QZSS (Quasi-Zenith Satellite System) Update

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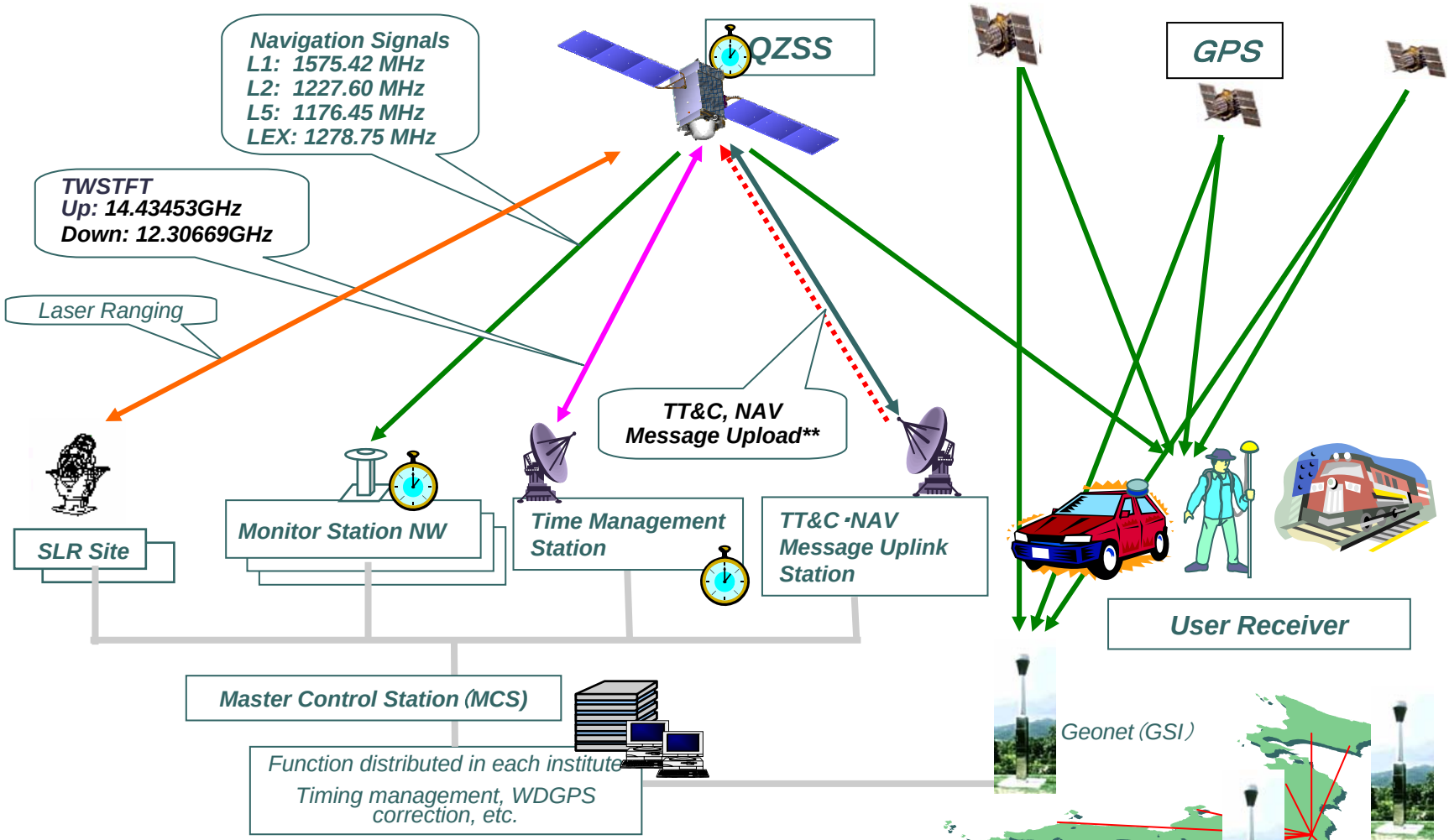
Contents

