The International Academy of Astronautics (IAA) Cosmic Study on

Space Traffic Management

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Scope of the Study

- **Background**
  - AIAA Workshops in 1999 and 2001
  - 2001-2006 IAA Study Group with 20 contributors of 8 countries
  - (IISL/ECSL Symposium 2002 at the UNCOPUOS LSC)

- **Space traffic already takes place**
  - Entering of non-governmental entities
  - Positioning of satellite constellations
  - Increase of space debris
  - Advent of re-usable launch vehicles
  - Growing number of launch vehicles and launch centers

Scope of the Study

- **Definition**
  - Space traffic management means the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference

- **Structure**
  - Current status
  - Elements for a space traffic management
  - Set of recommendations

Dimensions and Phases of Space Traffic

- **Two dimensions of space traffic**
  - Scientific-technical area
  - Regulatory field

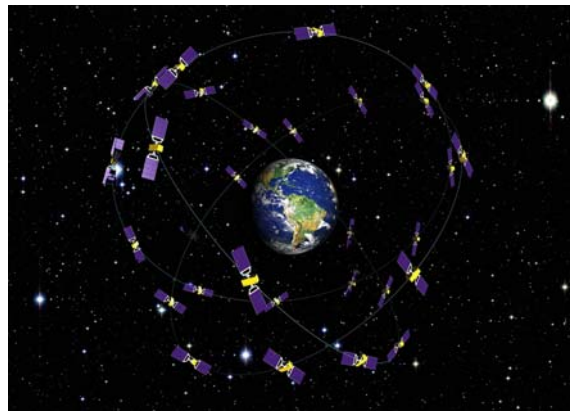
- **Three phases of space traffic**
  - Launch phase
  - In-Orbit operation phase
  - Re-Entry phase

Current Status and Prospects for 2010-2020

- The motion of space objects is influenced by different forces, which cannot be accounted for precisely
- The large majority of active satellites have no maneuvring capability
- Slow and steady decline of launch activities since 1980 but
- The prospects for the introduction of full/partly RLV are still open
- Human spaceflight has accounted for 13% of launches the past 20 years
- Following the successful flight of Spaceship One, there might be – if safety is guaranteed - a growing number of suborbital manned flights
- Technologies like tethers, stratospheric platforms or space elevators, which might be introduced in the future, will have to be taken into account

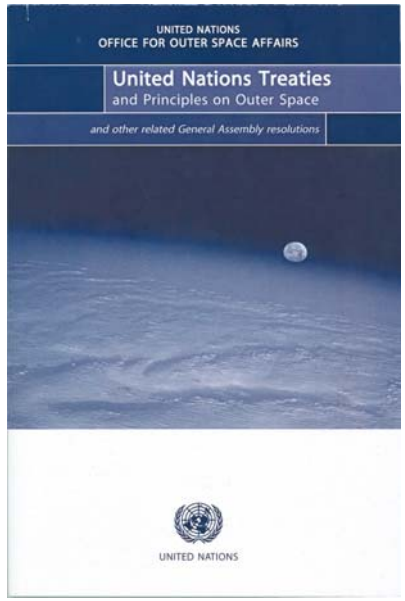
Current Status and Prospects for 2010-2020

- Space debris is continuously growing in quantity
- The number of catalogued objects is steadily rising
- The number of active satellites remains at 6-7% of the total catalogued objects
- The US's space surveillance capabilities dominate
- The capacity and accuracy of current space monitoring systems is not sufficient to cover small objects or to provide for orbital avoidance service for all space assets
- There are two major catalogues of space objects
- Information on space weather is still limited but is important for
- Constant monitoring and information of space weather would be a useful tool in implementing a space traffic management system



The Current Legal and Regulatory Framework

- The general principles of space law provide a basis and rationale to establish a space traffic management regime
- Some unique rules exist in international space law as well as in international telecommunication law
- The IADC space debris mitigation guidelines of 2002 (not legally binding agreement) encompass elements of space traffic management
- Space law lacks numerous provisions which are essential for a comprehensive traffic management regime (pre-launch notification)



