



Applying a Polycentric Form of Governance in the Space Environment

Empathy and inclusion are the buzzwords we hear while discussing space sustainability solutions. However, there is a huge synergistic gap among different proposed governance solutions/ideas. Empathy and inclusion will only remain buzzwords until a form of governance that includes empathy and inclusion as fundamental values is incorporated into the space environment. After studying different forms of governance, I found the polycentric form most suitable for the space environment primarily because of its decentralized nature. Polycentricity, as presented by Vincent and Elinor Ostrom, connotes a sophisticated form of governance with multiple centers of semiautonomous decision making. The concept emerges from the common's scholarship, a sophisticated framework that has tried to address the tragedy of the common [1].

Fundamentally, space operations' highly dynamic and decentralized nature mandates a polycentric model for safe and efficient operations, primarily because the stewardship of the respective anthropogenic space objects lies with different owners/operating bodies. Hypothetically, a polycentric space governance system will be characterized by decentralized operations, autonomous decision making, overlapping jurisdiction, mutual adjustment of decentral decision centers, standardization (norms, values), and effective coordination.

Multiple, Overlapping Decision-Making Centers with Some Degree of Autonomy: The dynamic nature of space operations by all owners/operators makes it an arena of numerous decision centers. The decision centers are drawn from public, private, and voluntary sectors. However, there exists a clear lack of cooperation between these centers. In polycentricity, the existence of these centers is vital. However, their functionality may be rendered useless if overlapping jurisdictions are lacking. Most anthropogenic space objects (ASOs) are unmaneuverable, posing an immediate collision risk to objects from another decision center. Unmaneuverable objects from the Russian anti-satellite test came directly into the path of the ISS, thus involving multiple decision centers in an overlapping jurisdiction [2].

Currently, there is no agreement among the active stakeholders on the definition of a possible conjunction. The probabilities of collision thresholds

are not mutually agreed upon nor is no consensus. There is no clear boundary beyond which no-action would lead to a catastrophic collision. The 2009 Iridium-Cosmos collision did appear in the list of possible conjunctions of that day based on the ephemeris data of objects available with the respective decision centers [3] [4]. However, for reasons unknown to common man, the probability of collision was not either computed, or was ascertained to be of less risk and not acted upon. We all know the end result: a significantly polluted LEO environment. In this collision, the American object (Iridium) came from the commercial sector while the Russian object (Cosmos) was military owned. Due to a lack of actionable legal bindings from existing space treaties/laws, a commercial owner/operator cannot be forced to execute a maneuver in case of a probability of conjunction. The owner/operator can argue a different probability of collision based on his own algorithms, since there is no overarching agreement. Therefore, such a situation can only be mitigated if different decision-making centers (e.g., U.S. Space Surveillance Network, Iridium Communications, Russian ISON, etc.) develop an overlapping jurisdiction that mandates harmony and action to avoid future collisions.

