

**Symposium to Strengthen the Partnership
with Industry**

Space Industry and Space Exploration in Japan

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Executive Fellow

**Electrical Systems Group
Mitsubishi Electric Corporation
(MELCO)**

15 February 2016



Courtesy of JAXA/NASA

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1. Company Introduction and MELCO Space Business

MELCO Introduction

Mitsubishi Electric Corporation (MELCO)

MELCO, a long-established & blue-chip company (founded in 1921), is the **world's leading manufacturer of electronic products and systems** in a broad range of fields, automotive equipment, factory automation systems etc. **Over the past four decades, MELCO have been involved in many satellite projects** for telecom operators, government agencies, and other large-scale clients.

President & CEO : Masaki SAKUYAMA

Head quarters : Tokyo, JAPAN

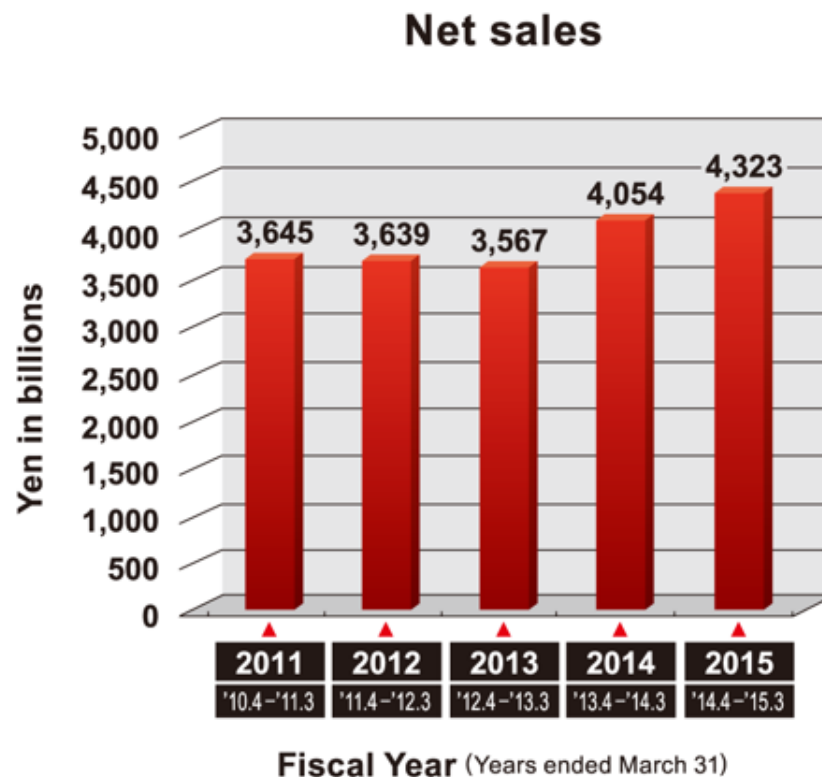
Net Sales in 2014 : ¥4,323,041 million
(US\$36,025 million)

No. of Employees: 129,249*

Moody's Rating : A1**


* Including employees of consolidated subsidiaries

** As of March 2015



Corporate Organization


As of April, 2014




Chairman
K. Yamanishi



PRESIDENT & CEO
M. Sakuyama



Senior Vice President
Group President
Y. Nakatani



Executive Fellow
H. Koyama



Corporate Research & Development Group



Communication Systems Group



Electronic Systems Group



Information Systems & Network Service Group



Energy & Industrial Systems Group



Public Utility Systems Group



Building Systems Group



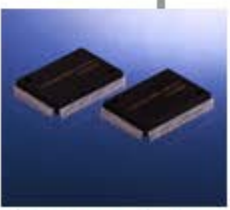
Living Environment & Digital Media Equipment Group