The Current Legal and Regulatory Framework

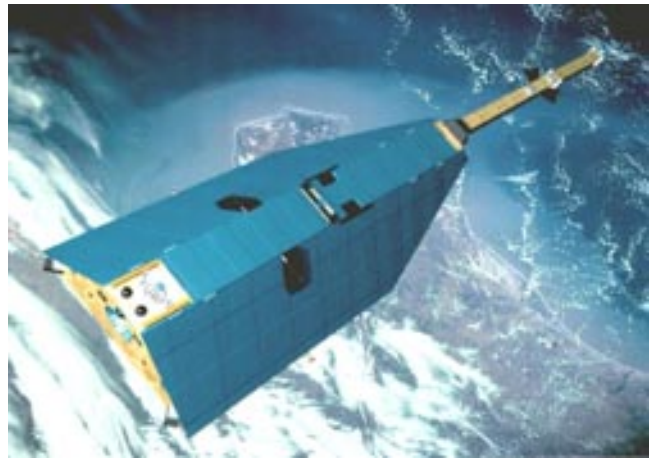
- A space traffic management regime has to consider
- In regard to arms control/disarmament negotiations, notification practices (prior to launch) have been developed through the Hague Code of Conduct against Ballistic Missile Proliferation (HCOC)
- The implementation of a comprehensive space traffic management regime would require additional regulation
- There are interfering factors which might hinder the establishment and operational effectiveness of a space traffic management regime

The Launch Phase

- Safety certifications should be introduced
- A clarification of the term "space object" is needed
- The question of delimitation of air space and outer space should be revisited
- The concept of "launching State" has to be clarified
- A pre-launch notification system is necessary
- Obligatory information in cases of damage is relevant
- An international level playing field for transport services should be aimed for

The In-Orbit Operation Phase

- Manoeuvring and in-orbit collision avoidance is growing in number and importance
- Manoeuvring in the GEO is utilised
- Reliable collision probabilities can be estimated
- There is already one-way traffic in GEO
- No systematic zoning of outer space is applied
- The ITU system of nominal orbital positions is applicable only to satellites in the GEO
- Private/commercial actors have started coordinating
- Matching spacecraft with space radio stations on board



The Re-Entry Phase

- Intentional and un-intentional de-orbiting is now more frequent
- Responsibility and liability for damages caused by space objects or their components ensue
- The generally shared aspiration to reduce space debris raises the question, whether regulation should also set a standard
- Already considered a best practice in coordinating launch activities
- Space Law and Air Law have to resolve the open issue of passage of space objects through airspace
- The question arises, whether to introduce certain internationally recognized descent corridors

Outline of a Comprehensive Regime

- **Securing the Information Needs**
  - Defines necessary data
  - Sets provision for the data
  - Establishes a database and distribution mechanisms for data
  - Establishes an information service on space weather

- **Notification System**
  - Sets pre-launch notification with better parameters than Registration Convention as well as other provisions
  - Provides information on the end of active/operational lifetime of space objects
  - Provides pre-notification of orbital maneuvers and active de-orbiting

Outline of a Comprehensive Regime

- **Traffic Management**
  - Clarifies "fault" or liability in case of damage caused in outer space
  - Sets delimitation for the launch phase and clarifies the concept of "launching State"
  - Provides traffic management rules based on the use of the database for the purpose of collision avoidance, including
    - Safety provisions for launches
    - Zoning (selection of orbits)
    - Right of way rules for in-orbit phase(s)
    - Prioritization with regard to maneuver
    - Specific provisions for GEO (harmonized with ITU rules)
    - Specific rules for LEO satellite constellations
    - Debris mitigation mechanisms
    - Safety provisions for re-entries
    - Environmental provisions (pollution of the atmosphere/troposphere, etc.)

Outline of a Comprehensive Regime

- Clarifies "space objects“
  - including legal distinction between valuable objects and valueless space debris
- Provides a framework and main features for national licensing regimes
  - which implement the provisions of the agreement
- Sets forth an enforcement mechanism (e.g. renouncement of access to information) and dispute settlement
- Clarifies institutionalized interlinks with ICAO, ITU and other relevant organizations

Outline of a Comprehensive Regime

- **Organization**
  - The provisions of the three agreements initially would be monitored by UNCOPUOS and handled by UNOOSA
  - The operative oversight, i.e. the task of space traffic management could be taken up by an already existing forum or organization
    - such as UNCOPUOS or ICAO
    - which would evolve into a body shaped for that purpose
    - looking 20 years ahead, it could also be handled by a non-governmental entity tasked by the State parties to an Outer Space Convention
  - Space activities by private actors will develop into the same legal status as in air traffic