- *Whole Sytem Archtechture*
- *Space Segment*
- *Ground Segment*
- *Planned Signals*
- *Expected Performance*
- *Current development status*
- *Summary*

1. Whole System Architecture



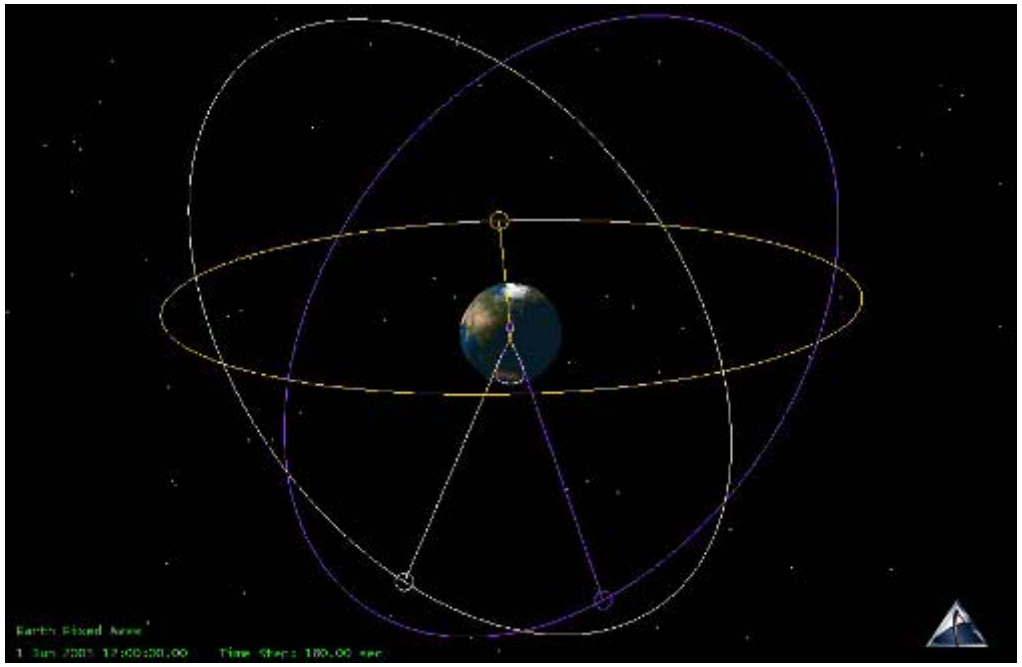
****: S (Up: 2025-2110, Down: 2200-2290MHz) band for LEOP and C (Up:5000-5010, Down:5010-5030MHz) band for Nominal Operation**

SLR: Satellite Laser Ranging, TWSTFT: Two Way Satellite Time and Frequency Transfer

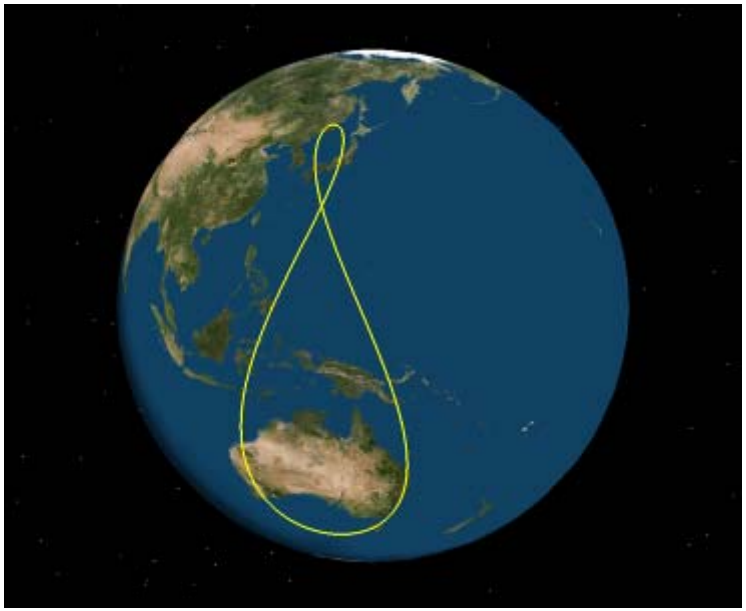
2.Space Segment- Orbit characteristics

- *QZSS is designed that at least one satellite out of three satellites can be observed more than 60 degrees of elevation angle in Japan.*
- *Three IGSO satellites are in different orbital planes to pass over the same ground track.*

