

# Space Debris Mitigation Mechanism in Japan -The Case of JAXA-

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# 1. Debris Mitigation Framework

## 1.1 International framework

- (1) Figure-1 shows the history of the world space debris mitigation standards and guidelines.
- (2) Following the NASA Debris Standard, the Japanese agency, NASDA, registered a debris mitigation standard in 1996.
- (3) IADC Guidelines developed from this plus US standard.
- (4) We are pleased to have UN Guidelines.
- (5) Now industrial society is developing a set of debris related ISO standards.
- (6) In spite of these efforts, the environment continues to deteriorate toward the chain reaction of collision among debris. This situation invites us to discuss here the legal aspects.

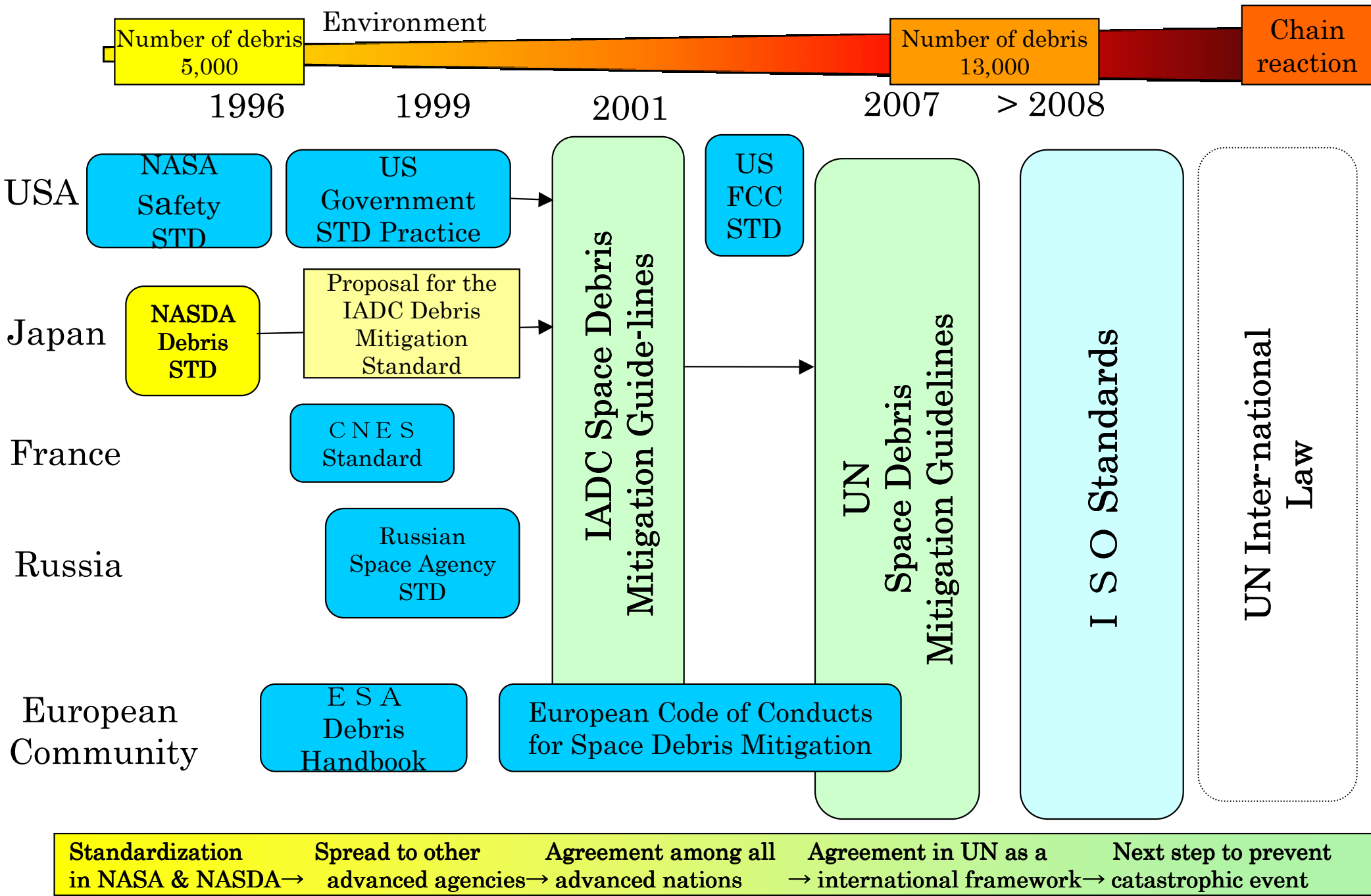


Fig.-1 International Framework for Debris Control

# 1. Debris Mitigation Framework in Japan

## 1.2 JAXA related activities

- (1) Japanese space activities are mainly conducted by JAXA.
- (2) JAXA controls debris issues with the JAXA Debris Mitigation Standard. This standard requires contractors to develop a Mitigation Plan to be authorized by JAXA.
- (3) The compliance of each project with the standard is reviewed by the Safety Review Board.
- (4) Other organizations that wish to launch spacecrafts are also required to respect the JAXA Debris Standard as a part of Payload Safety requirements.
- (5) International consensus will be reflected in future revisions of the JAXA Standard.

