Quasi-Zenith Satellite System

Service Performance Report
for 1stH FY2024

Sub-meter Level Augmentation Service (SLAS)

November 29, 2024

Quasi-Zenith Satellite System Services Inc. (QSS)

1. Evaluation Period

From April 1, 2024 to September 30, 2024 (UTC)

2. Evaluation Item

- Positioning accuracy (95%)
- Availability
- Continuity
- Integrity
- Time To First Fix (TTFF)

3. Evaluation Method

3.1. Positioning Accuracy

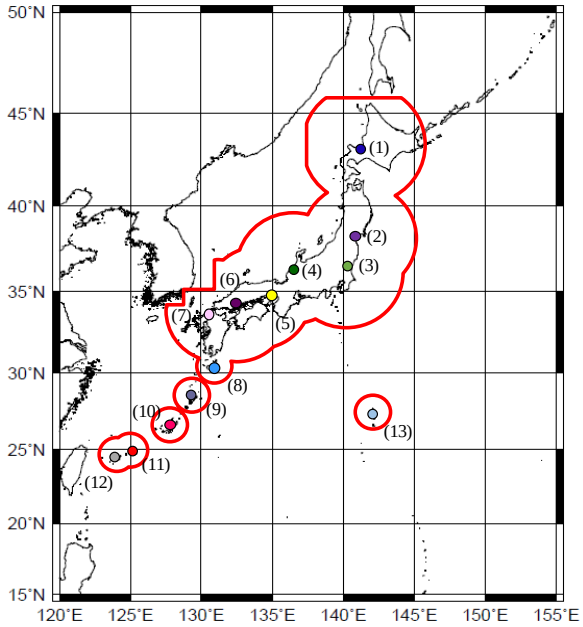
The positioning accuracy in evaluation points*1 are calculated based on IS-QZSS-L1S (5. User Algorithm). The differential tropospheric delay correction described in IS-QZSS-L1S (5.5.3.4 Differential Tropospheric Delay Correction) has been applied from October 25, 2023. The evaluation points are selected near the edge of the SLAS service area circles where each monitoring station is located at the origin. The location of each monitoring station and the service area of SLAS are shown in Figure 1. The detail of evaluation points and the results of evaluation are described in section 4.

It is evaluated whether the positioning accuracy (95%) of each evaluation point meets PS-QZSS (5.3.1Positioning Accuracy).

As a reference position of each evaluation point, a precise current coordinate for each reference station provided by the Geospatial Information Authority of Japan (GSI), called an “F5 solution” are used.

- Augmentation Information : DGPS augmentation information on the L1S message broadcasted from QZS
- Augmented Satellite (signal): GPS (L1C/A), QZS (L1C/A)

*1 These evaluation points are assigned from GEONET (GNSS Earth Observation Network Systems).



Monitoring station	Service Area[km]
(1) Sapporo	350
(2) Sendai	350
(3) Hitachiota	300
(4) Komatsu	300
(5) Kobe	300
(6) Hiroshima	300
(7) Fukuoka	250
(8) Tanegashima	100
(9) Amami	100
(10) Itoman	100
(11) Miyako jima	100
(12) Ishigaki jima	100
(13) Chichi jima	100

Figure 1 The location of Monitoring Station and the service area of SLAS

3.2. Availability

The availability metric of the L1S signal used in SLAS is evaluated every second for all evaluation period based on the definition of QZSS Performance Standard (PS-QZSS) Section 5.4.

3.3. Continuity

Continuity reports unscheduled interruptions that occur during the period.

The unscheduled interruption is the outage without a notification at least 48 hours in advance.

3.4. Integrity

Integrity reports integrity risks that occur during the period.

The integrity risk is the unhealth condition without a timely alarm.

3.5. Time to First Fix (TTFF)

TTFF reports the time required for the receiver to receive all the augmentation information necessary for positioning during the period.

