

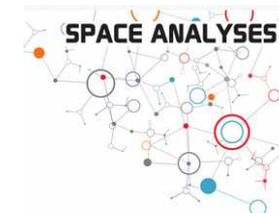
A Less Diplomatic View of Industry on the Implementation and Enforcement of Sustainability in Space

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3rd meeting of the Preparatory Group:
Hearing - 24 March 2021*

24.03.2021

Space as critical infrastructure



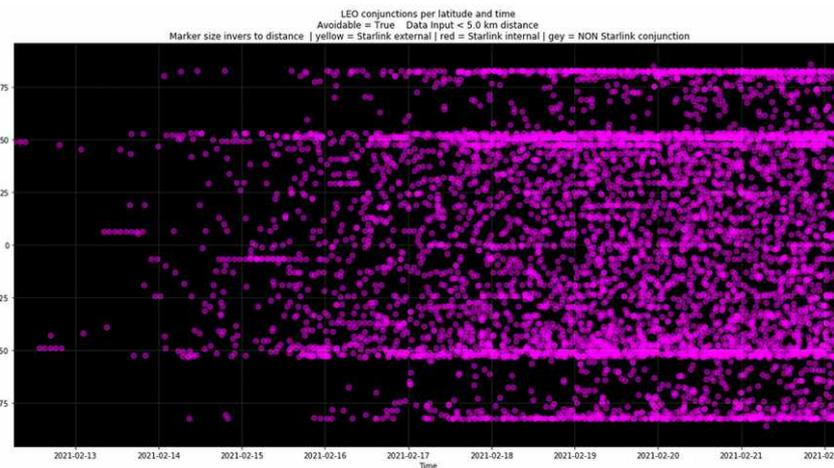
Vulnerability and Dependency is more than significant

France: classification of space infrastructure as strategic
 US: 7 Space Directives, Space Force

Unstoppable chain collision is the absolute 'worst case scenario'

Collision in GEO is the second 'worst case scenario'

