Michibiki makes a big step towards Asia Oceania region with 7 satellites

Feb. 10th, 2021

Japanese government has started preparation of the centimeter class accuracy augmentation system for Asia Oceania region with 7 satellites (Figure 1). Cabinet Office opened the plan at the QBIC overseas business development working group meeting held on 4th February 2021. It also became cleared that the preparation for EWS (Early Warning Service) over the region has been started. Those are first in the world. Three more satellites, which are to be launched till 2023, make service reliable over the Asia Oceania region, while expanding available area eastward and westward (Figure 2 & 3). Michibiki is expected to contribute greatly to the SDG's in the region.

November 2018, Centimeter Level Augmentation Service (CLAS) has been started in Japan as domestic service (Figure 4). After one year, CLAS has penetrated successfully into B2B market segments such as Survey / Construction / Map / Agriculture, which require high accuracy positioning. (http://qbic.eiseisokui.or.jp/media/pdf/council/International/3-01.pdf) Meanwhile, for overseas, the L6 test signal using MADOCA (Multi-GNSS Advanced Demonstration tool for Orbit and Clock Analysis) method for high accuracy augmentation has been provided (Figure 5). Since 2018, the performance has been evaluated in 6 countries in Asia Oceania. Assessing the system performance as practical service, the government decided to go forward. System installation necessary for the overseas service is to be made by two phases.

- Phase 1 (2024～2027): Practical operation of wide area high accuracy augmentation service +Experimental operation of wide area ionospheric correction service
  - Wide area high accuracy augmentation service over Asia Oceania is to be provided using L6E of QZSS 7 satellites.
  - For around three countries in Asia, wide area ionospheric correction data is to be generated using each country's CORS (Continuously Operating Reference Stations) Network and distributed experimentally for demonstration via L6D of QZS 5-7. By ionospheric correction, convergence time for precise positioning is expected to be improved significantly.
  - Other countries which are not participating are encouraged to make partnership agreement and to join the demonstration.
- Phase 2 (2028～):Practical operation
  - Wide area high accuracy augmentation service over Asia Oceania is to be provided using L6E of QZSS 7 satellites.
  - As a practical service, wide area ionospheric correction data are to be distributed in the countries and the region which have partnership agreement with Japan.

Japanese EWS is called Satellite Report for Disaster and Crisis Management (DC Report, shortly) and has been distributed in Japan, using Michibiki L1S Signal. (https://qzss.go.jp/en/overview/services/sv08_dc-report.html) Towards the service for Asia Oceania region, the followings are initiated in parallel.