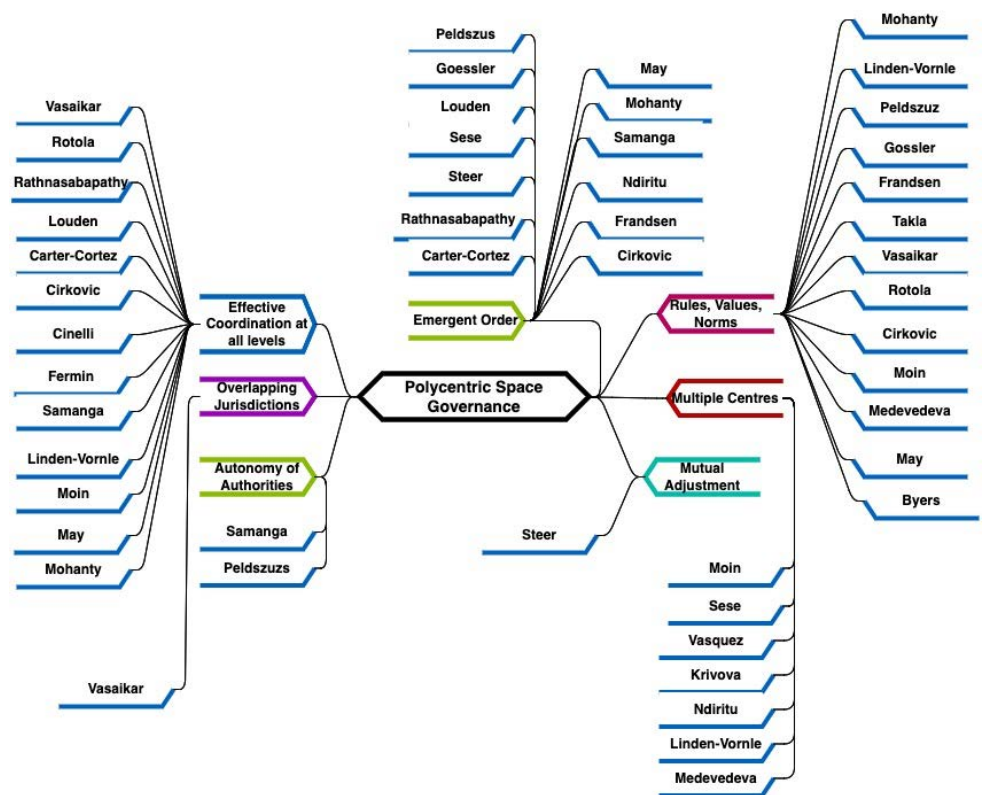


Figure 1: Mapping Polycentricity with 2020 and 2021 Diverse Dozen Op-eds [6–7].

Any ASO under astrometric/photometric observation through the sensory network of one decision center will be under observation of a neighboring network within minutes. This dynamicity of ASOs can only be accurately accounted for when a framework enhances an overlapping sense of action, autonomy, and mitigation between different polycentric centers. A polycentric governance model with legally overlapping jurisdictions in case of possible conjunction (under the agreed threshold of all decision centers) will promote a safer and more sustainable space environment.

Mutual Adjustment, Existence of Overarching RVMs (Rules, Values, Norms): Astrodynamically, the orbit determination models and accuracy of force fields that affect the orbital trajectories are constantly improving. The correct conjunction analyses and probability of conjunctions also enhance human understanding of the actual space environment vs. the simulated or perceived one. In a polycentric space governance model, the decision centers could adjust their *modus operandi* based on the latest verified information from academia/research. Under the multiple overlapping decision centers polycentric model, a mutual adjustment based on the correct/real understanding of the orbits and space environment would continually improve the algorithms that will make the space safer and more sustainable [5].

No matter how decentralized the global space traffic management system evolves, there has to be a framework of overarching rules that govern the system from an operational perspective. At present, different decision centers have different algorithms, concepts of operation, agreed accuracy levels, decision calculus, and collision thresholds. There has to be an agreed set of RVNs, such as an agreed level of collision thresholds, actionable CDMs (conjunction data messages), sustainability ratings, and legal bindings. With a common RVNs framework, the decision center will diverge at the times of conflict instead of converging/synergizing toward a solution. Moreover, polycentricity also promotes existence of means for effective coordination at all levels. The different levels we already know in space governance are of satellite owners/operators, regional networks, national agencies, and international organizations [5].

To qualitatively check my hypothesis, I used a mind mapping tool and assigned one or more of the previous D12 ideas to different facets of polycentricity.

Polycentricity of polycentric governance addresses maximum (if not all) issues the current space environment is facing. It fundamentally practices empathy and inclusion through an institutional arrangement involving a diversity of decision centers acting independently but under the constraints of an overarching set of RVNs. This restricts externalities and creates an environment for the emergence of an outcome at the entire system level [8].

[1] [Critical Commons Scholarship: A Typology](#)

[2] [Russian ASAT debris imperils DoD, NRO sats, while ISS risks increase: COMSPOC](#)

[3] [How and Why Did Two Satellites Collide This Week?](#), Nancy Atkinson, Universe Today

[4] [2009 Iridium-Cosmos Collision Fact Sheet](#), 10 Nov 2010

[5] [Polycentric Systems of Governance: A Theoretical Model for the Commons](#), Keith M. Carlisle

[6] [2020 AIAA ASCEND Diverse Dozen Op-eds](#)

[7] [2021 AIAA ASCEND Diverse Dozen Op-eds](#)

[8] [Co-Production, Polycentricity, and Value Heterogeneity](#), Paul Dragos Aligica and Vlad Tarko