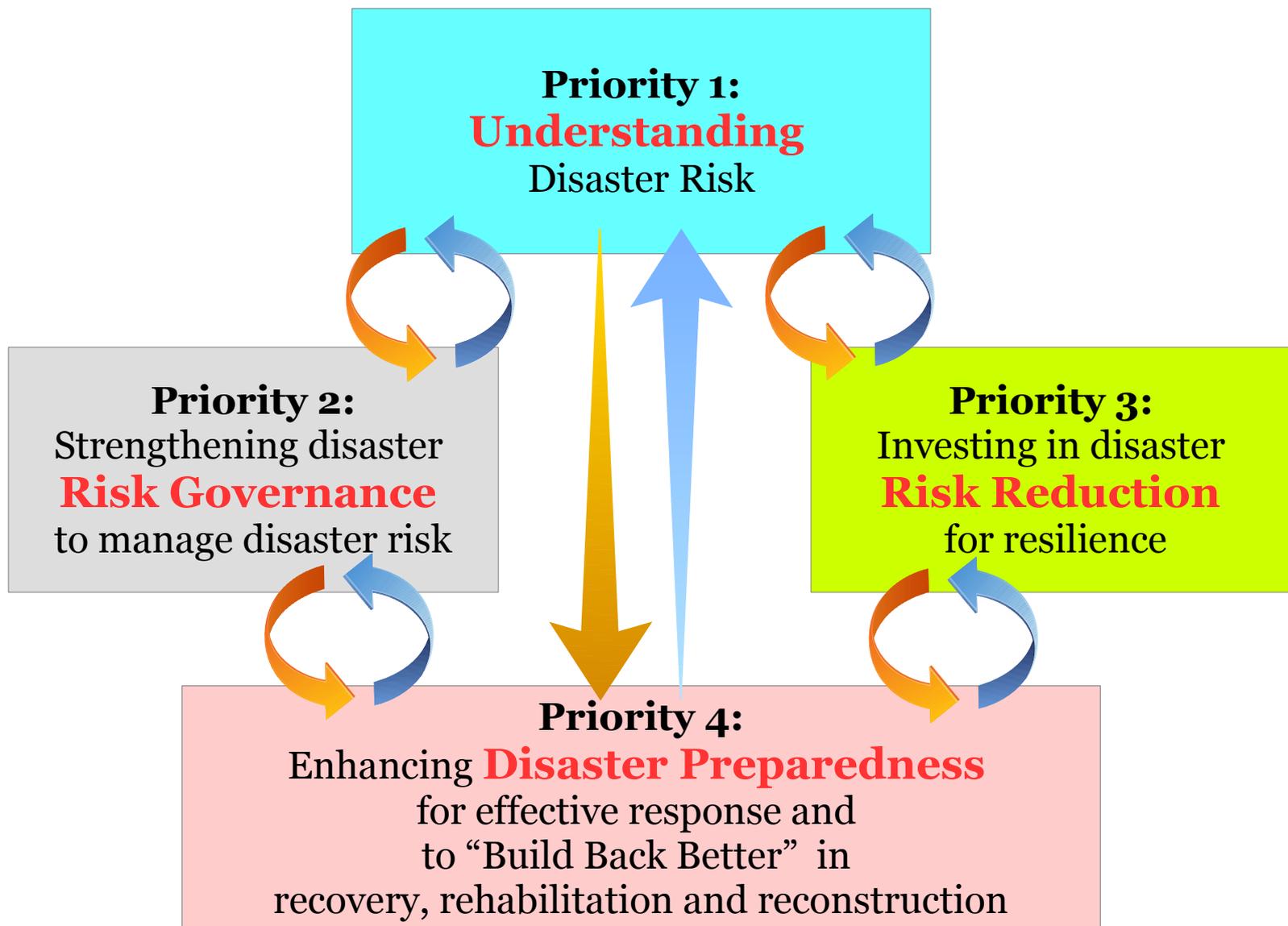
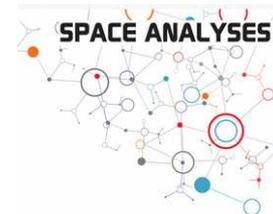
	<i>Global Navigation Satellite System (GNSS)</i>	<i>Communication (SatCom)</i>	<i>Metrology (SatMET)</i>
Energy Sector	Local Degradation	Local Degradation	Widespread Outage
Nuclear Industry	Local Outage	Local Degradation	Local Degradation
ICT	Widespread Outage	Widespread Outage	Not affected
Water Supply	Local Degradation	Not affected	Local Outage
Food Industry	Local Degradation	Local Degradation	Local Outage
Health Care	Local Degradation	Local Degradation	Local Degradation
Financial Sector	Widespread Outage	Local Degradation	Local Degradation
Transport	Local Outage	Local Degradation	Local Degradation
Chemical Industry	Local Outage	Local Degradation	Local Degradation
Research Facilities	Local Degradation	Local Degradation	Local Degradation



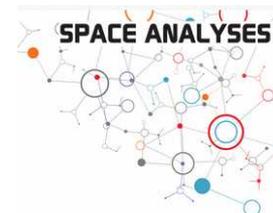
Combination of critical dependency, vulnerability, risk and consequences demands Classification as **Disaster according UN-SPIDER Sendai Framework**

Left picture data source: <https://www.rpsonline.com.sg/proceedings/esrel2020/html/4578.xml>

The 4 Priorities in UN-SPIDER Sendai Framework



Why Laws and Rules?



in abstract form **Laws and Rules should Enable or Prevent Situations by Regulating Behaviour**



Preventing

- The Kessler Syndrome
- Chain collisions
- Single collisions
- RF-Interference (to maintain the services)
- Occupation of territory (by flooding orbits with objects)
- Licence shopping

Enabling

- Access to Outer Space for all
- Continuity of safe and secure Outer Space usage
- Continuation of space services

Rules for Behaviour enable consequences in the event of deviation

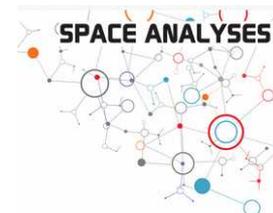
⇒ Monitor and detect deviations

“The FCC does not independently review the design for compliance with SD requirements but it is satisfied with a statement of compliance, plan of operation, and risk analysis provided by the operator. With the arrival of mega constellations a higher level of technical insight is necessary.”

Tommaso Sgobba, Executive Director of IAASS 12.03.21:

Proposal for implementation of a sustainable space environment in accordance with the LTS

1/3



1. Transparency of space objects

Entry into the UNOOSA registry of all objects before launch with all necessary details and with the duty to notify updates of any changes.



