Request for QZS-1 SLR Tracking

JAXA

QZSS Project Team

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QZSS Program

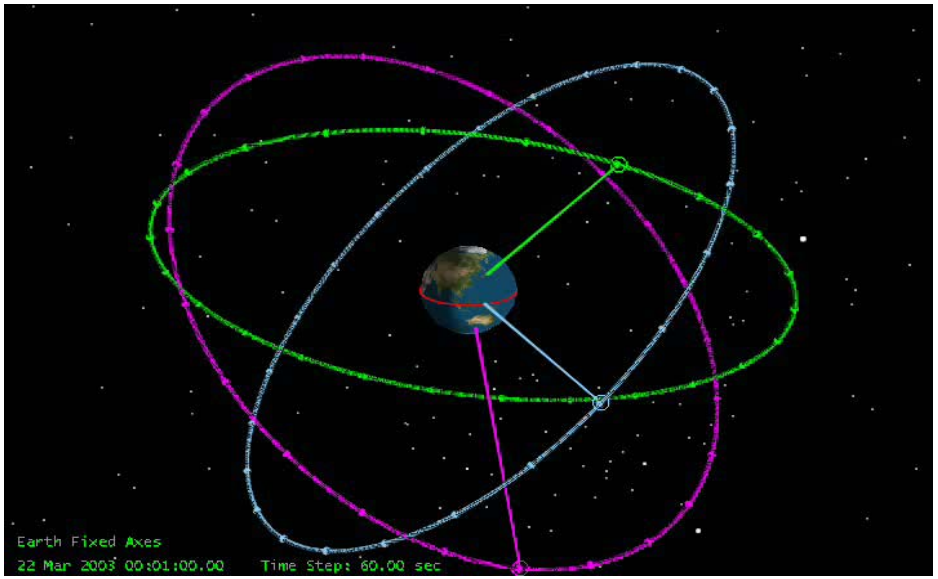
- The QZSS is a Japanese satellite navigation program aiming for a future evolution to the regional satellite navigation system in East Asia and Oceania in the future.
- Two stage system deployment is planned.
  - First Step: Only one satellite（QZS-1) will be launched in 2009
    Technical validation and application demonstration
  - Second Step: 2nd and 3rd satellites launched several years later.
    Full System operation will be demonstrated.
- JAXA and related research institutes are taking in charge of technology development and demonstration of GPS complement and augmentation from QZSS.

QZSS overview

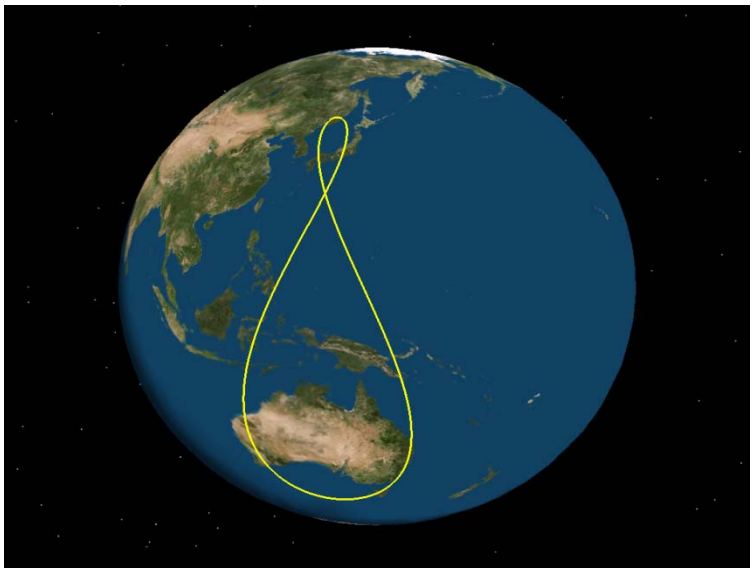
QZSS orbit constellation

- Three satellites constellation
- Each satellite is on the different orbital planes with inclined, geo-synchronous period and slight eccentricity.
- Each satellite is allocated on the orbit so as to pass over the same ground track at constant intervals and at least one satellite places near zenith over Japan.