(a=42,164km, e=0.099, i=45deg, Ω= 120deg apart)



QZSS orbit constellation



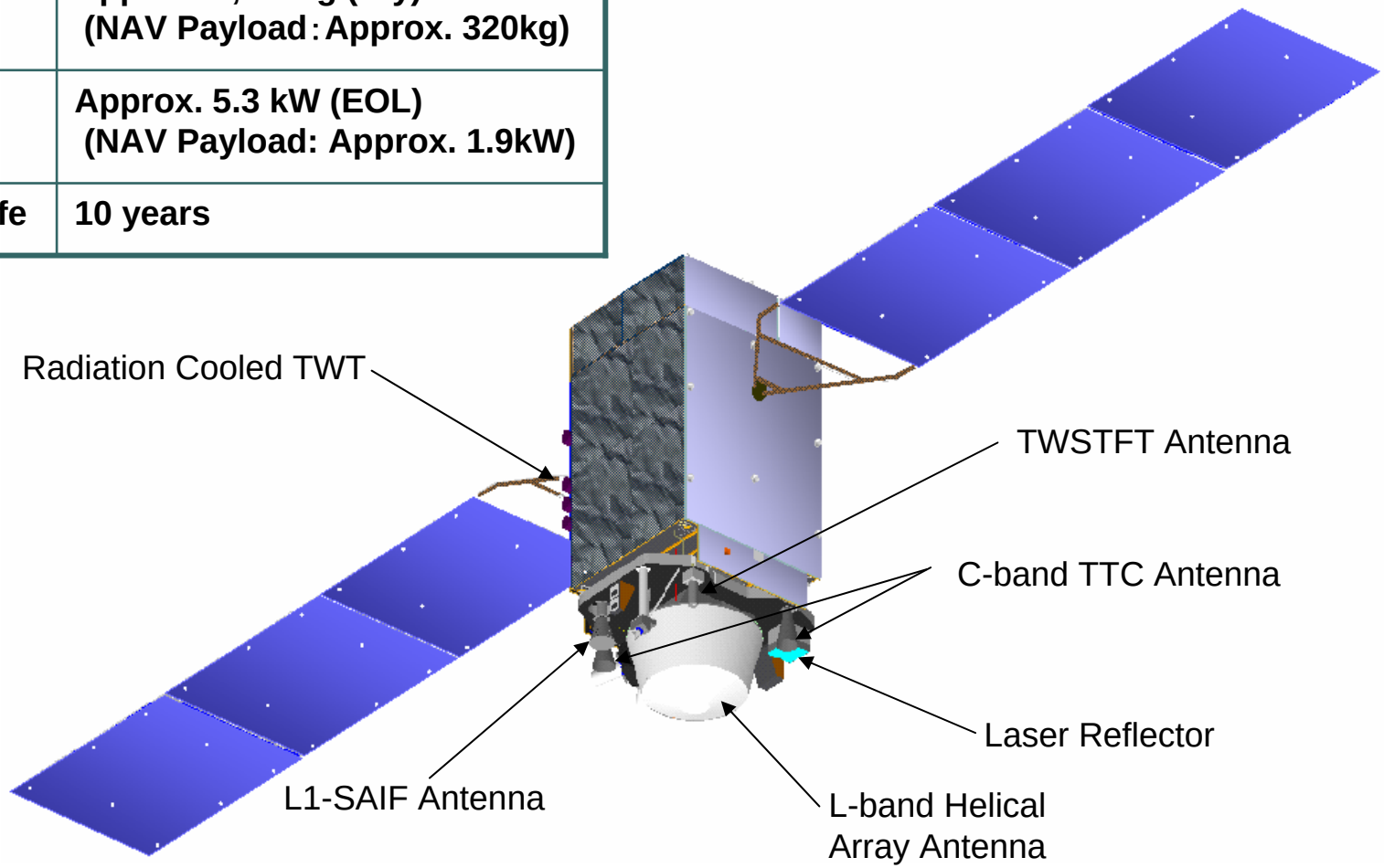
QZSS Ground Track

2. Space Segment- Orbit characteristics

- *Each satellite orbit has slight eccentricity so that can keep appropriate separation between GSO. The eccentricity vector will be maintained so as to keep the separation distance between QZS-1 and the nearest point on GSO more than 50 km during operational phase.*
- *After whole mission life, satellite will be injected into "Disposal Orbit", which defined that its perigee is 1000 km higher altitude rather than GSO altitude.*

