Quasi-Zenith Satellite System

Japan Aerospace Exploration Agency

QZSS Project Team

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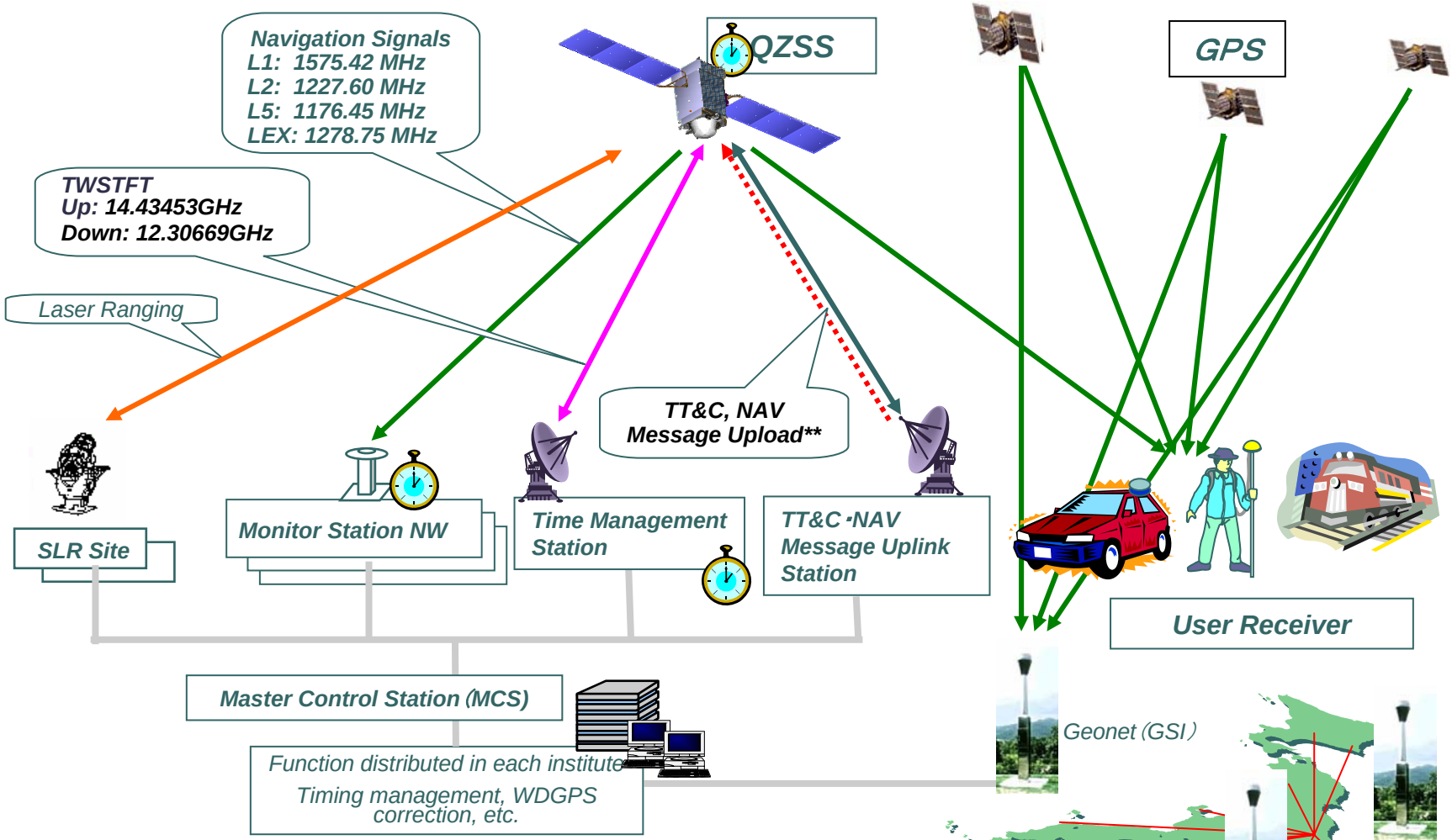
System Description
System architecture