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



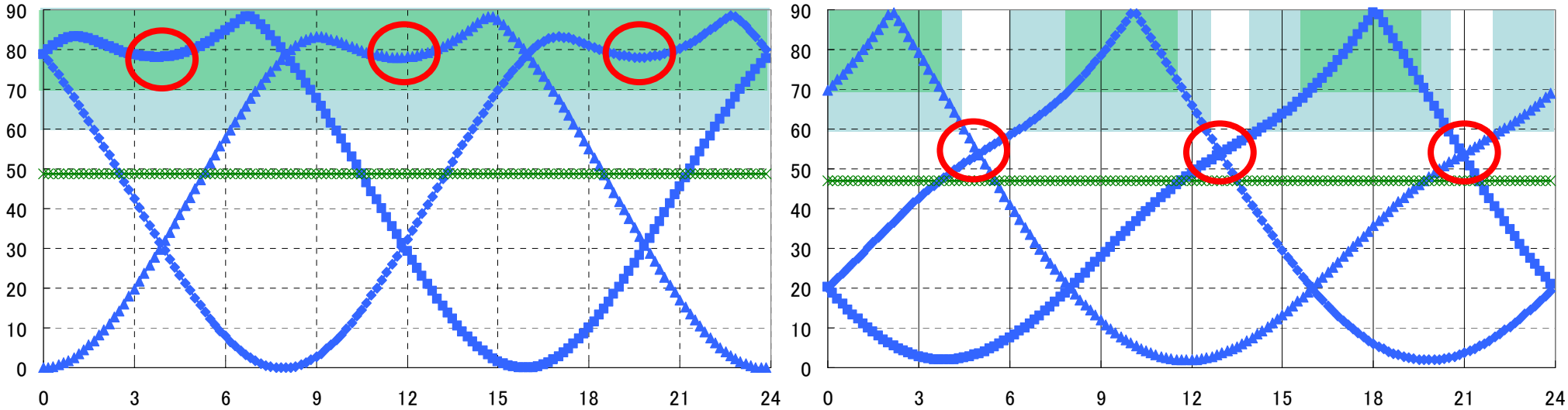
QZSS orbit constellation



QZSS Ground Track

QZSS Overview
QZSS Constellation

QZSS Elevation Angle from Tokyo (Left) and Sydney (Right)



Minimum value of the Max. Elevation angle of 3 QZS over 24 hrs.

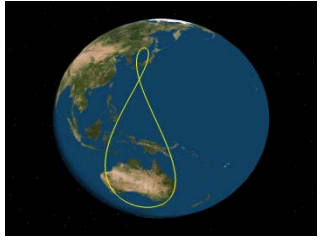
Tokyo; 78 deg, Sydney; 54 deg

Duration hatched by light blue shows users can observe at least one QZS more than 60 degrees elevation angle.

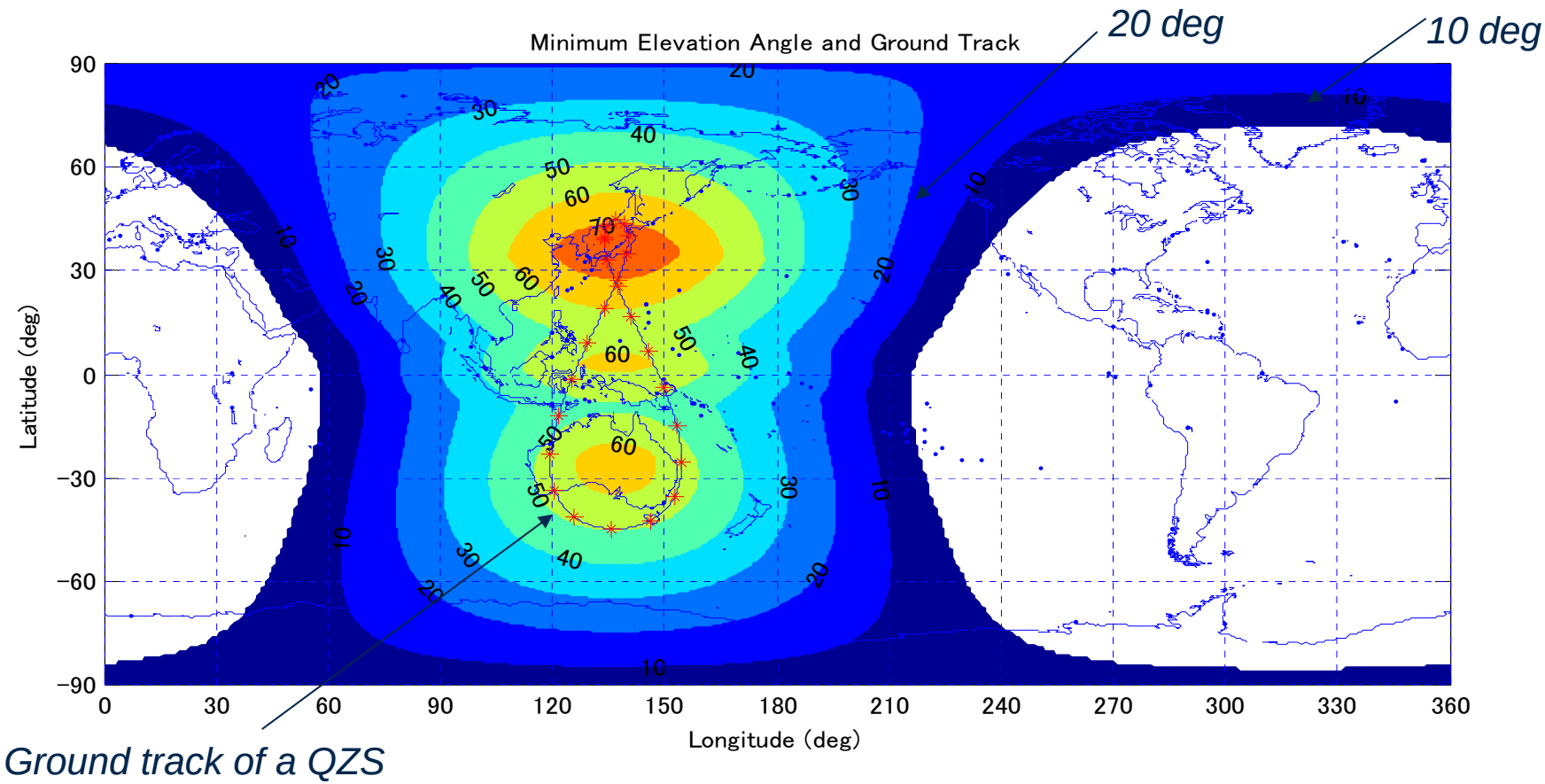
Same as above but more than 70 degrees elevation angle