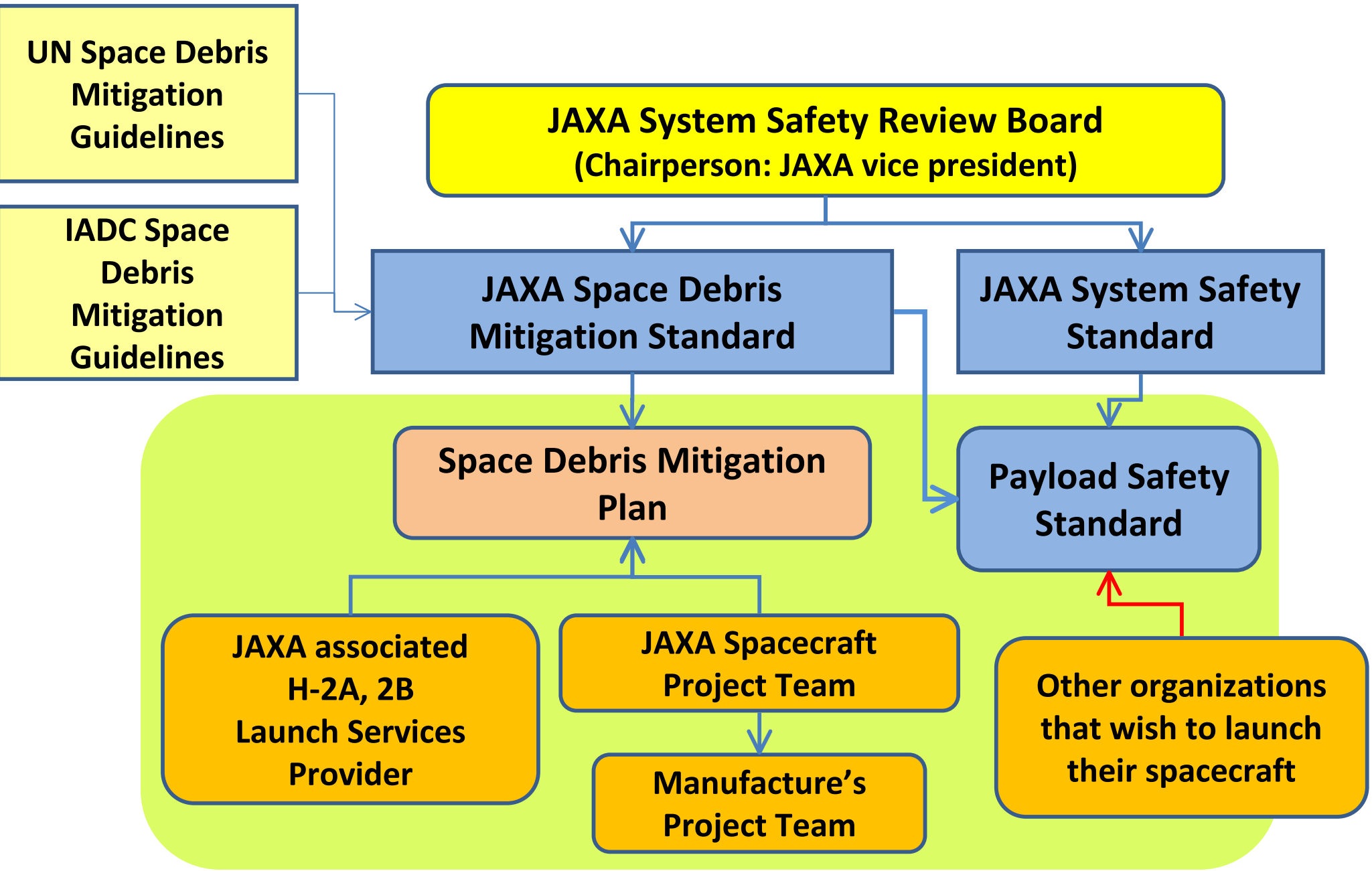


Fig.-2 Debris Mitigation Framework in Japan (JAXA related activities)

# 1. Debris Mitigation Framework in Japan

## 1.3 Commercial Activities

- (1) Commercial activities are basically conducted with respect to ITU, UN Guidelines, JAXA standard, ISO standards. (no clear governmental instructions or laws)
- (2) Launch providing services  $\Rightarrow$  JAXA STD
- (3) Commercial activities in GEO  $\Rightarrow$  ITU recommendation
- (4) Other organizations, which (a) contract their orbital operation work to JAXA, (b) apply to piggy back launch services, (c) conduct governmental mission, should respect JAXA standard.