Factory Automation Systems Group

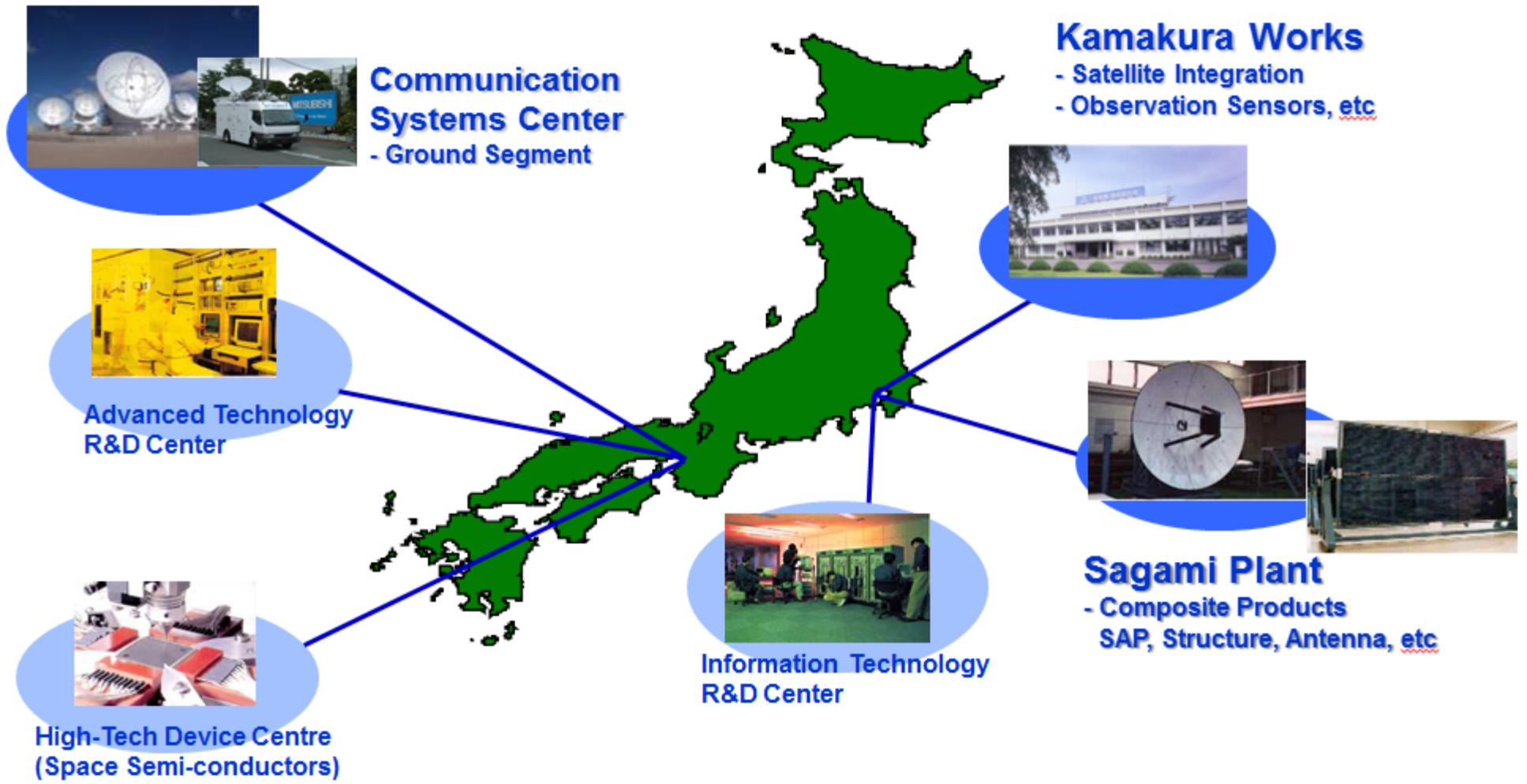


Automotive Equipment Group



Semiconductor & Device Group

Space Related Facilities



History of MELCO Space Business



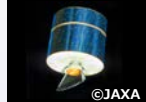
ISS x2



CS

1960s~70s Started Space Business

MOS-1



CS-2/3 x2

Participate in ISS program

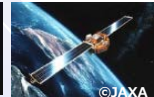
1980s Established Core Technologies for Space Systems



JERS-1



ADEOS



SFU

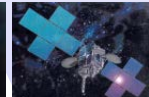
1990s Built Successful Records



ADEOS-II



DRTS



OPTUS-C1



USERS



SERVIS-1

Early 2000s Entered International Market



SOLAR-B



GOSAT



MTSAT-2



ETS-VIII



SUPERBIRD-C2



HTV1

Late 2000s Established DS2000 for Commercial Operators

Enactment of Aerospace Basic Act



ALOS-2



Himawari-8



ST-2



TURKSAT-4A



QZS-1



SERVIS-2



HTV2-5

Since 2010~ Extending Application Fields



GOSAT-2



Himawari-9



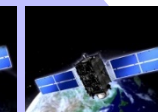
Es'hail-2



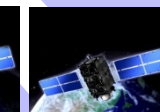
TURKSAT-4B



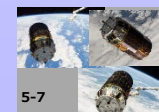
QZS-2



QZS-3



QZS-4



HTV6-9

Earth Observation

Communication & Navigation

Transportation & Exploration

MELCO Space Business

Communication

- Communication and broadcasting using GEO satellite
- MELCO established strategic standard GEO platform "DS2000"
- Chosen as the prime contractor for
 - E's hail-2(Qatar)
 - Türksat-4A/4B (Turkey)
 - ST-2 (Singapore/Taiwan)
 - Superbird C2 (Japan) ...and others.



Navigation

- Positioning using satellite signal
- First Japanese satellite navigation system called QZS(Quasi Zenith Satellite) was launched in Sep. 2010
- 4QZSs, 24hrs service, will start from 2018
- 7QZSs, self-contained navigation service, will start from 2023
- Chosen as the prime contractor for
 - 1st QZS(Michibiki)
 - 2nd-4th QZS



MELCO Space Business

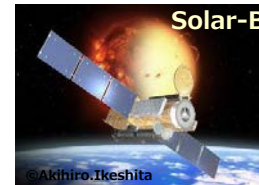
Earth Observation

- Earth Observation from **LEO using optical or SAR sensors**
- Chosen as the prime contractor for
 - GOSAT : greenhouse gases monitoring
 - ALOS-2: disaster surveillance
 - “Himawari 7/8/9”: meteorological
...and others.

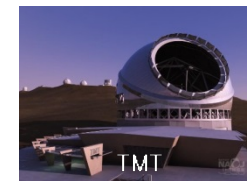


Space Exploration

- Astronomy using space telescope, VLBI etc.
- Chosen as the prime contractor for
 - Solar-B : Sun Surface Monitoring
 - MUSES-B : Space VLBI ...and others.