4. Evaluation Result

4.1. Accuracy

Table 1 shows the monthly horizontal and vertical 95th percentile values of positioning accuracy.

In addition, Figure 1 shows the cumulative frequency distributions in all evaluation points of positioning accuracy.

Table 1 Monthly 95th Percentile Values of Positioning Accuracy

Monitoring station	Evaluation point (GEONET ID)	Base line length [km]	Positioning accuracy (95%) [m]											
			April		May		June		July		August		September	
			H	V	H	V	H	V	H	V	H	V	H	V
Sapporo	Ani 2 (020924)	363	1.03	1.31	0.96	1.26	0.98	1.21	0.98	1.21	0.94	1.15	0.99	1.24
Sendai	Imabetsu (960534)	324	1.12	1.40	1.15	1.22	1.12	1.18	1.13	1.24	1.11	1.26	1.17	1.56
Hitachiota	Ogasa (960622)	305	1.16	1.34	1.01	1.33	1.03	1.38	1.08	1.29	0.95	1.19	1.16	1.32
Komatsu	Nachi katsuura3 (071155)	307	0.99	1.71	0.98	1.51	1.04	1.52	0.98	1.45	0.96	1.59	1.20	1.93
Kobe	Takaoka (950248)	287	1.06	1.84	1.02	1.53	1.08	1.52	1.04	1.39	1.04	1.52	1.10	2.04
Hiroshima	Ebino (960714)	296	1.44	2.11	1.13	1.47	1.06	1.39	1.02	1.30	1.15	1.45	2.13	2.70
Fukuoka	Kushima 1 (950484)	254	1.68	2.25	0.95	1.50	0.81	1.29	0.77	1.24	0.94	1.40	2.29	2.59
Tanegashima	Kiire (021092)	100	0.94	1.42	0.65	0.97	0.59	0.78	0.58	0.87	0.67	1.10	1.27	1.73
Amami	Kagoshima amagi A (141208)	102	1.03	1.64	0.81	1.18	0.64	0.95	0.69	1.01	0.87	1.46	1.46	2.54
Itoman	Izena (960736)	91	1.59	1.81	0.88	1.42	0.69	1.02	0.70	1.31	1.04	1.68	2.17	2.41
Miyakojima	Tarama (960748)	67	0.79	1.00	0.78	0.85	0.68	0.76	0.65	0.79	0.83	1.17	1.34	1.68
Ishigakijima	Hateruma jima (960751)	52	0.91	1.30	0.76	1.13	0.65	0.92	0.66	0.92	0.92	1.27	1.46	1.67
Chichijima	Hahajima (960603)	51	0.92	1.64	0.75	1.30	0.63	1.12	0.66	1.20	0.78	1.48	1.06	2.10

