

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

2019/2/25

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# 1.WHY STM NOW?

<The crucial role of SSA (Space Situational Awareness)>

Processing and Analysing



(Source) <https://www.mhpc.hpc.mil/>

**USSTRATCOM Combined Space Operation Center (CSpOC)**  
(former JSpOC)



Satellite operators  
around the world

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

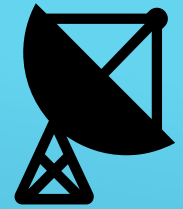
Advanced conjunction assessment  
Advanced collision avoidance

Operational  
tracking data

**【SSA Sharing Agreements】**  
12 nations, 2 international organizations,  
20+ commercial operators



Military, governmental and  
major commercial satellite  
operators



Data

Observation and tracking

## Space Surveillance Network

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



# <MEGA CONSTELLATIONS ISSUE>



⇒ much more objects : more alerts

Source: Space News March 13, 2018

# <SYSTEM UPDATE ISSUE>

Over 50 years ago, the world's first satellite was launched into space.



DEAD SATELLITES

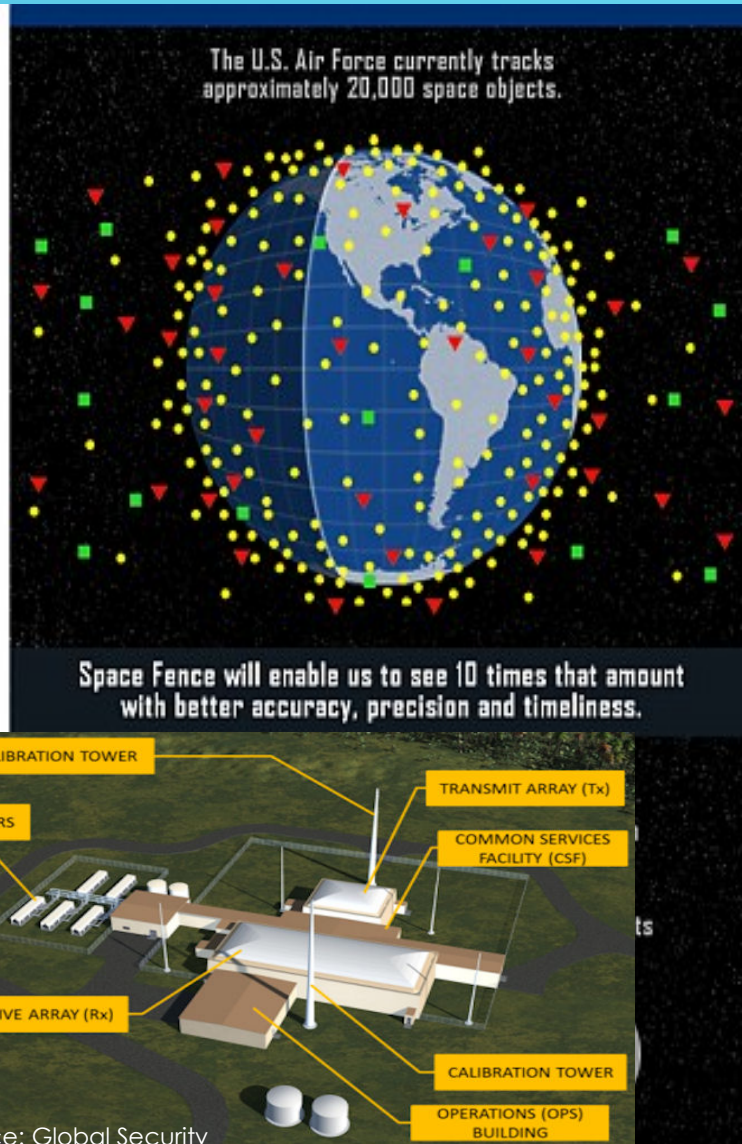
STRAY HARDWARE PIECES

SPENT ROCKET BOOSTERS

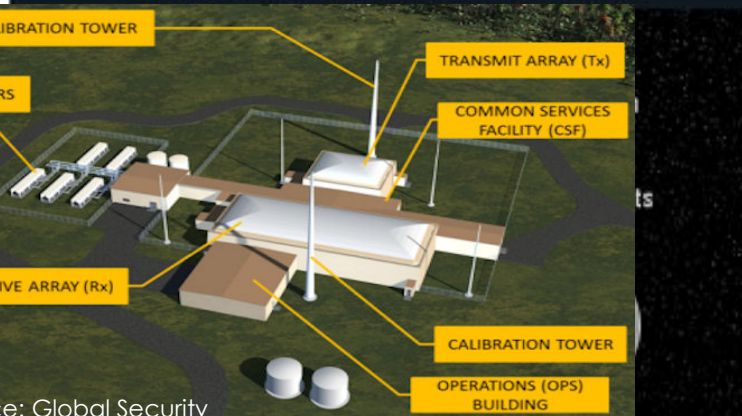
Now almost 6 decades later, space is more crowded than ever.