- Ground based telescopes



© NAOJ TMT-J Project Office/
4D2U Project

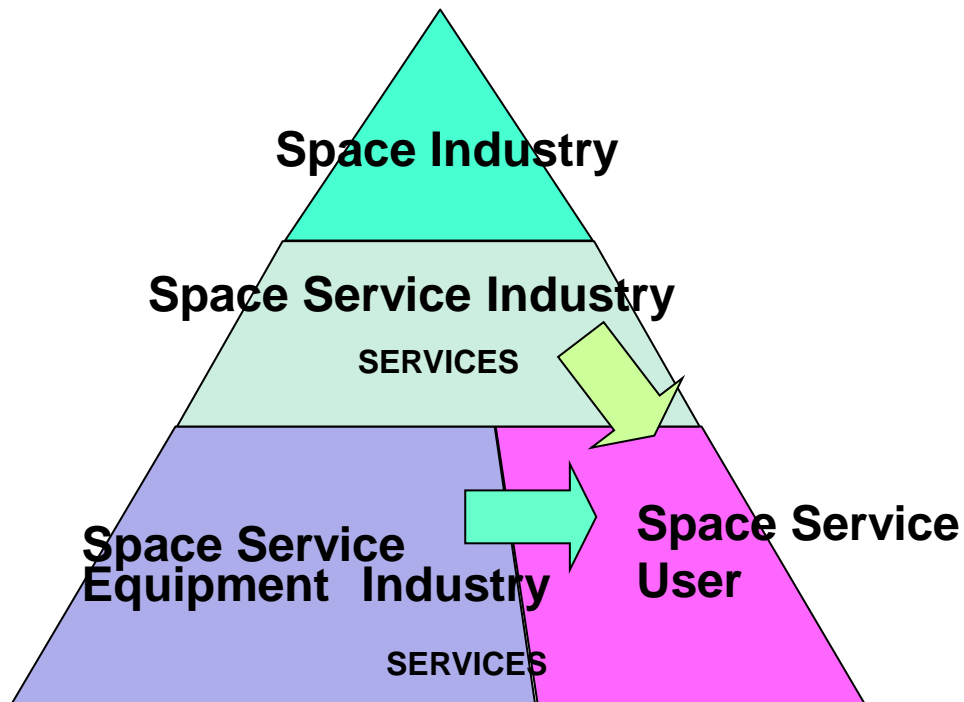
- H-II Transfer Vehicle(HTV)
HTV and its core technology can be applied for future planetary exploration missions



2. Overview of Space Industry in Japan

Space Related Industry in Japan

- Total sales volume of the Space Industry is **\$ 2.86 B**
- Sales for the User and Service Equipment Industry made major contribution
- Main user's sales depend on foreign satellites
- Space related Industry makes big contribution to development of the economy

