

# Status Update on the Quasi-Zenith Satellite System

The 4th Japan-EU Satellite Positioning Public-Private Roundtable

Mar. 14, 2019

**GO Takizawa**

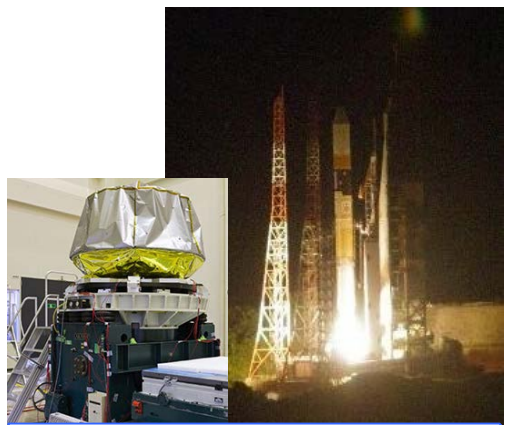
The Executive Director for QZSS Strategy

National Space Policy Secretariat

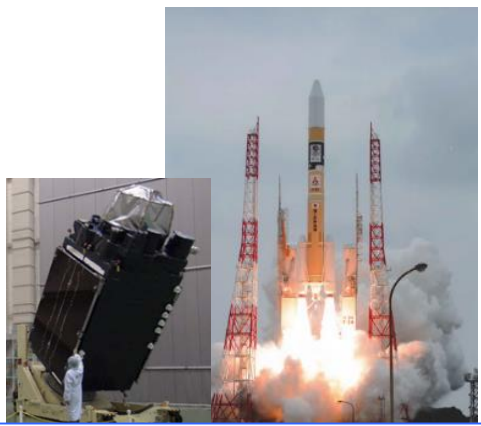
Cabinet Office, Government of Japan



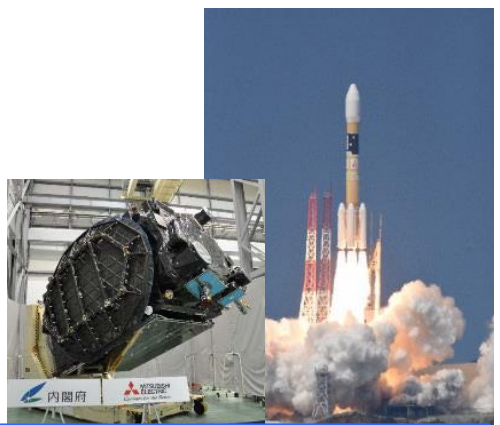
# Completion of 4 Satellite Constellation



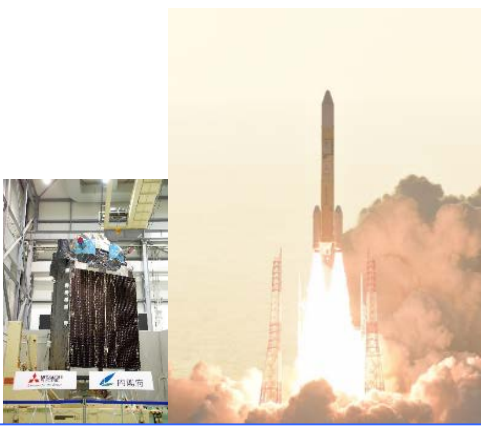
#1 Satellite : Sep. 11, 2010  
20:17:00(JST)



#2 Satellite : Jun. 1, 2017  
09:17:46(JST)



#3 Satellite: Aug. 19, 2017  
14:29:00(JST)



#4 Satellite: Oct. 10, 2017  
07:01:37 (JST)

# Official Launch of QZSS Service



On November 1<sup>st</sup> 2018, Prime Minister Shinzo Abe attended the ceremony to commemorate the launch of QZSS Service.

*“As its name suggests, “Michibiki” will guide us to Society 5.0, the society of the future. There are high hopes for the ever greater use of this satellite system in a wide range of fields. The Government aims to expand the system to a seven-satellite constellation by FY2023, with the goal of achieving a even more stable positioning services.”*



# QZSS Overview -System Architecture-

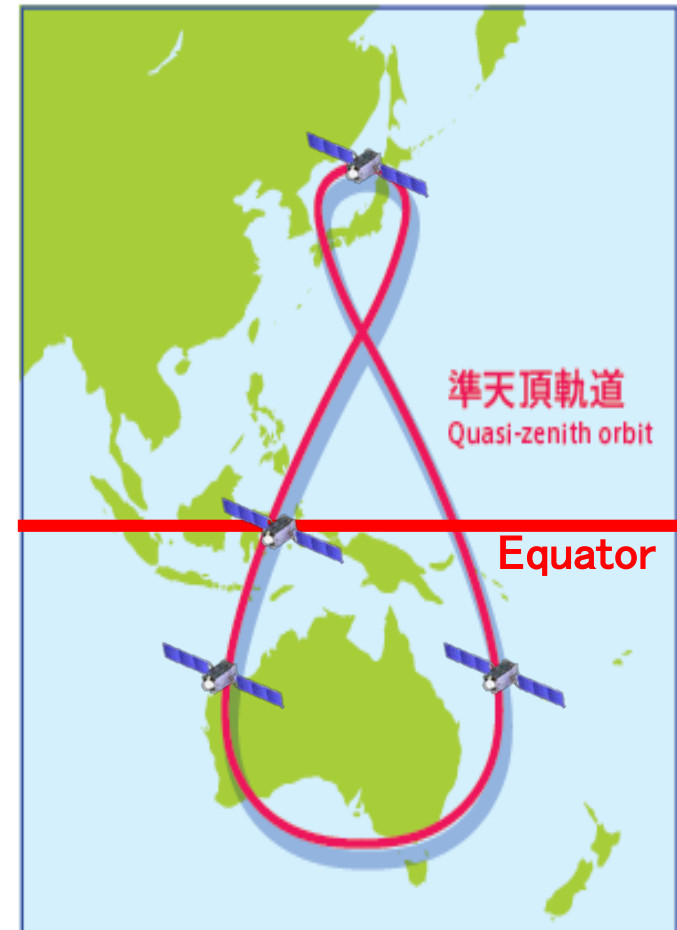


## ■ Constellation:

- 1 GEO Satellite, 127E
- 3 QZO Satellite (IGSO)

