[Tentative Translation]

Mid- to Long-term Policy on Efforts for Rule-Making on the Use of Earth Orbit

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Inter-Agency Task Force on Space Traffic Management

1 Background

Human space activities have continued to expand for about 60 years since the launch of the world's first artificial satellite "Sputnik" by the former Soviet Union in 1957. As a result, the number of satellites in orbit is about 8,200 today (including those that are no longer in operation), and the use of earth orbit (hereinafter referred to as "the use of orbit ") is in a further stage of development.

At the same time, however, congestion and increasing number of space debris (hereinafter referred to as "debris") in orbit has become an issue, with collisions between satellites and accidents that appear to be collisions with debris. It is also concerned that expanding use of earth orbit, such as the introduction of small satellite constellations, may make risk management, planning, and satellite operations more difficult, while the emergence of technologies enabling ASAT, orbital stalking and other security threats is another concern.

Under these circumstances, various entities have been addressing the need for space traffic coordination and management (STCM) in the international arena. However, rules on STCM at the inter-national level currently rely heavily on non-legally binding guidelines such as the Guidelines for the Long-Term Sustainability of Outer Space Activities. Moreover, conventional STCM discussions do not adequately address threats such as ASAT experiments and orbital stalking.

Therefore, as Japan aims to become an independent space power, it is necessary for Japan to take the initiative in making rules for the use of orbit ahead of other countries in order to promote discussions on STCM and responsible behavior in outer space, and to help formulate rules and norms thereon.

2 Areas of Effort

In the area of rules for STCM, including the use of orbit, only some of the basic

and principle issues have been stipulated in treaties and other international agreements. However, for most of the other elements, norms and standards are gradually being formed through the accumulation of individual practices to perform actual operations and develop domestic regulations on the basis of non-binding guidelines and recommendations in various forums, including the United Nations.

The "Basic Policy on Efforts for Rule-Making on the Use of Earth Orbit" adopted on May 27, 2021, sets forth the following as the areas where Japan should make efforts to establish international rules for the use of orbit: orbit planning, operation of spacecraft in orbit (including separation of objects and beaming of electromagnetic energy as an exercise of physical force), de-orbit of spacecraft, and the structure of spacecraft licensed to access orbit.

In establishing Japan's mid- to long-term policy on efforts for rule-making on the use of orbit, the Task Force has further fleshed out these rule elements along the life cycle of spacecraft, and reorganized those related to general operations by field, such as collision avoidance during navigation and debris mitigation. In addition, rule elements related to on-orbit servicing and large constellations (a group of roughly several hundreds or more satellites that are operated in an integrated manner) have been separately classified as being related to exceptional operations.

Area		Phase	Sample Requirement
General Provisions	Architecture, functions and performance	Design & manufacturing	To enable spacecraft to comply with and fulfill each of other provisions for the use of orbit (e.g., navigation, PMD, etc.) with its architecture, functions, and performance
			To enable spacecraft to prevent unintended object release (release or scattering of equipment and parts) during launch and operation with its architecture, functions, and performance
			To ensure with the architecture, functions, and performance that spacecraft do not easily lose control in the event of an accident, malfunction, or cyber attack
	Collision avoidance	Orbit planning	To plan an orbit and trajectory (including a launch trajectory) with a sufficiently small risk of conjunction or collision with other space objects
			When using a finite and contested orbit such as a geostationary orbit, the spacecraft operator or its state of registry is required to secure the right to use it internationally
			To coordinate with the operator or the state of registry of other spacecraft according to appropriate procedures and guidelines when the planned orbit may interfere with it
		Navigation in orbit	To navigate and perform conjunction avoidance so that the risk of conjunction or collision with other space objects is sufficiently small