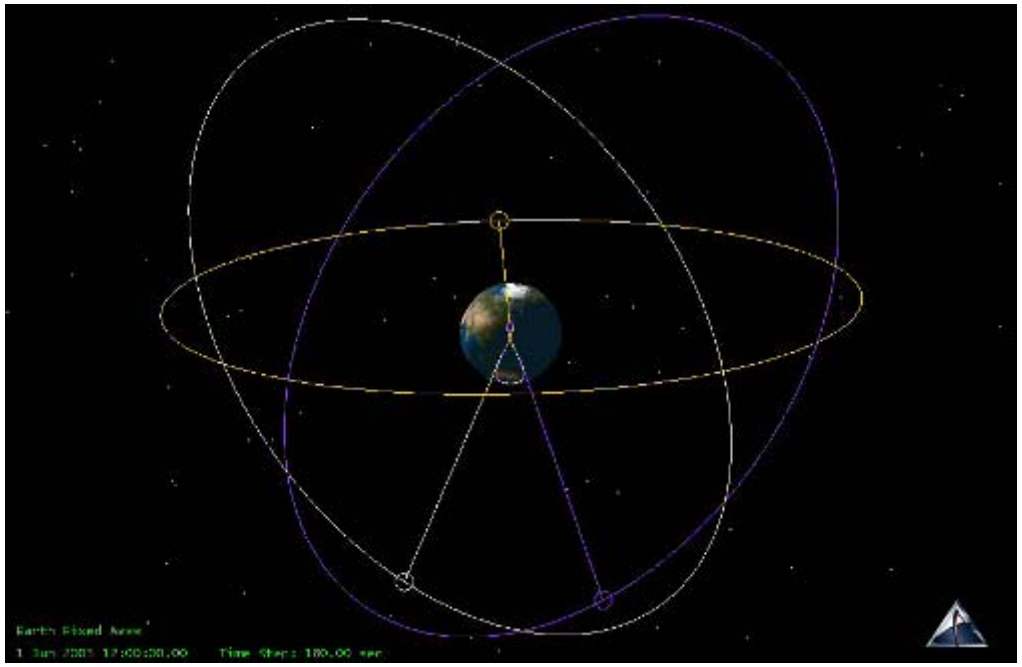
**: S (Up: 2025-2110, Down: 2200-2290MHz) band for LEOP
and C (Up:5000-5010, Down:5010-5030MHz) band for Nominal Operation

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

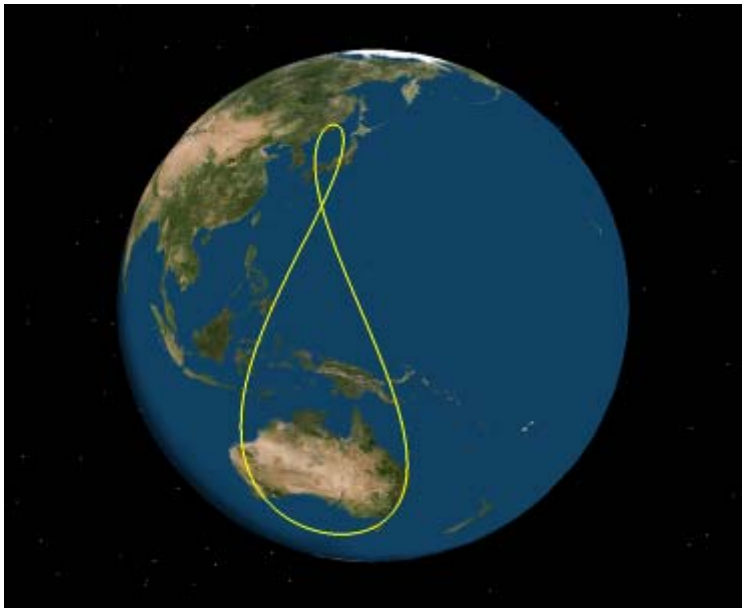
System Description
Space Segment- Orbit characteristics