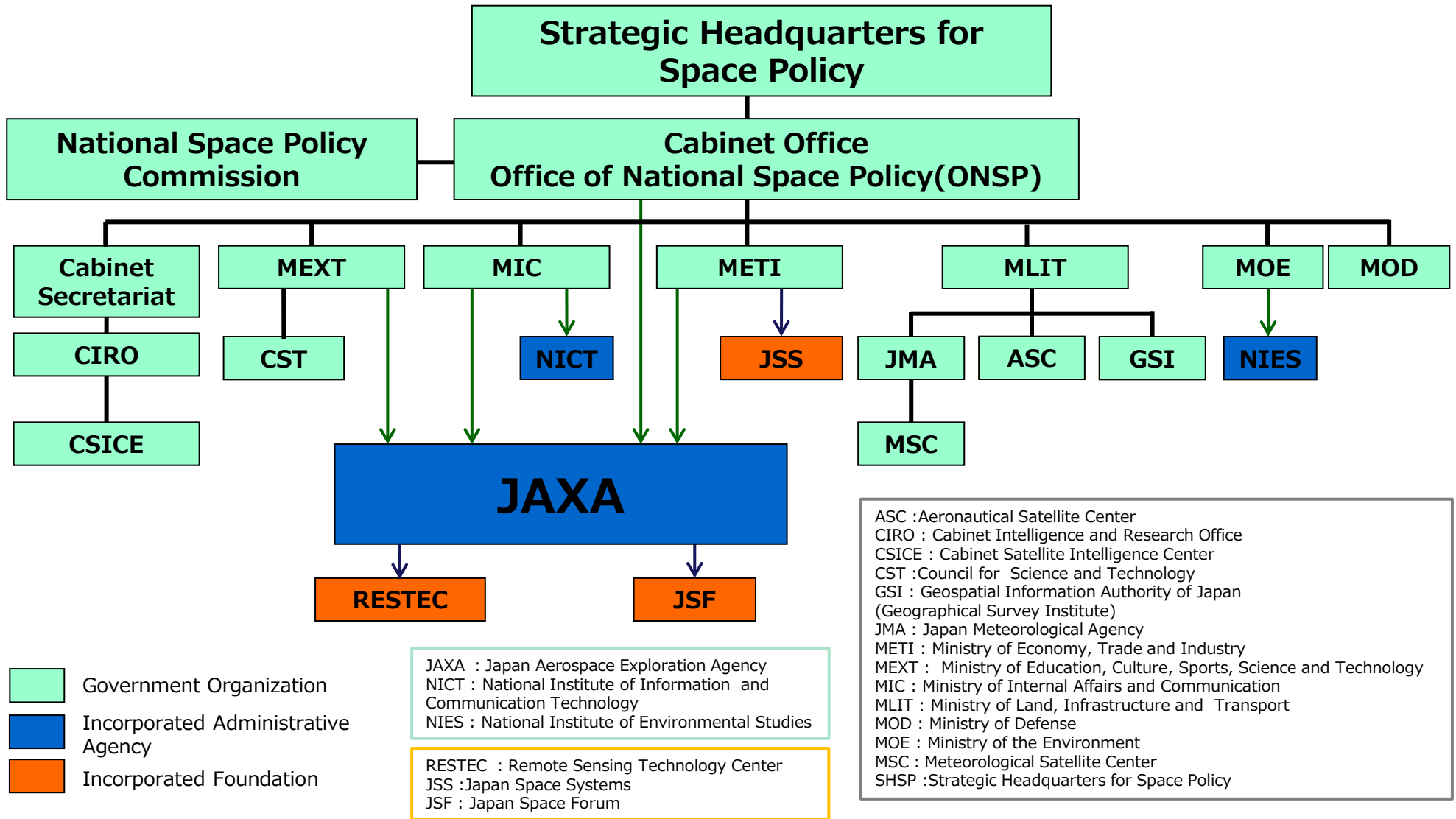


	Sales Volume [B US\$]
Space Industry (Rocket, Satellite, Ground Facility)	2.86
Space Service Industry (Communication, Broadcasting, Positioning, Remote sensing Service)	9.16
Space Service Equipment Industry (BS TV, BS Tuner, Car-Navi., GPS Equipment)	17.37
Space Service User (Utilization of Space Services)	35.99
Total Sales Volume	65.38

@ 1 US \$=¥98.65

The Society of Japanese Aerospace Companies ,2015 : OVERVIEW OF JAPANESE SPACE INDUSTRY

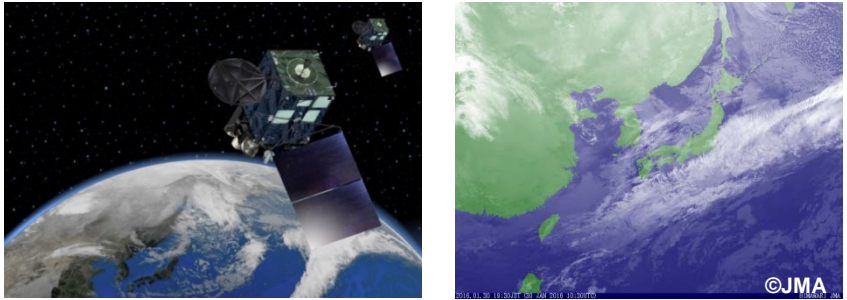
Organization Chart of the Space Related Establishments



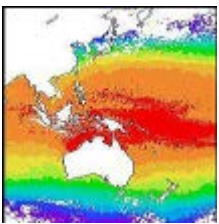
3. Activities for Sustainability

Earth Observation Satellites for Sustainability

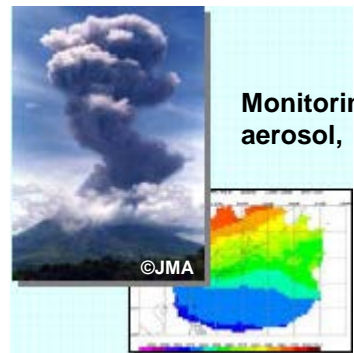
Himawari



- Meteorology Satellite
- Used for monitoring of
 - Climate, **Climate Change**
 - **Global Warming**
 - **Desertification**
 - **Atmospheric Environment**
 - **Marine Environment** etc.



Monitoring of Global Warming

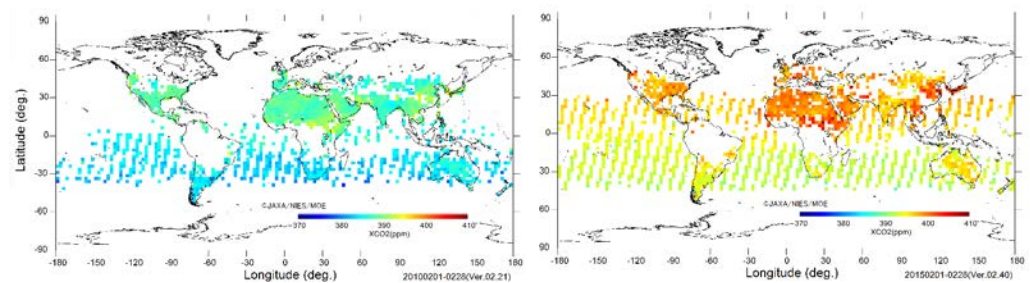


Monitoring of aerosol, volcanic ash ..