## ■ Ground System

- 2 Master Control Stations
  - Hitachi-Ota and Kobe
- 7 Satellite Control Stations
  - Located south-western islands
- Over 30 Monitor Stations around the world



# -System Architecture-



## QZSS Master Ground Station

[http://www.mlit.go.jp/koku/15\\_bf\\_000367.html](http://www.mlit.go.jp/koku/15_bf_000367.html)



QZSS Control Center, Kobe

- ✓ Two-Ground Station (Control Center) are available with site diversity.
- ✓ Hitachi-Ota station is main operation site and Kobe is a redundant site.



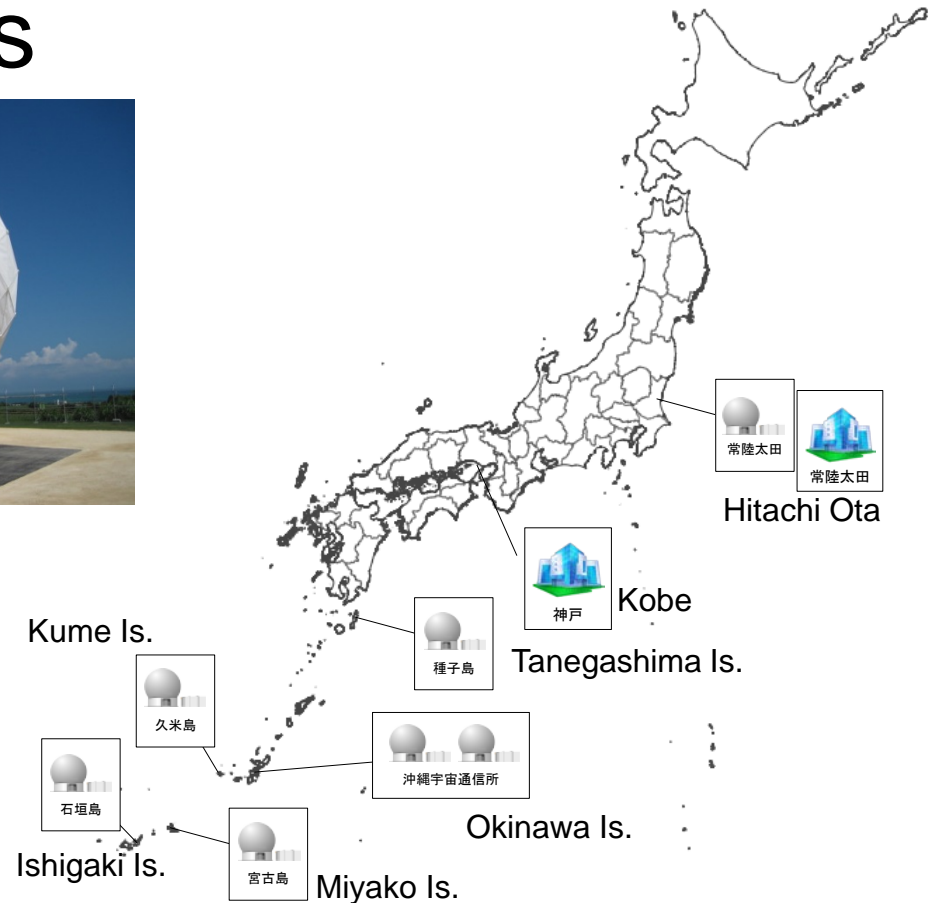
QZSS Control Center, Hitachi-Ohta,

[http://www.mlit.go.jp/koku/15\\_bf\\_000367.html](http://www.mlit.go.jp/koku/15_bf_000367.html)