*H=Horizontal, V=Vertical

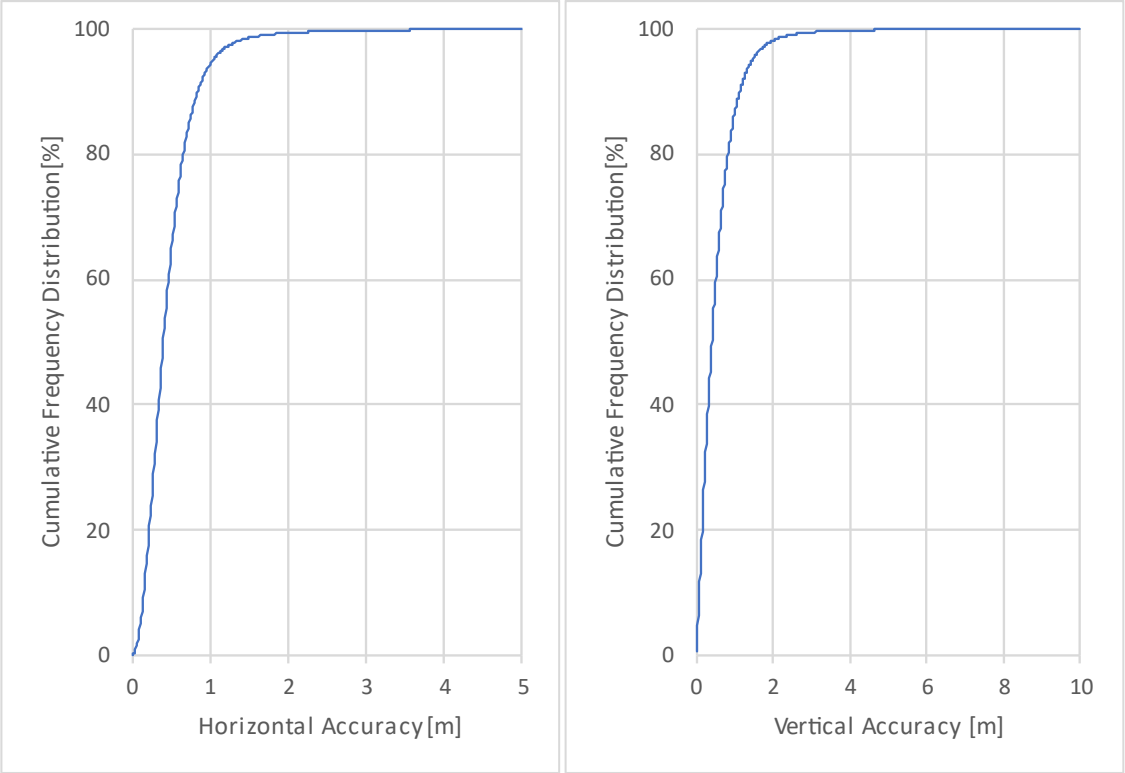


Figure 1 Cumulative frequency distribution of positioning accuracy in all evaluation points

4.2. Availability

Table 2 shows the availability for the evaluation period.

Table 2 Availability

Metric		Specification	Availability
Constellation Service Availability		≧0.9997	1.00000
Service Availability by Each QZS	SVN002(PRN184)	≧0.97	0.999
	SVN003(PRN189)	≧0.97	0.999
	SVN004(PRN185)	≧0.97	0.999
	SVN005(PRN186)	≧0.97	0.999
Constellation Service Availability at High Elevation Angles	Northern limit*1	≧0.83	0.897
	Southern limit*1	≧0.83	1.000

Note

*1 The northern limit is defined as 45.6° N, 148.8° E, and the southern limit as 24.4° N, 122.9° E.

4.3. Continuity

Table 3 shows the continuity for the evaluation period.

Table 3 Continuity

Satellite	Continuity
SVN002 (PRN184)	Unscheduled interruptions occurred on [Sep. 25, 2024] (NAQU 2024209).
SVN003 (PRN189)	Unscheduled interruptions occurred on [Sep. 23, 2024] (NAQU 2024176), [Sep. 29, 2024] (NAQU 2024252), [Sep. 30, 2024] (NAQU 2024277).
SVN004 (PRN185)	Unscheduled interruptions occurred on [Sep. 30, 2024] (NAQU 2024287), (NAQU 2024294).
SVN005 (PRN186)	Unscheduled interruptions occurred on [Sep. 23, 2024] (NAQU 2024158), (NAQU 2024175).

4.4. Integrity

Table 4 shows the integrity for the evaluation period.

Table 4 Integrity

Satellite	Integrity
SVN002 (PRN184)	No integrity risks occurred during the period.
SVN003 (PRN189)	No integrity risks occurred during the period.
SVN004 (PRN185)	No integrity risks occurred during the period.
SVN005 (PRN186)	No integrity risks occurred during the period.

4.5. Time to First Fix (TTFF)

Table 5 shows the TTFF for the evaluation period.

Table 5 Time to First Fix (TTFF)

Metric	Specification	TTFF
DGPS augmentation	≦30 (95%) [s]	29 (95%) [s]