

# Space debris remediation as a next step towards outer space sustainability

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# Some general rules of space law

- Space must be used for the benefits and in the interest of all countries
- Int'l law and UN charter apply
- States are responsible for objects launched into outer space
- Launching state is liable for damage caused by its space object
- States must register objects they launch, have jurisdiction and control, registration does not affect ownership
- States must avoid harmful contamination, duty to inform, consult



# Problems with regard to debris

- What is a space object?
  - Dead satellite? Malfunctioning one? Screw driver? Paint chip?
  - Should state remain responsible / liable if it can't control the object anymore?
  - What if a satellite is sold to a foreign company?
- No rules on debris in treaties, term is not mentioned
- IADC and UN Space Debris Mitigation Guidelines
  - Not legally binding, 'guidelines'
  - Do not really address remediation

# Int'l environmental law

- Trail smelter arbitration 1939
  - Obligation to prevent, reduce, control environmental harm
- Corfu Channel case 1940
  - Not knowingly allow territory to be used for acts contrary to rights of other states
- Cosmos 954, 1978
  - Ad hoc settlement
- Stockholm, Rio Declarations, etc.
- Advisory opinion on nuclear weapons, 1996
  - General obligation to respect int. environment
- Pulpmill case, 2010
  - EIA's
  
- Gradually emerging: legal obligation to protect environment and to remediate damage caused

# Mitigation v. remediation

- Mitigation: moderate, alleviate
  - i.e. not create any new debris by means of standards and guidelines in materials, re-entry etc.
- Remediation: correcting a fault or deficiency
  - i.e. reducing the current debris population



# Sustainability

- Kessler syndrome: cascade effect of colliding objects in space, in a cycle that will eventually become self-sustaining
- Collisions will occur even if we do not launch any more objects into space
- If 5 large intact objects per year were taken down, the cascade effect would be halted
- If 10 per year, the trend would be reversed
- And we could ensure sustainable use of space



# How does it work?

- Active removal of larger objects (intact satellites, upper stages of rockets), with high orbital lifetimes, in orbits with high spatial object density, from priority list
- Disposable recovery vehicle ('janitor satellite') launched from earth docks with objects and maneuvers them into re-entry trajectory
- Sequence: rendezvous, docking, controlled re-entry maneuver, direct atmospheric re-entry (and loss) of both objects

# More ways

- Nets dragging satellites to earth's atmosphere
- Lasers from ground or aircraft to change orbit or force re-entry of object
- Balloons puffing air to change orbit or force re-entry of object
- Tethers
- And more...



# Additional benefits

- Technology might also be used for in-orbit servicing, 'recycling' of re-usable parts
  - Solar arrays, transponders, etc.
- Less waste, longer life-time (MDA, DARPA,..)
- Salvage, commercial benefits

# Analogy: maritime salvage

- Born from economic motivation, lucrative but dangerous
- In the past, abandoned ships on high seas used to become res nullius, salvagers obtained ownership
- No longer the case, ownership remains
- But remuneration, taking into account :
  - No cure no pay, degree of risk, danger posed to property, skill, wear and tear
  - Assets back to owner

# Cont'd

- If wreck is a block or hazard, owner can be charged to remove it by public authorities
  - If e.g. oil spills, liability
- 1989 Int. Convention on Salvage (ICS) (no more 'no cure no pay'), limited scope, not applicable on high seas

# Possible show stoppers

- Cost
- Technology
- Security
  - Many technologies could be considered as weapons, aggression (lasers, etc.)
  - Satellite technology if salvaged can fall in hands of a foreign state or company
  - An object that can bring back a dead satellite could also catch a functional one
- Political will
  - Not yet an acute problem, it may have to get worse before it gets better
- Legal issues

# More legal issues

- Is it illegal to create debris?
- Is there an obligation to clean up debris?
- What if the wrong satellite is picked up?
- What if removal causes damage in space, on earth, in the air?
- Is consent or permission of owner needed for removal by third party (public or private)?
- Who pays?
- Who owns recovered parts?

# Developing custom, law

- Activity could help develop custom
  - A state may remove a space object it registered by means of another of its space objects
- States could include in their licensing requirements rules to assure active debris removal
- New international instrument?
- Soft law?
- Verification?

# National / international solution?

- Cost and technology would suggest international solution
  - But military & security problems may be huge
- International authority to collect money into a global cleanup fund and to decide about mission targets, to be recovered by licensed entities?
  - But depends on political will
- Or a national public/private entity, removing defunct satellites of that state, later for objects of its allies, for a fee, etc.



# Conclusion

- Remediation is the next step, after mitigation; not yet crucial, no catastrophic event yet
- Technologically possible
- Financial, security implications
- Many legal issues such as ownership, liability, need for permission, payment etc.
- Solve via int. cooperation, clean up fund, licensed salvagers
- Or start with national projects, develop custom
- Eventually reverse the process, create sustainability



# Thank you!

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