# -System Architecture-



## QZSS TTC Stations

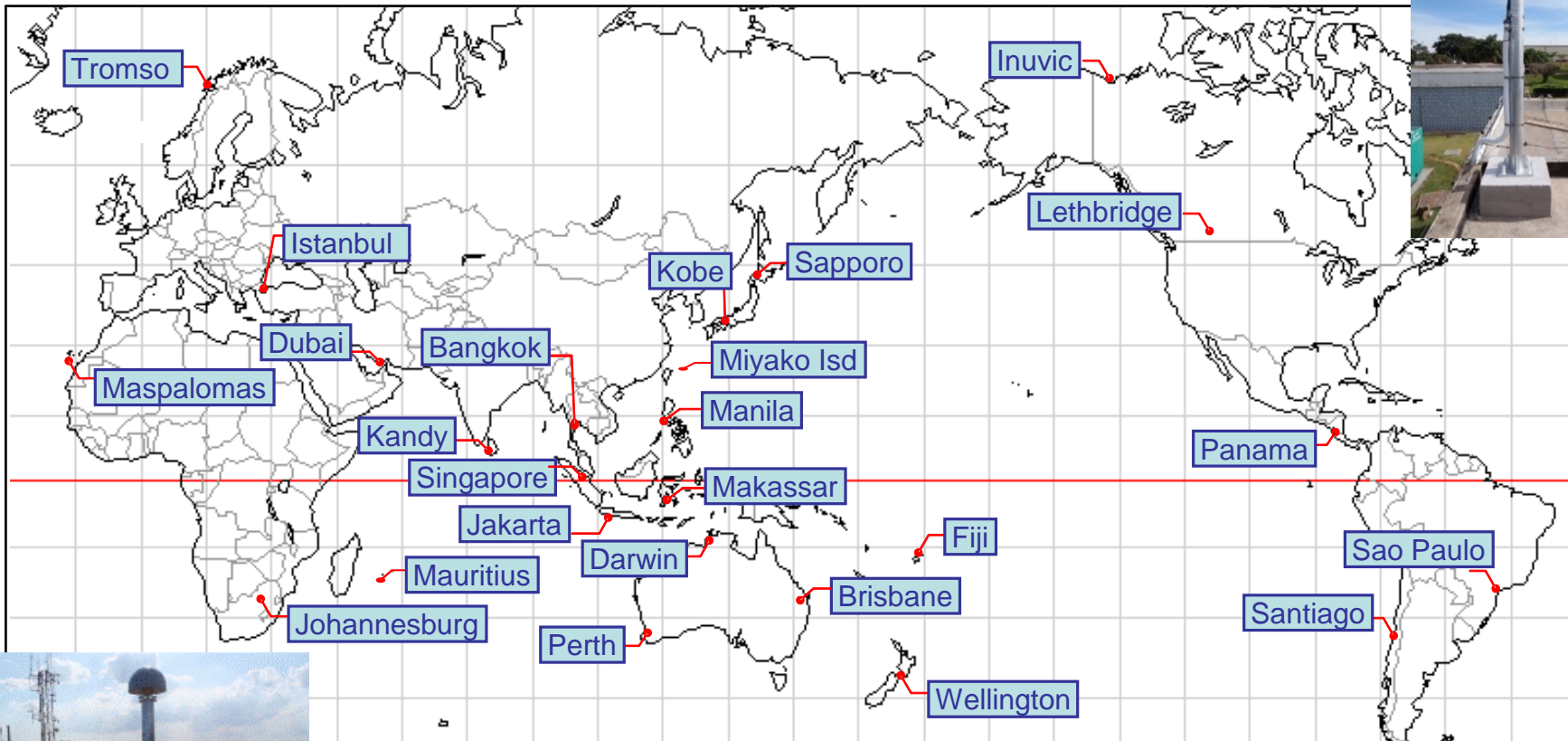


- 7 TTC (Telemetry, Tracking, and Command) stations: Most are at the southern part of Japan for satellite continuous visibility.
- All TTC stations were built and set operational by the end of 2016.

# -System Architecture-



## QZSS Monitor Stations Distribution



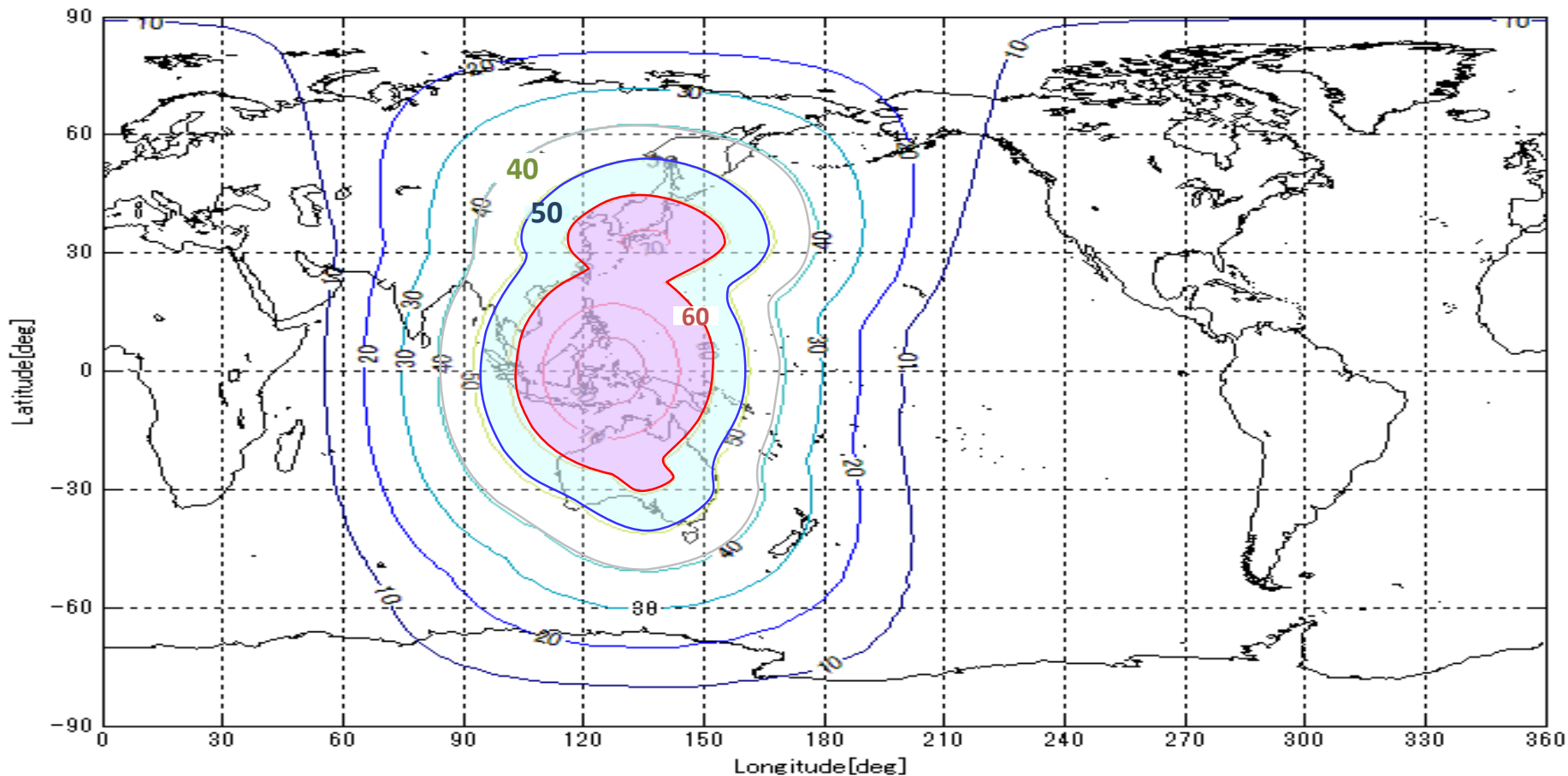
- 25 monitor stations for POD of both QZSS and GPS satellites
- Additional 10 domestic stations for SLAS (totally 13 sites)
- CLAS uses GEONET, Japanese CORS more than 1200 stations

