Highly-Accurate Positioning Experiment System using QZSS at ENRI
Contents

1. Outline of ENRI Experiment system
2. Development Schedule
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QZSS (1)

- **QZSS**: Quasi-Zenith Satellite System constellation consisted of several satellites orbiting in inclined orbital planes with GEO-synchronous period.
Example of QZS orbit

QZS: Quasi-Zenith Satellite
QZSS (2)

• minimum elevation angle: higher than about 70 (deg) through 24 H in service areas when there are three or more satellites

• One of satellites in QZSS: visible near zenith at any time
QZSS (3)

• Development of QZSS: 2003 ~

• missions of QZSS
  GPS Complement
  GPS Augmentation
QZSS design policies

• a) to preserve and improve existing GPS user benefit and convenience
• b) to develop and demonstrate highly accurate and reliable satellite positioning technology
Outlook of QZS

mass: 4,100kg
lifetime: 10 years
size:
2.9m(D) × 25.3m(W) × 6.0(H)
power: above 5300W

Launched on September, 2010
ENRI experiment

• FY2003 – FY2010

• Production of Messages for highly accurate positioning and integrity monitoring with QZSS and GPS
  ⇒ target accuracy: one-meter

• Use of a **L1-SAIF** signal

• Coverage: Japan
**L1-SAIF** Signal

- **SAIF**: Sub-meter Augmentation with Integrity Function
- Including **L1-SAIF** message: 250bps
- Including GPS-like ranging function
- Transmitted on GPS L1 frequency
- Based on SBAS
L1-SAIF Messages

- differential GPS corrections estimated separately for individual sources of ranging error
- integrity information using GPS reference stations
- SBAS compatible messages and extended messages
ENRI Experiment System

- GPS
- QZS
- GEONET
- GSI
- L1-SAIF MS
- QZSS MCS
- L1-SAIF RX
- ENRI

Connections:
- GPS Data from GSI to L1-SAIF MS
- L1-SAIF Message from L1-SAIF MS to QZSS MCS
- L1-SAIF Signal from QZSS MCS to L1-SAIF RX
- ENRI to QZSS MCS
- ENRI to L1-SAIF RX
$L_1$-SAIF Receiver (prototype receiver)
Development Schedule (1)

• **FY2003–FY2004**
  algorithm for production of
  \texttt{L1-SAIF} messages

• **FY2005–FY2007**
  development of a real-time
  production system of \texttt{L1-SAIF}
  messages and \texttt{L1-SAIF} receiver
Development Schedule (2)

• **FY2008**
  ground test using a satellite simulator and on-line data from GPS reference stations
Development Schedule (3)

• **FY2009–FY2010**
  1. Interface test between JAXA and ENRI
  2. Validation test using a QZS
Example of Positioning Errors(1)

• User position error measured at GEONET site 40058 (Takayama at the center of Mainland of Japan);
• Period: Jan. 19 to 23, 2008 (5 days).

NOTE: This result is obtained by the survey grade antenna and receiver.
Monitoring Stations and Test Sites
Example of Positioning Errors(2)

- GPS + $L1-SAIF$ → $0.29\text{m (RMS)}$
- GPS only → $1.45\text{m (RMS)}$
Summary

1. ENRI Experiment system: \textbf{L1–SAIF} Signal
2. Development Schedule
3. On-line Test Results