

# JAXA Perspective for Space Exploration and Interoperability

*Seminar on Interoperability and Space Exploration*

*Lunar & Planetary Exploration Team*

JAXA

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## 1. JAXA's future plan for Space Exploration

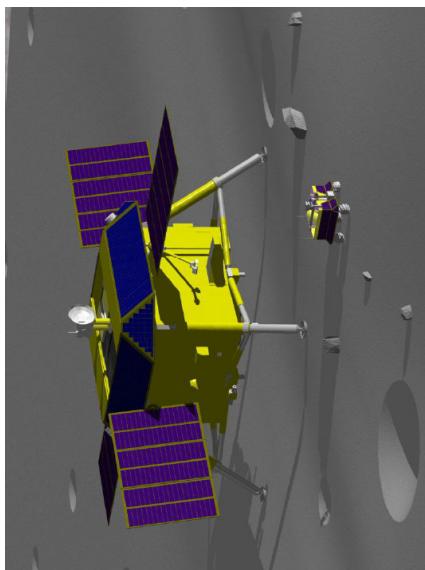
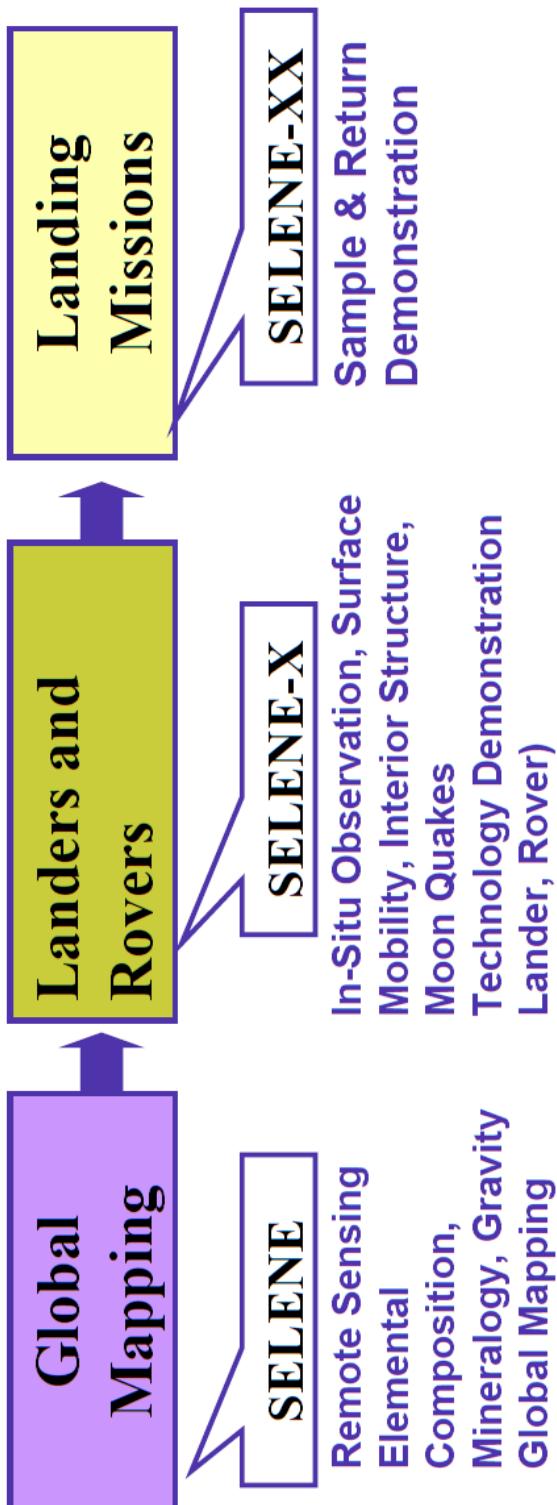
### 1.1 To the Moon

#### ● Within about 10 years

- Further moon exploration with robotic landers (SELENE, post-SELENE, etc.)
  - Scientific studies to understand origin and evolution of the Moon
  - Studies of possible utilization of the moon and development of innovative future technologies
- (\*) Around 10 years later, expecting a governmental policy decision on whether to go further toward the human surface activity on the Moon.
- #### ● Within about 20 years
- Contributions to the international community by taking roles in the implementation of international lunar initiatives
  - Development of enabling technologies for human and/or long-term stay on the Moon.