 :Monitor Site

# QZSS Overview -Services-



- **Coverage:** Asia and Pacific region



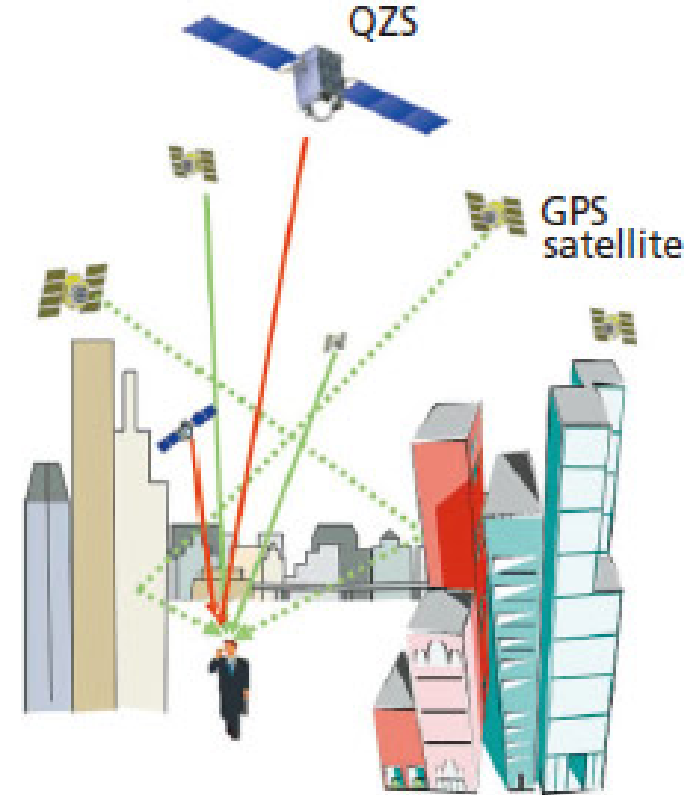
*Minimum Largest Elevation Angle Contour in the QZSS 4SV Constellation*





## ■ **Functional Capability:**

1. GPS Complementary
2. GNSS Augmentation
3. Messaging Service



# Functional Capability 1 GPS Complementary



## QZSS improves positioning availability time

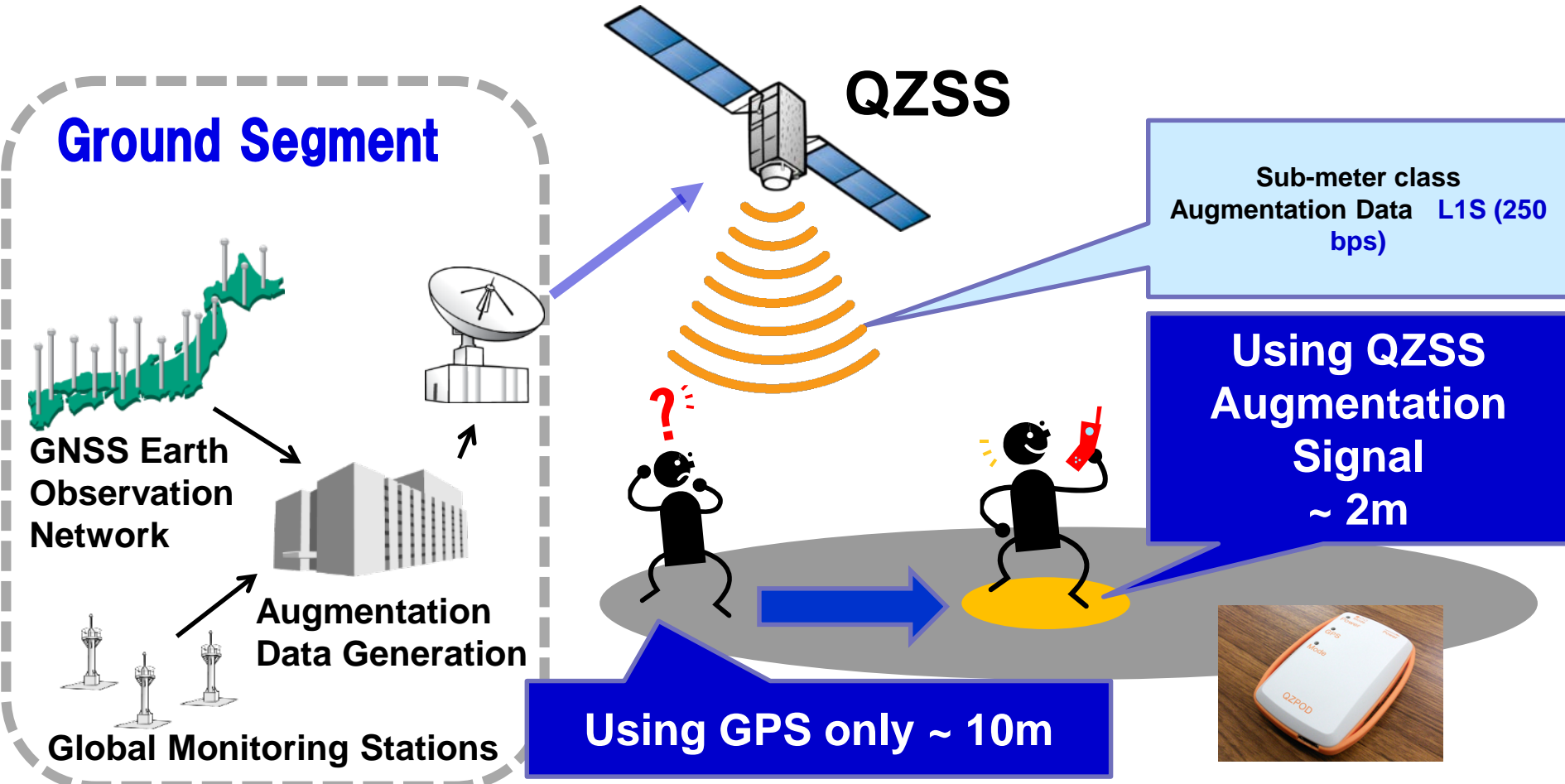
Navigation signals L1-C/A, L1C, L2C, and L5 sent from high elevation will improve the time percentage of positioning availability.