QZS

Ref: GSO Sat 135E



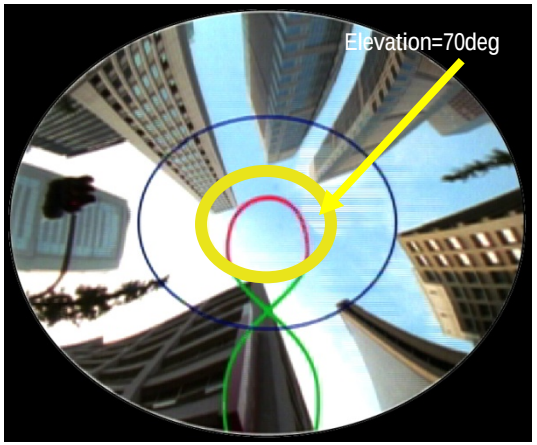
QZSS Overview
QZSS Constellation



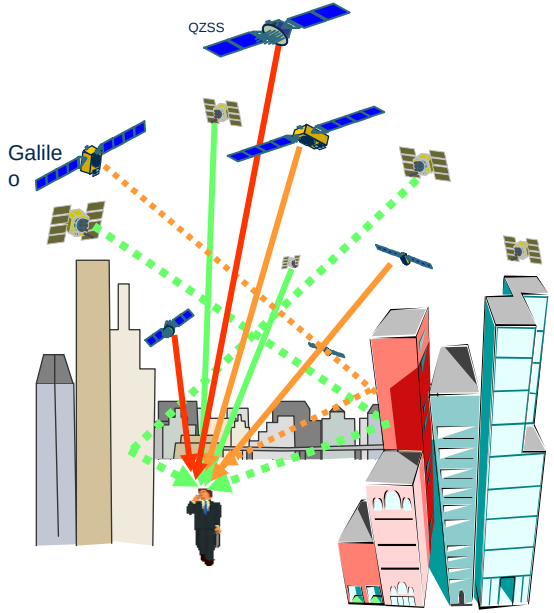
Minimum Elevation Contour for 3 QZS over 24 hours

** for maximum El of visible satellites*

QZSS Overview
Benefits of QZSS



An Example of QZS Path @ Shinjuku, Tokyo



"More Stars!"