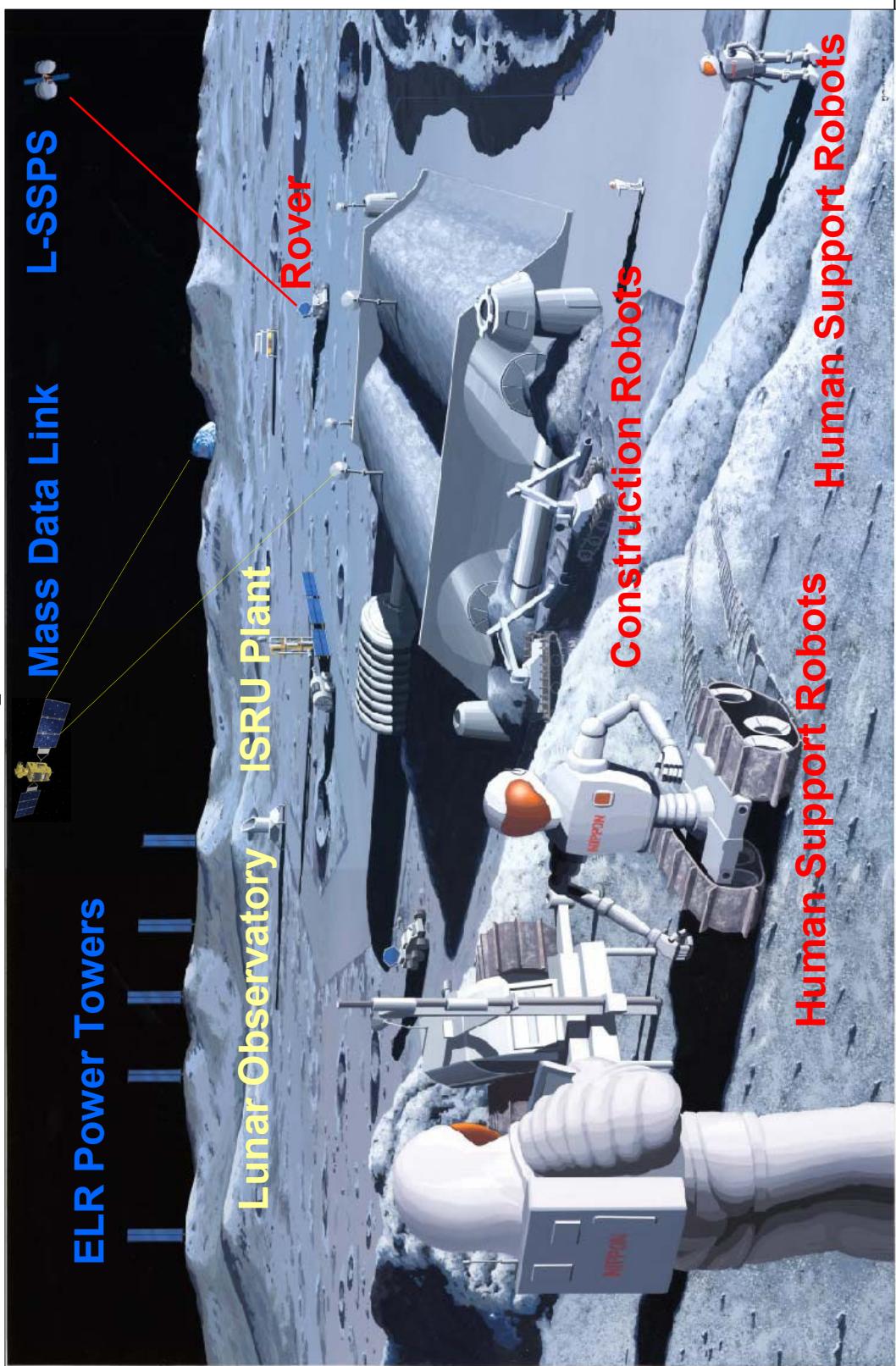
## 1. JAXA's future plan for Space Exploration