			To navigate on or away from certain designated orbits
			To grant right of way to one of mutually approaching spacecraft, and require the other to perform obligatory avoidance maneuver
			To coordinate with the operator or the state of registry of other spacecraft according to appropriate procedures and guidelines when there is a risk of interference with it
		PMD	To plan and execute the re-entry to the earth in such a way that the risk of conjunction or collision with other space objects in orbit is sufficiently small
	SSA	Orbit planning & registration	To provide planned orbital parameters to public SSA agencies so that other spacecraft operators can be aware
			To register and amend appropriate information for the space objects under control thoroughly according to appropriate procedures and forms
		Navigation in orbit	To plan and execute a maneuver [based on SSA information] in such a way that the risk of conjunction or collision with other space objects is sufficiently small
			To equip spacecraft with trackability and provide orbital parameters and maneuver information of spacecraft in operation to public SSA agencies so that other spacecraft operators can be aware
	Debris mitigation	Orbit planning	Not to launch satellites without maneuvering capability into orbit above a certain altitude
		Navigation in orbit	To plan and execute the separation and ejection of equipment and other objects in such a way that the risk of conjunction or collision between those released and other space objects is sufficiently small
		PMD	To take appropriate measures to remove the spacecraft from orbit with a risk of conjunction or collision with other space objects (post-mission disposal) when terminating its operation and control
	Atmospheric re-entry	PMD	To plan and execute the re-entry to the earth so that the risk of causing human and property damage on the earth is sufficiently small
On-orbit servicing		Mission planning	To obtain the consent of the right holder of the client object prior to the mission, and plan and implement the mission so that it will be recognized as a legitimate and peaceful business conduct
		Design & manufacturing	To enable servicer spacecraft to execute rendezvous, proximity operation, docking, and separation safely with its architecture, functions, and performance
		Planning & navigation	To utilize SSA information to monitor the situation of the specific space area where rendezvous, proximity operation or other service will be performed
			To take appropriate safety measures for each exceptional operation, such as rendezvous and docking (which are normally avoided)
Large constellation		Design & manufacturing	To suspend the launch of additional constellation satellites to resolve the problem which is identified with a satellite comprising a large constellation
		Orbit planning	To avoid overlapping orbit altitudes with other large constellations
		Navigation in orbit	To grant right of way to either the satellites comprising a large constellation or the spacecraft approaching them, and require the other to perform obligatory avoidance maneuver
		PMD	To execute PMD for each individual constellation satellite and, in addition, to manage the PMD success rate for the constellation as a whole

Table: Classification of elements to be developed as rules for the use of orbit

3 Policy on Rule-Making

The status of international rule-making differs for each of these areas, such as collision avoidance. For this reason, Japan will adopt an approach for each of these areas that is suited to the actual situation. In addition, in order to proactively work on the establishment of rules for the use of orbit ahead of other countries, we will first take the steps of immediate necessity in FY2022, and In FY2023 and beyond, we will leverage the results of these efforts and promote initiatives with a sense of urgency.

3.1. Prevention of Collisions during Navigation

There is de facto no international framework for coordinating and securing orbits except on geostationary orbits. If this point is improved, it will have a significant effect on the safety and facilitation of the use of orbit. In addition, there are no examples of rules or coordination procedures regarding the avoidance of conjunction and collision during orbital navigation (including during the transition toward re-entry) that have been stipulated as national standards. Improvements in this area will also have a significant effect on the safety and facilitation of the use of orbit.

However, Japan's sole regulation of collision avoidance in outer space, which is outside Japan's domain, will not function effectively. For this reason, it is necessary during the study to distinguish between those cases in which Japan's unilateral regulation would have a certain effect (e.g. setting trajectories with low collision probability) and those cases in which cooperation with the international community (e.g. right of way, coordination among operators) is indispensable.

Therefore, Japan will precede consideration of areas where Japan's unilateral regulation would have a certain effect. Japan will then examine the rule proposal, which should have excellent technical feasibility and practicality, and raise them with the international community.

3.1.1. FY2022

JAXA, a national research and development agency to support the Japanese government in its overall aerospace development and utilization, will establish JAXA standards (voluntary guidelines to be developed by JAXA), which are currently under study. In addition, for those regulations that have a certain effect

even if put in effect solely by Japan, we will examine guidelines for licensing criteria based on Japan's Space Activities Act so as not to conflict with the operation of spacecraft managed under the licenses of other countries, while referring to relevant international documents.

3.1.2. FY2023 and Beyond

Establish and disseminate guidelines that can be formulated independently in Japan with a certain degree of effectiveness. At the same time, we will also raise discussions to the international community on initiatives that are difficult for Japan alone to implement, and lead the discussion in the international community.

3.2. Build-up and Widespread Use of SSA

The improved completeness and accuracy of SSA will not only enhance the understanding of the space situation from a security perspective, but will also have a significant effect on the safety and facilitation of the use of orbit in that it will contribute to more accurate prediction of conjunction and collision risks.

In addition, even if Japan adopts and implements its own rules for the provision of information to SSA and making use of its service, it can contribute to improving the safety of the use of orbit without hindering the growth of the domestic space industry.

Therefore, Japan will develop its own regulation ahead of other countries as follows. The goal is to build a highly comprehensive SSA for the international community as a whole by informing the international community of this trial as a good practice, encouraging other countries to follow suit, and promoting the spread of similar initiatives.

3.2.1. FY2022

Japan will develop a mechanism to aggregate necessary information from satellites in general other than those (servicer spacecraft) to which the "Guidelines for a License to Operate a Spacecraft Performing On-orbit Servicing", which have already been established as governing the provision of information to the national public SSA organization, are applied.