GOSAT

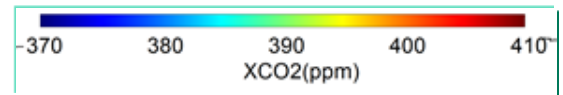


- Greenhouse Gas Monitoring Satellite
- Used for monitoring of
 - **Concentration of Carbon Dioxide**



Feb. 2010

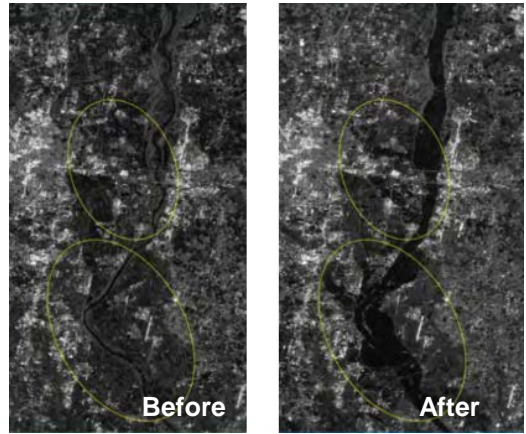
Feb. 2015



Average concentration of Carbon Dioxide

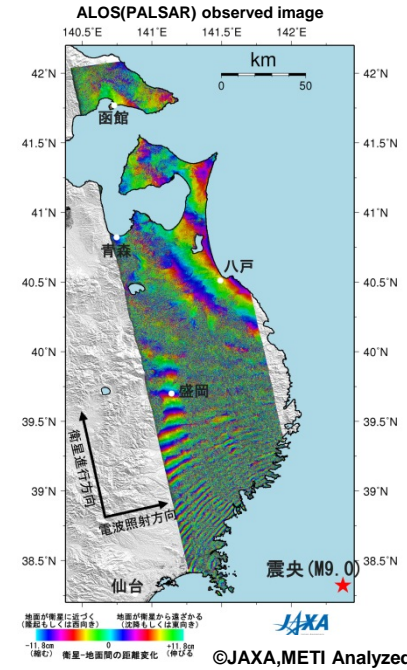
ALOS-2

- Advanced Land Observation Satellite 2
- Used for monitoring of
 - Effects of disasters to cities and rural areas (earthquakes, thunderstorms, floods, tsunamis)
 - Movement of Earth surface after earthquakes
 - Illegal logging

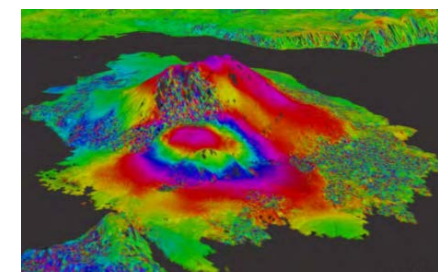


Detection of flooded areas

©JAXA

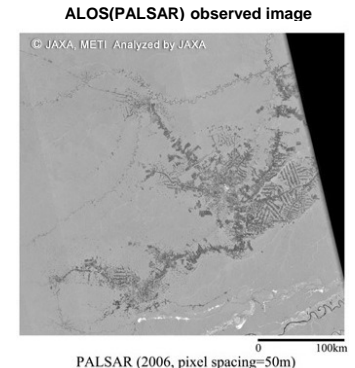


Movement of Earth surface after big earthquake



Movement of Earth surface before eruption of volcano

©JAXA



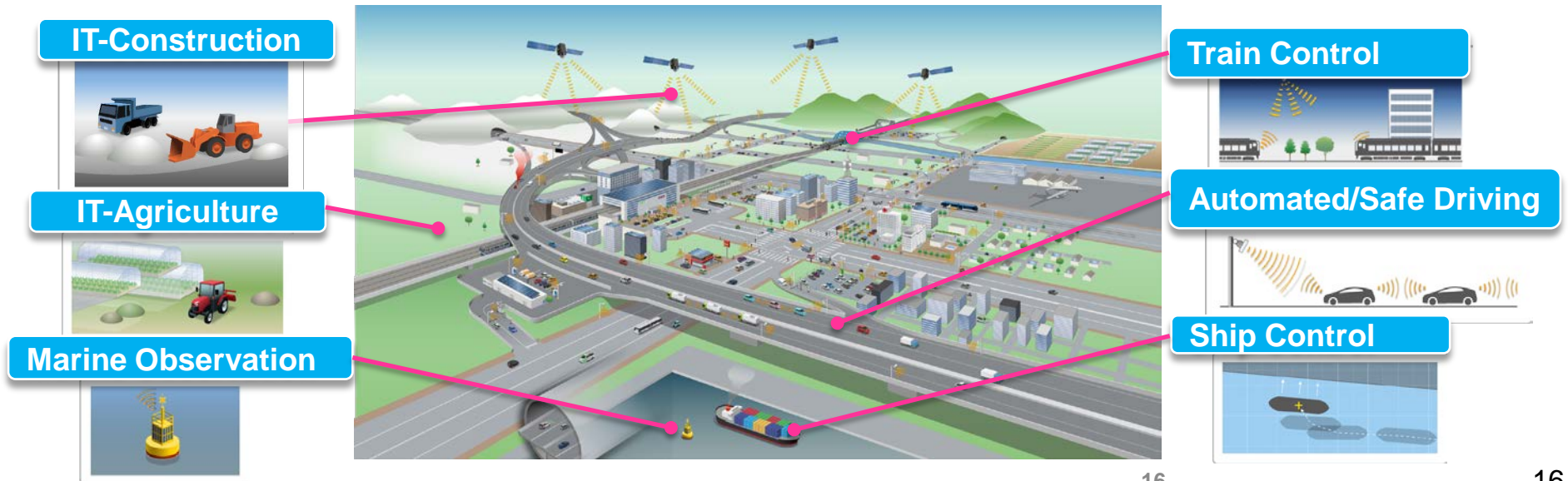
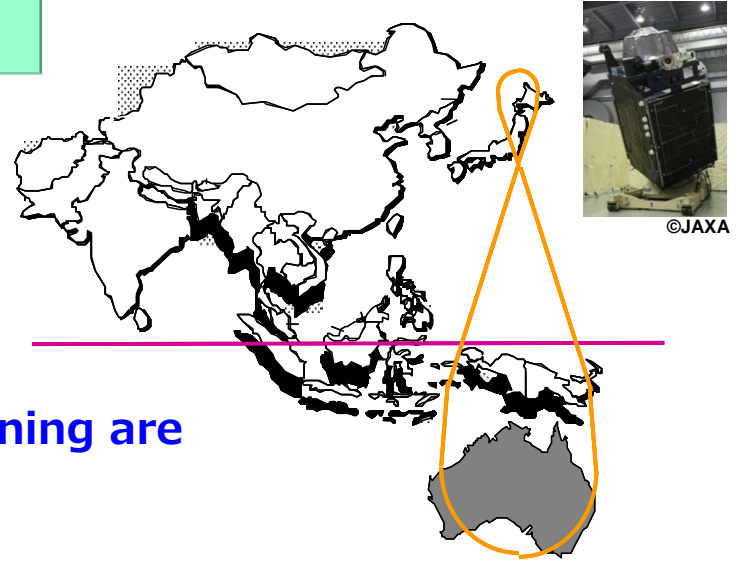
Monitoring of illegal logging