### 1.1 To the Moon (Strategic Robotic Pre-cursor)



## 1. JAXA's future plan for Space Exploration

- Human Lunar Exploration after 2025 -



## 1. JAXA's future plan for Space Exploration

### 1.2 To the Solar System



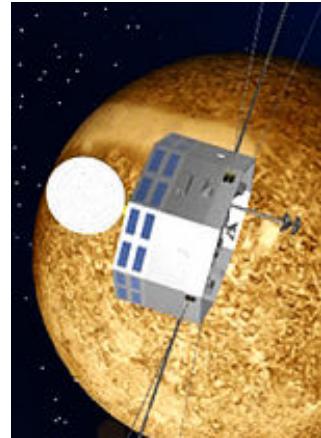
PLANET-C Venus Orbiter

2010



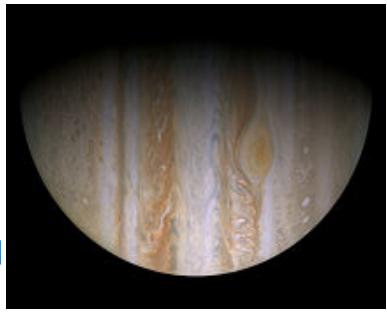
Hayabusa-next

2011(TBD)



Bepi-Colombo Mercury Orbiter

2012



Jovian Magnetosphere Probe

**With the advantage in its advanced capabilities.**

#### ◆ Planetary Exploration

JAXA provides Venus and Mercury

Exploration with international collaboration.

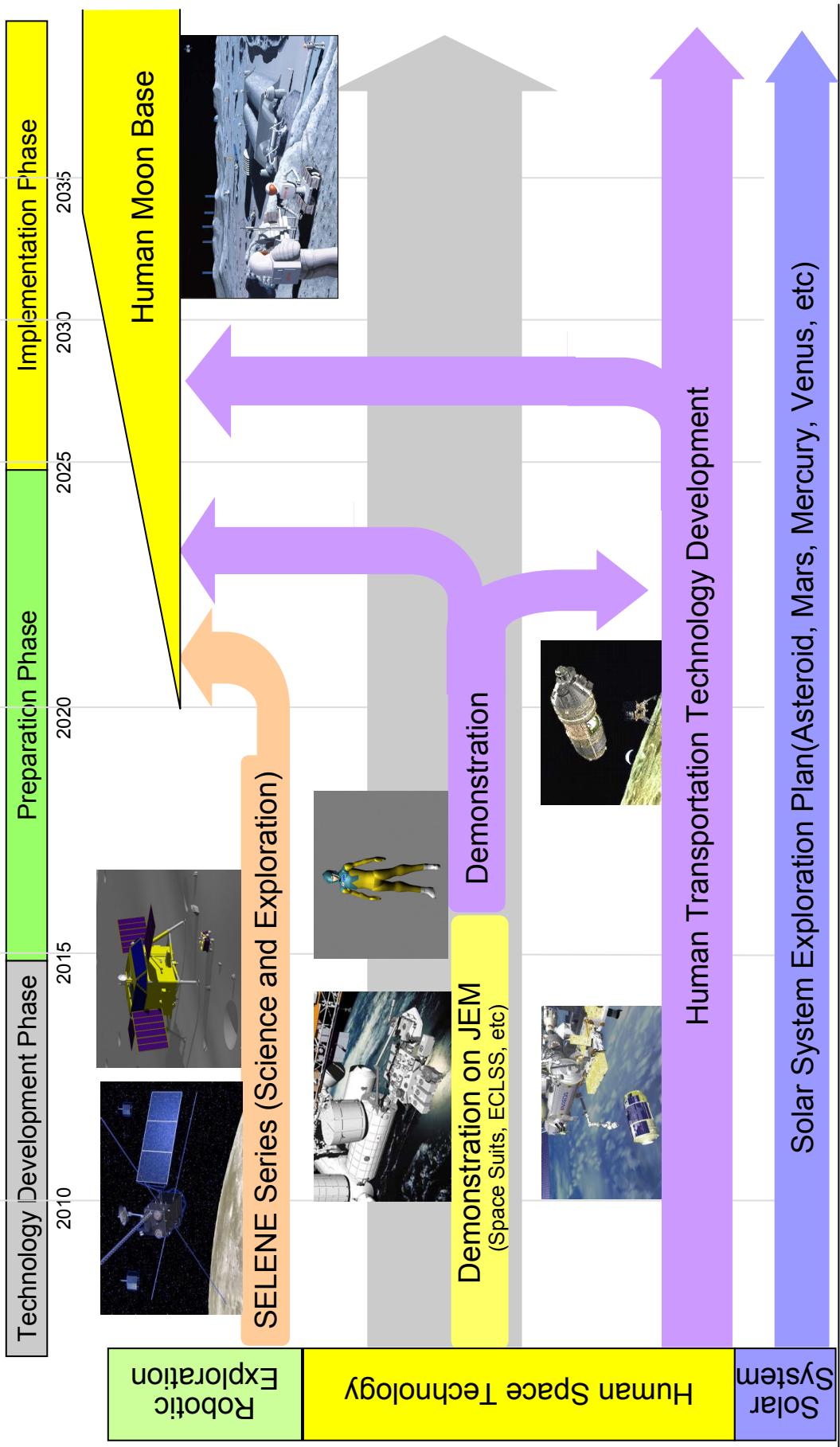
◆ JAXA focuses and concentrates its activity on