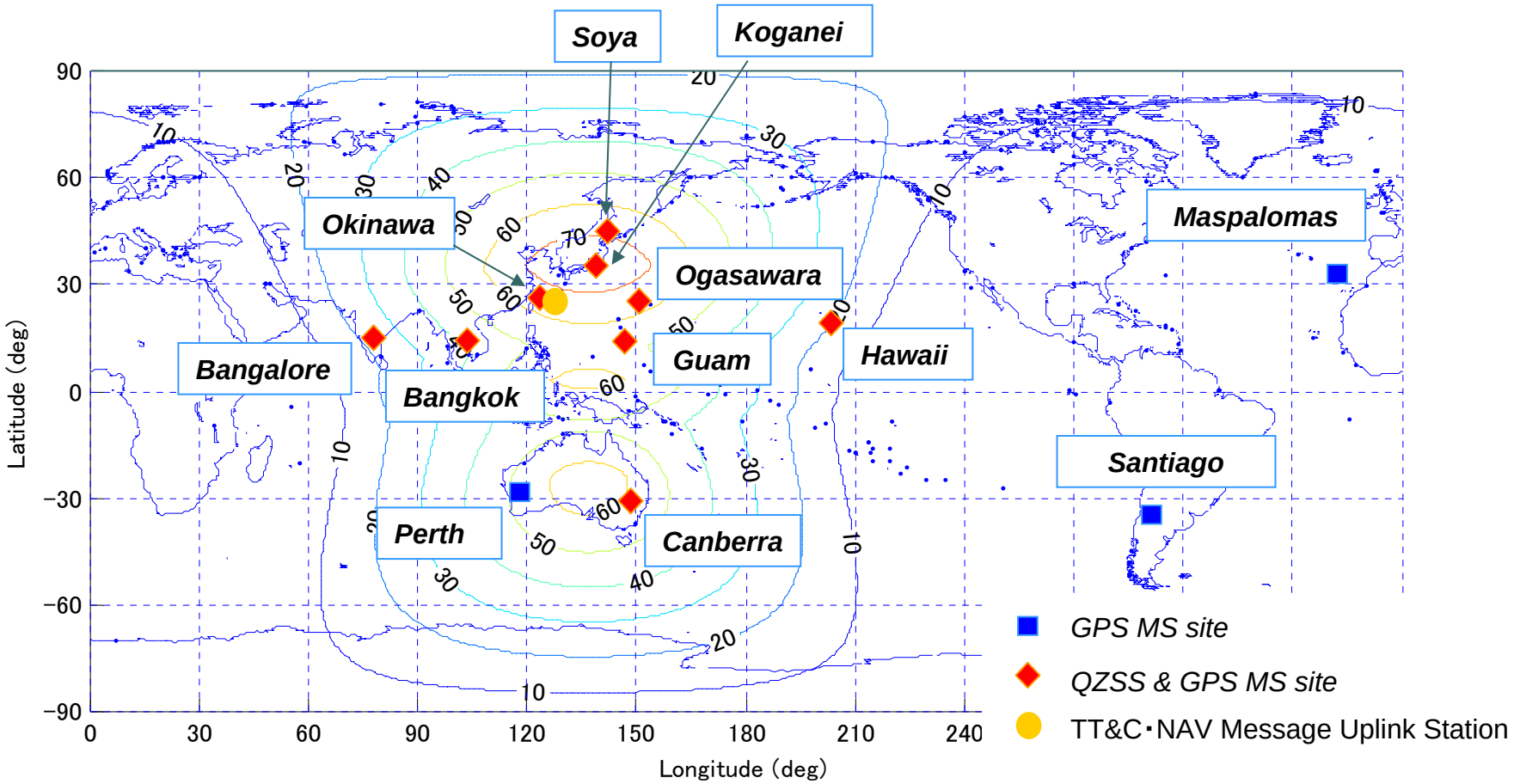
2. Space Segment - QZS-1

Mass	**Approx. 1,800kg (dry)** **(NAV Payload：Approx. 320kg)**
Power	**Approx. 5.3 kW (EOL)** **(NAV Payload: Approx. 1.9kW)**
Design Life	**10 years**



