CGMS-54-WGI-WP-04
10 April 2026

Prepared by: EUMETSAT
Agenda Item 5.1
Discussed at WG-I

Subject	**Report from CGMS WGI Task Group on Space Environment Sustainability**
In response to CGMS action/recommendation	WGI/A50.07: Deliver a Best Practice document on Space Environment Sustainability, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-54 WGI/A53.04: Define the requirement for supplying owner/operator orbit and manoeuvre information to TraCCS and identify steps for implementation WGI/A53.05: Identify steps to coordinate modelling of thermospheric density impacts and perform inter-comparison of model results WGI/A53.06: Discuss in intersessionals and prepare highlight presentations in next year's Task Group intersessionals and CGMS-54 WGs on: • The overall landscape of work on SES topics and where the CGMS TG on SES fits in it. • Agencies experience and practices on collision avoidance • Agencies experience and practice on Debris removal WGI/A53.07: Andrew Monham to develop a paper on CGMS work on SES for presentation at IAC in 2026. WGI/A53.08: Review current usage of space weather data for spacecraft operations and goals for improvement. WGI/A53.09: Produce a report of space weather observation requirements for improved STC services and space sustainability.
HLPP reference	2.5 Operational issues related to space weather 2.6 Space traffic coordination 2.7 Space Sustainability
Executive Summary	This document reports on the background, content of the Terms of Reference and progress achieved for the CGMS WGI Task Group on Space Environment Sustainability, relevant to CGMS member current and planned missions.

	The members of the Coordinated Group for Meteorological Satellites (CGMS) rely on the sustainability of the space environment to ensure their satellite missions remain able to deliver meteorological and space weather data to global forecasting services. In this regard, safety on Earth is very much intertwined with safety in space. CGMS has therefore established a Task Group on Space Environment Sustainability which shall address all aspects of operations in the space environment where CGMS member coordination can help improve the safety and sustainability of space operations for all space actors. The objectives include establishing best practices covering Space traffic coordination, lifetime extensions, end-of-life disposal and space weather mitigation of risks and effects. It is foreseen that a proposal on acceptable space traffic coordination practices can be submitted for consideration by UN COPUOS.
Action/Recommendation proposed	Extend due dates for the following actions to the CGMS-55 WGI meeting: WGI/A50.07, WGI/A53.05, WGI/A53.07, WGI/A53.08, WGI/A53.09. Proposed to close the following actions: WGI/A53.04, WGI/A53.06 **New action proposed:** ➢ *Action WGI/A54.XX: Assess overlap and scope for coordination with the Space Safety Coalition*

1 INTRODUCTION

1.1 Purpose

This document reports on the background, content of the Terms of Reference and progress achieved for the CGMS WGI Task Group on Space Environment Sustainability, relevant to CGMS member current and planned missions.

The status of Task Group membership and call for additional members and subject matter experts to support analyses is also highlighted.

Reporting on outreach activities and plan for future meetings are also provided.

1.2 Scope

This report describes the on-going activities and provides the Terms of Reference in its entirety in the Annex I.

An abridged version of Terms of Reference to highlight the main objectives and deliverables is provided in the body of this document.

1.3 Applicable Documents

There are no applicable documents identified.

1.4 Reference Documents

	Document Title	Reference
RD-1	Discussion on future CGMS WGI efforts on Space Debris and Collision Avoidance	CGMS-51-WGI-WP-07, PPT
RD-2	CGMS future direction 2022+ *Position paper theme: Space Situational Awareness*	CGMS-51-CGMS-WP-19
RD-3	CGMS future direction 2022+ Task Team - Terms of Reference (for information)	CGMS-51-CGMS-WP-07
RD-4	UN General Assembly: COPUOS Special report of the Inter-Agency Meeting on Outer Space Activities on developments within the United Nations system related to space debris	A/AC.105/1317
RD-5	European Space Policy Institute report: "A Party for Everyone? Analysing international efforts in space debris mitigation".	September 2024 https://www.espi.eu/reports/a-party-for-everyone-analysing-international-efforts-in-space-debris-mitigation/

2 BACKGROUND TO THE TASK GROUP

This Task Group has built upon the preliminary work initiated by its predecessor, the Space Debris and Collision Avoidance Task Group established in 2019, but having lapsed activities in 2022 [RD-1]. Note that activities conducted were limited to bilateral interactions between NOAA and EUMETSAT. The RD-1 provides the references to the reports issued, including the Terms of Reference.

The name of this revived Task Group was changed in recognition of the broader scope of activities, dealing not only with debris but also with safe operations in increasingly congested orbits and additionally taking into account potential impacts from space weather.

Furthermore, the objectives and actions from the CGMS Future Directions Project SSA theme were considered in the scope of this Task Group [RD-2].

3 SCOPE OF THE TASK GROUP TERMS OF REFERENCE

The Terms of Reference were approved at CGMS-52 and have generally remained stable, with a minor update to specifically include the development of practical approaches for pre-launch conjunction assessment as required by the UN Long-Term Sustainability Guidelines. Please refer to Annex I.

The Terms of Reference is addressed to all CGMS participants and is relevant for all management, engineering and legal functions responsible for ensuring the definition, implementation and operation of CGMS agency space-based systems is compatible with the space environment and its sustainability.

The Task Group objectives and activities defined by the Terms of Reference are therefore applicable across all satellite-based programmes in all mission phases.

The Terms of Reference intends to cover all space sustainability issues of relevance to CGMS missions without exclusion. In particular, this ToR includes all SSA aspects associated with the Short-, Medium- and Long-term Goals for CGMS, as defined in [RD-2] and split into the following categories:

- Space Traffic Coordination
- Space Weather
- Space Sustainability

It should be noted that there is potential relevance to other CGMS Future Directions Themes and any such cases identified during discussion should be highlighted. However, no specific case was identified during discussions since CGMS-52. The full scope of CGMS Future Directions Themes is summarised in [RD-3].

As reported at CGMS-53, UN-Space reported on the effort of this Space Environment Sustainability Task Group and the objective to report to UN-COPUOS. Please refer to the extract in Annex II.

Highlights of Objectives and Deliverables (abridged from the full Terms of Reference in the Annex I).

Task Group Overall Objective
This Task Group address all aspects of operations in the space environment where CGMS member coordination can help improve the safety and sustainability of space operations for all space actors.

Membership: CGMS member organisations. Outreach to interested external space actors is planned.

Detailed key objectives and deliverables

1. **Objective:** Stay abreast on the status, current events and foreseen evolutions of the space environment, together with related regulations, guidelines, approaches, tools and services with the potential to constrain or inform in-orbit and planned CGMS mission services.
    - **Deliverable:** Accessible Resource database.

2. **Objective:** Establish a Best Practice on Space Environment Sustainability aspects for CGMS member's missions covering:
    i. Space Traffic Coordination
    ii. Lifetime extensions and end-of-life disposal
    iii. Break-up and atmospheric re-entry notification process
    iv. Space weather forecast usage and mitigation of risks and effects.
    - **Deliverable:**
        a) A best practice document on Space Environment Sustainability based primarily on existing practices, but also with a view to emerging technologies and concepts for long-term, system lifecycle sustainability
        b) A gap analysis on global Space Traffic Coordination capabilities and alignment
        c) Updated proposal for best practices based on outputs from (a), (b), targeting approval by CGMS for submission to UN COPUOS, with focus on Space Traffic Coordination.

3. **Objective:** Identify and act upon risks to sustained operations.
    - **Deliverable:** A space environment sustainability SWOT analysis, with identified actions.

4 TASK GROUP MEMBERSHIP AND CALL FOR ADDITIONAL MEMBERS

Membership of the Task Group has been sufficient to allow a meaningful exchange to take place, but would still benefit from the participation of currently unrepresented agencies (particularly in the domain of space safety and situational awareness).

Identification of experts from member organisations who can support offline analyses of the Task Group is key to progressing on the objectives of the Task Group and active participation of experts from ESA, EUMETSAT and NOAA has allowed progress to be made in discussions of conjunction analyses and other space safety aspects. A broader participation of agencies remains critical to achieving the goals of this Task Group however. Agencies not yet identified as contributing to the TG are highlighted in red in the membership table below. Note however that ISTRAC and Cnes representatives are included in Task Group invitations and outputs.

Note that due to the applicability of discussions to all space operators, invitations to non-CGMS organisations have been made to participate. So far, SANSA (South African National Space Agency) have participated from the viewpoint of space weather related operations, while UKSA is in receipt of TG outputs.

Due to the scope of the Task Group, a secretarial / assistant function supporting the Co-Chairs has not yet become available, which slows progress of the activities.

The current status of membership is provided below (extracted from Terms of Reference in Annex I).

