



ISON, the International Scientific Optical Network, is an initiative of the Keldysh Institute to coordinate international optical observing campaigns. It focuses primarily on anthropogenic space objects in high Earth orbits, including the geostationary region, as well as near-Earth objects (asteroids, comets, etc.). The network comprises approximately 20 operational and planned sites, each hosting wide-field semi-automated telescopes with apertures ranging from 20 to 80 cm.

# Effective Space Traffic Management and Mitigation of Mega-Constellation Impacts on Astronomy

- Approaches and mechanisms for addressing the space debris problem and for mitigating the impact of mega-constellations on astronomy are closely interconnected. Both domains rely on extensive and transparent sharing of data on anthropogenic space objects — including orbital and photometric data, algorithms, and software tools — among constellation operators, space situational awareness (SSA) data providers, and end-users.
- An international online platform is needed to support data sharing, coordinate observations, and standardize data formats and communication protocols. A decentralized data-sharing approach is often optimal, as it allows SSA data providers to retain full control over the data lifecycle while applying flexible, provider-defined constraints on shared information.
- Data-sharing initiatives in both domains should complement, rather than duplicate, one another. They should build on shared experience, practices, and methods while utilizing their respective strengths and compensating for their weaknesses.
- End-users of SSA data for mitigating interference from mega-constellations can benefit from — and actively support — the stricter requirements introduced for satellite operators in response to the space debris problem. These requirements may include open access to up-to-date orbital data, algorithms, and software necessary for the precise determination of satellite state vectors, which should serve as a precondition for licensing and ITU frequency allocation. Additional measures may also include appropriate enforcement mechanisms in cases of deliberate withholding of required information.
- The situation with poor space traffic management, caused by oversecuritization and characterized by a lack of international data sharing and coordinated actions, remains in a state of gridlock. However, a limited approach focused on the specific case of mega-constellation impact mitigation could help overcome initial distrust and create a working model that lays the groundwork for future solutions for international space traffic management once sufficient political will is in place.

# Global Network of Electro-Optical Facilities

- Establishing a globally distributed network of electro-optical facilities across different latitudes and longitudes would provide continuous verification, validation, and improvement of orbital data, physical models, and software tools used to assess mega-constellation impacts. Ideally, the network would also include stations co-located with or in close proximity to the most affected observatories.
- This concept could draw on approaches used by the ISON network, which has been developed entirely through scientific and technical cooperation agreements. Under these agreements, host scientific and educational organizations take responsibility for the necessary infrastructure and provide personnel to operate telescopes and process data on a non-remunerated basis. This model significantly reduces costs related to site selection, infrastructure development, and operational support.
- Observatories affected by mega-constellations could install automated and semi-automated standardized electro-optical facilities on their premises. Institutions not directly affected — including institutions in countries with emerging space capabilities — may also be interested in hosting such stations at no cost, given the scientific benefit of collecting data on anthropogenic space objects.
- Equipment and software for the initial phase could largely be provided through donations, including contributions from mega-constellation operators. Host institutions could provide routine technical maintenance and process observations using standardized data formats and protocols, and, if necessary, independently plan observations of objects in low Earth orbit.
- Maintaining the overall operation of this system — including checking compliance with minimum data requirements, aggregating data, providing access to the data through an online platform, coordinating observing campaigns, and preparing activity reports — could be carried out by a small team within an international organization or a non-governmental organization.