Satellite Configuration on Orbit

3. Ground Segment



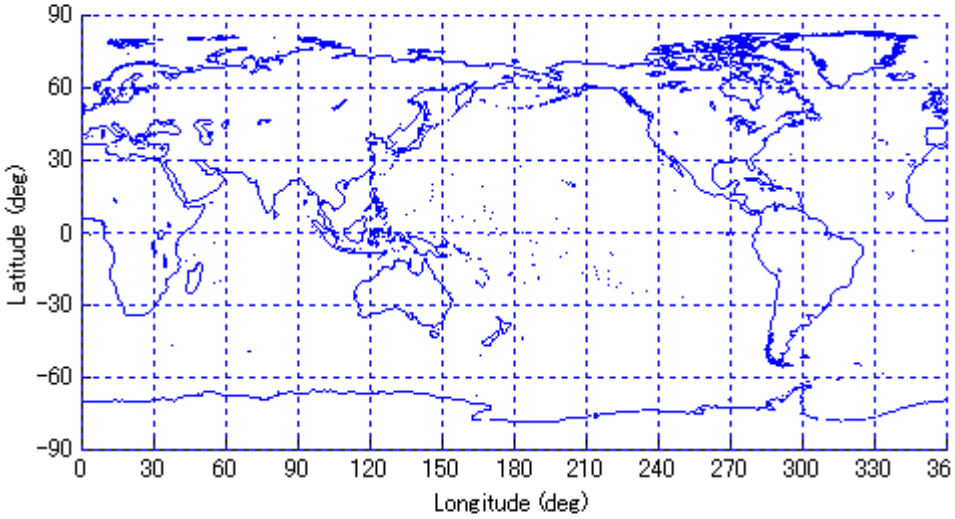
4. Planned Signals

- Planned Signal List for QZSS

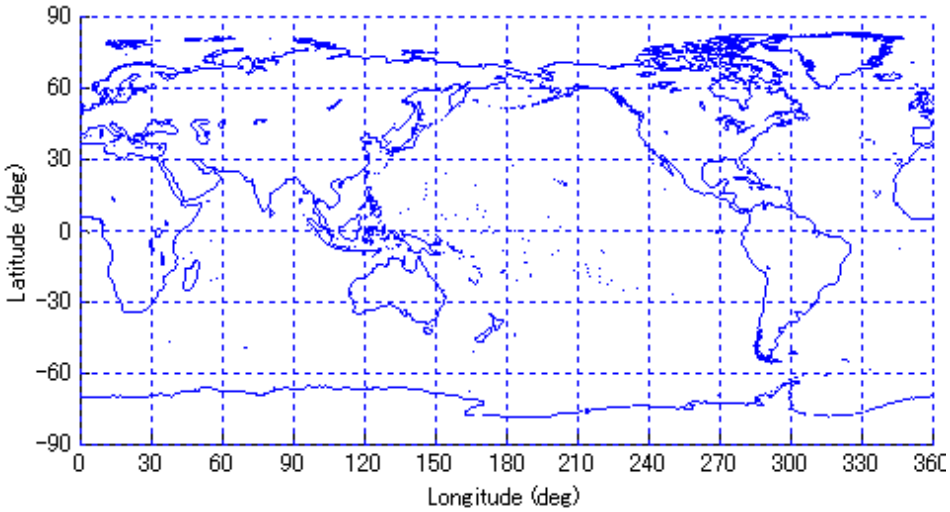
Generic Signal Name	*Center Frequency*	*Notes*
L1-C/A	1575.42MHz	■ GPS interoperable signals ■Compatibility and interoperability with existing and future modernized GPS signals
L1C		
L2C	1227.6MHz	
L5	1176.45MHz	
L1-SAIF*	1575.42MHz	■ Compatibility with GPS-SBAS ■ WDGPS
LEX	1278.75MHz	■Experimental Signal with higher data rate message (2Kbps) ■ Compatibility with Galileo E6 signal