Role	Organisation	Function	Names
Co-Chair	EUMETSAT	Space Environment Sustainability Coordinator	Andrew Monham Andrew.Monham@eumetsat.int
Co-Chair	ESA	Head of Space Weather CGMS Future Project SSA lead	Juha-Pekka Luntama Juha-Pekka.Luntama@esa.int
Secretary	TBC		
Member	CMA	Space Weather	Cong HUANG huangc@cma.gov.cn
Member	CNES		
Member	CNSA		
Member	IMD		
Member	ISRO		
Member	JAXA	JAXA STCC (Satellite Tracking and Communications Center	Shinichi Nakamaru
Member	JMA		
Member	KASA	Head of Space Weather	Kichang Yoon

Role	Organisation	Function	Names
Member	KASI	Chief Manager / Principal Researcher Space Hazards Program Office Center for Space Situational Awareness	Dr. Eun-Jung Choi eunjung@kasi.re.kr
Member	KMA	Senior Researcher of Satellite Operation Divison	Jaeyoung Byon jybyon@korea.kr
Member	NASA	Head of Space Weather Space Comms & Navigation	Jamie Favors james.e.favors@nasa.gov John Hudiburg john.j.hudiburg@nasa.gov
Member	NICT	Executive Researcher Space Environment Laboratory	Tsutomu Nagatsuma tnagatsu@nict.go.jp
Member	NOAA	Deputy Director of NOAA Satellite Operations	Scott Leonard scott.leonard@noaa.gov
Member	ROSCOSMOS		
Member	ROSHYDROMET		
Member	WMO		Heikki Pohjola hpohjola@wmo.int
Member	ISES	Deputy Director of ISES (http://www.spaceweather.org/)	Sergio Dasso sergio.dasso@gmail.com
Expert	ESA	Space Debris Office	Klaus Merz
Expert	EUMETSAT	Flight Dynamics	Pier Luigi Righetti
Expert	EUMETSAT	Mission Analysis	Jose Maria de Juana Gamo

Role	Organisation	Function	Names
Expert	EUMETSAT	Programme Development	Remy Chalex
Expert	EUMETSAT	Legal Affairs	Rachelle Antal-Wokes
Expert	NASA	LEO	Paul Apostolopoulos
Expert	NASA	GEO	Ian Ross
Observers	SANSA	Space Weather	Mpho Tshisaphungo Rendani Nndanganeni

5 TASK GROUP PRIORITIES

a) Top priority is to produce best / acceptable practices for Space Traffic Coordination (collision avoidance, active on active satellite coordination practices).
b) 2nd priority are the tasks/actions related to space weather observation requirements for improved STC services and space sustainability and reviewing current usage of space weather data for spacecraft operations and goals for improvement.

6 PROGRESS ON CGMS-53 ACTIONS

6.1 Action Overview

Action	Description	Status
WGI/A50.07	Deliver a Best Practice document on Space Environment Sustainability, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-54	Open
WGI/A53.04	Define the requirement for supplying owner/operator orbit and manoeuvre information to TraCCS and identify steps for implementation	Propose Closed
WGI/A53.05	Identify steps to coordinate modelling of thermospheric density impacts and perform inter-comparison of model results	Open
WGI/A53.06	Discuss in intersessionals and prepare highlight presentations in next year's Task Group intersessionals and CGMS-54 WGs on: • The overall landscape of work on SES topics and where the CGMS TG on SES fits in it. • Agencies experience and practices on collision avoidance • Agencies experience and practice on Debris removal	Propose Closed
WGI/A53.07	Andrew Monham to develop a paper on CGMS work on SES for presentation at IAC in 2026.	Open
WGI/A53.08	Review current usage of space weather data for spacecraft operations and goals for improvement.	Open
WGI/A53.09	Produce a report of space weather observation requirements for improved STC services and space sustainability.	Open

6.2 Action Progress

WGI/A50.07	**Deliver a Best Practice document on Space Environment Sustainability, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-54**	**Open**

Compilation and analysis of current practices

The Task Group has continued compiling a matrix of currently used practices in the different domains of space traffic coordination and debris mitigation. This covers various orbital domains used to support the activities of the CGMS members: LEO, GEO, HEO, Extraterrestrial. Annex III provides the latest status of the LEO matrix.

Inputs have been received from CMA, ESA, EUMETSAT, JAXA, NASA and NOAA.

A detailed review of these practices has been performed and presented by the EUMETSAT expert, to identify commonalities, deviations. Overall, a good alignment of operational practices is seen, driven by similar guidelines and standards used by the respective agencies. Examples of alignment are:

- USSF data are used by operators (ESA, EUMETSAT, JAXA, NASA and NOAA), plus some delta (CARA, EUSST, JMOD, commercial). CMA source of SSA data to be confirmed. It is noted that TraCCS will replace the USSF SSA data provision function (see separate action).
- In terms of manoeuvre timing, all operators target a collision avoidance manoeuvre (CAM) as late as possible.
- To mitigate impact on the operational mission, all operators foresee optimising CAMs considering planned routine manoeuvres.

Some variation in the details of how standards and guidelines are implemented has been identified, which the Task Group is following up for discussion and potential identification of a best practice. For example:

- Regarding collision risk assessments, different methods are being used in the calculation of the hard-body radius of primary and secondary objects and discussion is on-going as to the pros and cons of these methods and the potential for alignment.
- Concerning manoeuvre decision criteria, while most operators use a reference of 10^{-4}, ESA and EUMETSAT may use more stringent values for some missions to achieve a proportionate reduction in background risk. Understandably NASA's human spaceflight missions use more stringent values. Consideration is also being given as to whether more stringent thresholds should apply where the impact of a collision would have severe consequences to the space environment.
- Related to this is the need for more stringent risk thresholds for active-on-active conjunction at around 10^{-5} (instead of the more generally used 10^{-4}), with coordination starting with identified risks of $3x10^{-6}$ (to ensure operators have more time to establish communications)
- Also in the case of active-on-active conjunctions, considering whether a standard, simplified Hard Body Radius approach should be used, in order to ensure a common understanding of the collision risk between the operators involved.
- Some variation in the management of the acceptable, background risk is noted, with generally two orders of magnitude below the intervention threshold being considered OK for mitigation (ESA, CMA, Jaxa, NASA HSF), whereas NOAA reduce background risk much more and EUMETSAT and NASA a little less.

Implementation of the UN Long-Term Sustainability Guidelines.

Given the objective of compiling a report towards UN COPUOS, the Task Group has started compiling a matrix of how the TG is addressing the UN Long-Term Sustainability Guidelines (Section B on Space Safety) and how each member agency is implementing their approach to these. So far, inputs from EUMETSAT and NOAA have been received which indicate good alignment overall.

Annex IV provides the current status. As part of this analysis, it was noticed that pre-launch post-separation conjunction analyses for satellite payloads has not been considered in the scope of TG activities and this has now been added to the Terms of Reference. A presentation of the EUMETSAT approach newly implemented in support of MTG-S and Metop-SG-A1 launches was made. It was noted that:

- The EUMETSAT approach is mathematically proven to provide a real risk reduction despite uncertainties.
- Launcher authorities were reluctant to consider – possible actions were limited to altering launch window, not aborting launch.
- NOAA are working with NASA to implement a similar assessment.
- Other agencies encouraged to review and comment.

Compilation of Active-on-Active Contact Points and Information Exchange

The Task Group has continued to promote the listing of contact points to handle active-on-active satellite conjunctions, together with additional information on the formats of data etc. In addition, it is requested to identify if the named contact for a given member can be used as an intermediary to distribute information concerning such conjunctions to national or regional third-party operators who may otherwise not be contactable. Although contact point listings are also available in Space Track, it is felt this spreadsheet has the potential to include value-added information and further contributions are encouraged.

Both EUMETSAT and NOAA noted recent positive experiences concerning active-on-active conjunctions with Chinese space assets and information has been recorded in the LTS mapping concerning the contact point used (CASS@bittt.cn conjunction assessment service of Beijing Institute of tracking and telemetry technology).

- CNSA is invited to confirm the scope of missions being managed by the CASS@bittt.cn contact point.
- CMA have provided a separate contact point applicable to their satellites (lits@cma.gov.cn) which is recorded in the active-on-active sheet.

The latest status of the spreadsheet is in Annex V

Conclusion

The Task Group has been able to gather sufficient information from a subset of CGMS members to allow meaningful comparisons and analyses towards a best practices definition.

A draft Best Practice document at CGMS-55, with mapping to UN Long-Term Sustainability Guidelines should be achievable but requires:

- Further offline analysis with the support of member agency experts
- Additional CGMS member inputs to ensure the BPs are representative and feasible for the wider membership.

It is recommended to keep the action open until CGMS-55, noting that UN LTS Guideline mapping shall also be included in the deliverable document.

WGI/A53.04	**Define the requirement for supplying owner/operator orbit and manoeuvre information to TraCCS and identify steps for implementation**	**Proposed Closed**

NOAA have provided detailed information based upon their own experience, using publicly available TraCSS document links and example files from the NOAA GOES mission (a TraCSS pilot user). This should help other CGMS operators with example OCM and CDM formats before the service enters the production/public phase at a TBD date.

- Goal is to transition all (non-US military) users of Spacetrack to TraCCS
- Access to the TraCCS should be unrestricted – it is an international platform.
- Data will be fully public, including uploaded ephemeris

TraCSS Status:
- NOAA's Office of Space Commerce (OSC) is developing the Traffic Coordination System for Space (TraCSS) to provide basic space situational awareness (SSA) data and services to civil and private space operators, supporting spaceflight safety.
- TraCSS is being developed to implement **Space Policy Directive 3** for the U.S. Department of Commerce, providing space operators with space traffic safety data and services
- As the TraCSS user interface matures, OSC will migrate users from SpaceTrack to TraCSS.gov by reaching out to the community.
- TraCSS is currently undergoing testing and development with a set of pilot users in various orbits. It plans to enter production/public release for all operators on a date to be announced.