- *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



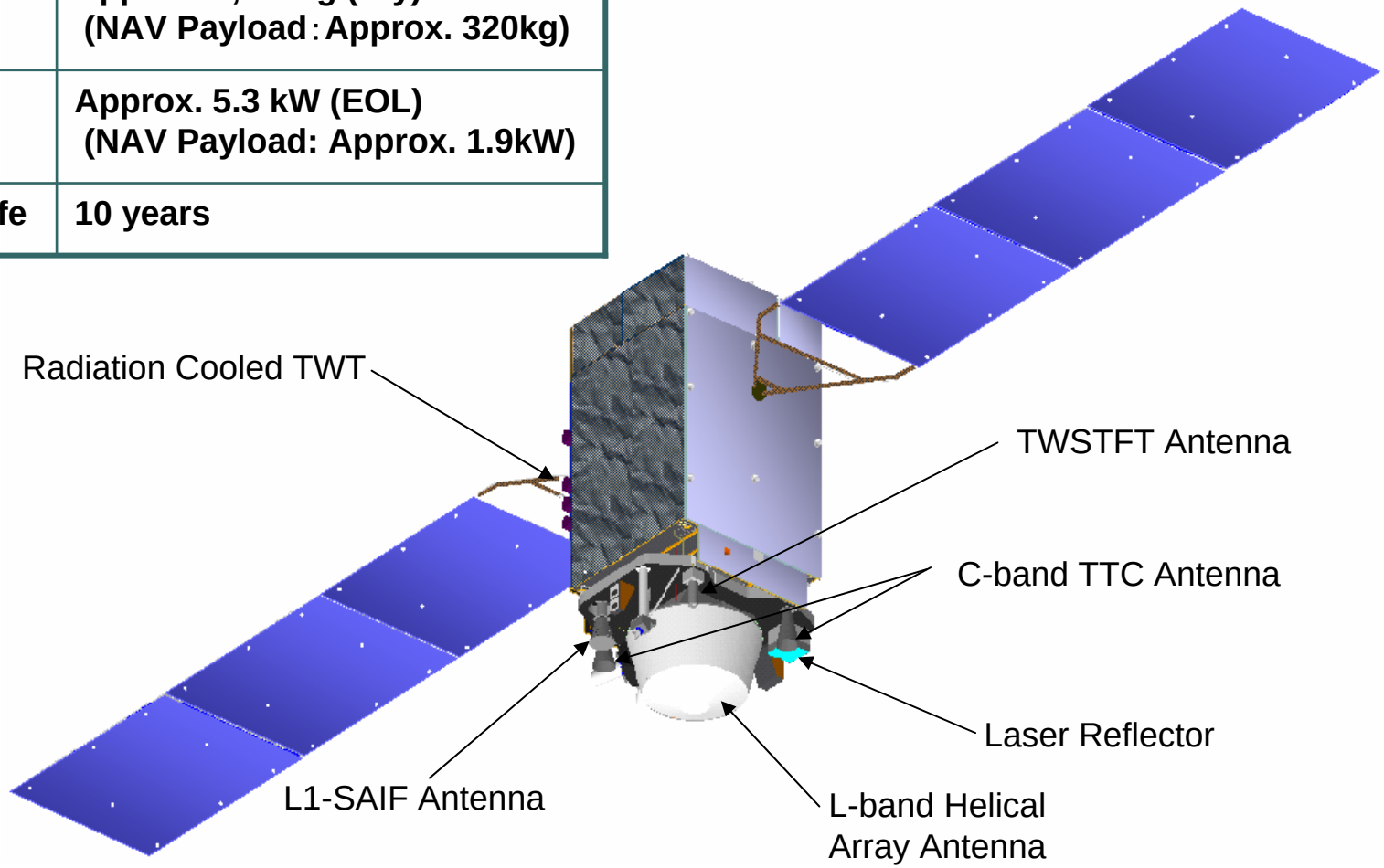
QZSS Ground Track

System Description
Space Segment- Orbit characteristics

- *Each satellite orbit has slight eccentricity so that can keep appropriate separation between GSO. The vector of eccentricity will be maintained separation more than 50 km during operational phase.*
- *After whole mission life, satellite will be injected into “Disposal Orbit”, which defined as orbit with 1000 km higher perigee altitude of GSO.*