2. Strengthening National space laws (Spider Prio 2)

(a) **National implementation of space laws** with LTS as guidance and strict compliance obligations on operators under respective authorisations.



(b) **Ban of companies who are not complying to LTS** from public contracts and grants (also in the role of sub-supplier to a mission not LTS compliant).



(c) **LTS Compliance for operators as self declaration** to enable and strengthen liability also on the civil law level.



(d) **Responsibility for the management of non-operational space objects** (without fuel and completely dead space objects) under the responsibility of the owner (and behind the owner: the registration state)

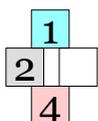
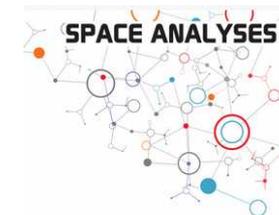


(e) Introduction of a **space resource utilization fee** to finance the monitoring of LTS compliance (e.g. €1 / orbit cycle and object)

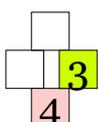


Proposal for implementation of a sustainable space environment in accordance with the LTS

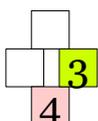
2/3



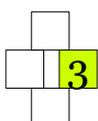
(f) Build up **LTS monitoring facilities** (analogy to terrestrial RF monitoring) to enable execution of national laws and license conditions



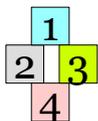
(g) Rules of **instantaneous public notice by operators of any irregularity** in space operations (space craft failures, close conjunctions, critical events, loss of propulsion...) →analogy to nuclear radiation events



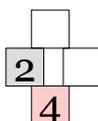
(h) Rules of mandatory **regular publishing of actual space craft location, manoeuvres and emissions** (e.g. RF) by operators



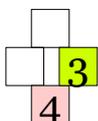
(i) Rules that all (new) **rocket bodies have to re-entered within max 2 days** after launch



(j) Rules to **publish the space-operation concepts** of the operators, especially for (mega) constellations

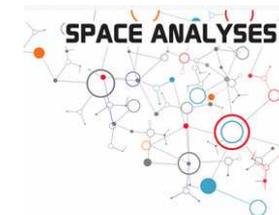


(k) Rules and requirements on **emergency plans and precautions, including mandatory clear escalation paths**



(l) Obligatory **orbit evacuation plans** (exit the orbits in case of collision), **exit paths** (in case of evacuation how and whereto bring the satellites in safe situations)





3. Resolve conflicts of interests

(a) Rules to **avoid and to handle conflicts-of-interest of stakeholders** (liability of transparency) → should apply e.g. for SDA, ESA, EUSST, EU, EUSPA/GSA contracts and operations.



(b) **Involve other disciplines** into the STM/SEM topic (e.g. <https://gmv.gu.se/>, <https://www.csh.ac.at/>) to utilise know-how from other science fields also in space management.



4. Finance space debris removal

Introduce a space debris removal fund financed by the operators/owners to remove space debris parts from rocket bodies, satellites and other objects (e.g. Envisat or dead GEO objects)