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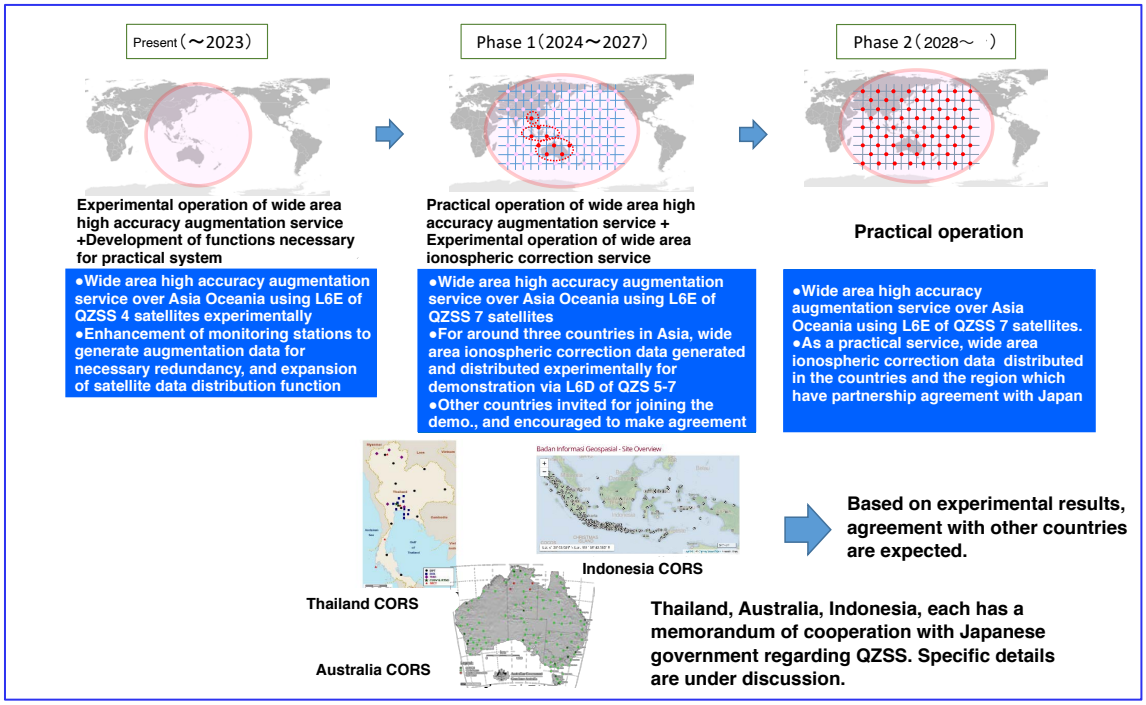
- Enhancement of system facility to receive the message from the overseas organizations (2020–2023)
- Demonstration and Feasibility Study (2020–2024)
  - The purpose is to find out the optimum system configuration such as terminals, receivers, and ground segments for each country through the demonstration.
  - Australia, Thailand, Fiji and other 6 countries are planned to be invited for the demonstration.

The service will be ready for 2024–2025. Consensus between countries must be made on the rule such as priority of message distribution when multi disasters happen simultaneously.

EU starts Galileo High Accuracy Service (HAS) from 2022+ in the EU+ region, then globally from 2024+. Horizontal accuracy is announced to be 20cm. In EU+ region, the convergence time is to be improved after 2024+. EU plans EWS to be provided globally using Galileo Second Generation (2027～). On both high accuracy service and EWS, the interoperability coordination between QZSS and Galileo has been on going. Furthermore, ICG (International Committee on GNSS) has already taken an action to start the interoperability discussion, inviting all GNSS providers to join. In near future, we can enjoy similar service all over the world.

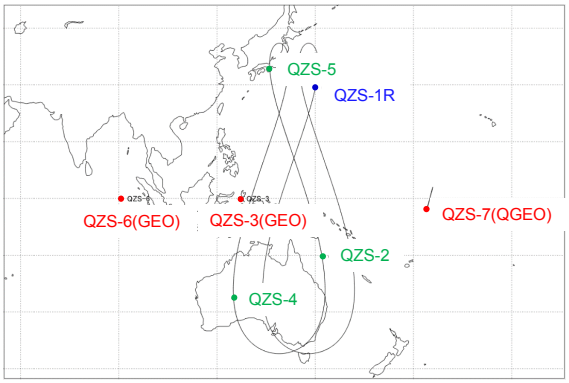
Satoshi Kogure, National Space Policy Secretariat Cabinet Office, told at the WG meeting, "I would like to invite all the companies to positively consider product development targeting QZSS overseas services".



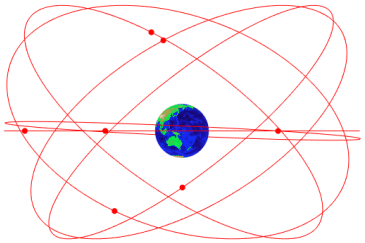
Base on the QBIC Working Group Meeting Material, 4th February 2021, Satoshi Kogure National Space Policy Secretariat Cabinet Office, Government of Japan (translated into English by SPAC from the original)