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Utilization of High Precision Navigation for Sustainability

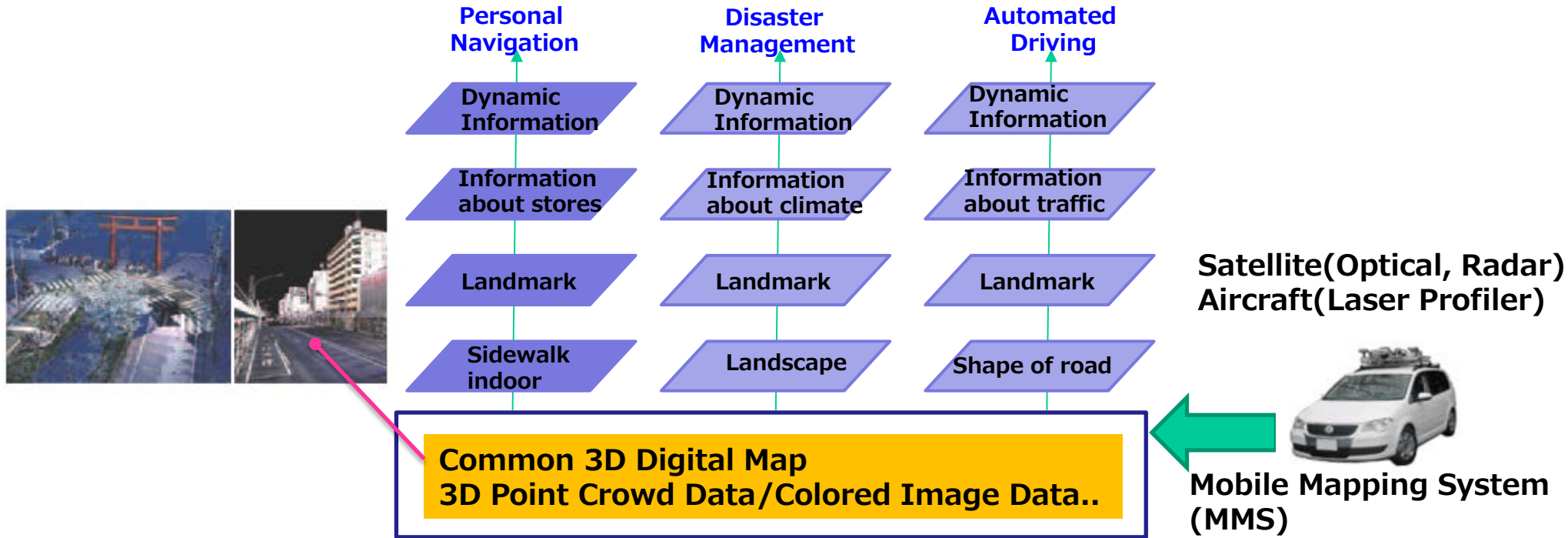
QZSS

- Quazi Zenith Satellite System for navigation
- Major functions of QZSS
 - GPS Complementary
Enhance positioning signal availability
 - Positioning Augmentation
Provide cm level high precision 3D positioning
- Various applications using high precision 3D positioning are investigated.



Utilization of High Precision Navigation for Sustainability

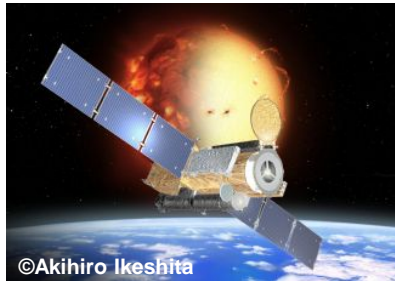
- To utilize **cm level high precision 3D positioning**, a **3D digital map** with the same level of accuracy is required
- At present, the **“Common 3D Digital Map Concept”** has been investigated in Japan through **“COCN(Council on Competitiveness-Nippon) “activities**
- The **“Common 3D Digital Map”** can be utilized for various areas such as **“Automated Driving”, “Disaster Management”, “Personal Navigation”** etc.
- **These applications contribute to the creation of a “Smart Society” for sustainable development**