Every year, hundreds of millions of dollars are spent to  spacecraft to avoid collisions.

The U.S. Air Force currently tracks approximately 20,000 space objects.



Space Fence will enable us to see 10 times that amount with better accuracy, precision and timeliness.



CALIBRATION TOWER

CHILLERS

RECEIVE ARRAY (Rx)

TRANSMIT ARRAY (Tx)

COMMON SERVICES FACILITY (CSF)

CALIBRATION TOWER

OPERATIONS (OPS) BUILDING

Source: Global Security

⇒ much more precision : more false alerts

# <SPACIAL DENSITY AFTER MEGA CONSTELLATIONS+SPACE FENCE>

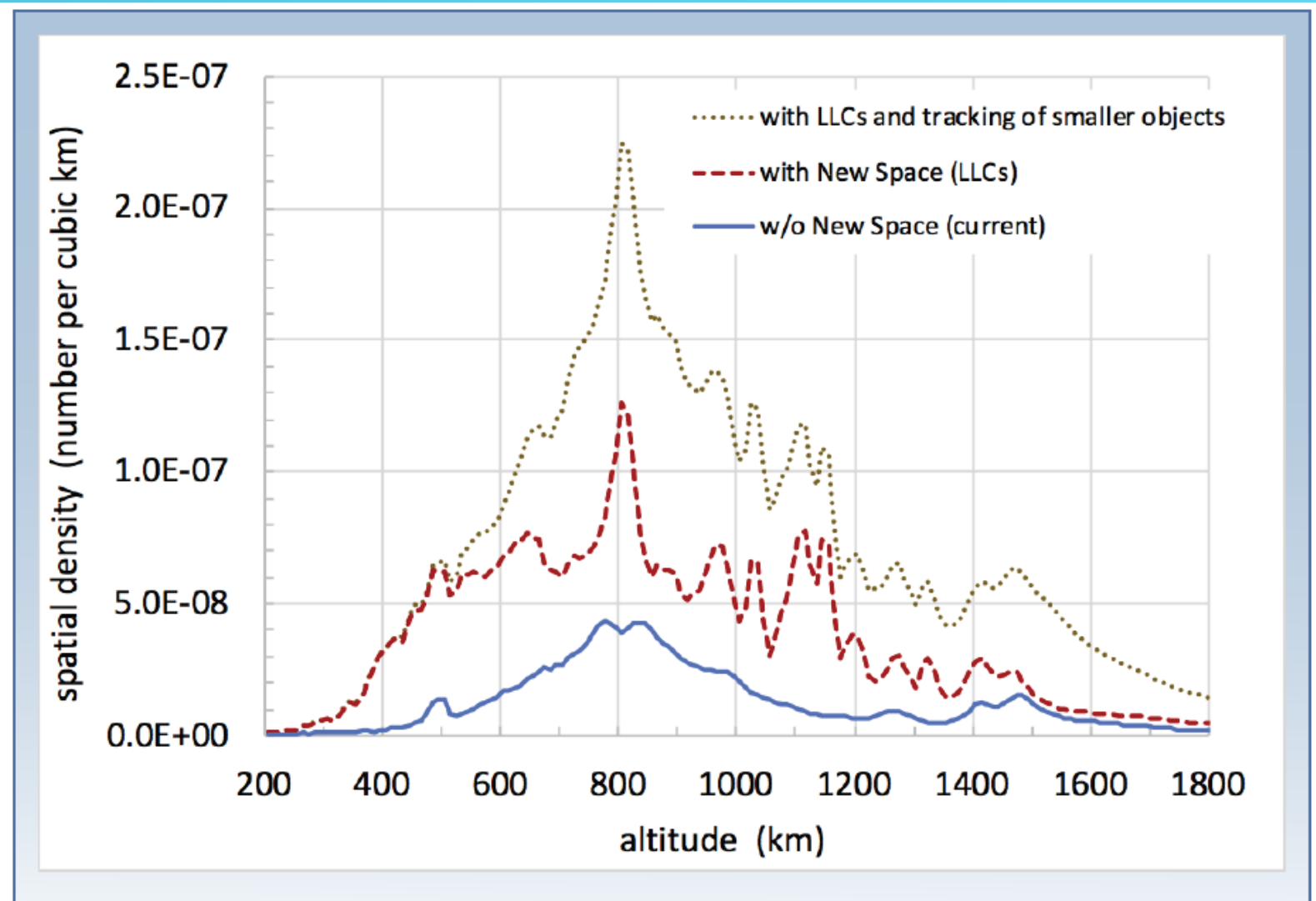
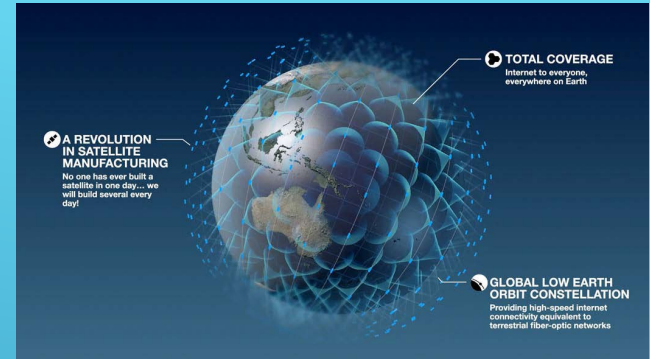
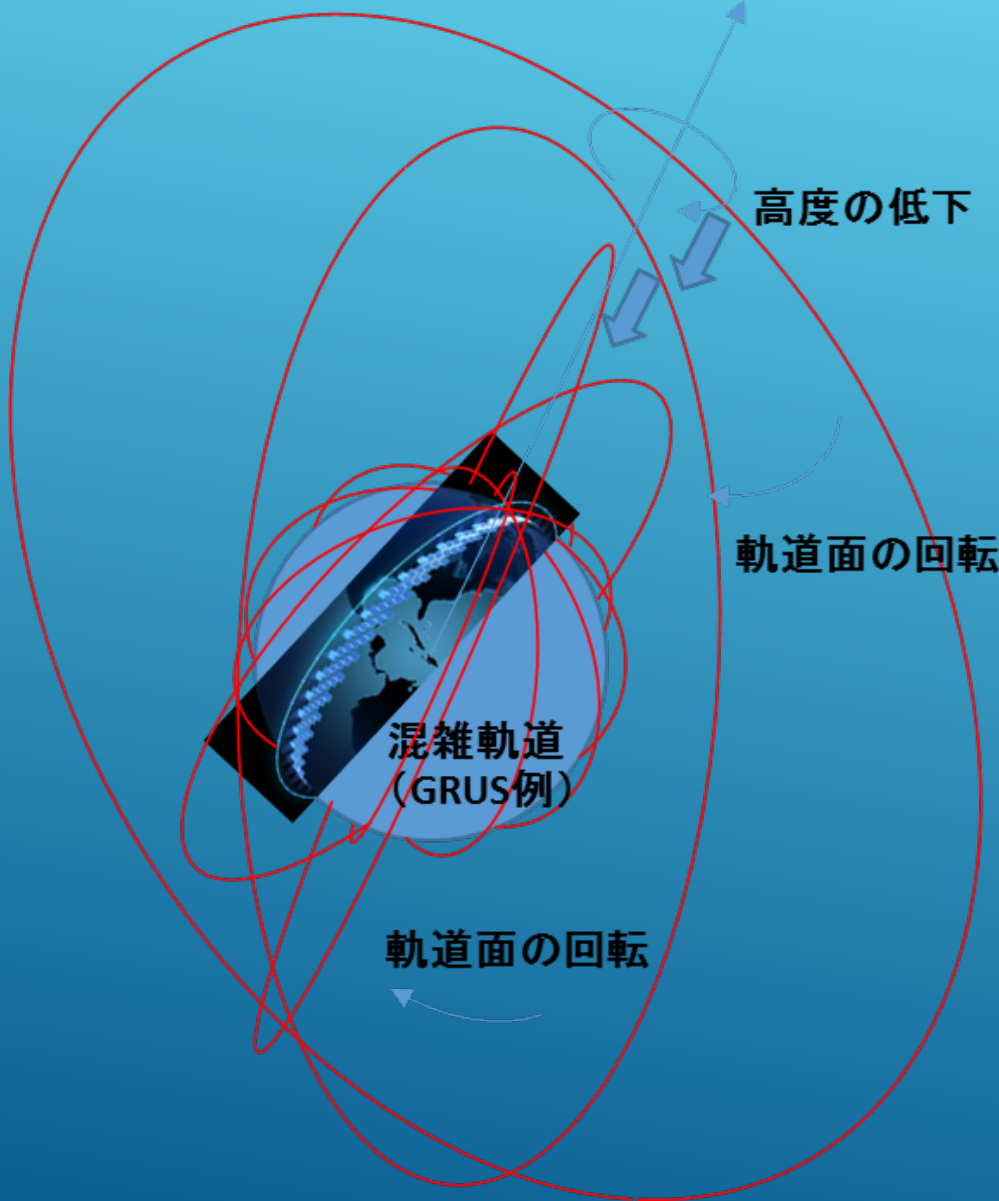