Supplying owner/operator orbit and manoeuvre information to TraCSS:
- TraCSS has developed its own unique CDM and OCM orbit data formats which are detailed on the public facing site and continue to be refined as the service rolls out: https://space.commerce.gov/traffic-coordination-system-for-space-tracss/videos-listening-sessions-documents/
- Operators are to generate OCM files containing details such as orbit data, physical properties, covariance data, maneuver data, OD information and other perturbation parameters along with meta data such as points of contact.
- TraCSS Conjunction Data Message (CDM) Specification: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://space.commerce.gov/wp-content/uploads/2026/01/TraCSS-Spec-001-v2.1_CDM.pdf
- TraCSS Orbit Comprehensive Message (OCM) Specification: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://space.commerce.gov/wp-content/uploads/2026/01/TraCSS_SE_SPEC_002_v2.1.pdf

- TraCSS Data Policy, User Agreement, and User Information Collection Plan: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://space.commerce.gov/wp-content/uploads/2025/08/TraCSS-Data-and-Information-Policy-and-User-Agreement-08132025-2.pdf

Example NOAA GOES Orbit Data Files used for ingest into TraCSS services and TraCSS generated CDM files have been made available: :

- **G14_EVENTS_25_294.ocm** (an example ephemeris file that NOAA GOES uploads to TraCSS, this mission has no maneuvers, so it is a good example of a non-maneuvering OCM format at that time)
- **G19_Inert_Ephem_20251028.ocm** (an example of a frequently maneuvering GEO spacecraft)
- **000060133_conj_000023656_2025307014859_1761664251.kvn** (an example TraCSS generated CDM file using the 18 SDS SP data for both primary and secondary object knowledge)
- **000060133E_conj_000023656_2025307014906_1761670037.kvn** (an example TraCSS generated CDM file using operator ephemeris OCM file for GOES-19 vs 18 SDS SP data for secondary object knowledge).

Implementation Steps:

- Operators are currently interfacing with TraCSS via APIs to upload and download orbit data and access CDMs automatically, without manually using the portal.
- Because the service and portals are currently in development, information will be shared with new operators as they are onboarded.
- Operators will need to create accounts on TraCSS when the service enters the production/public phase and set up their fleet details, any third-party partners and relevant operations details.

It is noted that this addresses also one of the points highlighted in the CGMS-53 Task Group report:" *The TG noted that currently good propagation products using space weather inputs come from US 18th Squadron. However, their starting point (knowledge of operator orbit) is based on their own measurements, rather than operator supplied orbit. If the owner/operator orbit and future manoeuvres could be supplied, then the propagation may be more accurate. TG members are requested to consider the requirement for this and steps for implementation. Recommended to follow up with TraCSS (US DoC).*"

- Since TraCCS can accept the owner/operator orbit and manoeuvre information, this should provide a more accurate propagation that previously possible, helping to improve the risk assessment accuracy.

Conclusion

Action WGI/A53.04 is proposed to be closed.

WGI/A53.05	**Identify steps to coordinate modelling of thermospheric density impacts and perform inter-comparison of model results**	**Open**

Modelling of thermospheric density is essential to better understand the drag environment of our satellites and the debris field around them, leading to more effective collision risk assessments.

The Task Group is working on building a table of thermospheric density models and related studies to facilitate intercomparison.

ESA have provided a first input which is reproduced in Annex VI.

It is expected that CCMC (Community Coordinated Modeling Center) expert inputs can be made via NASA, (https://science.gsfc.nasa.gov/674/ccmc-landing-page.html).

Inputs from other agencies are requested.

Conclusion

Action WGI/A53.05 remains open, pending inputs from other agencies to the thermospheric density model table and subsequent intercomparison and recommendations for coordination.

WGI/A53.06	**Discuss in intersessionals and prepare highlight presentations in next year's Task Group intersessionals and CGMS-54 WGs on:** • **The overall landscape of work on SES topics and where the CGMS TG on SES fits in it.** • **Agencies experience and practices on collision avoidance** • **Agencies experience and practice on Debris removal**	**Proposed Closed**

The overall landscape of work on SES topics and where the CGMS TG on SES fits in it.

It has been identified that a significant review of the overall landscape of SES topics is presented in the September 2024 European Space Policy Institute report: "*A Party for Everyone? Analysing international efforts in space debris mitigation*". https://www.espi.eu/reports/a-party-for-everyone-analysing-international-efforts-in-space-debris-mitigation/

This report offers a comparative analysis of key international instruments aimed at mitigating space debris, enhanced by detailed insights on their evolution. It is noted that "the report highlights a lack of broad international alignment on concrete implementation pathways and a fragmented landscape of a multitude of frameworks with heterogenous involvement."

Indeed, the CGMS SES Task group could be considered as belonging to that fragmented landscape, but is considered valuable as experienced operators with global scope have a direct forum to discuss and improve the implementation pathways to meet ever stricter debris mitigation standards and regulations.

Please ref to Figure 1, from the ESPI report which provides a comparative evaluation of some of the mechanisms identified in that report. It is worth noting that some of the Task group members and experts are also involved in the working groups evolving other mechanisms in this list (such as the ISO 24113 standard, the ESA SD requirements etc.)

Note on colour coding: The addition of colour coding to the analysis below was chosen to provide additional insights on the added value of each instrument, Light blue – indicates assessment that is closest to highest value in terms of addressing gaps and key effectiveness criteria (clarity, precision, inclusivity), Dark blue denotes partial or semi-satisfactory fulfilment and Orange denoting absent or minimal fulfilment,

Selected Mechanisms (incl. date of first release)		Content				Structure			Representation		
		I. Design & Architecture	II. Collision avoidance	III. Orbital Clearance	IV.Compliance & Monitoring	V. Type of commitment	VI. Centralisation degree	VII. Adaptability & Evolution	VIII. Number of partners	IX. Type of partners	X. Ease of access
IADC Space Debris Mitigation Guidelines	2002	Yes	Yes	Yes	No	Imprecise	Decentralised	Flexible	Internal	Public	Accessible
European Code of Conduct for Space Debris Mitigation	2004	Yes	Yes	Yes	No	Concrete	Decentralised	Partial	Internal	Public	N/A
UN COPUOS Space Debris Mitigation Guidelines	2007	Yes	Yes	Yes	No	Imprecise	Partial	Partial	High	Public	N/A
Rec ITU-R S.1003-2 (Geostationary)	2010	No	No	Yes	No	Concrete	Centralised	Partial	High	Public	Undefined
ISO 24113 Space debris mitigation requirements	2010	Yes	Yes	Yes	Yes	Imprecise	Centralised	Flexible	High	Pub.-priv	Accessible
UN LTS Guidelines	2019	Yes	Yes	Yes	Partial	Imprecise	Partial	Partial	High	Public	N/A
SIA Principles of Space Safety	2019	Yes	Yes	Yes	No	Imprecise	Partial	Partial	High	Private	Accessible
Space Safety Coalition's Best Practices	2019	Yes	Yes	Yes	No	Imprecise	Decentralised	Partial	High	Private	Undefined
CONFERS' Recommended Design & Practices	2019	Partial	Partial	No	Partial	Imprecise	Partial	Flexible	High	Pub.-Priv.	Undefined
PPF's Net Zero Space Initiative	2021	Partial	Partial	Partial	No	Imprecise	Decentralised	Flexible	High	Pub.-Priv.	Accessible
G7 Science and Technology Ministers' Communiqué	2023	Partial	Partial	Partial	No	Generic	Decentralised	Partial	Internal	Public	N/A
WEF's Space Industry Debris Mitigation Recommendations	2023	No	Yes	Yes	No	Concrete	Decentralised	Partial	Low	Private	Accessible
ESA Space Debris Mitigation Requirements	2023	Yes	Yes	Yes	Yes	Concrete	Centralised	Flexible	Internal	Public	N/A
GSOA Code of Conduct on Space Sustainability	2023	Yes	Yes	Yes	Partial	Imprecise	Decentralised	Flexible	High	Private	Accessible
Zero Debris Charter	2023	Yes	Yes	Yes	Partial	Concrete	Decentralised	Partial	High	Pub.-Priv.	Accessible

Figure 1: Comparative evaluation of selected space safety mechanisms, ESPI, 2024.

As part of the STC matrix presented under action WGI/A50.07, agencies have been asked to provide information on space debris guidelines, standards and regulations used within their organisations – information has been provided by ESA, EUMETSAT, JAXA and NASA.

As mentioned previously, the implementation approach to fulfilling the UN LTS Guidelines is requested from all agencies and has so far been supplied by EUMETSAT and NOAA.

Of the mechanisms indicated in the ESPI report, it is considered that the Space Safety Coalition's Best Practices most closely aligns with the objectives of the CGMS SES Task Group. Although this concerns a group of private, commercial operators, it is felt valuable to share lessons learned. To this end, an invitation has been made to the Chair of this Space Safety Coalition to present their work at an upcoming SES TG meeting. Scope for further cooperation will be examined.