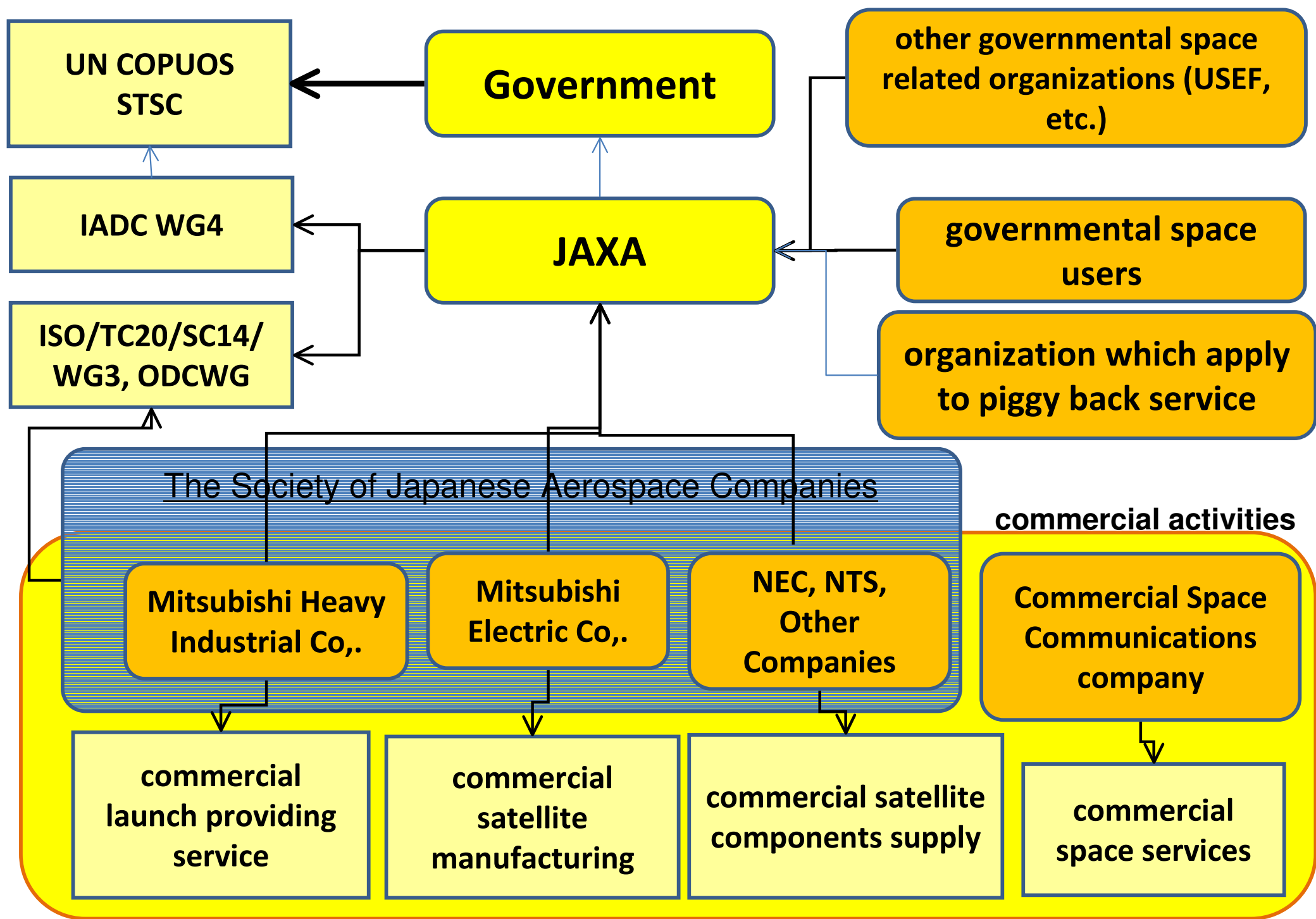


Fig.-3 Debris Mitigation Framework in Japan (including commercial activities) <sup>7</sup>