1) Primitive Bodies exploration,

2) Planeto-Magnetospheric exploration

# 1. JAXA's future plan for Space Exploration

## Overall Roadmap for Space Exploration (focusing on the lunar exploration)



## 1. JAXA's future plan for Space Exploration

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### 1.3 JAXA Basic Position To Exploration

- Space exploration is intrinsically linked to both international competition and international cooperation.
- In addition to promoting independent space exploration unique to Japan and studying as much as possible about asteroids and the moon, Japan also intends to get actively involved in international cooperation.
- In view of the benefits of international cooperation, particularly in terms of manned missions to the moon, Japan intends to share a reasonable responsibility with the United States and other countries.

## **JAXA 2. Status of Cooperation Framework Development and JAXA's position**

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### **2.1 International Coordination Activities Examples**

- ISEF @COSPAR
- ILD @COSPAR & ILEWG
- Lunar & Mars Spectrum Coordination
- 'Program of Programs' Approach

International coordination mechanism for the space exploration is highly desired among scientists and researchers as shown above, but also space agencies....

## 2.1 International Coordination Activities Examples

The objectives of the ISEF are to:

1. Share information and future plans relating to the development of national and international exploration programmes.
2. Enhance international co-operation in the development of exploration programmes.
3. Provide opportunities for engagement by all Members
4. Facilitate the interoperability of exploration systems and minimize duplication.
5. Explore opportunities for collaboration and/or coordinated missions.

The structure the ISEF will consist of:

- The ISEF Plenary,
- A chair and a vice-chair,
- Ad hoc bodies and sub-committees, as decided by the ISEF Plenary.

## JAXA 2. Status of Cooperation Framework Development and JAXA's position

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### 2.1 International Coordination Activities Examples

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Examples of possible national roles that could be adopted as International Lunar Decade are:

- Adoption of communication standards both in-space between spacecraft, and between spacecraft and Earth
- Use of relay satellite(s) and cooperative gravity mapping
- Initiation of a Lunar Internet protocol
- Coordination of observations to enable jointly defined scientific objectives
- Development of a Lunar Way-Station with cooperative operations
  - Inspection function
  - Navigation aids
  - In-situ propellant manufacture and power transfer experiments
  - Robotics experiments to support human operations
  - Rovers; cooperative rover tasks
  - Science and public involvement activities

# 2. Status of Cooperation Framework Development and JAXA's position

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## 2.1 International Coordination Activities Examples

### DISCUSSION OF SPECTRUM COORDINATION AND INTEROPERABILITY

- Are These Technical Meetings Completely Within the ITU Framework?
- Moon-Mars Mission Models
- Effective Mission Coordination for Individual Missions
- Need for New Frequency Allocations
- Need for New/Modified SFCCG/ITU Recommendations/Resolutions
- Charts Summarizing Frequency Band Usage
- Discussion of Agency Architectures
- Feasibility of Interoperability
- Technical Issues
- Work Plan and Action Items