Agencies experience and practices on collision avoidance

Information has been requested through the STC matrix presented under action WGI/A50.07. Please refer to the discussion of experience and practices under that action point.

Agencies experience and practice on Debris removal

Information has been requested through the STC matrix presented under action WGI/A50.07. Each agency providing data has included an answer on this point.

- NOAA, NASA and CMA consider direct de-orbit for manoeuvrable LEO satellites, ESA if the on-ground risk too high, EUMETSAT for new satellites.
- 25 years for uncontrolled re-entry considered by EUMETSAT and JAXA for existing satellites.
- EUMETSAT, in partnership with ESA, has been investigating the potential of In-Orbit-Servicing / Active Debris Removal in terms of mission lifetime benefits for existing missions and possible application to new missions.

Conclusion

The SES TG is one of many groups focussing on space safety and traffic management. However, most are aimed at defining requirements rather than exchanging experience in implementation of those requirements and aligning implementation methods. The closest body in terms of scope and objectives would appear to be the Space Safety Coalition (SSC). An invitation has been made for the SSC to present their work at an upcoming SES TG meeting. Scope for further cooperation will be examined. It is proposed to raise a new action to track progress.

WGI/A53.07	**Andrew Monham to develop a paper on CGMS work on SES for presentation at IAC in 2026.**	**Open**

The Abstract: *"Coordination of Space Environment Sustainability Approaches in the Coordinated Group for Meteorological Satellites (CGMS)"* has been accepted for presentation at the 77th IAC in the Space Debris Symposium.

Conclusion

Action to remain open until paper developed / presented at the IAC (Antalya, Turkey, 5-9 October) and feedback provided to the SES TG for reporting at CGMS-55.

WGI/A53.08	**Review current usage of space weather data for spacecraft operations and goals for improvement.**	**Open**

This covers space weather requirements supporting space traffic coordination and safe spacecraft operations and is considered to be the 2nd priority of this task group.

As reported in CGMS-53, space weather information is split on two tables separating the Space Traffic Coordination needs from the "safety of space operation" related information. The matrices are addressing explicitly the operations on Earth orbits for now. concentrating on LEO, GEO. So far, only inputs from ESA have been provided and no further inputs have been made since CGMS-53. The tables of Space weather needs for STC and Safe Operation are provided in Annex VII.

ESA have subsequently agreed to provide more details to facilitate comparison with other agencies' approaches and achieved accuracies and inputs from other agencies are expected soon.

Note the advances in assessing thermospheric density models and in improving space weather propagation from the space debris data provider (soon to be TraCCS) have progressed and are dealt with in separate actions.

Conclusion

Action to remain open, awaiting further refinement of the ESA inputs in the space weather matrices and inputs from other agencies to allow comparative analysis to be performed.

WGI/A53.09	**Produce a report of space weather observation requirements for improved STC services and space sustainability.**	**Open**

To be produced following delivery and analysis of inputs from WGI/A53.08

Conclusion

Action to remain open.

7 MEETINGS HELD / PLANNED

Since CGMS-53, the following 3 TG meetings have taken place.

10 October 2025, 21 January 2026, 10 March 2026

Not that the planned late November meeting had to be cancelled due to extended medical absence of the Chair.

An additional TG meeting prior to the CGMS-54 plenary is proposed for 20 May 2025.

Proposed CGMS-54-55 TG Meetings (all virtual, starting 12:00 UTC)

- 7 July 2026
- 3 Sept 2026
- 15 Oct 2026
- 2 Dec 2026
- 26 Jan 2027
- 11 Mar 2027

Opportunities for face-to-face discussions as side meeting in other conferences shall also be considered.

Foreseen outreach activities include the presentation of the CGMS SES TG activities at the 77th IAC in Antalya, Turkey, 5-9 October 2026.

Consideration shall also be made for an abstract for the SpaceOps2027 event which will take place in Munich, Germany, 10-14 May 2027.

8 CONCLUSION

WGI is invited to take note of the progress of the Task Group on Space Environment Sustainability and support the call for membership and subject matter expertise from each CGMS member organisation in order to help ensure the objectives can be met.

Summary of Proposed Action Status

WGI/A50.07	Deliver a Best Practice document on Space Environment Sustainability, with supporting presentation to CGMS WGI, for recommendation for endorsement in CGMS-55	Open
WGI/A53.04	Define the requirement for supplying owner/operator orbit and manoeuvre information to TraCCS and identify steps for implementation	Propose Closed
WGI/A53.05	Identify steps to coordinate modelling of thermospheric density impacts and perform inter-comparison of model results	Open
WGI/A53.06	Discuss in intersessionals and prepare highlight presentations in next year's Task Group intersessionals and CGMS-54 WGs on: • The overall landscape of work on SES topics and where the CGMS TG on SES fits in it. • Agencies experience and practices on collision avoidance • Agencies experience and practice on Debris removal	Propose Closed
WGI/A53.07	Andrew Monham to develop a paper on CGMS work on SES for presentation at IAC in 2026.	Open
WGI/A53.08	Review current usage of space weather data for spacecraft operations and goals for improvement.	Open
WGI/A53.09	Produce a report of space weather observation requirements for improved STC services and space sustainability.	Open

One new action is proposed:

- *Action WGI/A54.XX: Assess overlap and scope for coordination with the Space Safety Coalition.*

ANNEX I: TERMS OF REFERENCE

(UPDATE FROM CGMS-53)

1. INTRODUCTION

1.1 Purpose

This document provides the Terms of Reference for the CGMS WGI Task Group on Space Environment Sustainability, relevant to CGMS member current and planned missions.

Once established, the relevance and accuracy of this Terms of Reference shall be reviewed and maintained on a regular basis.

It should be noted that this Task Group will build on the preliminary work initiated by its predecessor, the Space Debris and Collision Avoidance Task Group established in 2019, but having lapsed activities since 2022 [RD-1]. Note that activities conducted were limited to bilateral interactions between NOAA and EUMETSAT. The RD-1 provides the references to the reports issued, including the Terms of Reference.

The name of this revived Task Group has been changed in recognition of the broader scope of activities, dealing not only with debris but also with safe operations in increasingly congested orbits and additionally taking into account potential impacts from space weather.

Furthermore, the objectives and actions from the CGMS Future Directions Project SSA theme are to be considered [RD-2].

1.2 Scope

This Terms of Reference is addressed to all CGMS participants and is relevant for all management, engineering and legal functions responsible for ensuring the definition, implementation and operation of CGMS agency space-based systems is compatible with the space environment and its sustainability.

The Task Group objectives and activities defined by this Terms of Reference are therefore applicable across all satellite-based programmes in all mission phases.

The Terms of Reference intends to cover all space sustainability issues of relevance to CGMS missions without exclusion. In particular, this ToR includes all SSA aspects associated with the Short-, Medium- and Long-term Goals for CGMS, as defined in [RD-2] and split into the following categories:

- Space Traffic Coordination
- Space Weather
- Space Sustainability

It should be noted that there is potential relevance to other CGMS Future Directions Themes and any such cases identified during discussion should be highlighted. The full scope of CGMS Future Directions Themes is summarised in [RD-3].

1.1 Applicable Documents

There are no applicable documents identified.

1.2 Reference Documents

	Document Title	Reference
RD-1	Discussion on future CGMS WGI efforts on Space Debris and Collision Avoidance	CGMS-51-WGI-WP-07, *PPT*
RD-2	CGMS future direction 2022+ *Position paper theme: Space Situational Awareness*	*CGMS-51-CGMS-WP-19*
RD-3	CGMS future direction 2022+ Task Team - Terms of Reference (for information)	*CGMS-51-CGMS-WP-07*
RD-4		

1.3 Implementation Documents

No relevant implementation documents at this issue.

1.4 Terminology

Acronyms and Abbreviations

Acronym/Abbr.	Explanation
CGMS	Coordinated Group for Meteorological Satellites
SES	Space Environment Sustainability
SSA	Space Situational Awareness
STC	Space Traffic Coordination
SWOT	Strengths-Weaknesses-Opportunities-Threats
TG	Task Group
UN COPUOS STSC	United Nations Committee for the Peaceful Usage of Outer Space Science and Technical Sub-Committee.

Definitions

Definition/Term	Explanation

2 TASK GROUP OBJECTIVES

The Task Group objectives are as follows:

1. Stay abreast on the status, current events and foreseen evolutions of the space environment, together with related regulations, guidelines, approaches, tools and services with the potential to constrain or inform in-orbit and planned CGMS mission services, including *inter alia*:
    - The space debris environment
    - Space debris mitigation standards and guidelines
    - International and regional policy measures for the sustainability of the space environment
    - Operational space traffic affecting CGMS space system orbits
    - Space Traffic Coordination[1]: approaches, regulations and guidelines
    - Space debris tracking capabilities and services
    - Pre-launch conjunction assessment approaches
    - Collision avoidance capabilities and services
    - Debris removal capabilities and services
    - Lifetime extension criteria, capabilities and services
    - Spacecraft design for sustainability: e.g. autonomous manoeuvrability, passivation methods, de-orbiting systems, preparedness for 3rd party removal, robustness against debris impact and space weather effects
    - Forecasting of space weather events and mitigation technologies/methods
    - Potential improvements to space situational awareness analysis (Use of AI, environmental modelling, collection of data to improve environment modelling, identification of micro-collisions from spacecraft telemetry)
    - Defunct space object information exchanges: Break-up notification process, atmospheric re-entry notification process, information on orbit and attitude of passivated satellites

[1] Also referred to as Space Traffic Management, encompassing awareness of active satellite trajectories and "rules of the road".

