physical cross-border transportation of cash and bearer monetary instruments introduced
2006	The last country on the NCCT list was de-listed
2012	Latest revision of the FATF Recommendations which addresses proliferation of weapons of mass destruction

# ORBITAL DEBRIS MITIGATION - AIAA SmSTC/TC



COPUOS – Committee on the Peaceful Uses of Outer Space  
 FATF – Financial Action Task Force (on Money Laundering)  
 FSRB – FATF-Style Regional Bodies  
 IADC – Inter-Agency Space Debris Coordination Committee  
 IMF – International Monetary Fund  
 IPCC – Intergovernmental Panel on Climate Change  
 ISO – International Organization for Standardization

ITU – International Telecommunications Union  
 OECD – Organisation for Economic Co-operation and Development  
 UNDOC – UN Office on Drugs and Crime  
 UNEP – UN Environment  
 UNFCCC – UN Framework Convention on Climate Change  
 UNOOSA – UN Office for Outer Space Affairs  
 WMO – World Meteorological Organization

	Group A	Group B
Sectors	<ul style="list-style-type: none"> <li>• Terrestrial</li> <li>• Space</li> </ul>	<ul style="list-style-type: none"> <li>• Financial</li> </ul>
Existence of problem acknowledged	<ul style="list-style-type: none"> <li>• Terrestrial: Not universally</li> <li>• Space: Acknowledge</li> <li>• Observability challenge</li> </ul>	<ul style="list-style-type: none"> <li>• Yes, universally acknowledged</li> <li>• Observable and controllable</li> </ul>
Status	<ul style="list-style-type: none"> <li>• Acknowledgement of problem needed</li> <li>• Enforcement mechanisms needed</li> <li>• Consequences to deter violations needed</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation and feedback mechanism in place</li> <li>• Effects of actions are observable, thus impact of modifications can be assessed</li> <li>• Consequences to deter violations</li> </ul>
Long-term sustainability	Ad hoc strategies in place for addressing needs	Pro-active measures in place to address current and emerging needs

- **Observability:** Ability to quantify internal system states from knowledge of its external stimuli
- **Controllability:** Ability to transition a system from one set of states to another within the system's configuration space via appropriate inputs

# Thoughts for Sustainability

- Identify appropriate metric(s) to monitor that is(are) agreeable to all
- Develop and implement punishment mechanism for violators
- Publicize and hold member states accountable for violations
- Develop and implement a feedback mechanism to address current and emerging trends/needs

**Can/should SmSTC lead this effort for smallsats?**

# Discussion

- ♦ Next Step
  - ♦ Strong Interest to Address the Subject?
  - ♦ Going Forward
    - ♦ Student Competition
    - ♦ Policy Committee Involvement
  - ♦ Continuation of Dialogue
    - ♦ Small Sat Conference August Utah
      - ♦ Ask Ryan if we can do a special session
    - ♦ IAC October 2018 Bremen, Germany (Washington, DC 2019)
      - ♦ To involve the International community (NFC)
  - ♦ Putting out document for comments
    - ♦ Providing an avenue for future best practices
      - ▶ Report for presenting at Small Sat Conference in Logan
      - ▶ Solicit concept papers on Space Debris Mitigation with deadline of June for Small Sat Conf. (Logan)