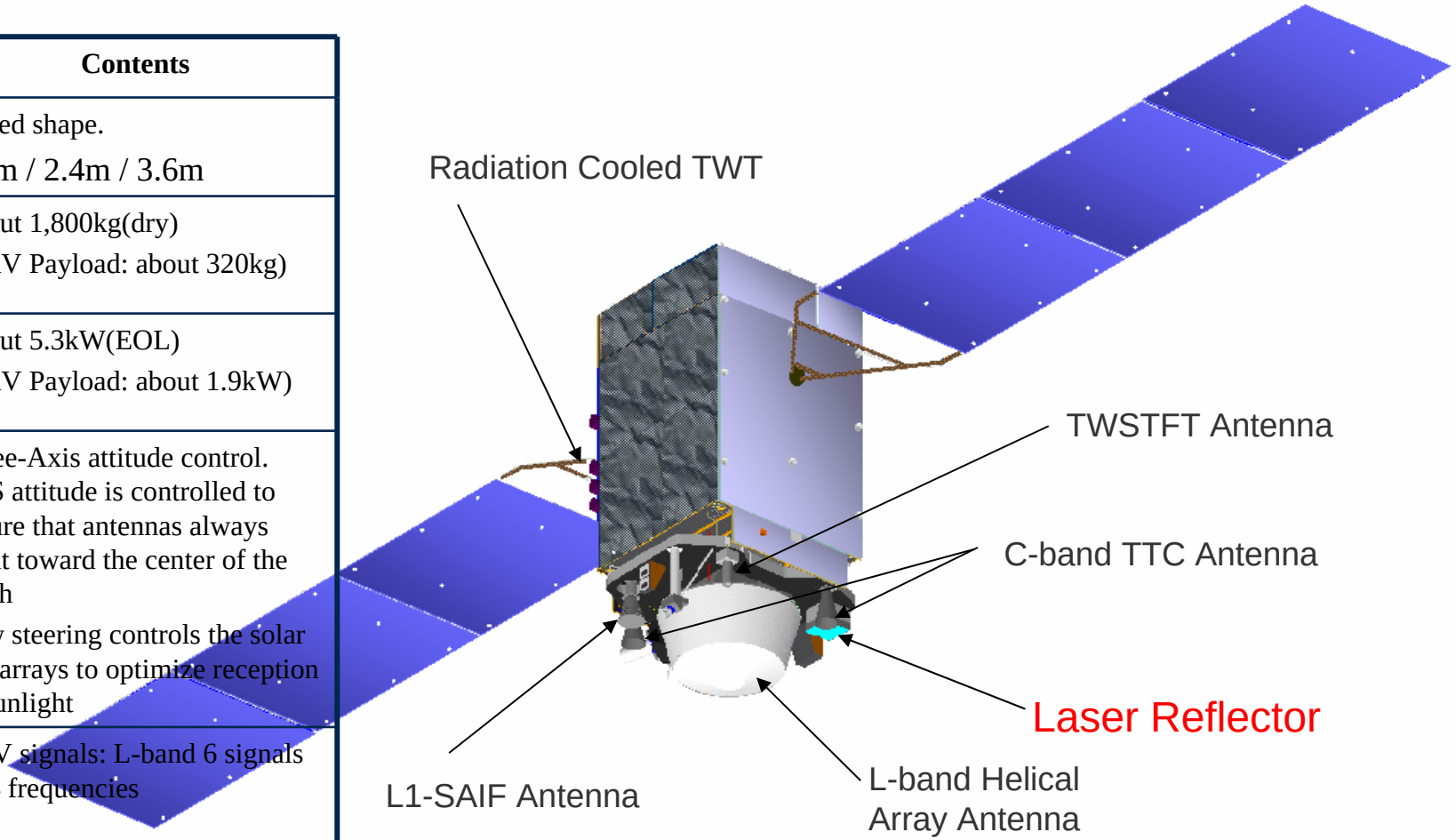
- *QZSS has complete interoperability with GPS*
- *A QZS will be worked as a GPS satellite with better geometrical position.*
- *QZS will improve availability and DOP comparing only GPS use, especially in urban canyon and mountainous terrain.*

Good Platform for WDGPS

- *High elevation angle characteristics can be applied to the WDGPS platform for stable link.*

