Quasi-Zenith Satellite System

Service Performance Report
for 1stH FY2021

Satellite Positioning, Navigation and Timing Service (PNT)

February 28, 2022

Quasi-Zenith Satellite System Services Inc. (QSS)

1. Evaluation Period
From April 1, 2021 to September 30, 2021 (UTC).

2. Evaluation Item
SIS Accuracy of the ephemeris for SVN001(PRN193), SVN002(PRN194), SVN003(PRN199) and SVN004(PRN195)

3. Evaluation Method
SIS Accuracy is based on $URE_{All\ Age(0\sim M)}$ calculated with the following method. This evaluation is carried out once a day.

(1) Calculate root-mean-square of SIS-URE (User Range Error) based on ephemeris k at a specified AOD (Age of date) in coverage of QZSS.

$$\overline{URE}_{k,AOD} = \sqrt{\frac{1}{S}\sum_{pos=1}^{S} URE_{k,pos,AOD}^{2}}\ ,$$

S : Coverage of QZSS where PNT signal can be received by elevation angle of more than 10 degree

$URE_{k,pos,AOD}$: SIS-URE based on ephemeris k at a specified position pos and a specified AOD (Refer to the following equation)

$$URE_{k,pos,AOD} = \frac{s\mathrm{Pr}_{AOD} - pos}{\left|s\mathrm{Pr}_{AOD} - pos\right|}(sEp_{k,AOD} - s\mathrm{Pr}_{AOD}) - c(dtEp_{k,AOD} - dt\mathrm{Pr}_{AOD})$$

$sEp_{k,AOD}$: Satellite position based on ephemeris k
$s\mathrm{Pr}_{,AOD}$: Satellite position based on rapid product
$dtEp_{k,AOD}$: Satellite clock offset based on ephemeris k
$dt\mathrm{Pr}_{,AOD}$: Satellite clock offset based on rapid product
pos : Evaluation points set by every 5 degree in S

(2) Calculate $URE_{All\ Age(0\sim M)}$ that is 95% value of $\overline{URE}_{k,AOD}$ across all AOD and any ephemeris, where Age(0) is zero AOD and Age(M) is maximum AOD.

4. Evaluation Result

The following table shows the result of SIS Accuracy.

Satellite	NAV Message	SIS Accuracy (95%) [m]					
		April	May	Jun	July	August	September
SVN001	LNAV	0.53	0.55	0.76	0.81	0.57	2.75
(PRN193)	CNAV	0.52	0.55	0.72	0.78	0.57	2.73
SVN002	LNAV	0.88	1.08	1.06	0.71	0.60	0.47
(PRN194)	CNAV	0.88	1.12	1.08	0.71	0.59	0.48
SVN003	LNAV	0.74	0.81	0.63	0.71	0.64	0.63
(PRN199)	CNAV	0.75	0.76	0.62	0.65	0.66	0.63
SVN004	LNAV	0.93	0.83	0.88	0.99	0.88	0.92
(PRN195)	CNAV	0.93	0.81	0.89	0.98	0.89	0.95