****L1-SAIF: L1-Submeter-class Augmentation with Integrity Function**

5. Performance
- Service Coverage -



A) EL 10 deg

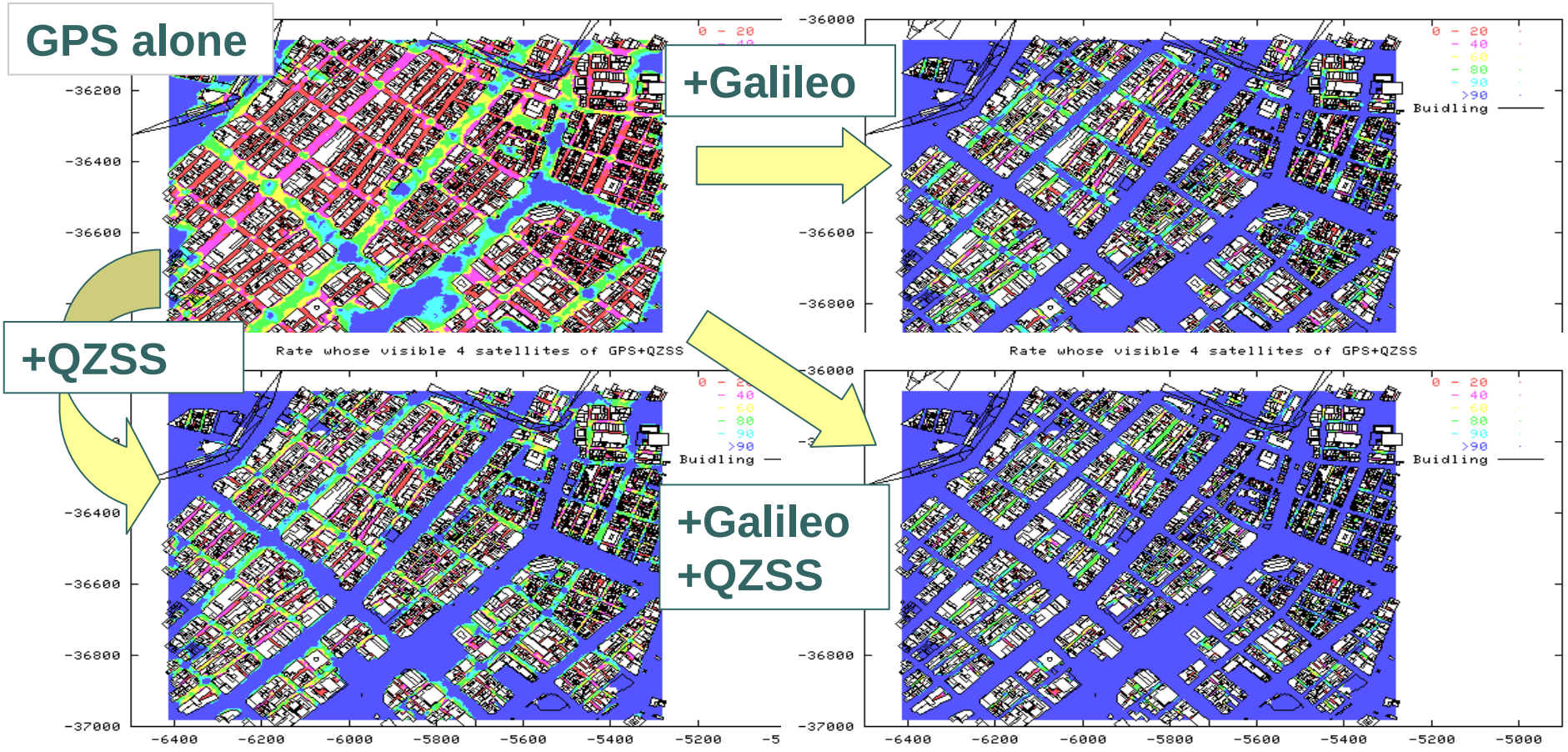


B) EL 60 deg

Percentage of time during which at least one QZS can be seen at an Min. elevation angle or more

5. Performance
- Availability Enhancement -

Availability at Ginza area (GPS 28, Galileo 30, QZSS 3)



Legend. 0-20, 20-40, 40-60, 60-80, 80-90 90-100 %

5. Performance
- Accuracy -

- The Signal-in-Space (SIS) User Range Error
  - **is less than 1.6 m (95%) Including time and coordination offset error.**