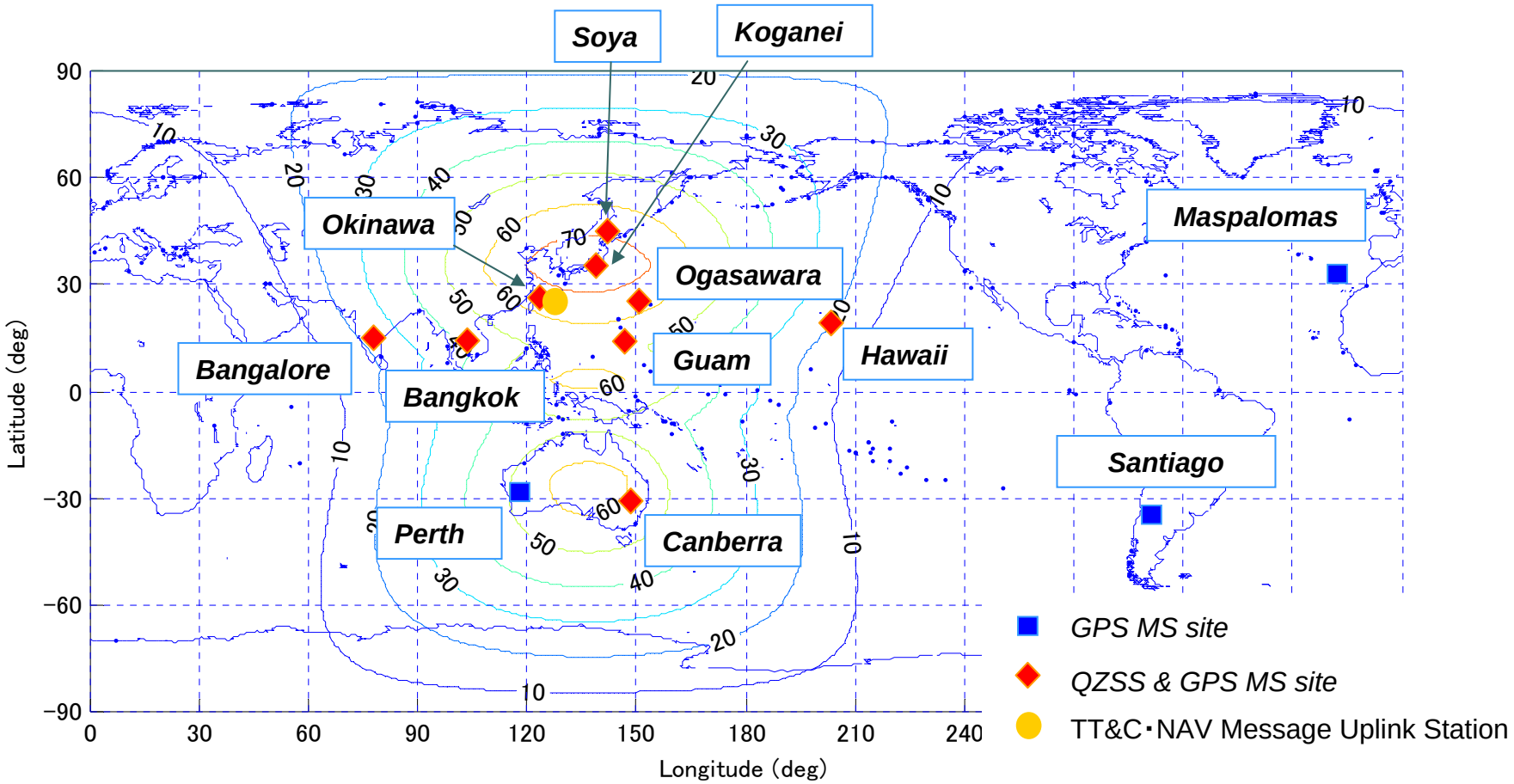
System Description
Space Segment - QZS-1