# Functional Capability 2 GNSS Augmentation



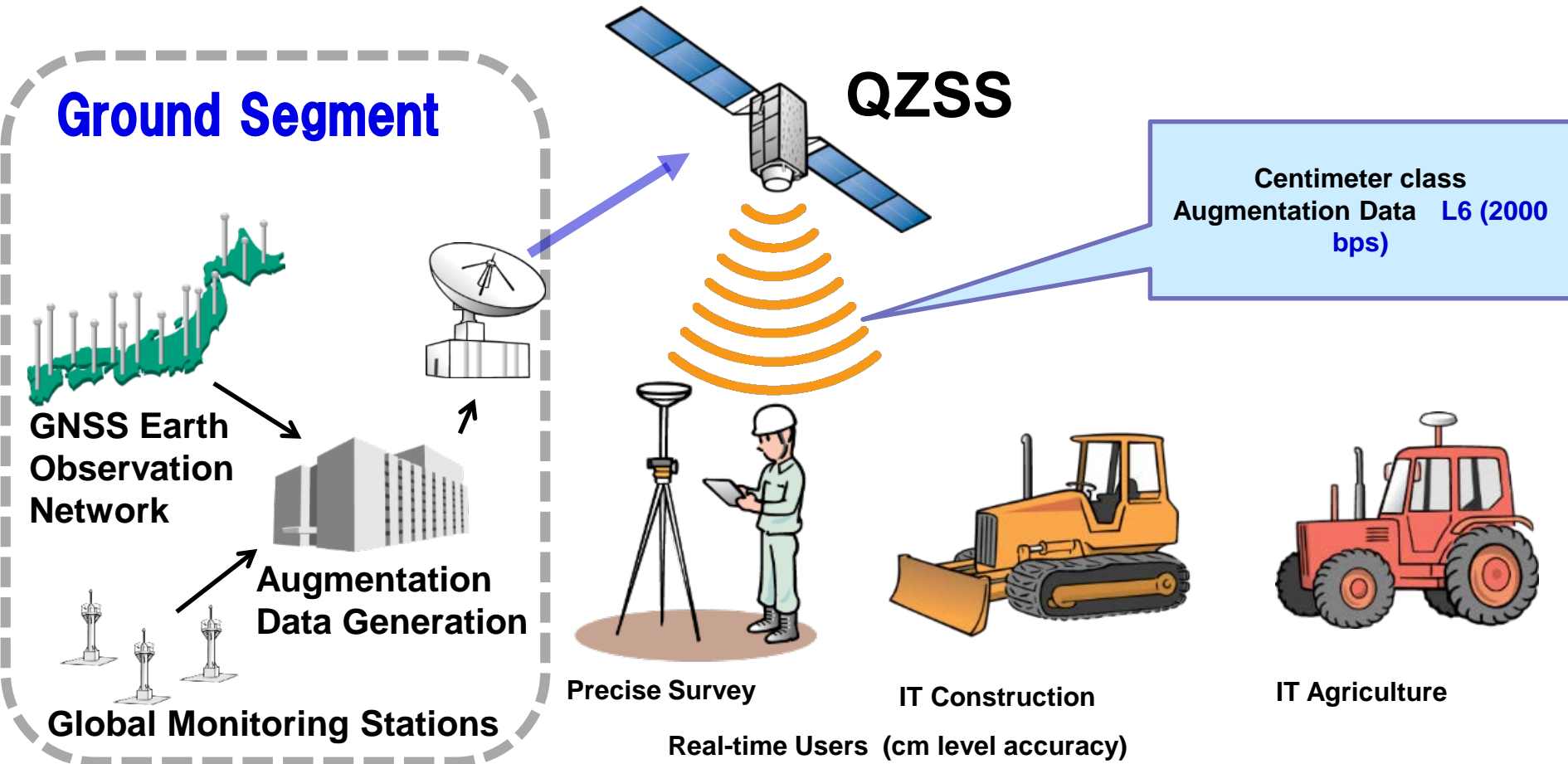
## Sub-meter Class Augmentation



# Functional Capability 2 GNSS Augmentation



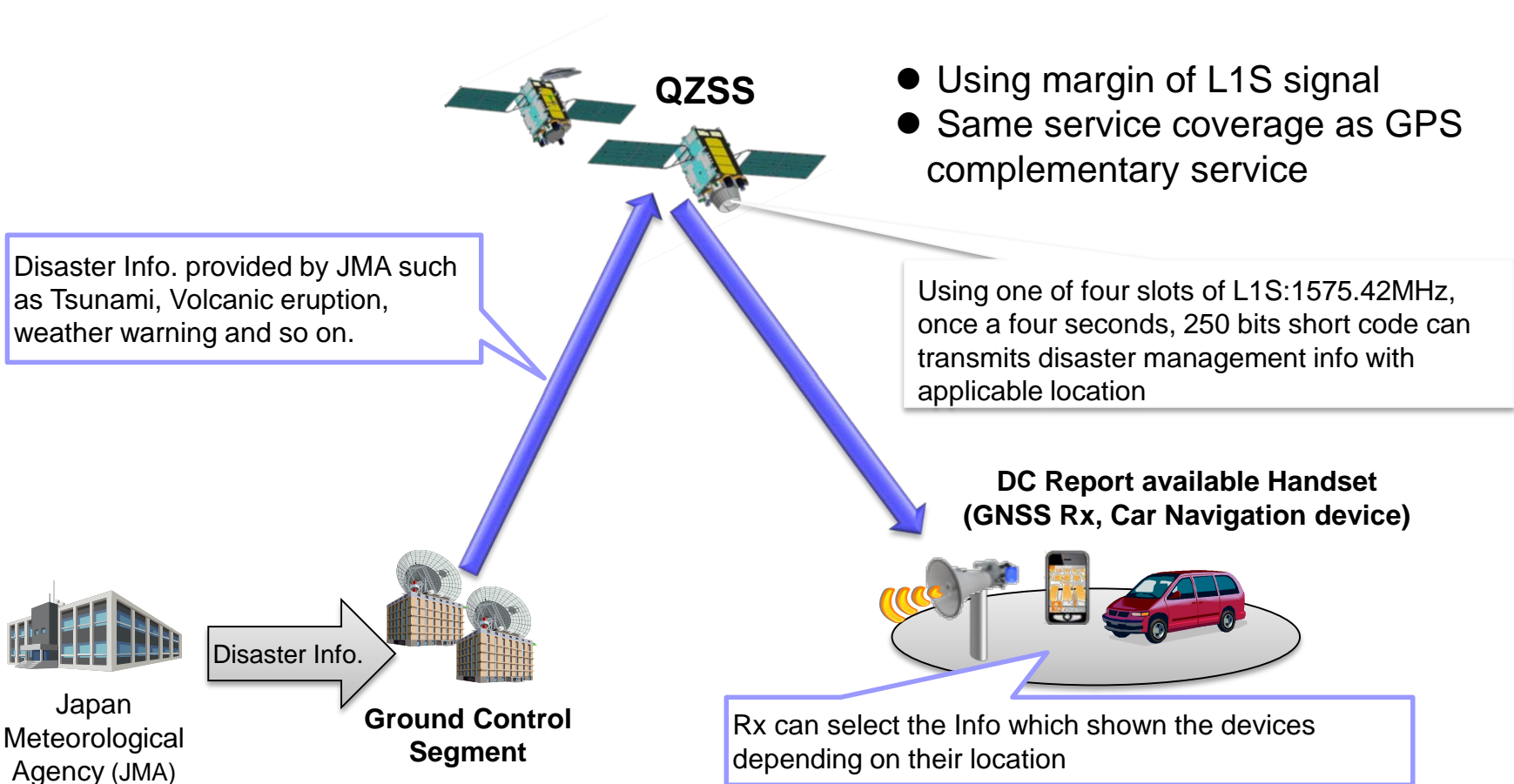