- User positioning Accuracy
  - define as positioning accuracy combined GPS L1_C/A and QZSS L1_C/A for single frequency user, L1-L2 for dual frequency user.

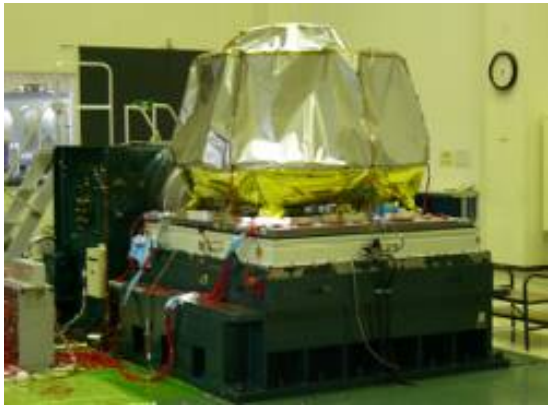
	Specification	Simulation result
SIS-URE	1.6m (95%)	1.5m (95%)
Single frequency user	21.9m(95%)	7.02m(95%)
Dual frequency user	7.5m (95%)	6.11m(95%)

  - L1-SAIF signal can provide WDGPS correction data, its positioning accuracy is 1m (1 sigma rms) except in cases of large multipath error and large ionospheric disturbance.