Figure 1 QZSS High Accuracy Service Development for Asia Oceania

QZSS Constellation Design



7-QZSS Ground Track



Orbit	SV	Center Longi. (deg.)
GEO(2-sats)	QZS-3, 6	127E, 90.5E
QZO(4-sats)	QZS-1R, QZS-2, 4, 5	148E(nom) 139E(nom)
QGEO(1-sat)	QZS-7	185E(nom)

*QGEO: Quasi Geostationary Earth Orbit (i>1deg, e=0.008)

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"Latest Status of QZSS" ION GNSS+ 2020, 23rd September 2020

Figure 2 QZSS 7 satellite constellation

- The highest priority is to provide good geometry (HDOP).
  - Japan and surrounding area should have good HDOP, less than 2.6 on 95 percentile.
- SBAS user requirements on the number of GSO satellites is satisfied.
  - More than 2 GSO SV for LPV service to be provided by Japanese Civil Aviation Bureau

4 IGSO + 2 GSO +1 QGSO* constellation will be completed around 2023

*: QGSO Quasi-Geo Synchronous Orbit
Geosynchronous orbit with small eccentricity and inclination

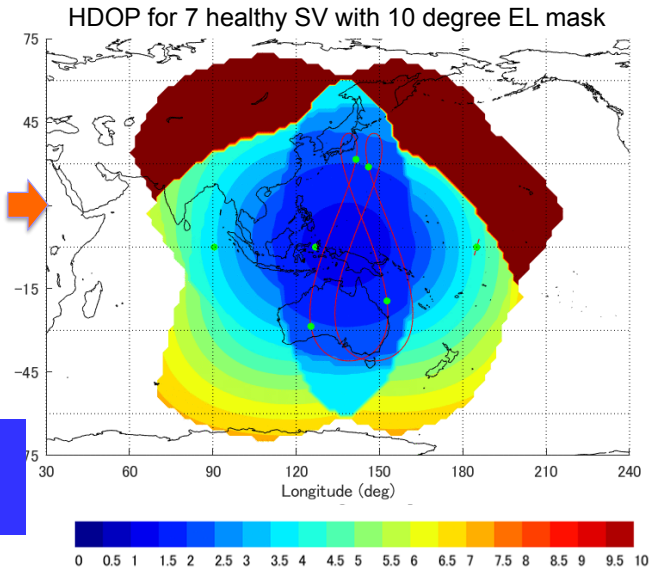

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Figure 3 QZSS 7 satellite constellation coverage