## Centimeter Class Augmentation



# Functional Capability 3 Messaging Services



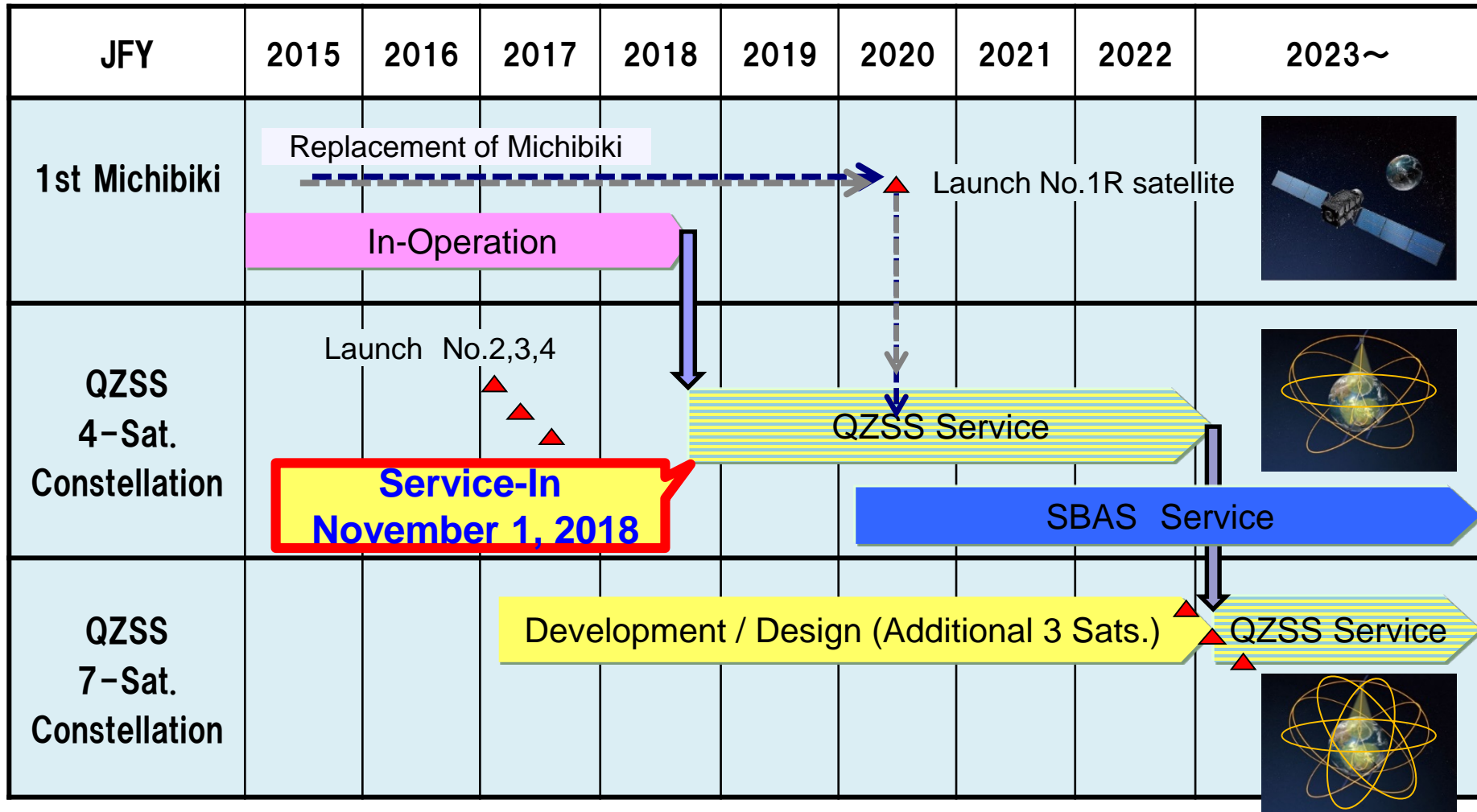
## Satellite Report for Disaster and Crisis Management (DC Report)