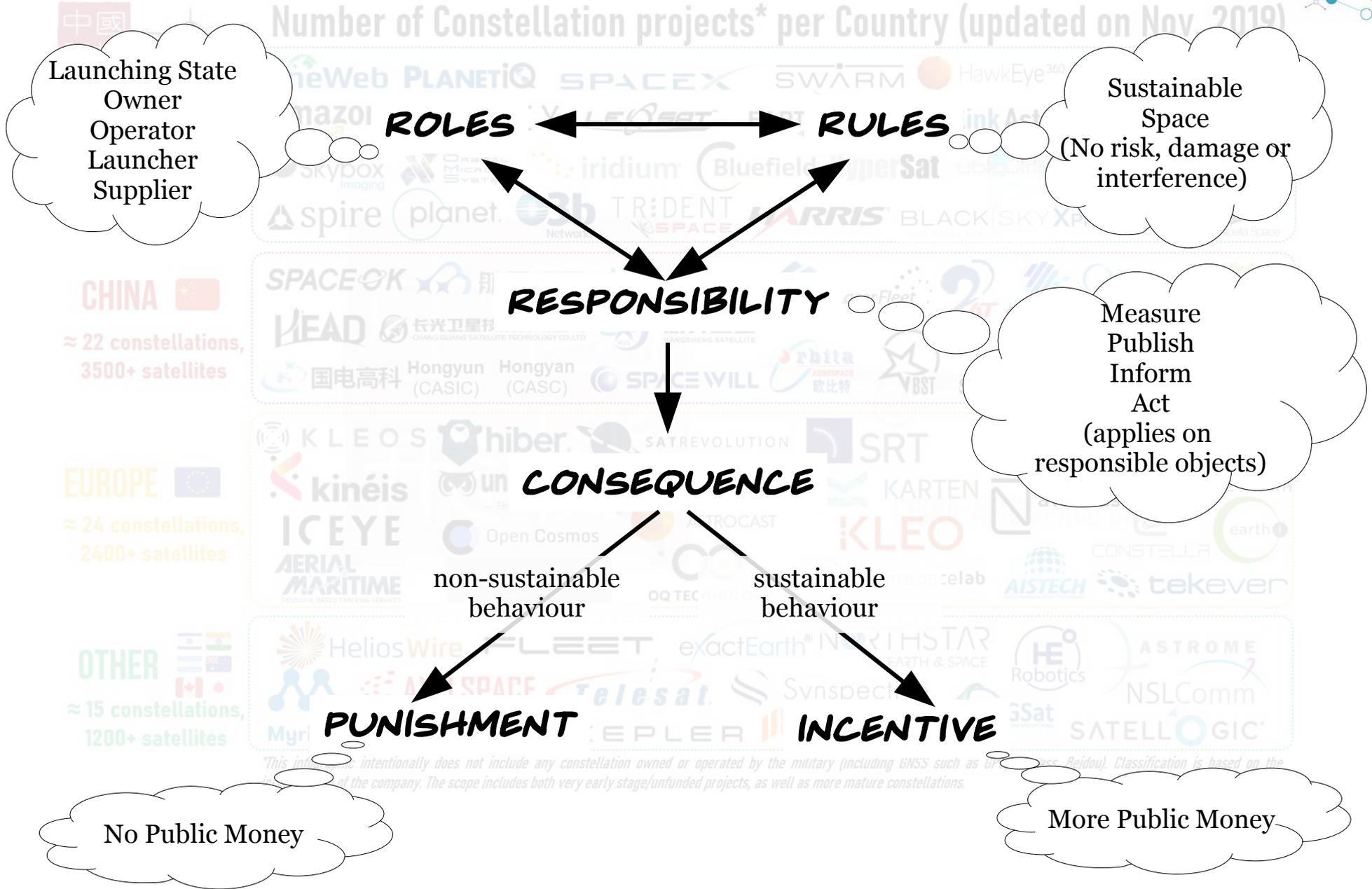
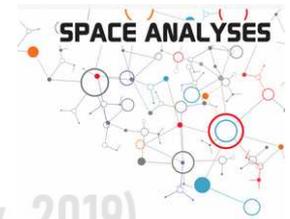
5. International ban of any anti satellite attacks

International ban of any anti satellite attacks (like Fengyun 1C) applicable to all types of space objects.



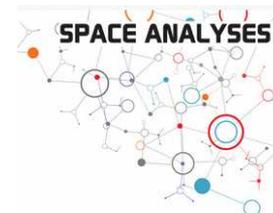
Rules, roles and responsibilities

Reference to WSF 2019 presentation



Background Figure Source: <https://china-aerospace.blog/space-industry-mapping/>

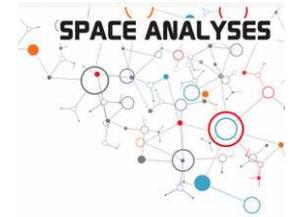
The Activities and Consequences



Launching/ National State	Operator	Supplier
<i>Activities</i>		
LTS Rules →	← LTS declaration → 	← LTS declaration 
Audit of Operators and Supplier   ✓ National ✓ International ✓ NGO / commercial ✓ Expert Centres	<ul style="list-style-type: none"> • Design • Build • Launch • Operate <ul style="list-style-type: none"> ● Measure ● Publish ● Get Information ● Act according LTS 	<ul style="list-style-type: none"> • Design • Build • Launch
<i>Consequences to actor if deviation to LTS behaviour rules</i>		
<ul style="list-style-type: none"> ✗ No Supply or Service of sub-contractors ✗ No Launch 	<ul style="list-style-type: none"> ✗ Withdrawal of license ✗ Ban on public money ✗ Penalty ✗ No supply or Service of sub-contractors ✗ No Launch 	<ul style="list-style-type: none"> ✗ Ban on public money ✗ Penalty ✗ Black-listed from Tenders

