



Implementation of the Outer Space Treaties in view of Small Satellites

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Bottom Line First

- The four core Outer Space Treaties apply to SmallSats the same as they do to other space objects.
- SmallSats present **unique challenges** because of:
 - their nature as secondary payloads,
 - potential quantity,
 - small size and potential launch sites,
 - the variety of launching entity types, and
 - limited life span vs. time in orbit.

Discussion Points

The UN Outer Space Treaties and Guidelines, as relate to:

- Responsibility,
 - Ownership,
 - Liability,
 - Registration, and
 - Debris mitigation
- of SmallSats.

SmallSats

- No set definition
- Categories of sizes:
 - Mini satellites < 1000 kg
 - Nano satellites < 10 kg
 - Pico satellites < 1 kg
 - Femto satellites < 0.1 kg
- CubeSat:
 - Cube 10 cm on each edge = 1 U; up to 6 U
 - 1 U size weighs about 3 lbs.
 - Launched from dispensers (NASA: P-PODs)



NASA

SmallSats (cont'd)

- Characteristics may include:
 - Short development times
 - Small development teams
 - Modest development and testing infrastructure requirements
 - Affordable development and operation costs

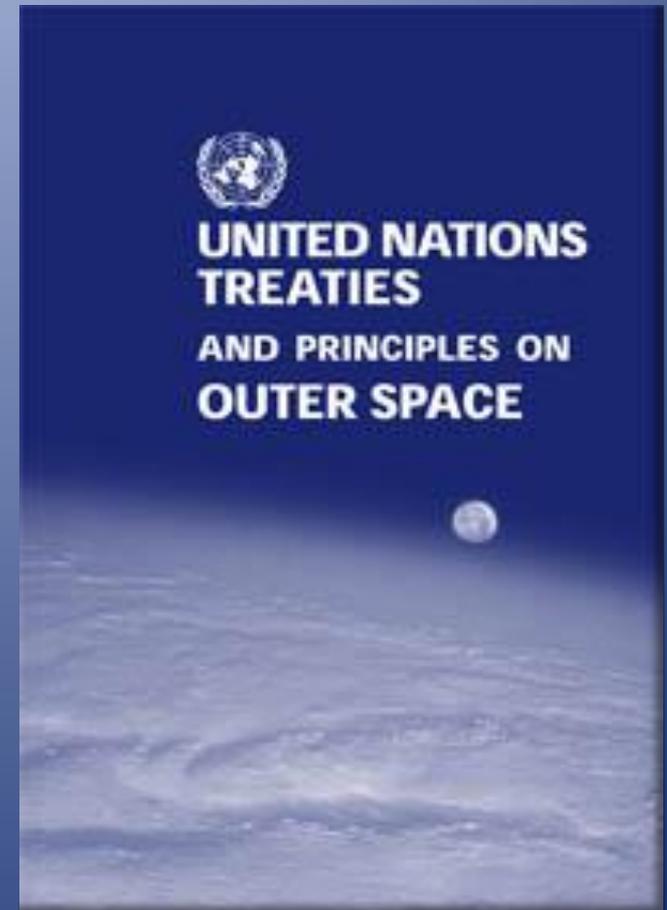
(Source: UNOOSA/ITU Guidelines)

SmallSat Prevalence

- “Deloitte predicts that **by the end of 2015 over 500 additional nanosats will be in orbit . . .** Prior to 2014, only 75 nanosats had ever been launched, so the prediction calls for a 400% increase.”
- SpaceWorks:
 - **2013 count: 92 nano/microsatellites launched (1-50 kg), 270% over 2012**
 - **2014-2020 projection: 2,000-2,750 total requiring launch.**

UN Core Outer Space Treaties

- 1967 Outer Space Treaty
- 1968 Rescue Treaty
- 1972 Liability Convention
- 1976 Registration Convention



Governance

- UN Committee on the Peaceful Uses of Outer Space (COPUOS)
 - Scientific and Technical Subcommittee
 - Legal Subcommittee
- Meet annually, working on the basis of consensus; COPUOS makes recommendations to the General Assembly
- 77 Member States are in COPUOS
- 4 Core Treaties and Agreements
- Declarations, Guidelines and Legal Principles



Outer Space Treaty

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies

- Article I: **Outer space shall be free for exploration and use by all States**; no discrimination; freedom of scientific exploration.

Outer Space Treaty - Limits

- Article II: Outer space, the Moon, and other celestial bodies are **not subject to national appropriation**
 - No claims of sovereignty
 - No claims of ownership by occupation
- Article IV
 - No weapons of mass destruction
 - The Moon and other celestial bodies- exclusively for peaceful purposes
- Article IX
 - No harmful contamination

Outer Space Treaty - Responsibility

- Article VI: “States . . . bear international responsibility for national activities in outer space . . . *whether such activities are carried on by governmental or by non-governmental entities*, and for assuring that national activities are carried out in conformity with the provisions [of the Treaty]. The activities of non-governmental entities in outer space . . . shall require *authorization and continuing supervision by the appropriate State party to the Treaty.*”

Outer Space Treaty – Liability and Control

- Article VII: provides for **international liability** of a launching State for damage to another State Party, in air space or in outer space.
- Article VIII: A State Party to the Treaty on whose registry an object launched into outer space is carried **shall retain jurisdiction and control over such object . . . while in outer space**

Outer Space Treaty – Ownership

- Article VIII (cont'd): **Ownership** of objects launched into outer space . . . is not affected by their presence in outer space . . . or by their return to the Earth.