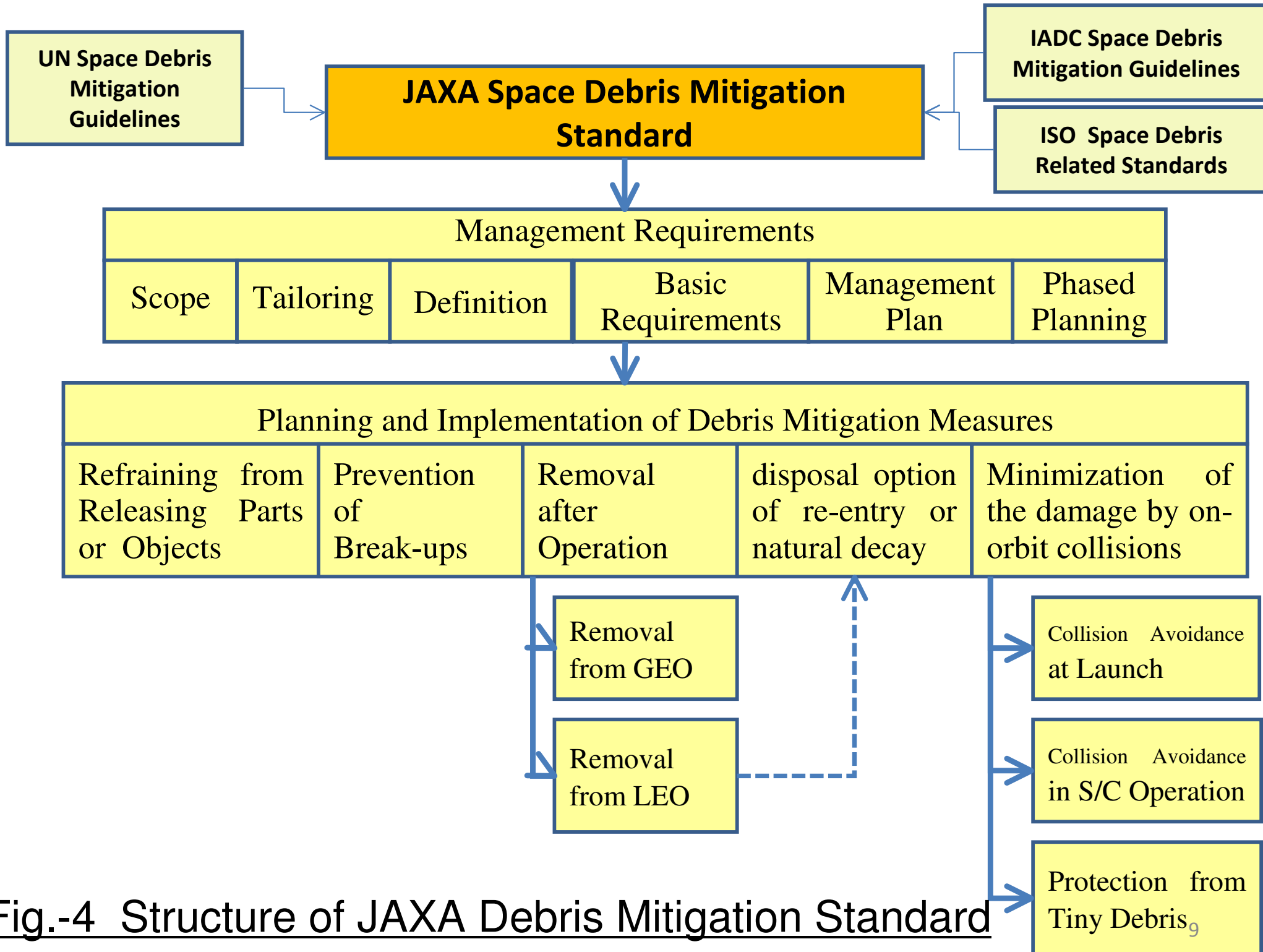
## 2. JAXA Debris Mitigation Standard

JAXA Debris Standard consists of management requirements and technical measures.

The major area of Technical requirements are

- ① Preventing the break-up after the end of its mission,
- ② Transferring a spacecraft that has completed its mission in GEO into higher orbit,
- ③ Reducing the orbital lifetime of a mission terminated LEO space systems.
- ④ Minimizing the number of objects released in orbit during operation of a space system
- ⑤ Minimizing damage posed by on-orbit collision





**Fig.-4 Structure of JAXA Debris Mitigation Standard**

## 4. Compliance with the JAXA Standard

Japanese space systems fully comply with the following mitigation requirements.

- a) On-orbital break-ups: There is no case of explosion.
- b) Preservation of GEO region: Japanese satellites including commercial ones have shown good compliance.
- c) Collision avoidance: For launch vehicles, collision avoidance for manned system is considered to set the launch time.

For operating spacecraft, all JAXA satellites are analyzed daily for collision probability, and results are made known to the relating departments.

Basically all the Japanese satellites launched after 1990 are not interfering the GEO Protected Region, except some malfunctions prevent to do so.