3.2.2. FY2023 and Beyond

While operating the framework where the Ministry of Defense, which has an official SSA organization in Japan, will consolidate necessary information on satellite operations and provide services such as collision warnings to spacecraft operating agencies and organizations, Japan will communicate this framework to the international community as a good practice and encourage other countries to establish similar frameworks.

3.3 Promotion of Debris Mitigation

Debris mitigation is an important issue for both security and safety of civil use in terms of long-term sustainability of outer space activities, and hence Japan and other major countries are working to make their regulation embody and voluntarily implement international guidelines.

Especially in the recent situation where new entrants into the satellite manufacturing and operation business continue to expand, it is even more increasingly important for Japan to enforce the requirements related to debris mitigation in the guidelines for the licensing criteria of the Space Activities Act. Accordingly, it is necessary to consider the content of the rules and strategies for their promotion from the perspective of enhancing the international competitiveness of Japan's space industry, keeping in mind that the rapid tightening of debris suppression rules will drive up the cost of manufacturing satellites and launch vehicles.

Therefore, as follows, Japan will first promote the introduction and improvement of debris restriction/reduction (removal) technologies by satellite manufacturers and operators, and then, by disseminating the results to the international community, Japan will lead the way in international rule-making.

3.3.1. FY2022

Japan will compile design and operational know-how and support documents accumulated by JAXA, IADC (Inter-Agency Space Debris Coordination Committee) and other space agencies in the form of guidance documents and provide them to private sector operators. In addition, with regard to technologies developed by private manufacturers and operators for de-orbit, active removal, etc., Japan will revise the Space Activities Act Guidelines to create an environment

for the demonstration and implementation of such technologies. Japan will then compile a list of what has been demonstrated and disseminate it internationally.

3.3.2. FY2023 and Beyond

To study and develop a mechanism to promote the implementation of debris mitigation technologies (de-orbit, active removal, etc.) by satellite manufacturers and operators, and to accumulate good practices in debris mitigation in Japan. Then, while presenting good practices, Japan will promote these mechanisms internationally so that they will become international rules, and continuously improve these mechanisms and initiatives based on trends in technological development and other factors.

3.4. Large Constellation

The project to deploy a large number of constellations satellites is progressing worldwide. If the rule formation cannot keep pace with the rapid increase in the number of large-constellation satellites, there is a risk that the use of outer space by other entities, including Japanese operators, will be severely hampered. In fact, there are some calls for regulation or responsible behavior regarding large constellations.

Meanwhile, no large-constellation projects are planned in Japan at this stage and Japan's position on rules covering large constellations has not yet been fleshed out.

Therefore, Japan will implement the following general efforts to ensure safe and stable use of outer space by other spacecraft operators.

3.4.1. FY2022

Japan will compile the technical issues and concerns associated with large-constellation deployment in securing space access for third-party operators.

3.4.2. FY2023 and Beyond

Japan will propose to the international community a rule outline that would ensure the use of space by all spacecraft operators, taking into account technical perspectives.

3.5. Other Areas

3.5.1. On-Orbit Servicing

Performing on-orbit servicing has relatively high safety risks, especially during the rendezvous and proximity operation phases, and the technology used for it has both civilian and security applications. Therefore, it is important that appropriate norms be formed for civilian use and, at the same time, the dissemination of Japan's guidelines, which are a precedent for on-orbit servicing rules, will be beneficial for the smooth international development of Japan's space industry in the field of on-orbit servicing.

Consequently, in order to reduce safety and security concerns and promote widely accepted operations for on-orbit servicing, which are expected to develop further in the future, Japan will continue to promote internationally the guidelines established in Japan, with the aim of contributing to the formation of international norms at an early stage.

3.5.2. Atmospheric Re-entry

Controlled re-entry of spacecraft and its launch vehicles that have a significant chance of not burning up by the time they reach the surface is important for safety on Earth. For this reason, many countries, including Japan, have established guidelines and standards to prevent damage to the earth caused by re-entry, and these are already in operation.

Therefore, Japan will continue and improve the implementation of the existing standards and, in response to individual irresponsible behavior by a foreign entity, Japan will demand appropriate action on a case-by-case basis.

3.5.3. Architecture, Functions and Performance of Spacecraft

Among the rules concerning the architecture, function, and performance of spacecraft, certain international and domestic standards and criteria already exist for preventing unintended object release (release or scattering of equipment and parts). Japan will continue to review these as appropriate in response to technological and business developments.

Other requirements related to the design and architecture are basically prescribed in the rules of other areas to be satisfied by design or architecture.

4 Review of the Policy

This policy identifies the areas and elements to be addressed and provides a direction for the rules for the use of orbit, based on the domestic and international situation at the time of publication. Therefore, this policy shall be revised in a timely and appropriate manner in accordance with the ongoing development of the use of orbit, including the areas and elements themselves to be addressed.