LTS = COPUOS Long Term Sustainability Guidelines for Space

The Logistical Impacts



Launching/ National State	Operator	Supplier
<i>Activities to implement LTS</i>		
Implementing LTS rules in national laws	Implement LTS compliance rules in the organisation and operation	Implement LTS compliance rules in the organisation
<ul style="list-style-type: none"> Build infrastructure or agree about external service to determine and document possible malpractice 	<ul style="list-style-type: none"> Build infrastructure or agree about external service to determine and document space object behaviour Integrate service to publish data Integrate service to inform the operation about other space objects 	

LTS = UNOOSA Long Term Sustainability Guidelines for Space

Please Switch on the Light

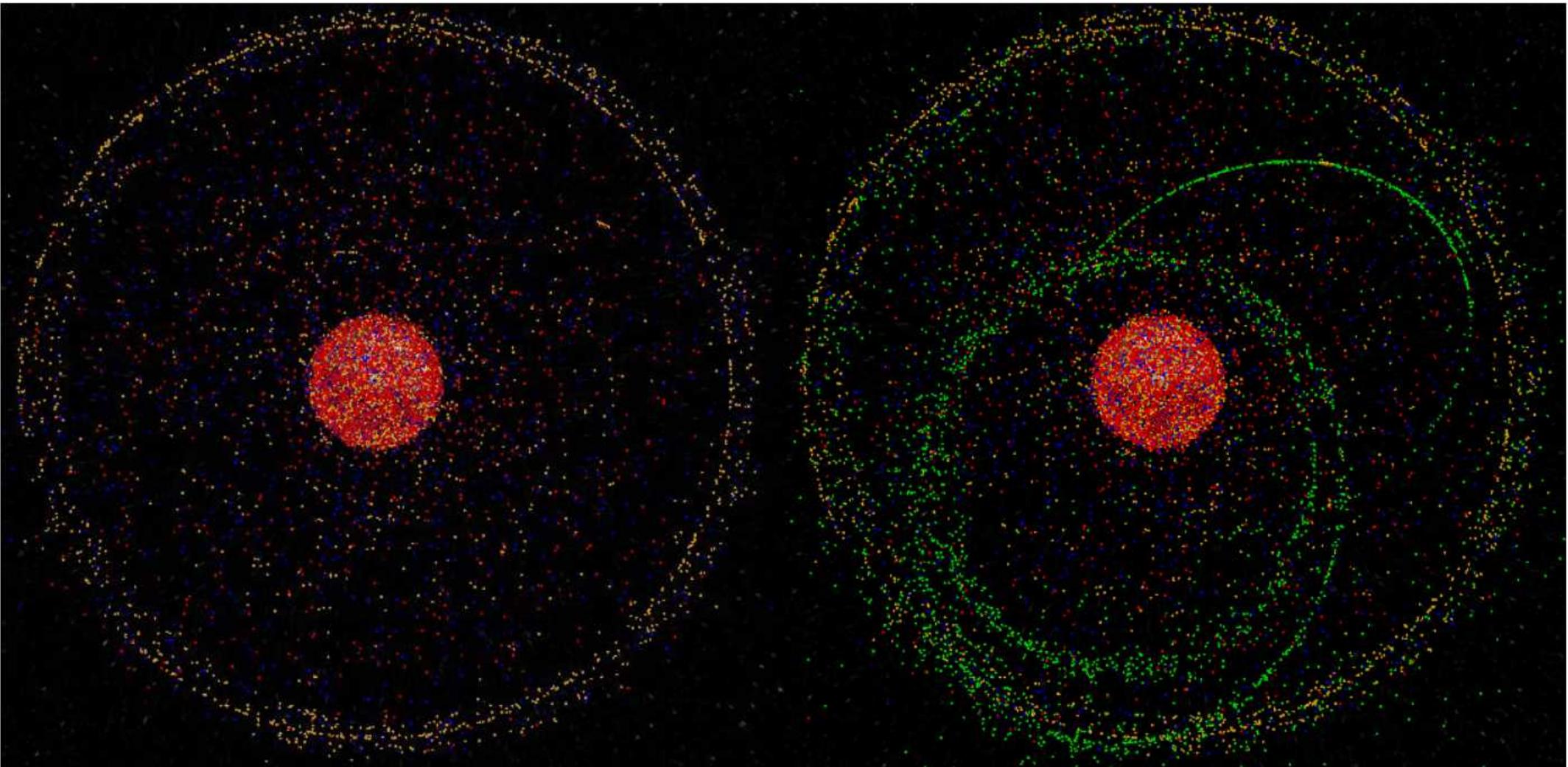
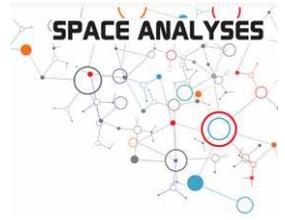
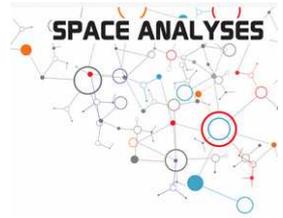