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



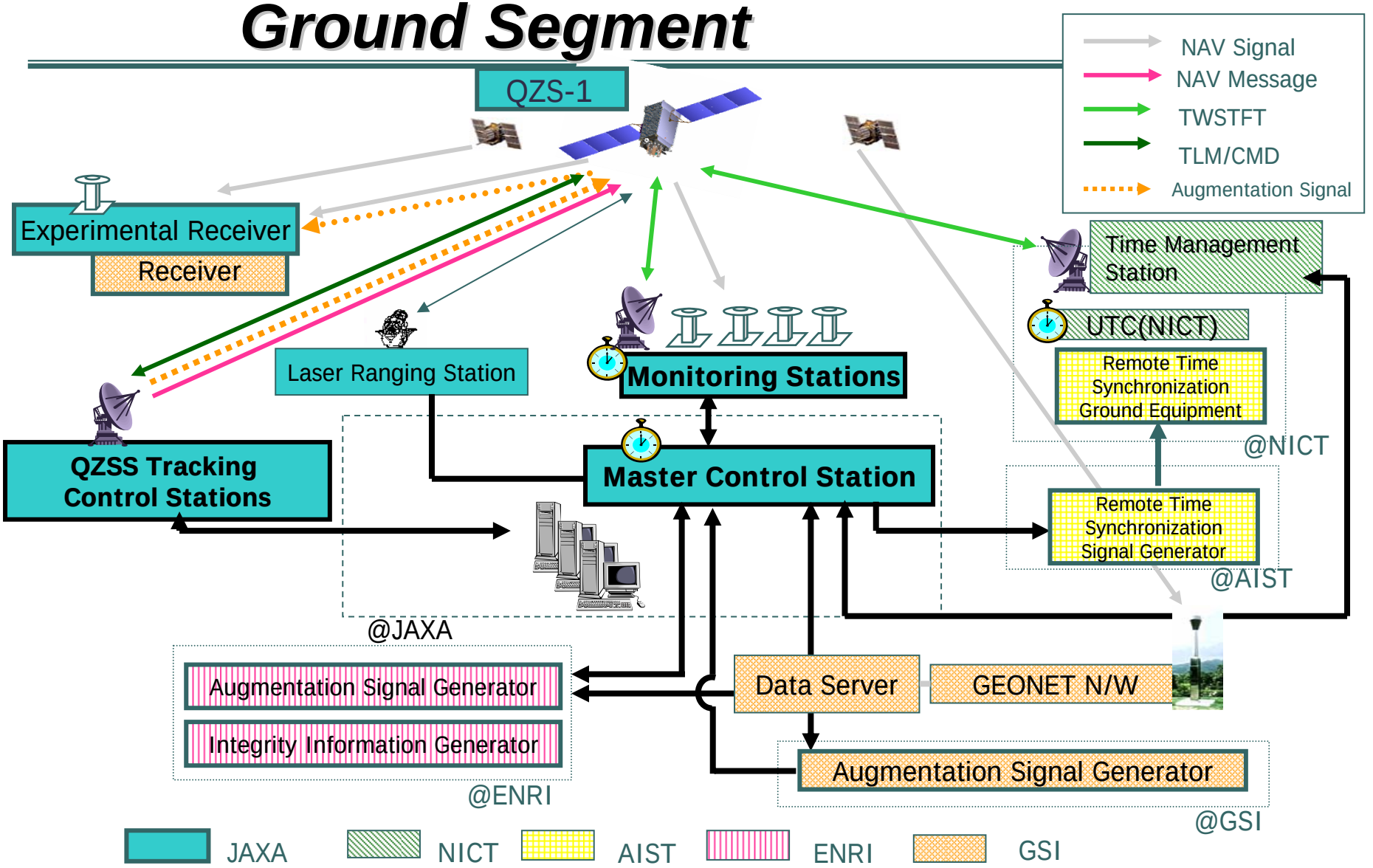
Satellite Configuration on Orbit

System Description
Ground Segment



Okinawa is primary TT&C station for nominal.
The number and locations of secondary sites are still being investigated.