QZS-1 System Description
Space Segment

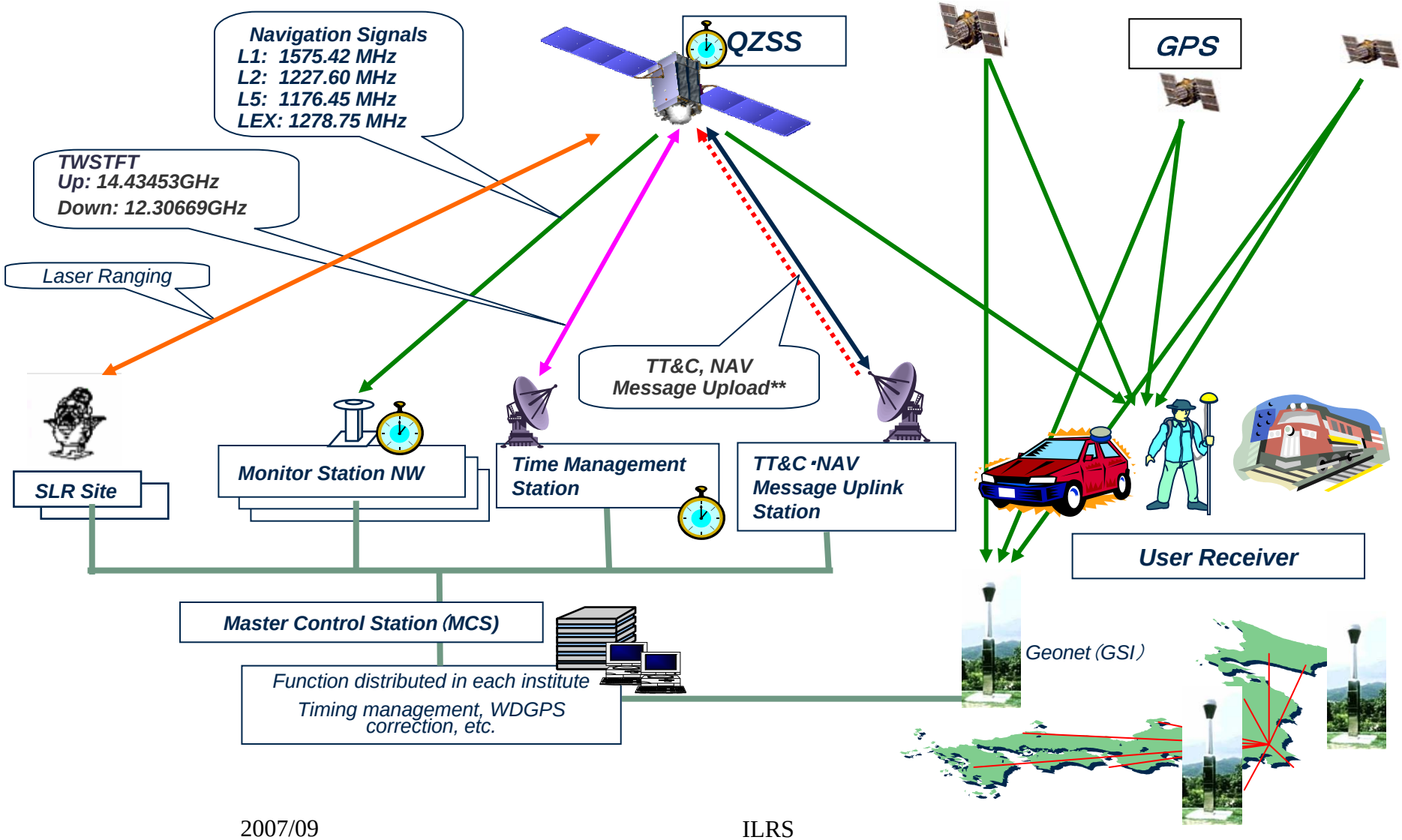
Item	Contents
Aspect	Boxed shape. 2.4m / 2.4m / 3.6m
Mass	About 1,800kg(dry) (NAV Payload: about 320kg)
Electric Power	About 5.3kW(EOL) (NAV Payload: about 1.9kW)
Attitude control	Three-Axis attitude control. QZS attitude is controlled to ensure that antennas always point toward the center of the Earth Yaw steering controls the solar cell arrays to optimize reception of sunlight
Frequency	NAV signals: L-band 6 signals on 4 frequencies
Lifetime	10 years