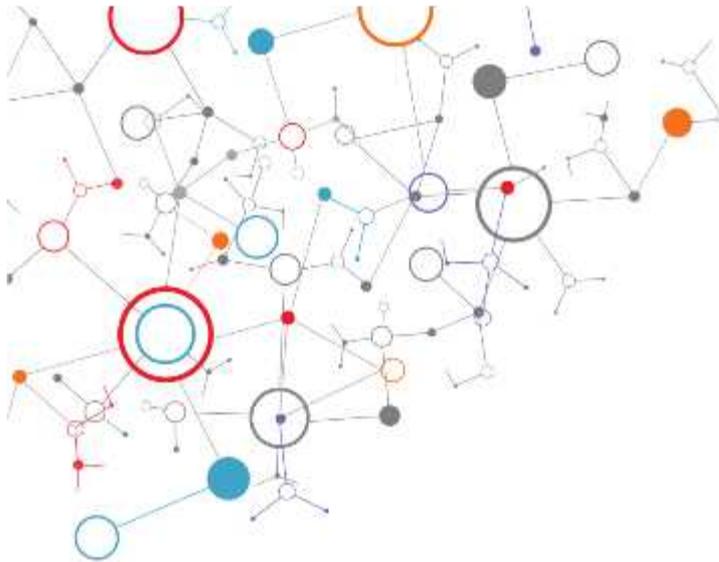
Image source: Schildknecht, T. et al,
ESA Optical Surveys to Characterize Recent Fragmentation Events in GEO and HEO , AMOS Conference, Maui, September 2019.

Contact



You can't manage what you don't know.

You can't know what you don't measure.

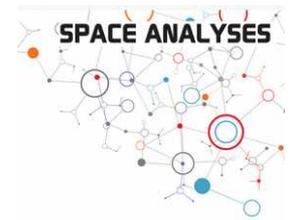


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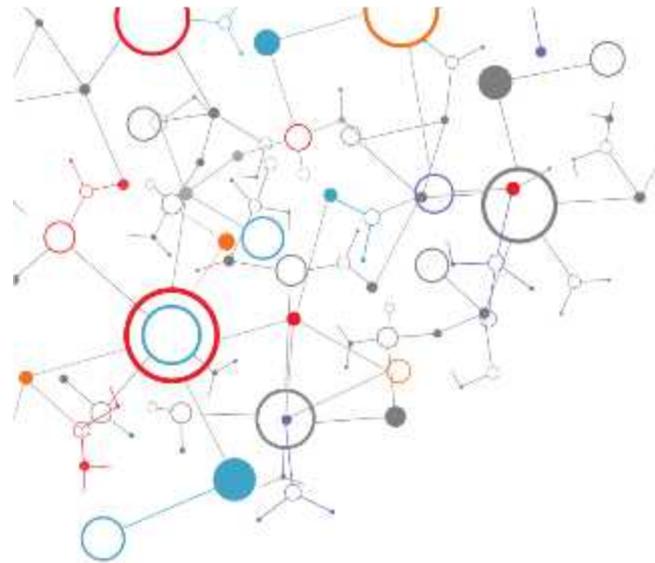
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Back-Up Slides