Liability Convention

Convention on International Liability for Damage Caused by Space Objects

- Article I:

(c) The term "**launching State**" means:

(i) A State which **launches** or **procures the launching** of a space object;

(ii) A State from whose **territory or facility** a space object is launched;

(d) The term "**space object**" includes component parts of a space object as well as its launch vehicle and parts thereof.

Liability Convention (cont'd)

- Article II: A launching State shall be **absolutely liable** to pay compensation for damage caused by its space object **on the surface of the earth or to aircraft flight.**
- Article III: Damage to a space object elsewhere than on the surface of the earth -- A launching State shall be liable only if the damage is **due to its fault or the fault of persons for whom it is responsible.**

Liability Convention (cont'd)

- Article V: Whenever two or more States jointly launch a space object, they shall be **jointly and severally liable** for any damage caused.
- Article VI: **Exoneration from absolute liability** may arise from gross negligence of or intent to cause damage by the claimant State.
- Article VII: Convention **does not apply to damage to nationals of the launching State**. (covered by national law)

Liability Convention (cont'd)

- Article VIII: A State which suffers damage, or whose natural or juridical persons suffer damage, may present to a launching State a claim for compensation for such damage.
- Article IX: Claims must be presented through diplomatic channels. Claim may be presented through the UN Secretary-General.
- More – 1 year time limit from when State knew or should have known; Claims Commission

Registration Convention

Convention on the Registration of Objects Launched into Outer Space

- Article I: Launching State -- Same definition as the Liability Convention
- Article II: **Launching States must register launched space objects on a national registry.**

Registration Convention (cont'd)

- Articles III and IV: UN Secretary-General shall maintain an open-access Register with the following information furnished by the launching States:

name of launching State or States	basic orbital parameters:
space object designator or reg. no.	-- nodal period
date and territory or location of launch	-- inclination
general function of the space object	-- apogee
	-- perigee

Registration Convention (cont'd)

- Article II: Two or more Launching States: **jointly determine which shall register** the space object.
- *“In general, States providing launch services do not register satellites launched on behalf of foreign clients.” (UNOOSA/ITU Handout)*

Registration

- Query which is the appropriate State of registry and what designator to provide:

SmallSat jointly designed and operated by an American university and a South American company is launched off of the ISS (Japan module), having been an auxiliary payload of a cargo resupply mission launched in Russia for Europe.

Ultimately, **under the jurisdiction and control of**

- **Designator example**, U.S. appropriate State of registry:
 - 1998-067CQ; Tech-Ed-Sat; 4 October 2012; International Space Station: Kibo -- Spacecraft engaged in practical applications and uses of space technology such as weather or communications

Registration Mechanics

- UN Registration may be completed using a form available online.
- Submit **ONLY** through a **Diplomatic Mission** accredited to the UN; States are to submit in hard copy and via email.
- States are to notify the UN as to reentry/decay (Article IV).


UNITED NATIONS REGISTER OF OBJECTS LAUNCHED INTO OUTER SPACE

Registration Information Submission Form (as at 1 January 2010)

Note: This form is available from <http://www.unoosa.org/oosa/SOR/register/resources.html>. Please see annex for instructions and definitions. Completed forms should be sent by hardcopy through Permanent Missions to UNOOSA and electronically to sorregister@unoosa.org.

Part A: Information provided in conformity with the Registration Convention or General Assembly resolution 1721 B (XVI)			
New registration of space object	Yes <input type="checkbox"/>	Check box	
	Submitted under the Convention: ST/SG/SER/E/ _____	UN document number in which previous registration data was distributed to Member States	
Additional information for previously registered space object (see below for reference sources)	Submitted under resolution 1721B: A/AC.105/NF. _____		
Launching State/States/International intergovernmental organization			Under the Registration Convention, only one State of registry can exist for a space object. Please see annex.
State of registry or international intergovernmental organization			
Other launching States (where applicable. Please see attached notes.)			
Designator			
Name			
COSPAR international designator (see below for reference sources)			
National designator/registration number as used by State of registry			
Date and territory or location of launch			
Date of launch (hours, minutes, seconds optional)	ddmm/yyyy	hrs min sec	Coordinated Universal Time (UTC)
Territory or location of launch (see below for reference sources)			
Basic orbital parameters			
Nodal period		minutes	
Inclination		degrees	
Apogee		kilometres	
Perigee		kilometres	
General function			
General function of space object (if more space is required, please include text in a separate MSWord document)			
Change of status			
Date of decay/reentry/deorbit (hours, minutes, seconds optional)	ddmm/yyyy	hrs min sec	Coordinated Universal Time (UTC)
Sources of information			
UN registration documents	http://www.unoosa.org/oosa/SOR/register/docs/sta8181.html		
COSPAR international designators	http://nssdc.gsfc.nasa.gov/planckmain/		
Global launch locations	http://www.unoosa.org/oosa/SOR/register/resources.html		
Online Index of Objects Launched into Outer Space	http://www.unoosa.org/oosa/online/index.html		