- Link to terrestrial sustainability issues with possible impact on space sustainability approaches, including carbon footprint, impact of material re-entry on atmosphere, etc.

In this respect establish links to other international groups on space sustainability related activities and iterate on approaches and best practices.

2. Establish and update as relevant a Best Practice on Space Environment Sustainability aspects for CGMS member's missions with objective of submitting a CGMS agreed proposal for consideration by UN COPUOS Science and Technical Subcommittee (STSC), with particular emphasis on global space traffic coordination.
3. Define and manage related risks and opportunities, including identification of actions and formulation of a corresponding SWOT analysis.
4. Report status, risks, opportunities and recommended actions to the CGMS WGI, including recommendations for interactions with CGMS Plenary.
5. Coordinate interactions amongst the CGMS members' expert teams taking ownership of agreed actions and responsible for the implementation of the space environment sustainability approach, including *inter alia*:
   - Satellite operations and mission analysis teams for management of in-orbit conjunctions, lifetime extension, and end-of-life planning and operations
   - Programme development authorities for all missions under definition and development, addressing the applicable regulations, guidelines, approaches and tools to ensure mission concepts and designs are consistent with space environment sustainability objectives
   - Legal affairs for identification of applicable regulations, guidelines and assessment of compliance and related liabilities.
6. Encourage space environment sustainability issues to be addressed in CGMS members' organisations, e.g. in satellite and system level reviews in every phase of a mission lifecycle, with a nominated space environment sustainability representative in every relevant review.
7. Ensure the continued relevance and accuracy of the TG objectives, activities and membership through regular review of this Terms of Reference and associated best practices.

3 TASK GROUP TASKS

The SESTG will nominally meet four times per year or on request of the Chair to:

a) Review the status and foreseen evolutions of the space environment, together with related regulations, guidelines, approaches, tools and services (Objective 1).

b) Identify and establish links to related workshops, conferences, committees where CGMS representation should be considered, obtain reports from relevant proceedings and iterate on approaches and best practices (Objective 1).
c) Identify level of compliance across CGMS space mission to applicable standards and highlight current and foreseen evolutions (Objective 1).
d) Define, review and propose updates to the Best Practices on Space Environment Sustainability for CGMS missions. (Objective 2). This shall be broken down into specific aspects, inter-alia:
    i. Space Traffic Coordination: Review of approaches to identify best and minimum acceptable practices which can form the basis of an international norm, acceptable to global operators and SSA analysts. (Builds upon the NOAA-EUM CGMS-50 Papers), including:
        - Securing access to situational awareness data from object tracking and owner-operator state-vectors
        - Conjunction Analysis for LEO and GEO satellites, considering (as appropriate):
            - Asset conjunction risk assessment geometry and characteristics
            - Collision risk avoidance mitigation manoeuvre decision criteria
            - Optimal timing of manoeuvre decision and implementation
            - Minimizing impact of avoidance manoeuvre on nominal orbit maintenance
            - Acceptable background and mitigated risk analysis
            - Awareness and notification of risk for non-manoeuvrable satellites
            - How space weather inputs are being used in the trajectory assessment and identification of the space weather observation requirements
            - Practical approaches for pre-launch conjunction assessment
        - Inter-operator coordination and process for implementing avoidance manoeuvres for active-on-active conjunctions
    ii. Lifetime extensions and end-of-life disposal
    iii. Break-up and atmospheric re-entry notification process
    iv. Space weather forecast usage and mitigation of risks and effects. In particular:
        - The Task Group shall work with spacecraft operators and their supporting space weather services to establish best practices in the effective usage of space weather data in support of spacecraft operations. The Task Group shall:
            - review CGMS member's current practices and plans, covering:
                a. usage of space weather forecast data

b. usage of space weather data for anomaly root cause analysis
- invite selected external operators to present their approaches.
- Analyse and report on current best practices and goals for improvement

v. Long-term space systems design for sustainability, considering lifecycle sustainability issues, including emerging, enabling technologies, materials, concepts on re-use and recycling in support of a “zero-debris approach”.

e) Perform a gap analysis between the needs and the available/used Space Traffic Coordination (STC) services, including identification of shortcomings. This will need to highlight deviations in regional STC service approaches and address feasibility of alignment / identification of acceptable minimum capabilities (Objective 2)
   i. Develop proposal for updated Best Practices on Conjunction Management based on agreed STC global capability alignment
   ii. Seek CGMS Plenary agreement to submit this BP proposal for consideration by UN COPUOS STSC.
f) Define, review and propose updates to a space environment SWOT analysis and identify relevant actions (Objective 3).
g) Prepare reports and presentations to WGI, comprising status, risks, opportunities and recommended actions for approval (Objective 4).
h) Define and prepare coordination exchanges between relevant CGMS member expert entities responsible for the implementation of the space environment sustainability approach, including cooperating partners as appropriate (Objective 5).
i) Discuss reported space sustainability issues arising from CGMS members’ satellite and system level development reviews, operations mission lifetime reviews and identify planned reviews where space sustainability should be included in the organisational objectives, along with foreseen space sustainability representative (Objective 6).
j) Review continued relevance and accuracy of this Terms of Reference managed by the TG on an annual basis and publish updates when required (Objective 7).

4 TASK GROUP DELIVERABLES

The Task Group shall deliver:

1. An internationally accessible resource database capturing relevant information from Objective 1.
2. A best practice document on Space Environment Sustainability based primarily on existing practices, but also with a view to emerging technologies and concepts for long-term, system lifecycle sustainability. This Best Practice may be delivered in stages with increasing scope, according to a detailed work plan to be defined within the TG itself.
3. A gap analysis on global Space Traffic Coordination capabilities and alignment.
4. Updated proposal for best practices based on outputs from (2), (3), targeting approval by CGMS for submission to UN COPUOS, with focus on Space Traffic Coordination.
5. Supporting presentation to CGMS WGI for recommendation for endorsement by the CGMS Plenary.

5 TASK GROUP COMPOSITION

The Task Group composition aims to encompass all CGMS members with space assets.

Due to the wide scope of technical tasks, members may call on experts in their organisations. Members are encouraged to identify such experts here.

Since the scope of this activity extends beyond operators of meteorological satellites, observer members of the group from such agencies are encouraged to participate.

Further *ad hoc* participation in meetings or activities may be requested by the TG Chair or proposed by members.

Role	Organisation	Function	Names
Co-Chair	EUMETSAT	Space Environment Sustainability Coordinator	Andrew Monham Andrew.Monham@eumetsat.int
Co-Chair	ESA	Head of Space Weather CGMS Future Project SSA lead	Juha-Pekka Luntama Juha-Pekka.Luntama@esa.int
Secretary	TBC		
Member	CMA		Cong HUANG huangc@cma.gov.cn
Member	CNES		

Role	Organisation	Function	Names
Member	CNSA		
Member	IMD		
Member	ISRO		
Member	JAXA	JAXA STCC (Satellite Tracking and Communications Center	Shinichi Nakamaru
Member	JMA		
Member	KASA	Head of Space Weather	Kichang Yoon
Member	KASI	Chief Manager / Principal Researcher Space Hazards Program Office Center for Space Situational Awareness	Dr. Eun-Jung Choi eunjung@kasi.re.kr
Member	KMA	Senior Researcher of Satellite Operation Divison	Jaeyoung Byon jybyon@korea.kr
Member	NASA	Head of Space Weather Space Comms & Navigation	Jamie Favors james.e.favors@nasa.gov John Hudiburg john.j.hudiburg@nasa.gov
Member	NICT	Executive Researcher Space Environment Laboratory	Tsutomu Nagatsuma tnagatsu@nict.go.jp
Member	NOAA	Deputy Director of NOAA Satellite Operations	Scott Leonard scott.leonard@noaa.gov
Member	ROSCOSMOS		
Member	ROSHYDRO MET		
Member	WMO		Heikki Pohjola hpohjola@wmo.int

Role	Organisation	Function	Names
Member	ISES	Deputy Director of ISES (http://www.spaceweather.org/)	Sergio Dasso sergio.dasso@gmail.com
Expert	ESA	Space Debris Office	Klaus Merz
Expert	EUMETSAT	Flight Dynamics	Pier Luigi Righetti
Expert	EUMETSAT	Mission Analysis	Jose Maria de Juana Gamo
Expert	EUMETSAT	Programme Development	Remy Chalex
Expert	EUMETSAT	Legal Affairs	Rachelle Antal-Wokes
Expert	NASA	LEO	Paul Apostolopoulos
Expert	NASA	GEO	Ian Ross
Observers	SANSA	Space Weather	Mpho Tshisaphungo Rendani Nndanganeni

Table 1: Space Environment Sustainability Task Group Membership

Annex II: Extract from UN-Space Special Report on Space Debris

The United Nations Office for Outer Space Affairs (UNOOSA) acting as Secretariat to UN-Space (the Inter-Agency Meeting on Outer Space Activities) reference the CGMS activity in the Special Report on Space Debris presented for consideration by the Committee on the Peaceful Uses of Outer Space at its sixty-seventh session, in June 2024 (RD-4). The extract is reproduced below.