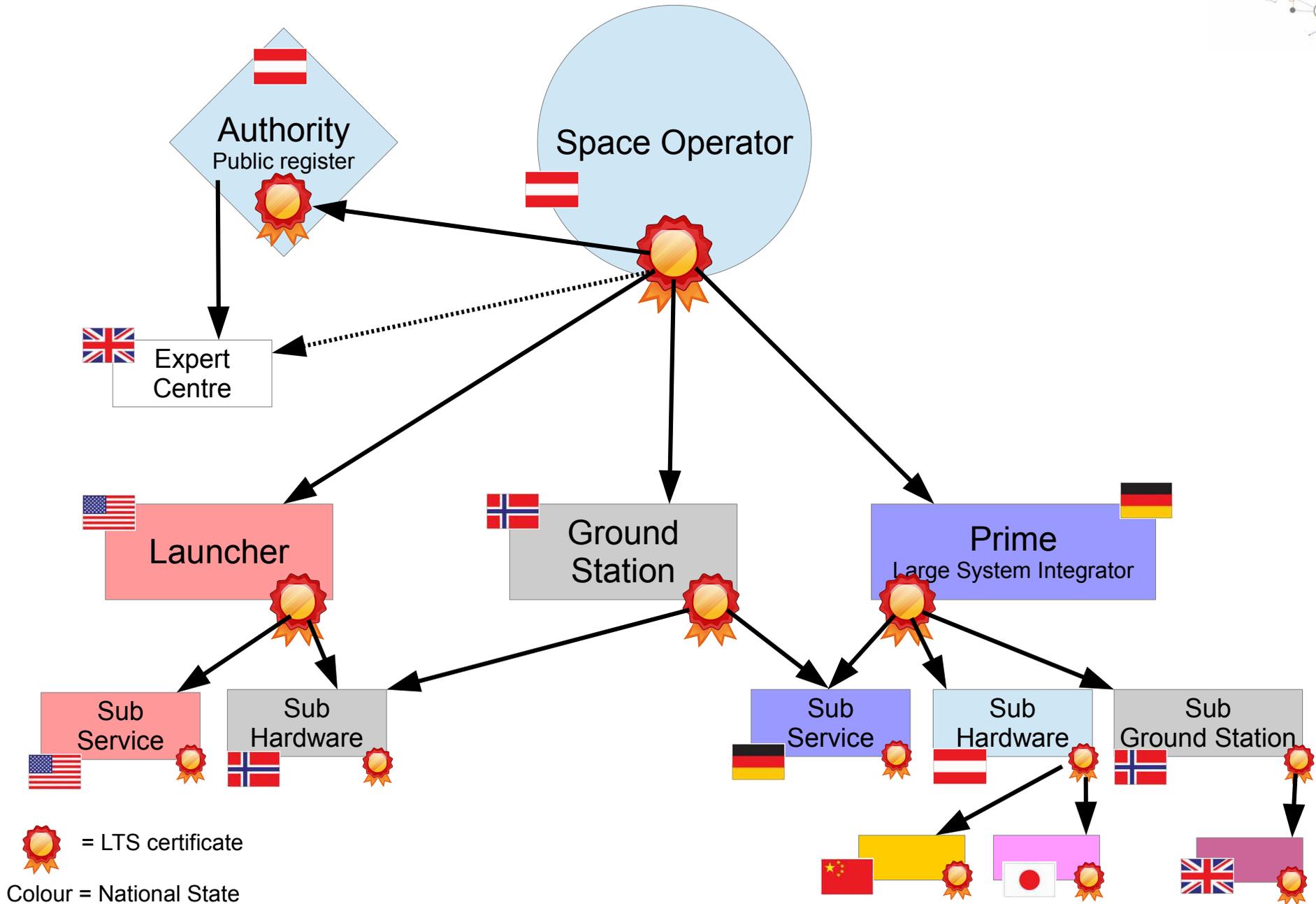
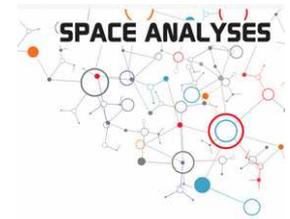


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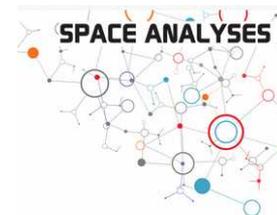
SPACE ANALYSES

LTS Certificate and Delivery Block Diagram

Flow down and example



Why Laws and Rules by Politics?