Satellite Configuration on Orbit

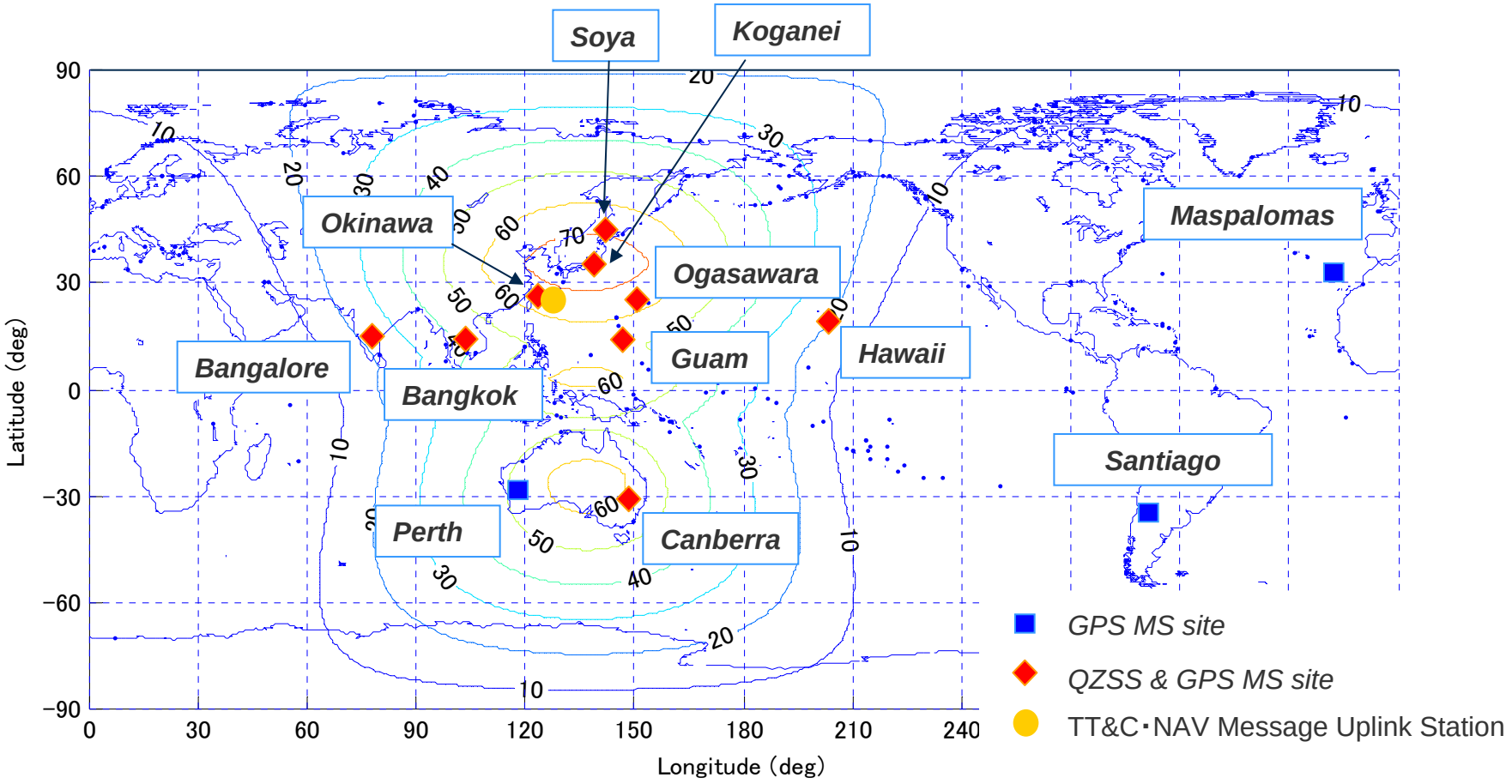
QZS-1 System Description

Ground System



QZS-1 System Description

Ground System



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

Necessity of SLR

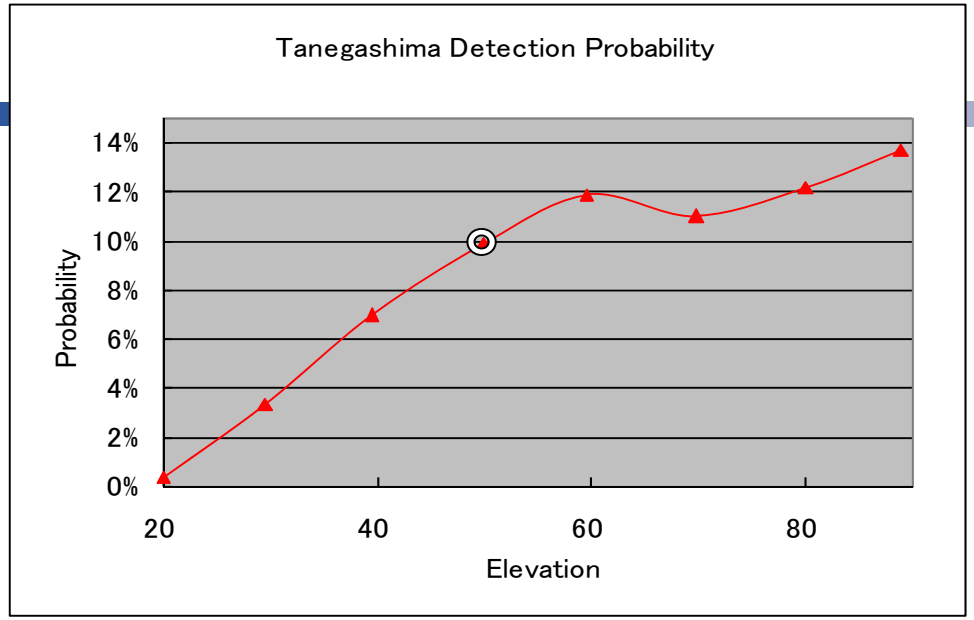
- QZS-1 precise orbit ephemeris will be transmitted through the QZS-1 Navigation Message in the same way as GPS.
- JAXA will perform QZS-1 precise orbit determination using L-band Navigation data received at monitor stations. Target accuracy of SIS-URE (radial direction) is several tens centimeters.