N. Meteorology

86. The members of the Coordination Group for Meteorological Satellites (CGMS), of which WMO is one, rely on the sustainability of the space environment to ensure their satellite missions remain able to deliver meteorological and space weather data to global forecasting services. In this regard, safety on Earth is very much intertwined with safety in space. CGMS has therefore established a Task Group on Space Environment Sustainability which shall address all aspects of operations in the space environment where CGMS member coordination can help improve the safety and sustainability of space operations for all space actors. The objectives include establishing best practices covering space traffic coordination, lifetime extensions, end-of-life disposal and mitigation of space weather risks and effects. It is foreseen that a proposal on acceptable space traffic coordination practices may be submitted for consideration by the Committee on the Peaceful Uses of Outer Space.

Annex III: Space Traffic Coordination Agency Inputs (Example LEO Satellites)

Collision Avoidance / Space Traffic Coordination	NOAA Approach	EUMETSAT Approach	ESA Approach (during operations)	CMA Approach	JAXA Approach	NASA
Situational awareness data sources	Prime: CARA Sec: Commercial	Prime: 18th SPCS moving to TraCCS (DoC) Sec: EUSST	prime: 18th SPCS, EUSST, commercial under test, TraCCS followed	NCSW, CMA	18th/19th SPCS, JMOD	USSF Delta 2 (w/NASA contractors onsite at Vandenberg)
Risk assessment: LEO	CARA + Commercial Static Hard Body Radius	CARA + EUSST + Internal Dynamic Hard Body Radius	Internal, static HBR, worst case assessment when needed https://conference.sdo.esoc.esa.int/proceedings/sdc9/paper/391/SDC9-paper391.pdf https://conference.sdo.esoc.esa.int/proceedings/sdc8/paper/296/SDC8-paper296.pdf	Static Hard Body Radius		CARA (FOD for HSF missions)
Manoeuvre decision: LEO	If Pc risk ≥ 4.4e-4 and operational concerns	If Pc risk ≥ 1.0e-4 for EPS If Pc risk ≥ 3.0e-5 for S3/6	Mission specific, 10-4 or lower driven by 90% risk reduction overall. Req for new missions: ESSB-ST-U-007 Issue 1 requires the acceptable collision probability threshold shall be below 10-4 per conjunction.	If Pc risk ⩾ 1e-4	A RMM is recommended If 1.0e-3>Pc≥1.0e-4. A RMM is requested if Pc≥1.e-3.	If Pc risk ≥ 1e-4 for non-HSF HSF If Pc risk ≥ 1e-5 pending operational impact to mission (different thresholds needed during prox ops, EVA, …)
Manoeuvre Timing Consider constraint on latest CAM decision	As late as possible	As late as possible, but anticipation considered	As late as possible, considering operational constraints.	As late as possible, but anticipation considered	As late as possible, considering operational constraints.	as late as possible given spacecraft constraints (ISS ~2.5 hrs prior to TCA)
Mitigating nominal mission impact	Optimization of satellite maneuver ops	Usage of routine maneuvers if possible	Optimisation and consideration of routine orbit control manoeuvers	Usage of routine maneuvers	Optimisation and consideration of routine orbit control manoeuvers	
Background risk analysis Consider residual risk after CAM on other objects	Mitigation target: 1.0e-7	Mitigation target: 3.0e-6 Less acceptable	Typical mititgation target: reduce the collision probability by at least two orders of magnitude below the threshold.	Mitigation target: 1.0e-6	Mitigation target: 1.0e-6	Mitigation target of 3e-6 (HSF 1E-7)
Non-Manoeuvrable satellites	Monitoring for high risk Notification: Pc ≥ 1.0e-3	Not applicable	Support coordination with other operators via space-track and status/ephem exchange New missions: Manoeuvre capabilities are required for GEO, LEO with>5year orbital lifetime, constellations, CPOs, and when cumulative collision probability with space objects larger than 1 cm is above 10−3 through to its end of [orbital] life.	Not applicable	Monitoring for high risk Notification: Pc ≥ 1.0e-3	Monitor, report remaining risk to management at TCA-24 hours, ask for Headcount from USSF

Space Traffic Coordination Agency Inputs (Example LEO Satellites, continued)

Collision Avoidance / Space Traffic Coordination	NOAA Approach	EUMETSAT Approach	ESA Approach (during operations)	CMA Approach	JAXA Approach	NASA
Active on Active conjunctions	No case experienced: one to one coordination	Several cases observed: one to one coordination	mutual coordination, bilateral working-level arrangements, coordination platforms under evaluation	No case experienced: one to one coordination	Several cases observed: one to one coordination	work with secondary operator to coordinate who will maneuver
EOL Debris Mitigation	Direct de-orbit of maneuverable satellites Passivation otherwise	Uncontrolled de-orbit except for next EPS generation (controlled)	Controlled re-entry if casualty risk above threshold 10^-4 (may not be feasible for legacy missions). Else max 5 years lifetime or and max cumulative collision probability of 10^-3 with objects larger than 1 cm	Direct de-orbit of maneuverable satellites Passivation otherwise	Minimize release of objects, prevention of breakup and minimize orbital lifetime 25 years or less after disposal.	Direct de-orbit of maneuverable satellites Passivation otherwise
Experience with In-Orbit Servicing and Maintenance (ISAM) incl. Active Debris Removal (ADR)		Current and planned EUM satellites not prepared for ISAM. Future EU operated satellites will be fitted with interface devices. Studies with ESA supported on potential ADR of Metop first generation.				
Applicable Space debris mitigation standards and guidelines		ISO 24413 operationally, ESA SD requirements alignment for missions to be developed in the future. Supporting ECSS WG on SD and STM	ESA Space Debris Requirements ESSB-ST-U-007 Issue 1.1 (goes beyond ISO24113) https://sdup.esoc.esa.int/documents/download/ESSB-ST-U-007_Issue_1_Revision_1_23_October_2025.pdf		Space Debris Mitigation Standard (JMR-003E) [JAXA]	NPR 8715.6, NPR 8079.1
Applicable International and regional regulations		Potential impact from foreseen EU Space Act under discussion Support to EU DEFIS STM WG			Act on Launching of Spacecraft, etc. and Control of Spacecraft (Act No. 76 of 2016) [GOJ] *Guidelines on License Related to Control of Spacecraft *Guidelines for preventing collisions with satellites, etc.(Only Japanese)	
Usage of Space Weather Data in orbit prediction		NOAA SWPC predictions (averaged)	NOAA SWPC and ESA S2P	CMA NCSW predictions	NOAA SWPC predictions	each spacecraft operator makes this decision individually

Annex IV: CGMS Agency Coverage of UN Long-Term Sustainability Guidelines (Section B)

LTS Guideline	CGMS Coverage in Objectives	CGMS Member Supporting Activities	
		NOAA Approach	EUMETSAT Approach
B. Safety of space operations			
Guideline B.1: Provide updated contact information and share information on space objects and orbital events			
1. States and international intergovernmental organizations should exchange, on a voluntary basis, and/or make readily available regularly updated contact information on their designated entities authorized to engage in exchanges of appropriate information on on-orbit spacecraft operations, conjunction assessments and the monitoring of objects and events in outer space, in particular those entities that are responsible for processing incoming incident reports and forecasts and adopting precautionary and response measures. This may be achieved either by providing such information to the Office for Outer Space Affairs so that the Office can make it available, within its standing mandate and existing resources, to other States and international intergovernmental organizations and/or by providing it directly to other States and international intergovernmental organizations, with the understanding that contact information for national focal points, at a minimum, will likewise be communicated to the Office.	Full	Situational awareness data sources: Prime: CARA/18 SDS moving to TraCSS (DoC). Sec: Commercial (+EUSST/SDA for GEO) LEO Active-on-active: No case experienced: one to one coordination GEO Active-on-active: Coordination via 19 SDS/EUSST or SDA	Registration with UNOOSA Situational awareness data sources: Prime: 18 SDS moving to TraCSS (DoC) Sec: EUSST (+SDA for GEO) Contact, orbit and manoeuvre data sharing with all above. LEO Active-on-active: Several cases observed: one to one coordination GEO Active-on-active: Coordination via SDA
2. States and international intergovernmental organizations should establish appropriate means to enable timely coordination to reduce the probability of and/or to facilitate effective responses to orbital collisions, orbital break-ups and other events that might increase the probability of accidental collisions or may pose a risk to human lives, property and/or the environment, in the case of uncontrolled re-entries of space objects.	Addressing definition of criteria to flag potential events requiring coodinated mitigation	Yes: Reporting to above mentioned data exchange partners. NOAA follows best practise to inform community, EUSST and 19 SDS of any breakups / uncontrolled reentries.	Yes: Reporting to above mentioned data exchange partners - have lower threshold to start risk assessment process. EUM foresees to inform EU SST, ESA SDO and US SpaceTrack of any breakups / uncontrolled reentries.
3. States and international intergovernmental organizations should exchange, on a voluntary basis and as mutually agreed, relevant information on space objects and information related to actual or potential situations in near-Earth space that may affect the safety of outer space operations. The information exchanged should, to the extent practicable, be reliable, accurate and complete, and be concluded to be so by the providing entity. The information to be exchanged, including time reference and period of applicability and other relevant information, should be provided in a timely manner and on a mutually agreed basis.	Full: Development of an active-on-active coordination data sheet for CGMS	LEO Active-on-active: No case experienced: one to one coordination GEO Active-on-active: Coordination via 19 SDS/EUSST or SDA	LEO Active-on-active: Several cases observed: one to one coordination GEO Active-on-active: Coordination via SDA Stakeholders to be informed if a satellite loses manoeuvre capability (also temporarily), as well as inform in advance if manoeuvre is planned / executed.