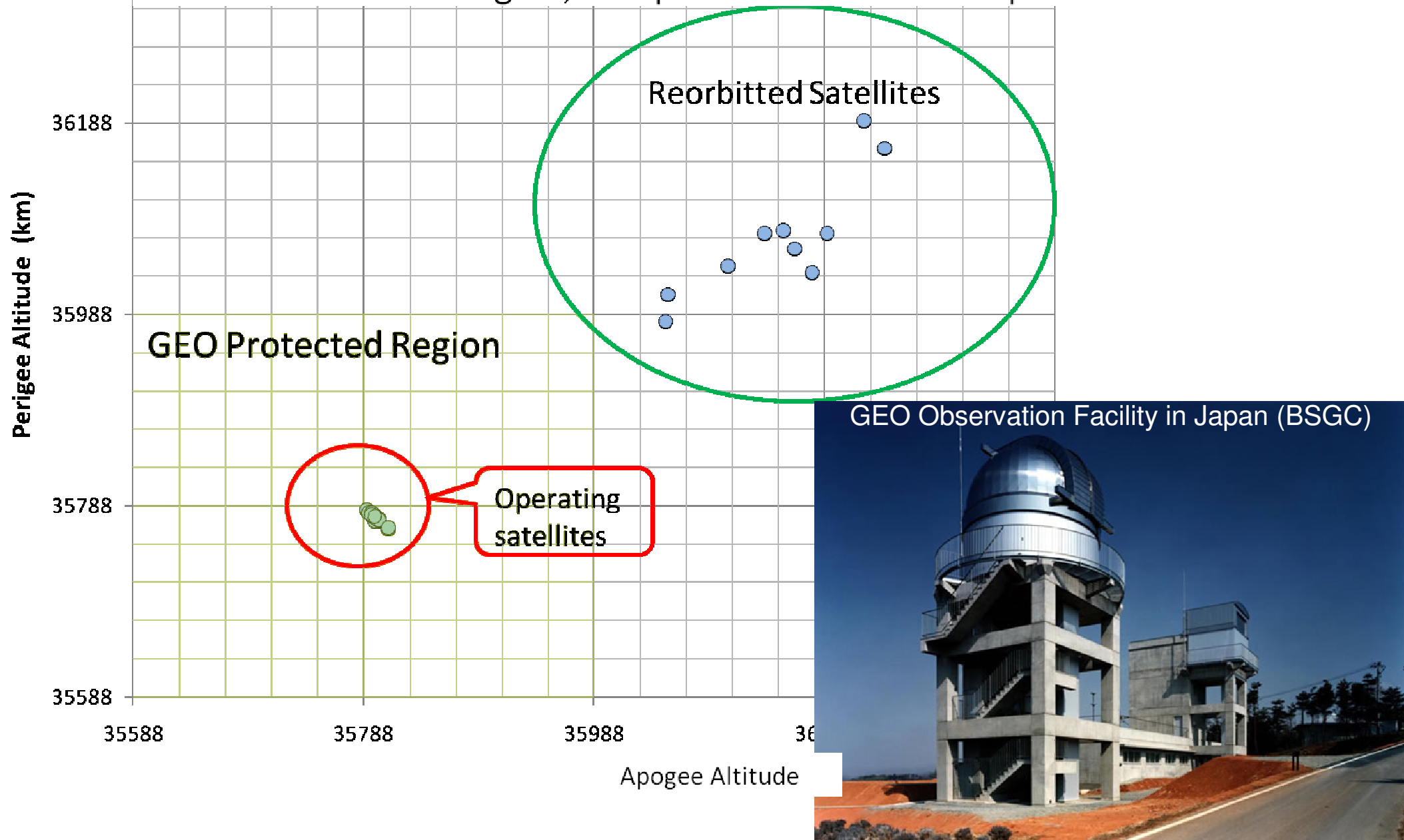
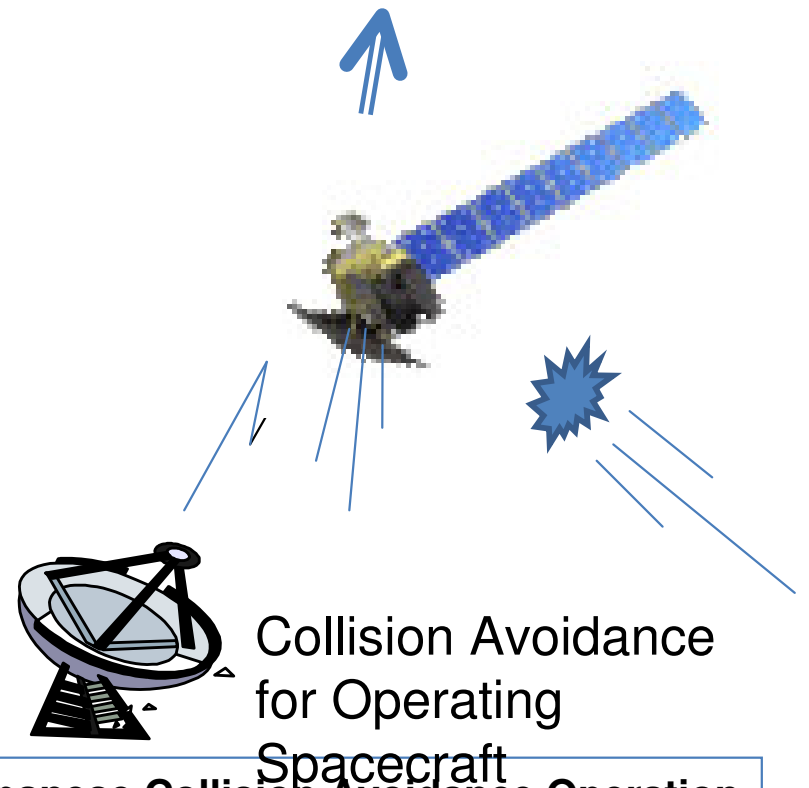