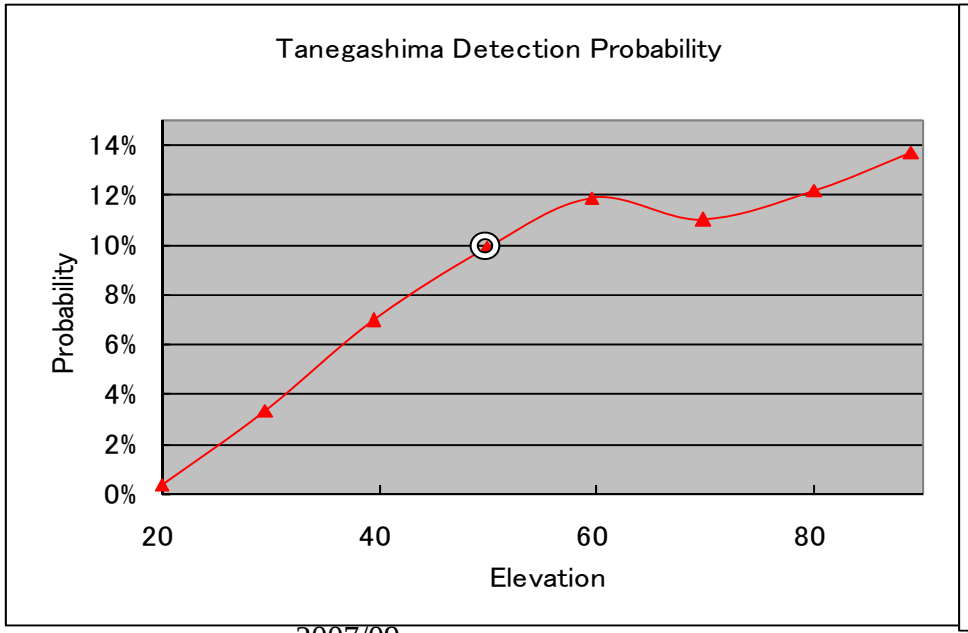
◆SLR of QZS-1 is necessary to estimate Navigation data biases and evaluate orbit determination accuracy.

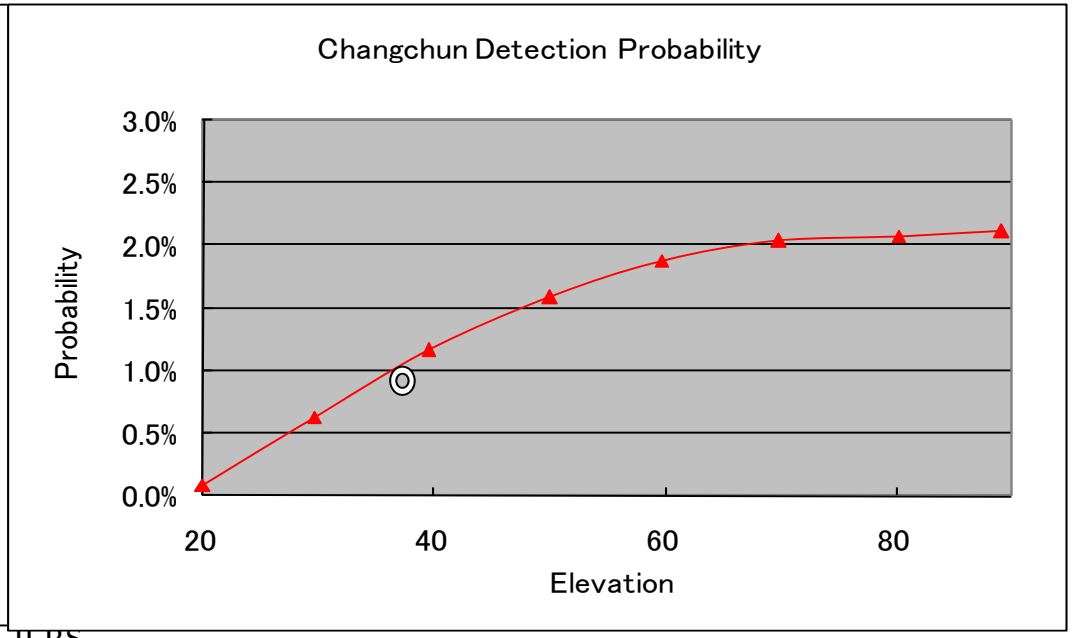
Link Analysis for QZS LRA

- Assumption, for simplicity, we consider below conditions
- Period: Only Night Tracking
- SLR station :Tanegashima, Koganei, Changchun, Yarragadee, Mt.Stromlo
- Reflector Array : Same as ETS-8
- Parameters on Link equation:
- We got SLR station's parameters from ILRS web.
- We have chosen artificial parameters, in which actual return rate of
- ETS-8 agrees with results of its link calculation.
- As for another parameters such as dark current density, we assume that those
- parameters same as JAXA SLR station, which is most sensitive station.
- My calculation have trend of over estimate.