# QZSS Development Plan



## QZSS Program Schedule (latest)

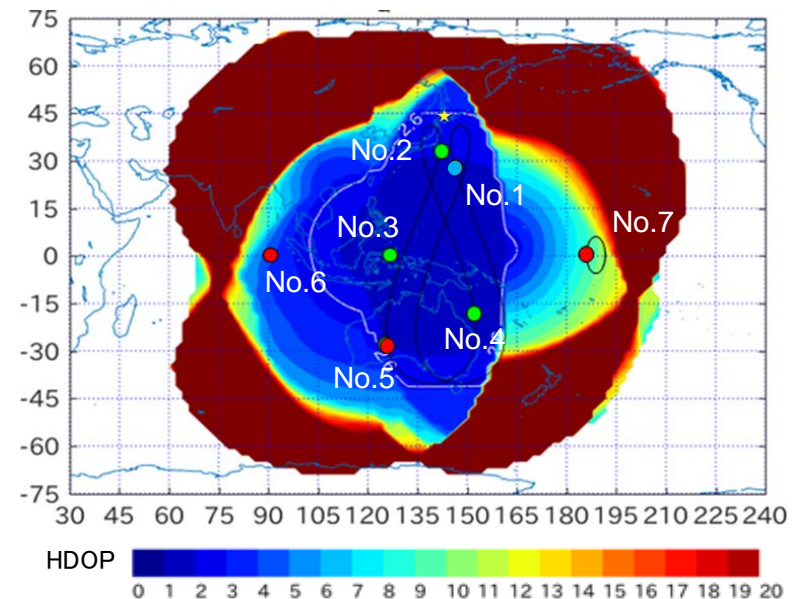


# 7 Satellites Constellation of QZSS



- Japanese government has decided orbits of 3 additional satellites to complete 7 satellite constellation.
- 7 Satellite constellation QZSS will cover Asia Pacific region.

Satellite orbit	Satellite Number	Orbital Position
Quasi Zenith Satellite (4 satellites)	No.1	148 deg E
	No.2	139 deg E
	No.4	139 deg E
	No.5	139 deg E
Geostationary Orbit (2 satellites)	No.3	127 deg E
	No.6	90.5 deg E
Quasi Geostationary Orbit (1 satellite)	No.7	190 deg E



# *-Applications-*

## Autonomous driving



## Smart Agriculture



## Autonomous sailing



## Drone logistics







## Autonomous Drive and Robot Tractor

- GNSS Augmentation Service by QZSS is expected to contribute to various application fields such as autonomous driving, automatic operation of tractor and other agricultural machines, and cars traffic management system.
- Demonstrations have been conducted to show cm-class control by using position correction information supplied by QZSS.



Mitsubishi Electric Corporation



EG453 Multi Robot Tractor with  
QZSS(CLAS)



Technologies for Creating Next-Generation  
Agriculture, Forestry and Fisheries



Research Faculty of Agriculture,  
Hokkaido University



## System for Driving Assistance in Snowplows

- Started demonstration on snow removal with the support system utilizing QZSS high-precision positioning information.
- This system provides vision support for driving operation and aims at improving safety, efficiency and energy saving for snow removal.



準天頂衛星受信アンテナ + 受信機

ガイダンスモニター(開発中)