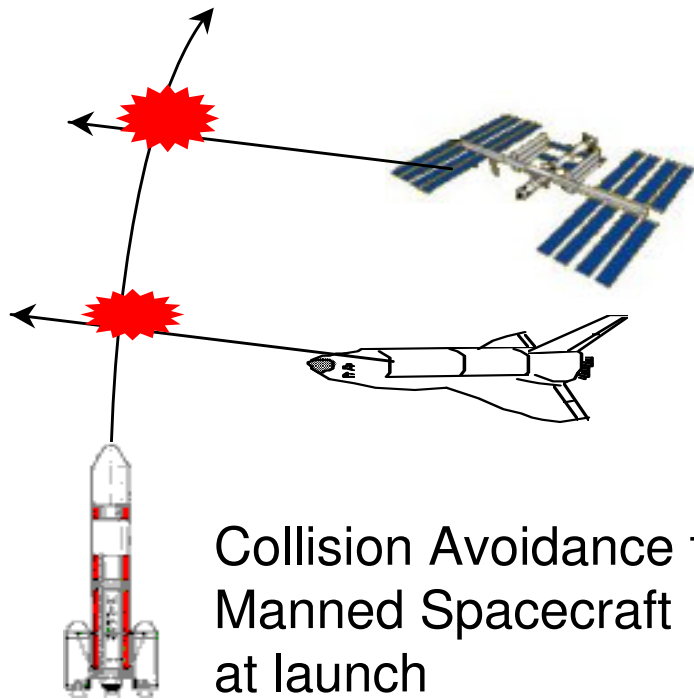