Quote:

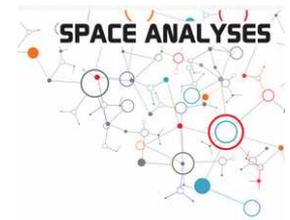
Although specialized commercial companies and private entities can provide efficient and competitive space safety services and technical support, it is not advisable to delegate the definition of space safety and sustainability policies to consensus standards development organizations (SDO). The reason is that:

- ***Enforcement of safety and (environmental) sustainability policies is a government responsibility.***
- ***Definition of rules and their enforcement cannot be separated***

SDOs should deal only with industrial consensus standards development

Tommaso Sgobba, Executive Director of IAASS 12.03.21:
<https://www.linkedin.com/feed/update/urn:li:activity:6775527917846831104/>





What Laws and Rules?

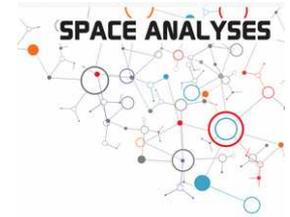
Lon Fuller and the rule of law ¹

- The requirements of law, lay down **the basic minimum requirements for the very existence of a system** to which he would accord the label 'legal'.
- Law does **not exist** in a vacuum **separate from the society it regulates**.
- Law demands that the legal system be **directed towards altruistic, beneficial ends**.
- Society must be free and directed **to the good of each of its members**.

John Rawls ²:

states that 'practice' is a technical term that refers to **'any form of activity specified by a system of rules which defines offices, roles, moves, penalties, defenses, and so on, and which gives the activity its structure.**

1 - cw.routledge.com/textbooks/9780415611084/data/reading/THE-RULE-OF-LAW.pdf
2- https://www.irks.at/en/assets/irks/Publikationen/Unterlagen/IRKS_AC_Rawls.pdf



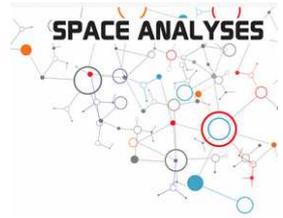
The Responsibilities of Operators

Compliance to LTS for space objects and radio frequency through

- **Measure** (*behaviour of own space objects*)
- **Publish** (*behaviour of own space objects*)
- **Get Information** (*about behaviour of all other space objects*)
- **Act according the LTS rules**
 - ✘ Do not damage / destroy
 - ✘ Do not jeopardise / bring into danger
 - ✘ Do not interfere

***Applying the Obligation to Exercise Due Care
by
Self-declaration to Authorities and Contract
Partners***



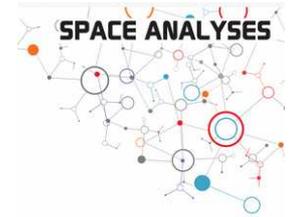


Determine LTS Deviations for Space Objects and Radio Frequency through

- **Implementing national laws to secure LTS**
Secure: Measure / Publish / Get Information / Act according the LTS rules
- **Monitor the implementation**
Measure / Publish
- **Execute possible deviations of the implementation**
Withdrawal of License / Ban on Public Money / Penalty

***Execution of Obligation to Exercise Due Care
by
Authorities at the Operators / Suppliers***





Implementation of LTS for Space Objects and Radio Frequency through

- **Compliance check of LTS implementation at contract partners**

Secure to : Measure / Publish / Get Information / Act according the LTS rules

- **Monitor the implementation / compliance**

Inform yourself about deviations / malpractice

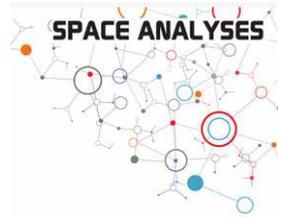
- **Execute possible deviations of the implementation**

Withdrawal from delivery / service to malpractice partners

***Execution of Obligation to Exercise Due Care
by
Suppliers versus the Operators***



Impact to Paradigm Changes



- **Continuous Monitoring of Space Operators behaviour**
- **Space Craft Operator as central responsibility role**
- **Supplier involvement**
- **Self-Declaration**
as Activation of Civil Liability
- **Inversion of burden of proof**
Operator needs to prove the fulfilment of the Obligation of Exercise of Due Care
- **Responsibility of National State reduced**
to Law-Making and Monitoring
- **LTS Guidelines are business case relevant**
for the Space Operator
Fragmentation will become a significant cost!