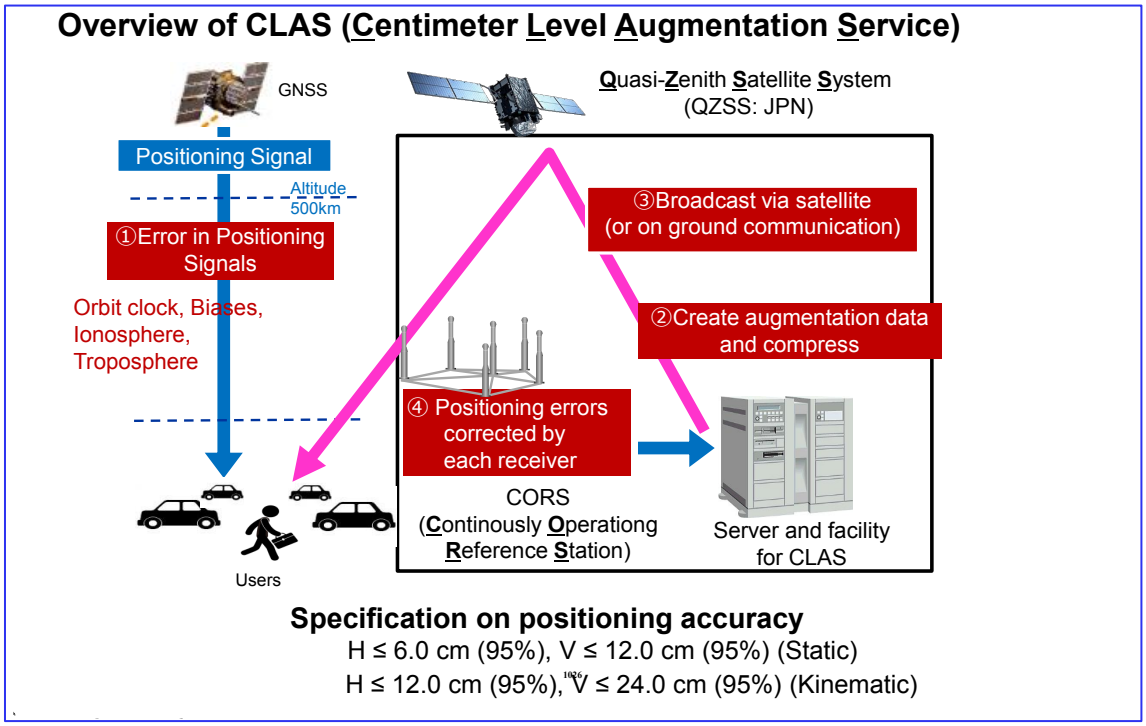

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Figure 4 Overview of CLAS

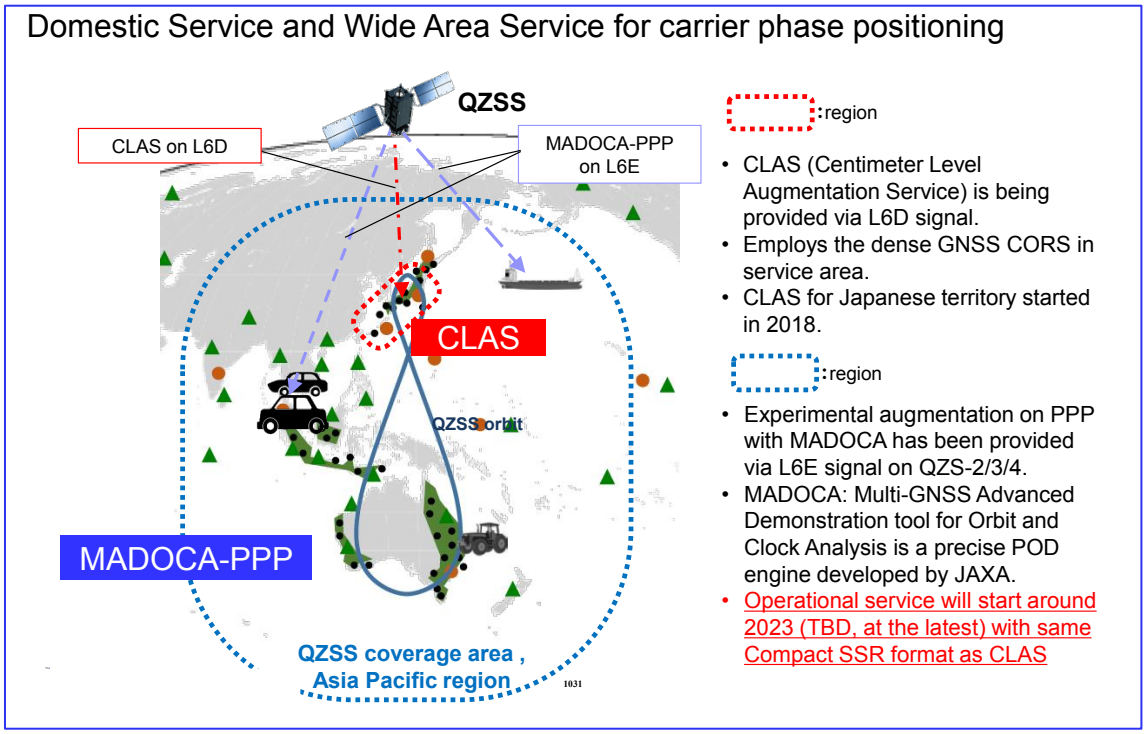

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Figure 5 Domestic and Wide Area Service of High Accuracy Service

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