Figure 3: Spatial density of objects in LEO with and without New Space activity. Adding New Space LLCs will increase the density at all altitudes due to replenishment, disposal, and failed satellites. Adding the smaller objects that would appear with an improved tracking system could increase the density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

# <STM NECESSITY>



OneWeb

(Source: Airbus website)

高高度周回衛星群  
1000km以上  
(OneWEB例)

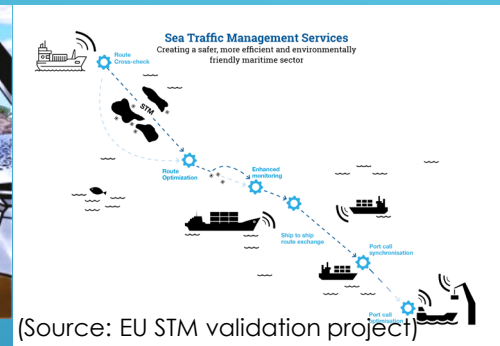
GRUS (Axel Space)



(Source: Cabinet Office website)

# 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).





## <DEFINITION SHIFT>

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.

(IAA Cosmic Study of STM = SEC.1102, NASA Authorization Act 2008)



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.

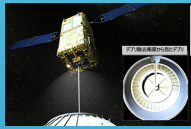
(Space Policy Directive 3 – National Space Traffic Management Policy,

(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)