East Nippon Expressway Company Limited

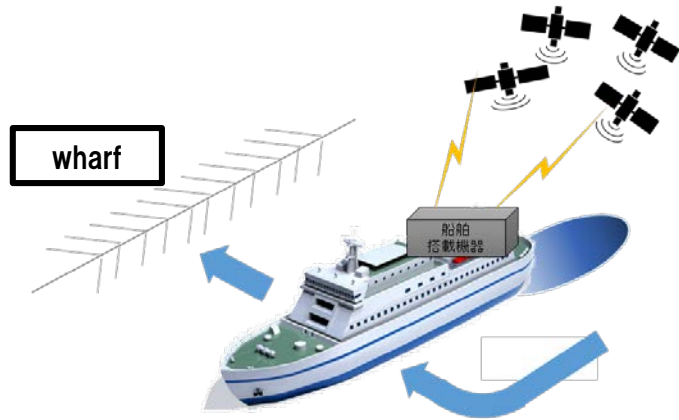


# Logistics by using automated drone system



# Other Applications

## Automatic Berthing System



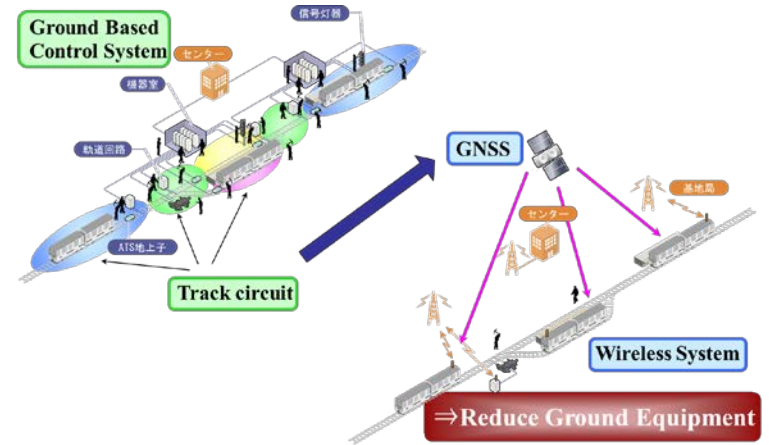
<http://www.mlit.go.jp/common/001215815.pdf>

## Construction in the ocean



TOA Corporation

## Simplification of Rail Traffic Management System



KYOSAN ELECTRIC

## Wearable Devices for Sports



precise distance at golf course

MASA

# GNSS Receiver and Chipset



- Chipsets for GPS complementary service of QZSS have already been installed on smartphones.
- Several companies have started development of receivers and chipsets for sub-meter and centimeter service, and several products have been already in the market.




## Receiver and Chipset for sub-meter service

{Now on sale}	{Now on sale}	{Now on sale}	{Now on sale}
			
SoftBank 90×61×29mm	FORTE FB102 83×44×17.7mm	genext QZ05S	Sony Semiconductor Solutions CXD5603GF 3.0×3.0mm

## Receiver and Chipset for Centimeter service

{Now on sale}	{Now on sale}	{Now on sale}
		
Mitsubishi Electric AQLOC-VCX 184×98×74mm	Magellan Systems Japan 206×155×86mm	CORE Chronosphere-L6 200×140×60mm

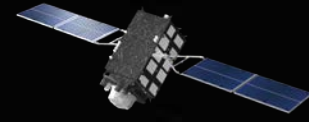
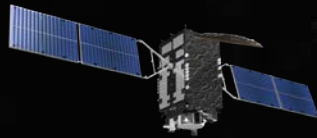
{Now on sale}	{Now on sale}	{To be on sale}
		
Position GSU-141 11.0×7.5×1.5mm	U-blox Japan NEO-M8U, L 12.2×16×2.4mm	FURUNO GN-87 12.2×16.0×2.8mm

{To be on sale}	{To be on sale}	{To be on sale}
		
Mitsubishi Electric AQLOC-VCX II 139×94×39mm	JRC JG11 9.0×9.0mm	Magellan Systems Japan (card size)

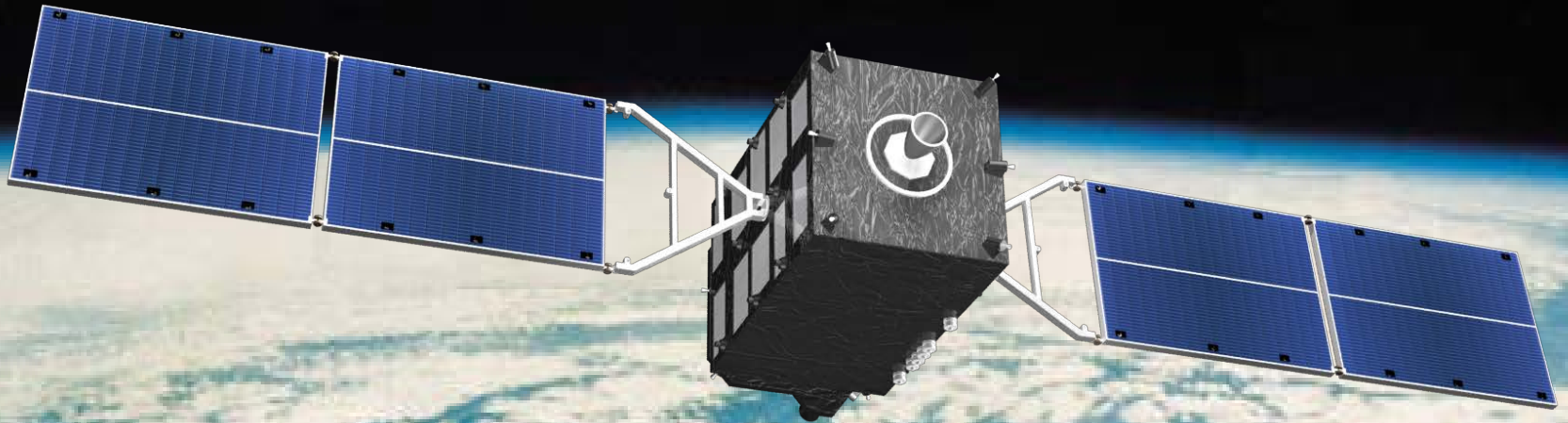


# Summary

- QZSS is Japanese regional navigation satellite system to improve not only GNSS availability but also accuracy and reliability
  - 4 satellite constellation: Three IGSO and one GEO satellites
  - We have started development activity in order to establish the 7 satellite constellation of QZSS in FY 2023
- On Nov 1st, Japanese Government officially launched QZSS service. Prime Minister Shinzo Abe attended the ceremony to commemorate the launch of the service.
  - Some services were launched such as driving assistance for agriculture, and wearable devices for sports.
  - We are promoting experiments of QZSS utilization for various application fields such as Automotive, Robot Tractors, Drones, Ships, and Trains.



Thank you for your attention!



For more information, please visit our web site  
<http://qzss.go.jp/en/>