CGMS Agency Coverage of UN Long-Term Sustainability Guidelines (Section B, Continued)

LTS Guideline	CGMS Coverage in Objectives	CGMS Member Supporting Activities	
		NOAA Approach	EUMETSAT Approach
4. States and international intergovernmental organizations should, through a dedicated consultative process, preferably under the auspices of the Committee on the Peaceful Uses of Outer Space, taking into account the work of relevant technical bodies, consider, acquire specific understanding of, and develop shared positions on the practical issues and modalities, as appropriate, relating to the exchange of relevant information on space objects and events in near-Earth space obtained from different authorized sources, in order to achieve harmonized and standardized record-keeping on space objects and events in outer space.	SES TG to address standardisaiton approaches		Considering observer status in UN COPUOS
5. States and international intergovernmental organizations should consider the options for effectively accumulating and providing access to information on objects and events in outer space on a timely basis and for achieving consistency in the understanding and use of such information as one of the means to support their activities aimed at maintaining the safety of space operations. The options for consideration could include: standards and formats for representing information to enable the interoperability of information shared on a voluntary basis; bilateral, regional or multilateral arrangements to exchange information; bilateral, regional or multilateral coordination among providers of information to enable cooperation and interoperability; and the establishment of a United Nations information platform. Those options could serve as a basis for a distributed international information system for multilateral cooperation in sharing and disseminating multi-source information on objects and events in near-Earth space.	Full: - Development of an active-on-active coordination data sheet for CGMS - addressing standards in orbit / manoevre definitions.	Orbit data (ephems and maneuvers)available on request, various formats (OCM, OEM, OPM, STK.e) NOAA has multiple existing informal bi-lateral orbit data sharing agreements with O/Os and research groups upon request Orbit data (ephems and maneuvers) will be publically available on TraCSS.	Orbit data available on request Format OEM Orbits are available through SpaceTrack
Guideline B.2 **Improve accuracy of orbital data on space objects and enhance the practice and utility of sharing orbital information on space objects**			
1. States and international intergovernmental organizations should promote the development and use of techniques and methods to improve the accuracy of orbital data for spaceflight safety and the use of common, internationally recognized standards when sharing orbital information on space objects.	CGMS members provide feedback to ground network providers / promote institutional and commerical solutions Operator supplied orbit information actively addressed in TG.	Current GEO operating GPS derived OD solutions. Legacy GEO missions operating GeoLocation and tonal ranging ODs. NOAA GEO Commercial SSA service provides OD solutions with fused GPS and optical tracking based measurements. SSA Services also derive covariance on GEO ephems (EUSST, SpaceNav, Commercial) For orbit data sharing - see standards used above	LEO satellites - we have implemented GNSS based orbit determination GEO - using dedicated optical tracking service For sharing - see standards used above (OEM)
2. Recognizing that spaceflight safety strongly depends upon the accuracy of orbital and other relevant data, States and international intergovernmental organizations should promote techniques and the investigation of new methods to improve such accuracy. Those methods could include national and international activities to improve the capabilities and geographical distribution of existing and new sensors, use of passive and active on-orbit tracking aids, and combining and validating data from different sources. Special attention should be paid to encouraging the participation and capacity-building of developing countries with emerging space capabilities in this domain.	as above	See above	See above

CGMS Agency Coverage of UN Long-Term Sustainability Guidelines (Section B, Continued)

LTS Guideline	CGMS Coverage in Objectives	CGMS Member Supporting Activities	
		NOAA Approach	EUMETSAT Approach
3. When sharing orbital information on space objects, operators and other appropriate entities should be encouraged to use common, internationally recognized standards to enable collaboration and information exchange. Facilitating greater shared awareness of the current and predicted location of space objects would enable timely prediction and prevention of potential collisions.	CGMS addresses formats and standards for orbit data sharing	Orbit data (ephems and maneuvers) available on request, various formats (OCM, OEM, OPM, STK.e)	OEM used
Guideline B.3			
Promote the collection, sharing and dissemination of space debris monitoring information			
States and international intergovernmental organizations should encourage the development and use of relevant technologies for the measurement, monitoring and characterization of the orbital and physical properties of space debris. States and international intergovernmental organizations should also promote the sharing and dissemination of derived data products and methodologies in support of research and international scientific cooperation on the evolution of the orbital debris population.	CGMS members reporting capabilities. CGMS encourages sharing of information on mechanisms.	Promoted through use of government and commercial SSA services, access to independent tracking catalogs, indpendent covariance estimations and CDM generations to assess overall risk and environment	EUM analyses received CDM to keep track of environment/risk evolution
Guideline B.4			
Perform conjunction assessment during all orbital phases of controlled flight			
1. Conjunction assessment should be performed for all spacecraft capable of adjusting trajectories during orbital phases of controlled flight for current and planned spacecraft trajectories. States and international intergovernmental organizations should, through national mechanisms and/or international cooperation, perform conjunction assessments during all orbital phases of controlled flight for their current and planned spacecraft trajectories. With due consideration to article VI of the 1967 Outer Space Treaty, States should encourage entities, including spacecraft operators and conjunction assessment service providers under their jurisdiction and/or control to perform conjunction assessments through national mechanisms, when applicable. International intergovernmental organizations should perform such assessments through their respective mechanisms.	CGMS members reporting capabilities. CGMS encourages sharing of information.	NOAA follows and promotes SSA best practise	EUM is fully compliant
2. States and international intergovernmental organizations should develop and implement in an appropriate manner approaches to and methods for conjunction assessment that may include: (a) improving the orbit determination of relevant space objects; (b) screening current and planned trajectories of relevant space objects for potential collisions; (c) determining the risk of collision and whether an adjustment of trajectory is required to reduce the risk of collision; and (d) sharing information on the proper interpretation and usage of the conjunction assessment results, as appropriate. States and international intergovernmental organizations should, where applicable, encourage entities under their respective jurisdiction and/or control, including spacecraft operators and conjunction assessment service providers, to develop or help develop such approaches and methods to conjunction assessment.	CGMS members reporting capabilities. CGMS encourages sharing of information.	NOAA follows and promotes SSA best practise	EUM is fully compliant

CGMS Agency Coverage of UN Long-Term Sustainability Guidelines (Section B, Continued)

LTS Guideline	CGMS Coverage in Objectives	CGMS Member Supporting Activities	
		NOAA Approach	EUMETSAT Approach
3. Spacecraft operators, including those of non-governmental entities, that are unable to perform conjunction assessments should seek support, via State authorities, as necessary and in accordance with relevant applicable regulations, from appropriate around-the-clock conjunction assessment entities. International intergovernmental organizations that are unable to perform conjunction assessments should seek support through their respective mechanisms.	All CGMS operators have conjunction assessment capablities.	NOAA follows and promotes SSA best practise. Utilizes Government and commercial conjunction assessment services and data providors	
4. States and international intergovernmental organizations should, in a dedicated international consultative process, acting through their designated entities, as appropriate, share knowledge and experience related to the interpretation of conjunction assessment information with the objective of developing methods and consistent criteria for assessing probability of collisions and making avoidance manoeuvre decisions and agreeing on classes of methods applicable to different types of conjunctions. States and international intergovernmental organizations that have developed practical methods and approaches for conjunction assessments and collision avoidance manoeuvre decision-making processes should also share their expertise by, inter alia, providing training opportunities for emerging spacecraft operators and disseminating best practices, knowledge and experience.	CGMS SES TG actively sharing information on experience and methods and seeking consistent criteria. Development of best practices is foreseen.	NOAA follows and promotes SSA best practise. Active in SDA, Operators' Workshops and supports STM Research and development upon request	Share information on evolution of CA capability. Sharing information on our conjunction risk assessment / mitigation criteria via participaiton to dedicated symposia, e.g. SpaceOps, ISSFD. Also on determinaiton of an active on active conjunction, info provided to the othe operator.
5. States and international intergovernmental organizations should encourage conjunction assessment service providers under their jurisdiction and control to consult on screening criteria and notification thresholds with spacecraft operators and pertinent parties before providing conjunction assessment services, as practicable.	CGMS members reporting on screening criteria and notificaiton thresholds and assessing consistency.	NOAA has established conjunction warning and action thresholds, and continually develops/refines with SSA service and data providors	EUM already has clear criteria estbalished with SSA service providers.
Guideline B.5			
Develop practical approaches for pre-launch conjunction assessment			
1. States and international intergovernmental organizations are encouraged to advise launch service providers under their jurisdiction and control to consider conducting pre-launch conjunction assessment for space objects to be launched. To facilitate and promote such pre-launch conjunction assessment practices, States and international intergovernmental organizations are encouraged, with the involvement of launch service providers and, as necessary, other relevant entities under their jurisdiction and control, to develop, implement and improve the corresponding methods and procedures.	Indicate corresponding member practices	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	EUM has performed pre-launch CA screening in 2025 for MTG-S1 and EPS-SG-A1 and will continue to do so on all future missions. **EUM to present in TG.**
2. States and international intergovernmental organizations are encouraged to advise launch service providers under their jurisdiction and control to seek support, as necessary, via designated entities authorized to engage in exchanges of information on pre-launch conjunction assessment, as appropriate and in accordance with relevant applicable regulations, for pre-launch conjunction assessment from appropriate conjunction assessment entities.	Indicate corresponding member practices	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	

