Quasi-Zenith Satellite System

Office of National Space Policy, Cabinet Office, Government of Japan

(c)JAXA
QZSS Overview

Quasi-Zenith Satellite System

- **Functional Capability:**
  - GNSS Complementary
  - GNSS Augmentation
  - Messaging Service

- **Coverage:** Asia and Pacific region

- **Signals:**
  - L1C/A, L1C, L2C and L5
  - L1S (L1-SAIF) on 1575.42 MHz
  - L6 (LEX) on 1278.75 MHz

- **First QZSS satellite “MICHIBIKI”**

- **Four satellites constellation shall be established and the service will start in 2018.**
### Timeline of QZSS (planned)

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<td>Development (~6 years)</td>
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<td>Operation (15 years)</td>
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QZSS 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 from 90 % (GPS only) to 99.8 % * (GPS + QZSS.)

* The time percentage that the position dilution of precision (PDOP) is less than 6 when a satellite whose elevation angle is 20 degrees or over is used for positioning calculation.
QZSS Functional Capability 2

GPS Augmentation

QZSS improves positioning accuracy and reliability

QZSS

Navigation Signal
GPS  Galileo  GLONASS

Navigation Signal and Augmentation Data

Ground Segment

GNSS Earth Observation Network
Augmentation Data Generation
Global Monitoring Stations

User Segment

L6
centimeter (accuracy)
sub-meter

5
QZSS Functional Capability 2

**GPS Augmentation**

Sub-meter Class Augmentation

**Ground Segment**

- GNSS Earth Observation Network
- Augmentation Data Generation
- Global Monitoring Stations

**QZSS**

- Sub-meter class Augmentation Data L1S (250 bps)

Using QZSS Augmentation Signal ~ 2m

Using GPS only ~ 10m

QZSS Network
QZSS Functional Capability 2

GPS Augmentation

Centimeter Class Augmentation

Ground Segment

GNSS Earth Observation Network

Augmentation Data Generation

Global Monitoring Stations

QZSS

Centimeter class Augmentation Data L6 (2000 bps)

Precise Survey

Real-time Users (cm level accuracy)

IT Construction

IT Agriculture
QZSS Functional Capability 3

**Messaging Service**

QZSS can **send short messages**

- QZSS can send short messages such as emergency warnings simultaneously to everyone with a mobile phone.
QZSS Update

- Basic policy on the implementation of the operational QZSS project *(Cabinet Decision on September 30, 2011)*
  - The Government of Japan has decided to accelerate the deployment of the operational QZSS as expeditiously as possible.

- Verification of QZS-1 MICHIBIKI
  - Technical Verification by JAXA
  - Application Verification by private companies
The QZSS will contribute to

- Welfare of the Asia and Pacific region
- Broad range of security
  including the improvement
  the capacity to respond to
  natural disasters

Basic policy on the implementation of the operational QZSS project (1)
Cabinet Decision on September 30, 2011
Basic policy on the implementation of the operational QZSS project (2)
Cabinet Decision on September 30, 2011

- GOJ has decided to accelerate the deployment of the operational QZSS as expeditiously as possible.
- Four satellites constellation shall be established by the late 2010s.
- In the future, seven satellites constellation shall be completed to enable sustainable positioning.
- The Cabinet Office shall develop, deploy and operate the operational QZSS, based on the achievement of the first QZSS satellite MICHIBIKI, and shall submit a budget request to cover relevant cost.
- Legal amendments shall be made in order for the Cabinet Office to fulfill such a role in time for budget implementation.
Accuracy : Signal-in-space User Range Error (SIS-URE)

MICHIKI SIS-URE meets its specification, within +/- 2.6m (95%). Its SIS-URE(RMS) is about 40cm & less than that of GPS’s target, about 90cm*. (*refer to GPS Program Update to CGSIC 2011)
Availability Improvement in Ginza, Tokyo (Feb. 19, 2011)

Date of Observation: 2011/2/19
250 minutes driving observation data during 6:00-12:30 obtained under JAXA-Melco joint research experiment
Single Frequency DGPS positioning

GPS: 39.5%

GPS+QZSS: 69.1%
QZSS Technical Verification of QZS-1 MICHIBIKI

Accuracy Improvement using augmentation signal L1-SAIF from MICHIBIKI

Comparison with positioning accuracy for GPS stand-alone use and for GPS+L1-SAIF signal use (24 hours observation)

Positioning Error (RMS)

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<th>Horizontal</th>
<th>Vertical</th>
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<tr>
<td>GPS Only</td>
<td>1.56m</td>
<td>3.85m</td>
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<tr>
<td>GPS+ L1-SAIF</td>
<td>0.46m</td>
<td>0.57m</td>
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* Observation Point
GPS-based control station in Kawagoe, Japan, 5/3/2011

* SAIF : Submeter-class Augmentation with Integrity Function, conformable to SBAS signal

(c)SPAC
Master Plan of QZSS

- The Cabinet Office shall develop, deploy and operate QZSS.
- Four satellites constellation shall be established and the service will start in 2018.
- The four satellites constellation will consist of three QZSs (IGSOs) and one GEO satellite.
- In the future, seven satellites constellation shall be completed to enable sustainable positioning.