Fig.-5 Reorbit of Japanese GESs which were launched after 1990



radars to support Japanese Collision Avoidance Operation

When the collision probability is high, JAXA requests more precise data of the risk object to a foreign radar or domestic radar.



Kamisaibara (KSGC) Radar / Japan Space Forum  
Detestability: 1m  $\phi$  at 577km



TIRA Radar / FGAN, Germany  
2cm  $\phi$  at 1000km [2]

Fig.-6 Collision avoidance operation in launch operation, and orbital operation.

## 5. Other situations

However there are some problems to be addressed.

a) Mission related object released into orbit: All the fasters are designed not to release any parts. However, in multiple payloads launching, the support structure to sustain payload will be released, which is customarily allowed in the world due to its short orbital lifetime.

b) Preservation of LEO region: It is hard to limit orbital lifetime to be less than 25 years for scientific satellites (whose orbits are relatively high to avoid effects of the atmosphere), small satellites (which do not have a propulsion system) , and orbital stage of launch vehicle. JAXA will gradually apply its requirements more strictly to inside and outside payload customer.

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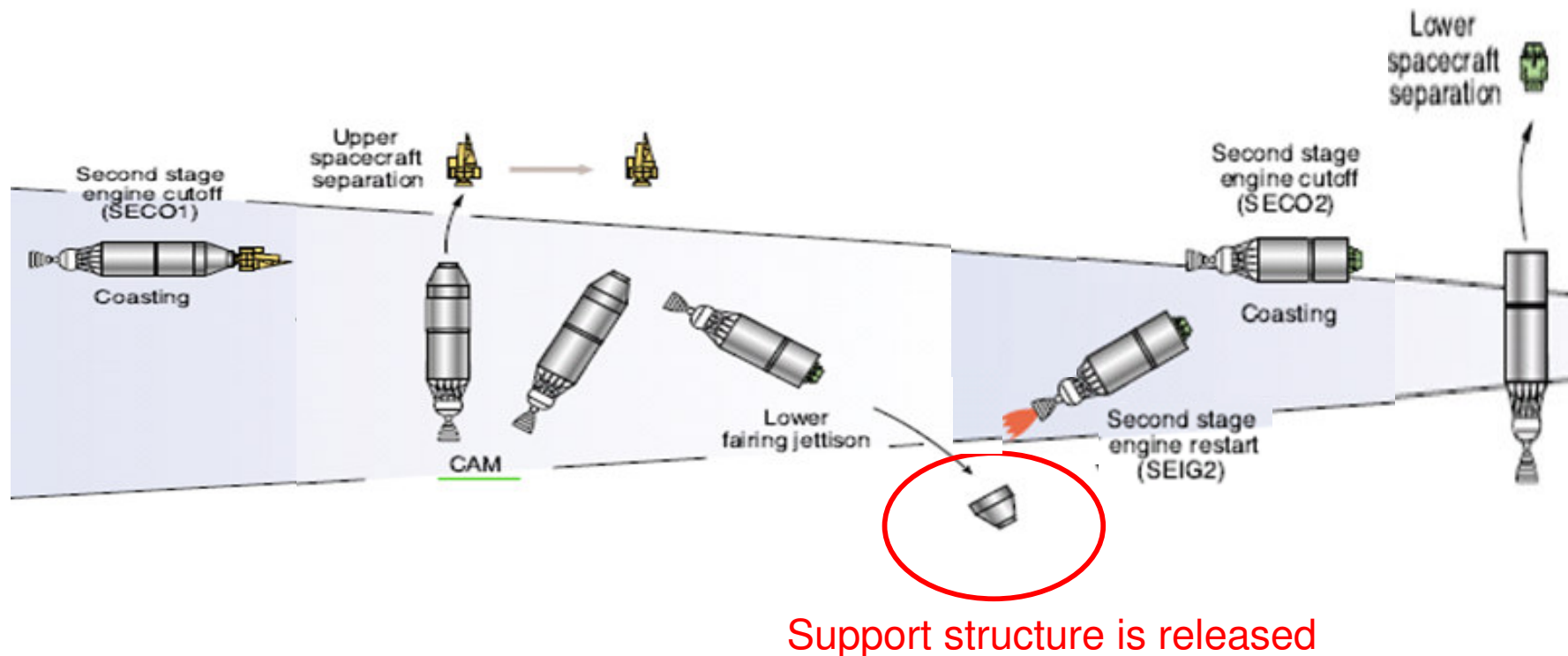


Fig.-7 Example of unavoidable mission related objects.

## 6. Conclusion

- (1) Current JAXA Space Debris Mitigation requires not only limitation of debris generation but also protection from debris, and measures to ensure the ground safety from the re-entry.
- (2) Although there aren't enough governmental regulations or laws, the contractors of JAXA, applicants for piggy back payloads, and commercial space users show good compliance with JAXA standard, or UN Guidelines in other words.
- (3) However there are a few areas in which industries and space users can't perfectly comply with UN Guidelines. For example,
  - a) There are unavoidable cases to release objects, for example, support structure in multiple payloads launching.
  - b) Requirement to limit orbital lifetime is not easy to meet in the case of small satellites and orbital stages.