CGMS Agency Coverage of UN Long-Term Sustainability Guidelines (Section B, Continued)

LTS Guideline	CGMS Coverage in Objectives	CGMS Member Supporting Activities	
		NOAA Approach	EUMETSAT Approach
3. When performing a specific pre-launch conjunction assessment, launch service providers are encouraged to coordinate, via designated entities authorized to engage in exchanges of information on pre-launch conjunction assessment, with pertinent States and international intergovernmental organizations concerning the given assessment, if necessary.	Indicate corresponding member practices	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	
4. States and international intergovernmental organizations should, with the involvement of launch service providers and other relevant entities under their jurisdiction and control as necessary, develop common international standards for describing relevant information required for pre-launch conjunction assessment in order to facilitate the provision, as mutually agreed, of pre-launch conjunction assessment support.	Indicate standards followed, participation in development of standard. SES TG to encourage this.	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	
5. States and international intergovernmental organizations are encouraged to exchange their analytical assessment of the trends in the change of the risk of collision of space objects to be launched with other space objects operating near the planned insertion orbit.	Indicate corresponding member practices. SES TG to encourage this.	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	
6. States and international intergovernmental organizations are encouraged to consider providing, using, as appropriate, applicable existing and/or new dedicated mechanisms, information on launch schedules useful for assessing changes in the future population of space objects, pre-launch notifications containing information on the launch plan that would be useful for assisting in the identification of newly launched space objects, and notices for mariners and pilots on restricted zones at sea and in airspace. The contents and attributes of such information should be appropriate for its intended use.	SES TG to check level of sharing performed / plans for imrovement / obstacles.	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	
7. States and international intergovernmental organizations should, through a dedicated consultative process within the Committee on the Peaceful Uses of Outer Space, consider, acquire and develop shared positions on information to be provided for pre-launch conjunction assessment.	Check status of process definition / plans for imrovement / obstacles.	NOAA works jointly with NASA/CARA/19SDS/FDF on SSA coverage for pre-launch and orbit raising phases of missions following best practise	

Annex V: Active-on-Active Conjunction Contacts and Formats

CGMS SES TG Active-on-Active Conjunction Contact List					
CGMS Agency	**Nominal Contact Points**	**Emergency Contact Point**	**Own satellite orbital state vector available?**	**Own satellite manoeuvre plan available?**	**Ability to contact other national/regional operators?**
SES TG agency			**Public / On-request**	**Public / On-request**	**List operators**
			Format (OEM recommended)	**Format (OPM recommended)**	**For each operator, analogous info on orbit and manoeuvre**
EUMETSAT	Pier Luigi Righetti Email: PierLuigi.Righetti@eumetsat.int	CA on-call engineer Email: FDYN.LEO@eumetsat.int Tel (Control Room): (To request to inform CA on-call engineer)	Available on request Format: OEM	Available on request Format: EUM specific (effect included in orbit)	Contact with SDA Members can SDA Members share orbital information (various formats)
JAXA	JAXA CA Team Z-JAXA.STCC_CA-OPERATORS@ml.ja	JAXA CA Team Z-JAXA.STCC_CA-OPERATORS@ml.jaxa.jp	Available on request Format: OEM (ver 2)	Available on request Format: JAXA Own Format (Now) OPM (near future, Summer	Only JAXA
CMA	lits@cma.gov.cn	lits@cma.gov.cn			Yes, CNSA

Annex VI: Thermospheric Density Table Input from ESA

Model	Type	Project / Owner	Key drivers (cadence)	Main outputs	Known Biases	Altitude	Uncertainty	Access	Typical uses	Notes / version	References
NRLMSIS	Empirical neutral atmosphere	NRL / CCMC	F10.7, 81-day F10.7, Ap/Kp (daily–3-hourly)	ρ, T, He, N, N2, NO	temperature biases are typically <3 K in the mesosphere and smaller below	~70–1000+ km	No (point est.)	Open code via CCMC	Drag, baseline density	Adds NO to 2.0; Emmert 2022. (ccmc.gsfc.nasa.gov)	Emmert, J. T., Jones Jr, M., Siskind, D. E., Drob, D. P., Picone, J. M., Stevens, M. H., ... & Pérot, K. (2022). NRLMSIS 2.1: An empirical model of nitric oxide incorporated into MSIS. Journal of Geophysical Research: Space Physics, 127(10), e2022JA030896.
JB2008	Empirical density	Space Environment Technologies; CCMC	F10.7, S10.7, M10.7, Y10.7, 81-day means; Ap, Dst (3-hourly)	ρ, Texo, Tn	constant bias during storms	~120–800 km	No (point est.)	Docs + Fortran	drag, atmospheric variability	Inputs detail in CCMC + SET docs. (ccmc.gsfc.nasa.gov)	Bowman, B., Tobiska, W. K., Marcos, F., Huang, C., Lin, C., & Burke, W. (2008, August). A new empirical thermospheric density model JB2008 using new solar and geomagnetic indices. In AIAA/AAS astrodynamics specialist conference and exhibit (p. 6438).

Annex VII: Space Weather Requirements for Space Traffic Coordination (STM related)

Space Weather Data, Service or Product	ESA Approach* (Mission Operations)
Observation data	
Solar activity indices used in atmospheric density models (e.g. R, F10.7, F30, S10, E10, M10, Y10,…)	ESA SWE System, NOAA SWPC (orbit prediction)
Geomagnetic activity indices used in atmospheric density models (e.g. Ap, Kp, Dst, …)	ESA SWE System, NOAA SWPC (orbit prediction)
Services and Products	
Long term (100-200 y) forecasts of solar and geomagnetic indices for long term atmospheric density forecasting	Prediction models in ESA Space Debris office
Long term (100-200 y) atmospheric density forecast	Prediction models in ESA Space Debris office
Atmospheric density estimate archive of at least one year	Not available yet
Atmospheric density forecast	NRLMSIS operationally, DTM being tested
Thermospheric density estimates to compute drag of spacecraft at altitudes below which drag exceeds 1% of the overall forces acting on the spacecraft	NRLMSIS operationally, DTM being tested
Near real-time monitoring of space weather events (geomagnetic storms)	Alerts and bulletins from ESA SWE System (https://swe.ssa.esa.int/)
Forecasts of space weather events (geomagnetic storms)	Alerts and bulletins from ESA SWE System (https://swe.ssa.esa.int/)
Near real-time assessment of ionospheric disturbances effecting s/c operations	Warnings based on https://swe.ssa.esa.int/tio_for

Space Weather Requirements for Space Traffic Coordination (safe operation related

Space Weather Data, Service or Product	ESA Approach* (Mission Operations)
Observation data	
Ionospheric electron density as a function of altitude	Not in operational use yet. Pre-operational product in https://swe.ssa.esa.int/web/guest/fmi-tomoscand-federated
Services and Products	
Long term (100-200 y) forecasts of solar and geomagnetic indices for long term atmospheric density forecasting	Prediction models in ESA Space Debris office
Long term (100-200 y) atmospheric density forecast	Prediction models in ESA Space Debris office
Relevant environmental data to estimate ionospheric refraction of radio waves	Tailored bulletin based on https://swe.ssa.esa.int/tio_for
Relevant environmental data to estimate ionospheric group delay	Not available yet
Near real-time monitoring of space weather events (solar flares, SEPs, fast solar wind streams)	Alerts and bulletins from ESA SWE System (https://swe.ssa.esa.int/)
Forecasts of space weather events (solar flares, SEPs, fast solar wind streams)	Alerts and bulletins from ESA SWE System (https://swe.ssa.esa.int/)
Forecasts of effects on spacecraft:	Alerts and bulletins from ESA SWE System (https://swe.ssa.esa.int/)
Archived space environment data for post-event analysis	Tools and data in https://swe.ssa.esa.int/sco_pst
Tools or models to correlate s/c housekeeping data with space environmental data	https://swe.ssa.esa.int/scd_pst
Spacecraft anomaly prediction based on anomaly statistics from similar missions	Mainly based on SOM experience from earlier missions. Studies on IA based approaches in progress.