Country Report from Japan

Quasi-Zenith Satellite System
Program Updates
- referring to the JAXA’s Official presentation -

The Space-based PNT Advisory Board
5-6 November, 2009 at Alexandria, VA

Hiroshi Nishiguchi
Japan GPS Council
I. System Description

Concept of the QZSS (1/2)

- 3 satellites in elliptical and inclined geosynchronous orbits
  \( a=42,164\text{km}, e=0.06-0.09, i=39-47\text{deg}, \Omega=120\text{deg} \) apart
- at least one satellite exists near zenith over Japan

QZSS Ground Track
I. System Description

**Expected Performance - Service Area**

Minimum Elevation Contour for 3 QZS over 24 hours

*for maximum elevation of visible satellites*
I. System Description

Concept of the QZSS (2/2)

- **seamless** service from high elevation angle
- **Increased PNT availability** (downtown, mountainous areas)

![Diagram of satellite trajectories in Ginza, Tokyo]

*Two color bars timely indicate the satellites formation for positioning.*

![Diagram showing QZSS satellite orbit and coverage areas over cityscape]*
I. System Description

System Architecture

**: S (Up: 2025-2110, Down: 2200-2290MHz) band for LEOP and C (Up:5000-5010, Down:5010-5030MHz) band for Nominal Operation

SLR: Satellite Laser Ranging, TWSTFT: Two Way Satellite Time and Frequency Transfer
### I. System Description

**Space Segment - QZS-1 -**

<table>
<thead>
<tr>
<th></th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td><strong>Mass</strong></td>
<td>Approx. 1,800kg (dry) (NAV Payload: Approx. 320kg)</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>Approx. 5.3 kW (EOL) (NAV Payload: Approx. 1.9kW)</td>
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<tr>
<td><strong>Design Life</strong></td>
<td>10 years</td>
</tr>
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**Satellite Configuration on Orbit**

- **L-band Helical Array Antenna**
- **L1-SAIF Antenna**
- **C-band TTC Antenna**
- **TWSTFT Antenna**
- **Laser Reflector**
- **Radiation Cooled TWT**
- **25.3m**
I. System Description

Navigation Payload on the QZS-1

Navigation Payload

- Rb Atomic Clock
- Time Keeping Unit
- Synthesizer
- Navigation Onboard Computer
- Modulator
- Amplifier
- MUX
- TT&C Subsystem
- L1-SAIF-Ant
- L-Ant
- Laser Reflector
- Ku-Ant

Navigation Signal

Sine Wave

Baseband Signal (Navigation Message + PRN Code)
Signal of Two Way Satellite Time and Frequency Transfer

Uploaded Data (including Remote Synchronization Signal (by AIST))

Navigation Message, Phase Error

Control

TLM

Control

Uploaded Data (including Remote Synchronization Signal (by AIST))
Okinawa is primary TT&C station for nominal operation.
LEOP operation is to be conducted by using JAXA Ground TT&C Network
# I. System Description

## Planned Signals

<table>
<thead>
<tr>
<th>Signal</th>
<th>Frequency</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>L1-C/A</td>
<td>1575.42MHz</td>
<td>- Complete compatibility and interoperability with existing and future modernized GPS signals</td>
</tr>
<tr>
<td>L1C</td>
<td>1227.6MHz</td>
<td>- Differential Correction data, Integrity flag, Ionospheric correction</td>
</tr>
<tr>
<td>L2C</td>
<td>1176.45MHz</td>
<td>- Almanac &amp; Health for other GNSS SVs</td>
</tr>
<tr>
<td>L5</td>
<td>1278.75MHz</td>
<td>- Compatibility with GPS-SBAS</td>
</tr>
<tr>
<td>L1-SAIF*</td>
<td>1575.42MHz</td>
<td>- Experimental Signal with higher data rate message (2Kbps)</td>
</tr>
<tr>
<td>LEX</td>
<td>1278.75MHz</td>
<td>- Compatibility &amp; interoperability with Galileo E6 signal</td>
</tr>
</tbody>
</table>

* L1-SAIF: L1-Submeter-class Augmentation with Integrity Function
IV. Summary

- QZSS is a Japanese regional Space-based PNT System
  - Enhance GPS capability
  - High level interoperability with GPS

- QZSS is being developed by step by step manner
  - First satellite (QZS-1) will be launched in Summer of 2010

- Proto-Flight test of QZS-1 is in process as planned.

- The User Interface document, IS-QZSS ver. 1.1 is available on
  [http://qzss.jaxa.jp/is-qzss/index_e.html](http://qzss.jaxa.jp/is-qzss/index_e.html).
The US Strong Mind for Sustainability of Consistent GPS Service Policy

- 1996.3 : Clinton PDD
  - Gave us “Peace of mind” for GPS Civil Use

- 1998.9 : Clinton/Obuchi Joint Statement
  - Gave us “Reliability” for commercialization of GPS applications

- 1998.10 : Gazette of “Commercial Space Law” including PDD
  - Gave us “Real Trust” for GPS Civil Use in Worldwide
  - Moved to full bloom of Car-Navi Market cherry blossoms

- 2004.12 : Bush PDD
  - Gave us “Truth of Unchanged Policy” even if President Change

Thank you for the US generous contribution to the international GNSS community.