RECENT DEVELOPMENT OF THE CONCEPT OF SPACE TRAFFIC MANAGEMENT (STM)

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* The views expressed herein are entirely those of the author and do not reflect any official views of the organizations that the author belongs to.
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1. WHY STM NOW?

The crucial role of SSA (Space Situational Awareness)

Processing and Analysing

SSA Sharing Agreements

12 nations, 2 international organizations, 20+ commercial operators

Provide TLE through web site, and Conjunction Summary Message (alerts) through e-mail etc.

Advanced conjunction assessment Advanced collision avoidance

Military, governmental and major commercial satellite operators

Space Surveillance Network
Worldwide Network of 20 Optical and Radar (Mechanical & Phased Array) Sensor Sites

Satellite operators around the world

Data

Observation and tracking

(Source) https://www.mhpcc.hpc.mil/

USSTRATCOM Combined Space Operation Center (CSpOC) (former JSpOC)
<MEGA CONSTELLATIONS ISSUE>

⇒ much more objects : more alerts

Source: Space News March 13, 2018
⇒ much more precision: more false alerts
Figure 3: Spatial density of objects in LEO with and without New Space activity. Adding New Space LLCs will increase the density at all altitudes due to replenishment, disposal, and failed satellites. Adding the smaller objects that would appear with an improved tracking system could increase the density at all altitudes even more.

2. WHAT IS STM?

STM is a concept of managing space activities as a traffic. Parallel with Air Traffic Management (ATM) or Maritime Traffic Management (MTM).
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.


The planning, coordination, and on-orbit synchronization of activities to enhance the safety, stability, and sustainability of operations in the space environment and avoid interference in satellite operations.

(Space Policy Directive 3 – National Space Traffic Management Policy,

(Cf. Air Traffic Management)

Air traffic management is an aviation term encompassing all systems that assist aircraft to depart from an aerodrome, transit airspace, and land at a destination aerodrome, including Air Traffic Services (ATS), Airspace Management (ASM), and Air Traffic Flow and Capacity Management (ATFCM)
Start by resource re-allocation issue within the US, but result with solutions for congested, contested and competitive current space situation.
3. DEVELOPMENT OF STM CONCEPT

2007
Russian new PPWT*

2008
Draft International Code of Conduct

2009
GGE on Space TCBM* Report (2013 UNGA)

2010
COPUOS Debris Guidelines

2011
EU

2012
Fr. Space Activities Act

2013
ISO Debris Standards

2014
COPUOS Long-Term Sustainability of Space Activities draft guidelines

2015
Fr. new PPWT*

2016
Russia&China new new PPWT

2017
Russia and China new new PPWT

2018
GGE regarding PAROS

2019
ISO debris standard revision

*PAROS: Prevention of Arms Race in Outer Space
*PPWT: Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects
*TCBM: Transparency and Confidence Building Measures
*GGE: Group of Governmental Experts
*CONFERS: Consortium for Execution of Rendezvous and Servicing Operations
*WEF: World Economic Forum (Global Future Council, The Future of Space Technologies)
## 4. LEGAL NATURE IN RE STM

<table>
<thead>
<tr>
<th>Jurisdiction to vehicle</th>
<th>Jurisdiction to area</th>
<th>Vehicle registration</th>
<th>Sanction to registration failure</th>
<th>Traffic management rules</th>
<th>Traffic management authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>Maritime</td>
<td>Aviation</td>
<td>Space</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Territorial State</td>
<td>Flag State</td>
<td>State of registry</td>
<td>State of registry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Territorial jurisdiction</td>
<td>Territorial sea jurisdiction</td>
<td>Territorial air jurisdiction</td>
<td>None</td>
<td></td>
<td>Space object registration</td>
</tr>
<tr>
<td>Vehicle registration</td>
<td>Vessel registration</td>
<td>Aircraft registration</td>
<td>Denial of traffic navigation/landing/passage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denial of travel</td>
<td>Subject to capture by authority/Denial of entry to ports</td>
<td>Denial of traffic navigation/landing/passage</td>
<td>None</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Road traffic rules</td>
<td>Sea way/preventing collision</td>
<td>Aerial routes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maritime safety authority/military</td>
<td></td>
<td>Civil aviation authority</td>
<td></td>
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</tr>
</tbody>
</table>

Non-sense to wait State actions!
<JAPANESE INDUSTRIES IN INTERNATIONAL DISCUSSIONS>

Consortium for Execution of Rendezvous and Servicing Operations

Source: https://www.satelliteconfers.org/members/

World Economic Forum

Source: https://www.weforum.org/communities/the-future-of-space-technologies
5. CHALLENGES PER DISCUSSION ORDERS

1. Providing civil STM services
   ⇒ How to gather data from operators
   ⇒ How to allocate costs for service provision

2. International sharing of SSA data
   ⇒ How to clear national security concerns.
     - US and Russia have global capability, China may have and others (France, Germany, Australia, Japan, UK) have partial capability.
     - Need to neutralize within a combined data.
     - Standardizing data format, meta data analysis is necessary.
     - Meta data contains information of the capability of observation of that system, which is classified information.
   ⇒ Cost allocation for database sharing, maintaining the common data center and the rules’ harmonization process.

3. Common rules for operators
   ⇒ Regulations for data sharing (flightplan, maneuver information, POC)
   ⇒ Traffic regulations (standard database, conjunction analysis operation standard, communication standard)
All welcome to the “STM STUDY GROUP”

【Principles】
- Chatham House Rule based
- No individual goals, accept diversity, allow repeat discussions

【Purposes】
- Fostering understanding on the issues of STM through diverse discussion.
- Understanding why and what is difficult to realize STM.
- Rely on participants to take actions back in their own entities.

【Achievements so far】
- Why STM Now?
- What will be the prioritized points to be discussed in the topic?
- Detail discussion of the elements consist STM.

【Participants】
Practitioners, academia, officials from industries, agencies, ministries and universities.
“PROGRESS THROUGH COLLABORATION”

slogan of the 5th Space Traffic Management Conference
(26-27 Feb. @Austin, Texas)