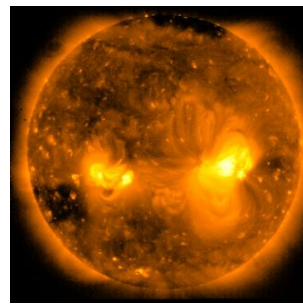
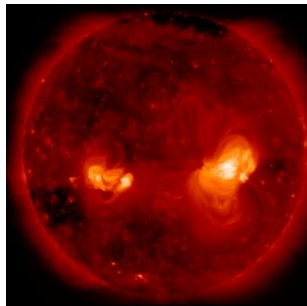
4. Activities for Space Exploration

Contributions to Space Astronomy

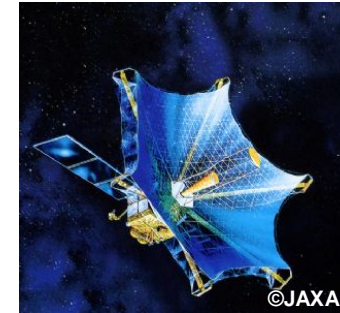
Solar-B



- Mission of Solar-B is the **investigation of magnetic activity of the Sun**
- Solar-B provides
 - quantitative measurements of the full vector magnetic field
 - change in the solar atmosphere with high resolution and sensitivity



MUSES-B



- Radio astronomy satellite
- MUSES-B provide
 - **radio-wave observation** in orbit in combination with radio telescopes on the ground

HTV and Future Contribution to Exploration

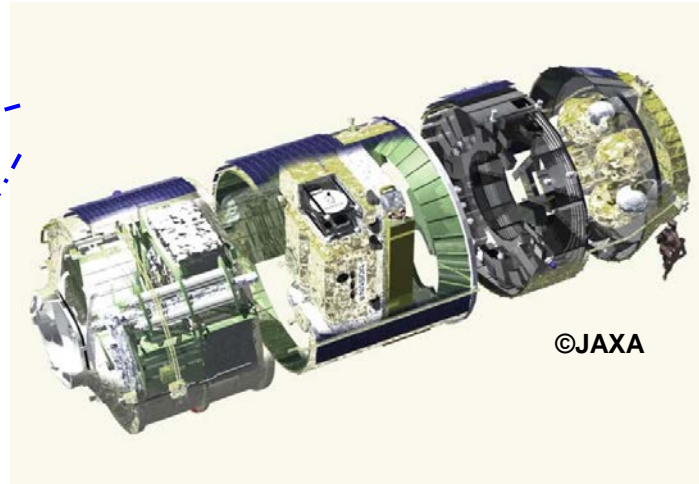
HTV

- **HTV (H-II Transfer Vehicle) is an unmanned cargo transporter to the ISS**
- **MELCO's contribution to HTV is "3 Essential Intelligent System" such as "HTV Avionics Module", "HTV Operation Control System" and "Proximity Communication System"**

Proximity Communication System



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©JAXA

HTV Avionics Module

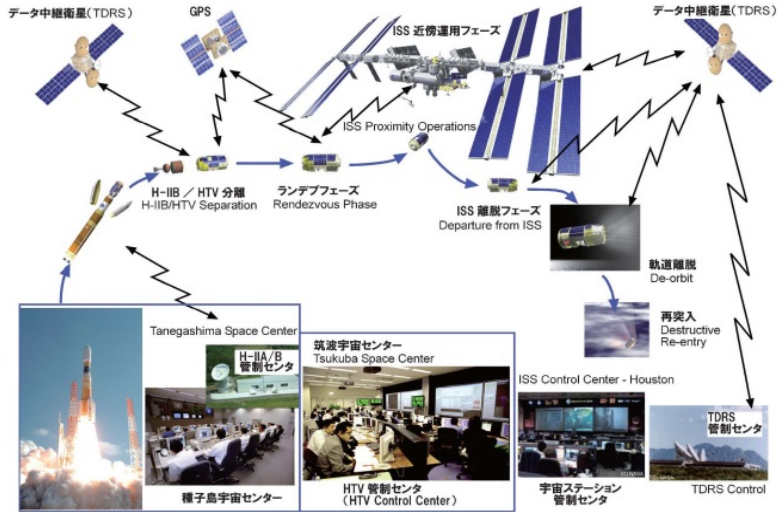


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HTV Operation Control System (HTV OCS)

HTV and Future Contribution to Exploration

- HTV is a fully automatic unmanned rendezvous vehicle
- **HTV itself and development results** such as the Avionics System, rendezvous software and designed trajectories etc. **can be used for future planetary exploration missions**



HTV Flight Sequence

- Designed results can be used for various planetary exploration missions such as automatic landing, sample return and etc.

- **Small Lander for Investigating Moon, SLIM** is planned to launch in 2019 and various HTV development results are utilized for the SLIM spacecraft