System Description
Ground Segment



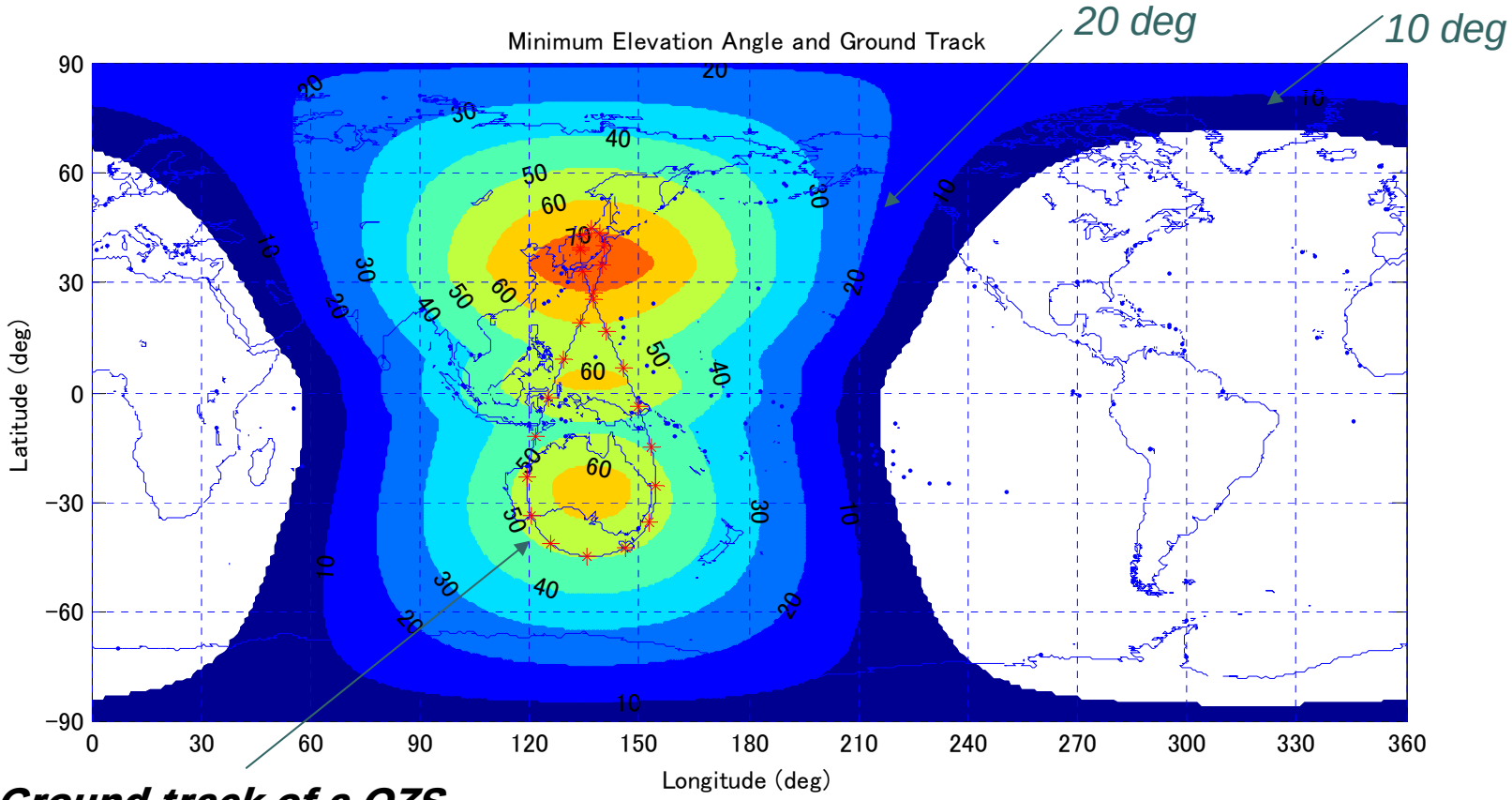
System Description
Planned Signals

- 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**

System Description
Performance - Service Area



Ground track of a QZS

Minimum Elevation Contour for 3 QZS over 24 hours

** for maximum elevation of visible satellites*

System Description Performance

- 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
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.

System Description IS-QZSS

- IS-QZSS describes;
  - System architecture of whole QZSS
  - Signal structure and specifications
  - Service properties
- First draft of IS-QZSS (ver. 0.0) was released January 22, 2007.
- Second draft, IS-QZSS ver. 0.1 was released June 8, 2007 on following web site.

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

Perspective on Compatibility and Interoperability

- GPS
  - GPS-QZSS Technical Working Group (TWG) established to achieve compatibility and technical interoperability between QZSS and current and future configurations of GPS in 2002.
  - QZSS and GPS success in designing “common” signals
    - Five of six QZSS signals use same signal structures, frequencies, spreading code families, data message formats as GPS or SBAS signals
  - US-Japan Joint Statement, 27 January 2006 :
    - The Technical Working Group concluded that GPS and QZSS are designed to be fully interoperable and compatible.
- Galileo
  - JAXA-EU Galileo signal task force have had six coordination meetings to secure RF compatibility between QZSS and Galileo.
  - QZSS and Galileo have same spectrum of L5–E5a, LEX-E6, and almost close in L1C-E1OS.
- COMPASS
  - RF compatibility coordination between QZSS and COMPASS has just started since July 30, 2007.
- Other RNSS systems
  - There is no overlapping in QZSS signal with other RNSS systems currently.

GNSS Spectrum Protection Activities

- National-level RNSS spectrum regulation/management procedures
  - No specific regulation/management procedure for national-level RNSS spectrum as of now.
- Views on ITU RNSS spectrum issues or WRC Agenda items
  - As for Agenda item 1.6 WRC07, Japan support NOC position, which protects RNSS 5 GHz band.
  - Japan contribute to ITU-R WP8D activities related to RNSS issues in collaboration with other GNSS providers.
- RNSS interference detection and mitigation plans and procedure
  - No specific plans and procedure for RNSS interference detection and mitigation as of now.

ICG Participation

- *"The Fundamental Act of Promotion for Utilization of Geographical Spatial Information" stipulates the importance of contacts with operators of global satellite based positioning systems.*
- *Japan will participate in ICG to contribute to the cooperation in the compatibility and interoperability among GNSS systems.*