# <CONTEMPORARY 3 ELEMENTS OF STM>

## ③ How to solve congested space



On-orbit services



Deep space exploration

Space mining



Space tourism

Mega-constellation satellites



Active space debris removal



## ② How to regulate "New-space"

Satellite operators



Conjunction analysis/message

COLA analysis

Reentry analysis

## ① Transition of services to civil operators from military to civil authority



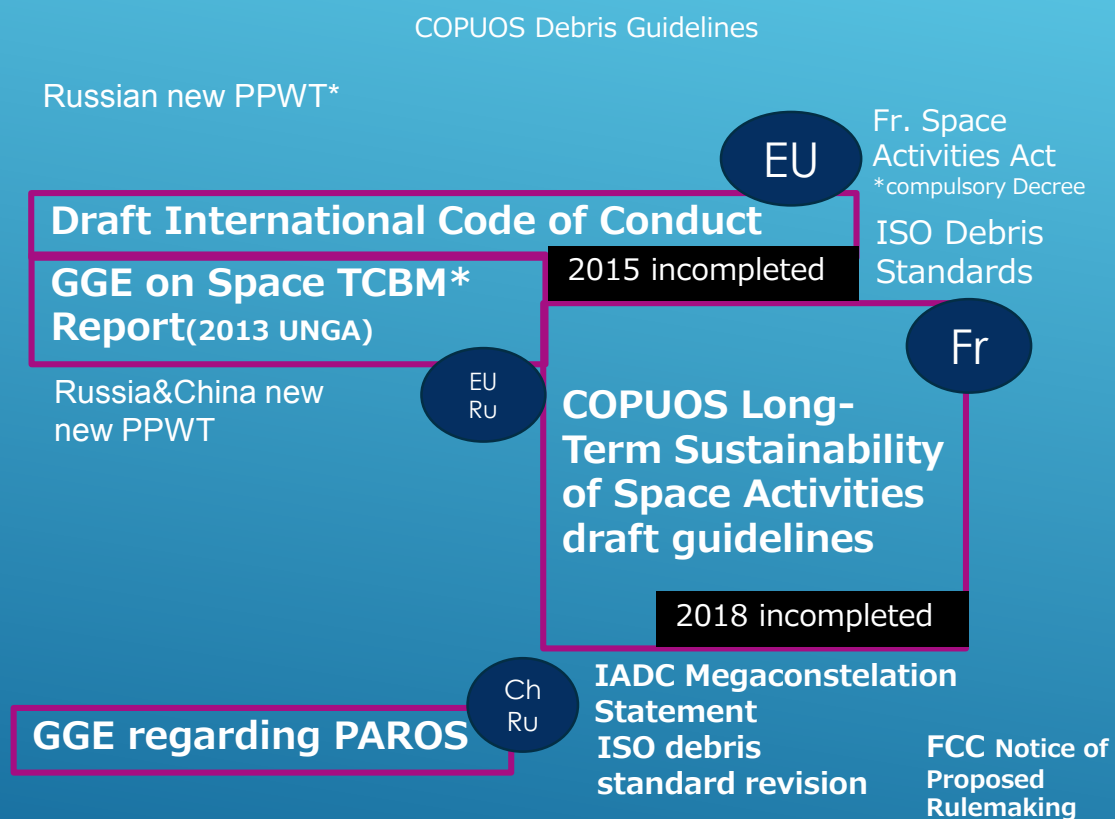
CSPOC (former JSPOC) at US STRATCOM

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  
2008  
2009  
2010  
2011  
2012  
2013  
2014  
2015  
2016  
2017  
2018  
2019



IAA Cosmic Study

Chinese ASAT

ISU Studies

Authorize research in NASA Authorization Act

Cosmos-Iridium collision

US Security Space Strategy

#1 STMConference (ERAU)

US Space Act of 2015

#1 GSTMW(UK)

US CSTM policy

US SPD 3

CONFERS\* WEF\*

**US STM international conference ?**

\*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:Transparence 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

	Ground	Maritime	Aviation	Space
<b>Jurisdiction to vehicle</b>	Territorial State	Flag State	State of registry	State of registry
<b>Jurisdiction to area</b>	Territorial jurisdiction	Territorial sea jurisdiction	Territorial air jurisdiction	None
<b>Vehicle registration</b>	Vehicle registration	Vessel registration	Aircraft registration	Space object registration
<b>Sanction to registration failure</b>	Denial of travel	Subject to capture by authority /Denial of entry to ports	Denial of traffic navigation/landing/passage	None
<b>Traffic management rules</b>	Road traffic rules	Sea way/pro	Aircraft	Space services
<b>Traffic management authority</b>	Police	Maritime safety authority/military	Civil aviation authority	None

**Non-sense to wait State actions!**

# <JAPANESE INDUSTRIES IN INTERNATIONAL DISCUSSIONS>

## Consortium for Execution of Rendezvous and Servicing Operations

The screenshot shows the CONFERS website with a navigation menu including ABOUT, HOW TO JOIN, RESOURCES, NEWS & EVENTS, MEMBERS, and CONTACT. Below the navigation, the 'Current Members' section displays logos for the following organizations:

- AEROSPACE
- AIRBUS
- AGI
- ALTIUS SPACE MACHINES
- Astroscale
- ATOMOS NUCLEAR AND SPACE
- AXA XL Insurance Reinsurance
- Ball
- BluHaptics, Inc.
- Chandah
- Cislunar Space Development Company
- Effective Space

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

## World Economic Forum

The screenshot shows the World Economic Forum website with a navigation menu including Agenda, Initiatives, Reports, Events, and About. Below the navigation, the 'Global Future Council on Space Technologies' section is highlighted. The page content includes:

Upcoming challenges for the space sector include the need for new global governance frameworks, new metrics for measuring the Space economy, as well as further discussions on Moon exploration. The Global Future Council on Space Technologies will consider and discuss these and other issues, as well as help steer the Space Sustainability Rating project, a framework developed by the council during the 2016-2018 term.

**Co-Chairs:**

- Alice Bunn, Director, International, UK Space Agency
- Jeffrey R. Tarr, Senior Adviser, TPG Global

**Council Managers:**

- Nikolai Khlystov, Community Lead, Aerospace Industry, [nikolai.khlystov@weforum.org](mailto:nikolai.khlystov@weforum.org)
- Bruce Weinelt, Head of Partner Development, NA & EU, New York Based Industry Clusters, [Bruce.Weinelt@weforum.org](mailto:Bruce.Weinelt@weforum.org)

**Members:**

Mohammed Al Ahbabi	Abdul Mohsen Al Hussein	Anousheh Ansari
Alice Bunn	Carissa Christensen	Simonetta Di Pippo
Daniela Genta	Doris Grosse	Takeishi Hakamada
Aarti Holla-Maini	Tomohisa Kunisawa	Sumita Mohanty
Jamie Morin	Nobu Okada	Ruy Pinto
Minoo Rathnasabapathy	Kai-Uwe Schrogl	Omran Sharaf
Olga...	...	Jeffrey R. Tarr

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 5<sup>th</sup> Space Traffic Management Conference  
(26-27 Feb. @Austin, Texas)