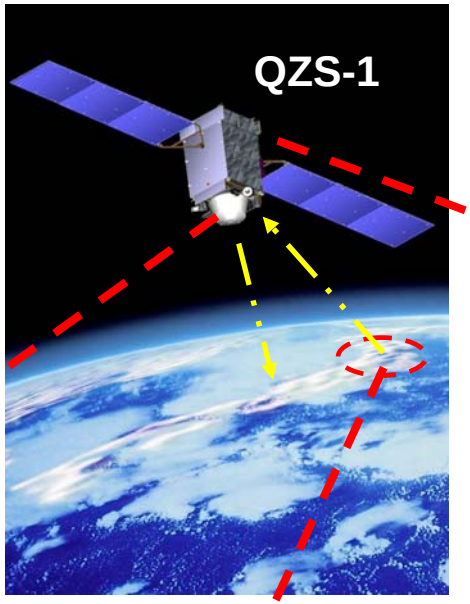
6. Current Development Status

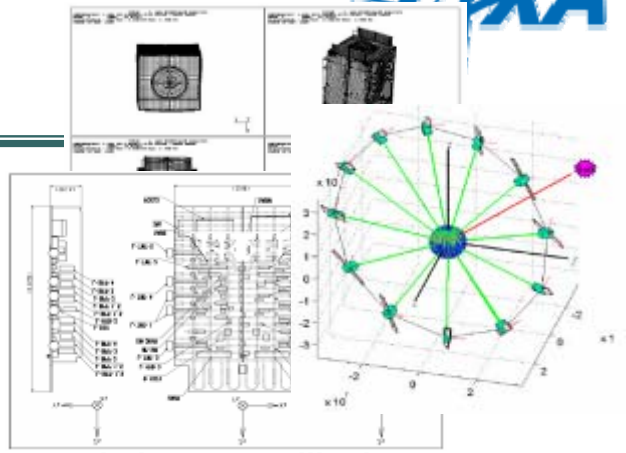
- *Originally, QZSS began as a PPP program in 2003.*
  - *Mobile Com, Broadcasting by private sector and R&D activities for satellite based PNT by public sector*
- *Japanese government announced R&D policy about QZSS on the end of March 2006.*
  - *Dedicated for space based PNT system*
  - *Step by Step R&D process*
    - *Technological verifications and demonstrations by using first satellite, planned to be launched in the end of March 2010 (the end of JFY2009).*
    - *After the evaluation of the results of technological verifications and demonstrations of the 1st stage, 2nd and 3rd satellites will be built for system demonstration with industry participation.*
- *The PNT experiment system design for the 1st stage completed, flight H/W is being manufactured and tested.*
- *The satellite bus system design completed as well, CDR was held on 13 MAY, 2008.*

6. Current Development Status



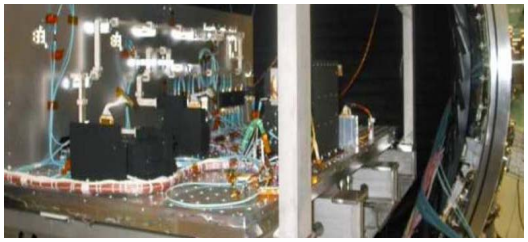
L-band Antenna Engineering Model Vibration Test
（January 2007）





Completion of satellite bus system critical design（May 2008）

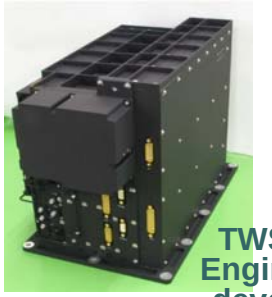
Development of main structure development model (Central Cylinder type)
【METI】



Thermal Vacuum Test of Navigation Payload EM
（April 2007）

Prototype system for GPS augmentation message generator
【MLIT】

Ground Antenna for TWSTFT via QZSS
（NICT Koganei）
【MIC】



TWSTFT Modem Engineering Model development test
（March 2006）【MIC】

6. Current Development Status
- IS-QZSS -

- *IS-QZSS describes;*
  - *System architecture of whole QZSS*
  - *Signal structure and specifications (RF and Messages)*
  - *Service characteristics*
- *First draft of IS-QZSS (ver. 0.0) was released January 22, 2007.*
- *IS-QZSS ver. 1.0 was established on June 18, 2008, is available on following web site.*

  :http://qzss.jaxa.jp/is-qzss/index_e.html

5. 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 JFY 2009*
- *Development of QZS-1 and NAV system are under going.*
  - *H/W manufacturing and test are being conducted*
- *The User Interface document, IS-QZSS has been released and available on* http://qzss.jaxa.jp/is-qzss/index_e.html*.*

International Symposium on GPS/GNSS 2008

- November 11-14, 2008 @Tokyo

http://gnss2008.jp/en/