5. Future Contribution Areas in Space Exploration

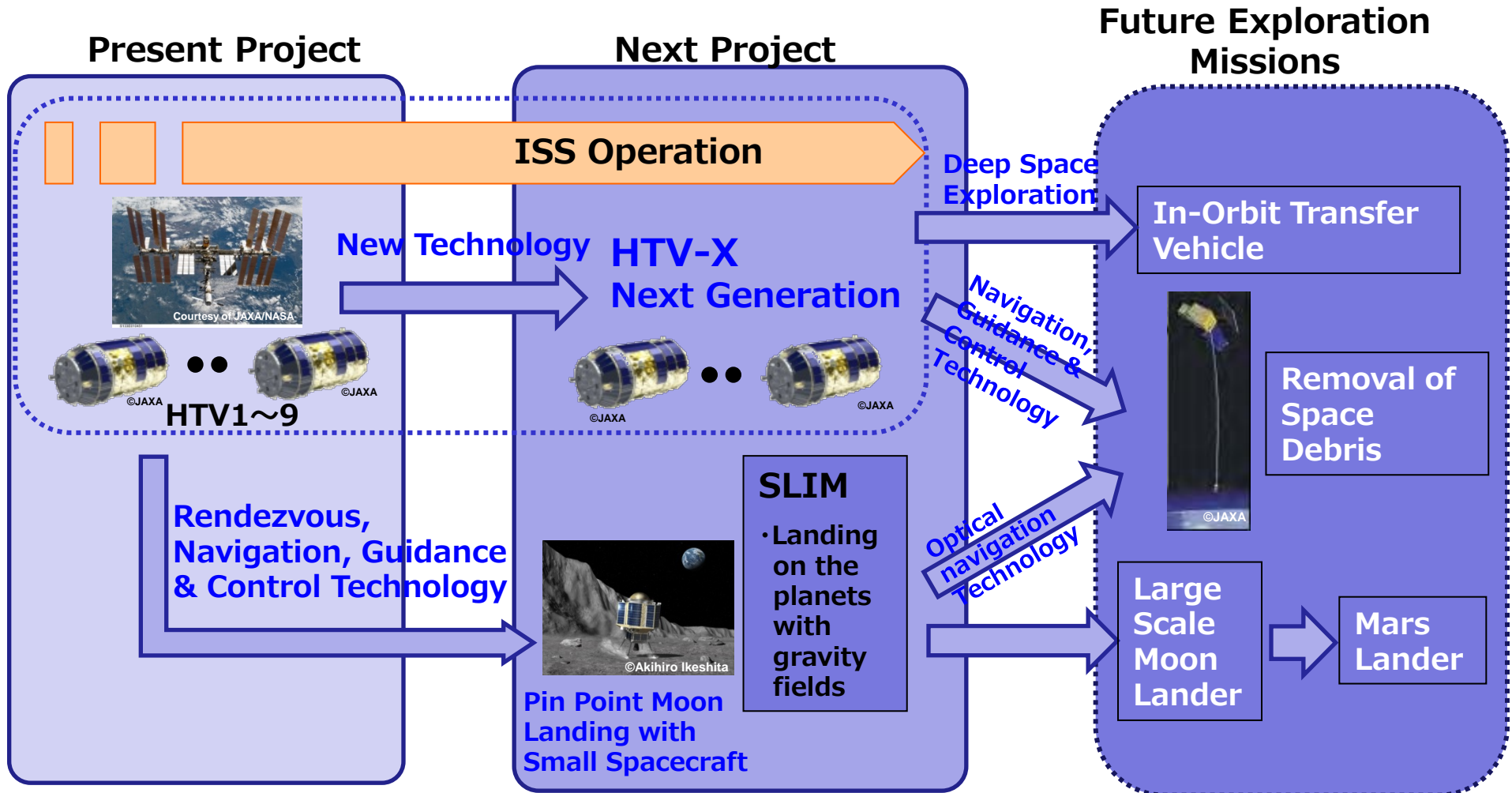
Space Basic Plan

- **ONSP**(Office for National Space Policy) decided on an **“Update Basic Plan for Space Policy”** in December, 2015
- In this updated Plan, the following Space Science & Exploration Activities are defined

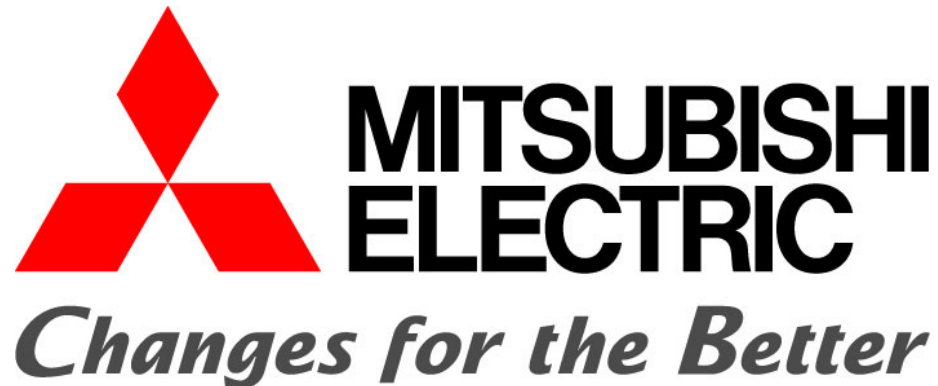
F Y	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
	Hayabusa-2			▲ Arrive at small planet			▲ Return to Earth				
	Operation										
	ASTRO-H(X-ray Astronomy)										
	▲ Launch		Operation								
	BepiColombo(Exploration of Mercury)									▲ Arrive at Mercury	
	▲ Launch		Operation								
	ERG(Exploration of Geospace)										
	▲ Launch		Operation								
	Martian Moons Exploration										
								▲ Launch		Operation	
	SLIM(Small Lander for Investigating Moon)										
			▲ Launch				Operation				

Future Contribution Area

- We would like to contribute to future exploration missions using **HTV & SLIM technology** for Moon/Mars Lander, removal of space debris etc.



Thank you for your attention



for a greener tomorrow