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Registration Mechanics (cont'd)

- Information in conformity with the Registration Convention and GA resolution 1721 B (XVI)
 - Previously discussed data (above)
- **Change of status in operations**
 - Date when space object is no longer functional
 - Date when space object is moved to a disposal orbit
 - Physical conditions when moved to a disposal orbit
- **Basic orbital parameters**
 - Geostationary position

Space Debris Mitigation Guidelines

By COPUOS, 2010

1. Limit debris released during normal operations

- Design systems not to release debris in normal operations
- Minimize the effect of any debris release

2. Minimize the potential for break-ups during operational phases

- Avoid failure modes that lead to accidental break-ups
- If a failure is detected, execute disposal and passivation measures to avoid break-ups

Mitigation Guidelines (cont'd)

3. Limit the probability of accidental collision in orbit.

- Estimate and limit probability of collision during launch phase and orbital lifetime.
- Adjust launch time or perform on-orbit maneuver.

4. Avoid intentional destruction and other harmful activities.

- Intentional destruction poses a threat to creating long-lived space debris.
- Only conduct necessary break-ups at low altitude to limit orbital lifetime of fragments.

Mitigation Guidelines (cont'd)

5. Minimize potential for post-mission break-ups resulting from stored energy.
 - On-board sources of stored energy should be depleted or made safe when no longer required.
6. Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission.
 - Remove in a controlled fashion space launch and vehicle orbital stages that have terminated their operational phases in orbits that pass through the LEO region.
 - If removal is not possible, dispose of in orbits that avoid long-term presence in the LEO region.

Mitigation Guidelines (cont'd)

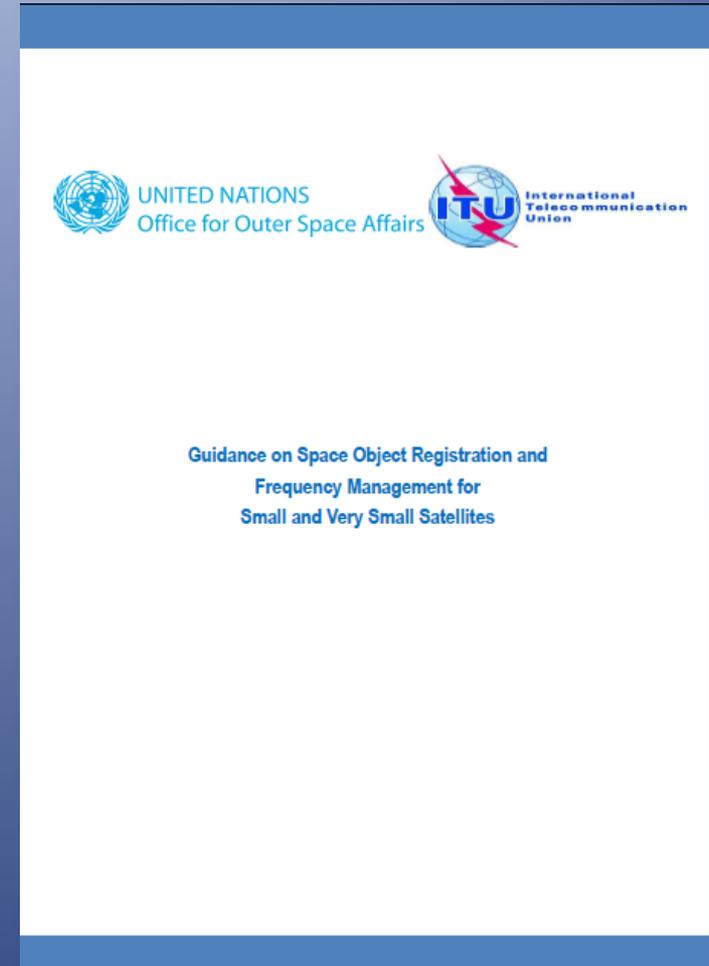
7. Limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit (GEO) region after the end of their mission.
 - Where vehicle stages have terminated their operational phases in orbits that pass through the GEO region, leave in orbits that avoid GEO region interference.
 - For objects in or near the GEO region, leave objects in an orbit above the GEO region.

Summary

- **Responsibility** – States are responsible for the compliance of their national private parties and academic institutions with the Outer Space Treaties.
- **Ownership** – ownership of a space object remains with the original owner throughout launch, operation, and re-entry, unless expressly transferred.
- **Liability** – States are absolutely liable for damage on the earth and in air flight; fault determines liability in space.
- **Registration** – when a space object is launched into Earth orbit or beyond, the launching State shall register the space object.

Reference Material

- UN Office for Outer Space Affairs (UNOOSA) and International Telecommunications Union (ITU) handout: *Guidance on Space Object Registration and Frequency Management for Small and Very Small Satellites (April 2015)*



Outer Space Treaties and SmallSats

- Thank you!