## JAXA 2. Status of Cooperation Framework Development and JAXA's position

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### 2.1 International Coordination Activities Examples

#### Presentation at Mars Strategic Roadmap Committee in 2005

All exploration activities, taken together, comprise a global enterprise for exploration, a two-tiered “Program of Programs”

##### Expected Products

- Consolidated International Exploration Roadmap
  - Aggregate of national plans
- Consolidated Roadmap → Coordinated Roadmap
  - Members make independent decisions about national programs, but can choose to be interdependent
  - Standards to facilitate interoperability
- Bilateral and Multilateral Cooperative Programs
  - Developed and negotiated separately by participants

## 2. Status of Cooperation Framework Development and JAXA's position

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### 2.2 Coordination Initiatives among Space Agencies

#### ➤ NASA lead Strategy Building Activity

- WS in Washington (April, 2006)
- Intended to solicit information inside and outside US.
- Strategy Rolls out in Houston (Dec., 2006)
- Still Unclear: 'Global' Strategy Of NASA?, For NASA?, By NASA?

#### ➤ ESA lead International Coordination

- WS in Spinetto/Italy (May, 2006)
- Seeking an International Coordination Mechanism.
- Failed to identify / specify an acting organization to it.
- Just monitors who, what and how performed for one year.
- Implicitly admits NASA lead coordination activity for the time being.

#### ➤ JAXA

- Respects both activities and participates aggressively in both meetings.
- Provides International Coordination opportunity next year in Japan.

## **JAXA 2. Status of Cooperation Framework Development and JAXA's position**

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### **2.3 What is sought First?**

- Interoperability/Standardization will usher the International Coordination.
- Especially, Data Archiving / Sharing is the most agreeable and useful activity.
- Space-developed nations/organizations shall make a substantial contribution to it.

## JAXA 2. Status of Cooperation Framework Development and JAXA's position

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### 2.4 JAXA Contribution

- JAXA will offer establishing a Lunar and Planetary Science Data Archiving / Distribution Facility, which is compatible with the Standards built.
- JAXA contributes to building data archiving / sharing standards with international partners.
- JAXA looks at facilitating payload opportunities exchanged with other nations / organizations.

### 3. JAXA perspective on Interoperability for Exploration

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#### 3.1 Based on the following perception

- Space Exploration will be much more global, cooperative, collaborative activities among larger participants than ISS.
- Space Exploration will be OPEN architecture which welcomes new participants and facilitates architecture amendment that might occur, and also facilitates exchanging and sharing the data gained as much as possible.

#### 3.2 Recognize that the INTEROPERABILITY

- Is essential to the Global Space Exploration.
- Expands the flexibilities of the scheme of exploration
- Contributes to share the obtained knowledge
- Reduces the developing and operating cost of exploration
- Mitigates risks of exploration

### 3. JAXA perspective on Interoperability for Exploration

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#### 3.3 Possible area where Interoperability or Standardization needs to be considered

- Scientific data sharing for the moon and other planets
- Physical and environmental condition among transportation systems  
(Both Human and Robotic)
- Spacecraft including vehicles tracking system
- Frequency/Spectrum sharing
- Emergency system (Crew rescue, evacuation, etc)
- Interface design for plug-in component/module
- Man-machine interface
- Safety requirement/design

## 3. JAXA perspective on Interoperability for Exploration

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### 3.4 Lessons Learned from ISS

- Design/Requirement standardization was pursued in ISS program.  
Structural, Mechanical, Electronics, Communication, Human Machine Interface, Safety, Operation, etc.
- Efforts for standardization for some area started late (e.g. Robotics and Graphical User Interface), which caused turmoil and failed to maximize the effectiveness of standardization.
- Efforts for standardization need significant resources.
- Provision of data related the common parts purchased abroad were restricted due to strict export control, which caused difficulty in integration and verification.

### 3. JAXA perspective on Interoperability for Exploration

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#### 3.5 Recommendation

- ◆ The area where the interoperability/standardization should be prioritized first.
- ◆ Standardization for design and operation needs to start as early as possible to maximize the effectiveness.
- ◆ Global framework for alleviation of data export control for space exploration is needed.