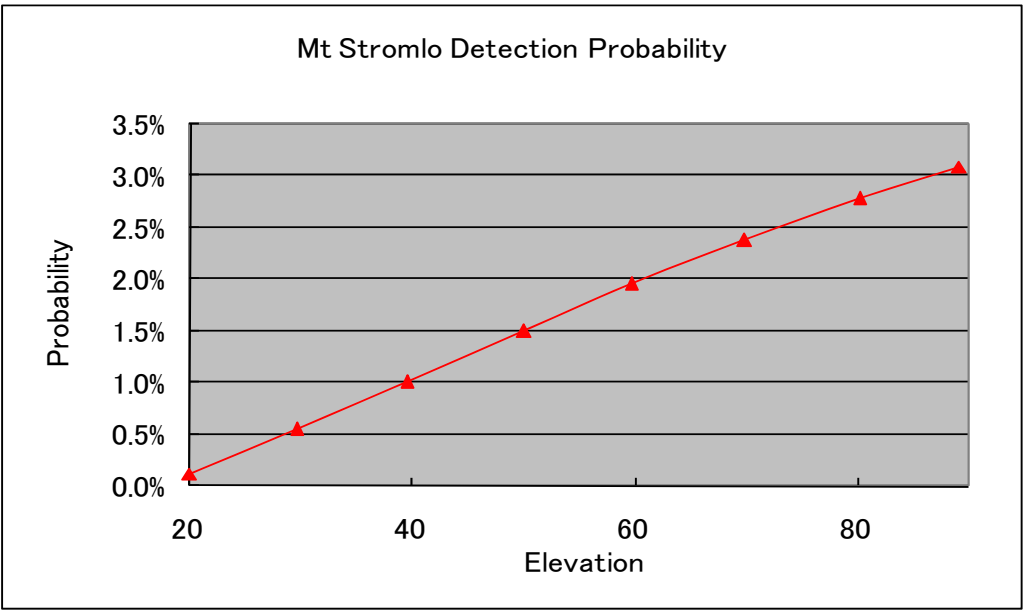
•From North Hemisphere (Japan, China)







From South Hemisphere (Australia)



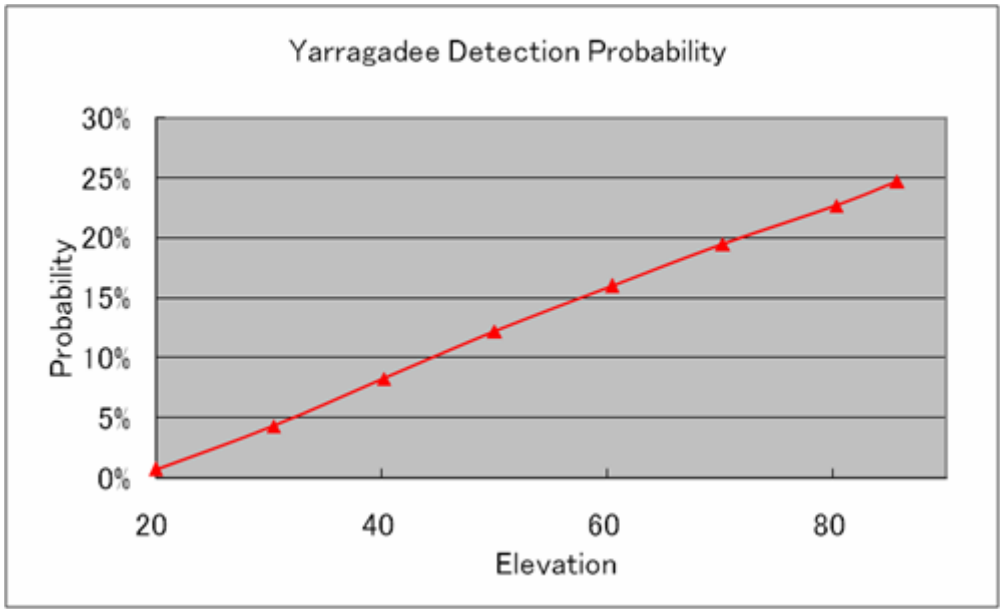
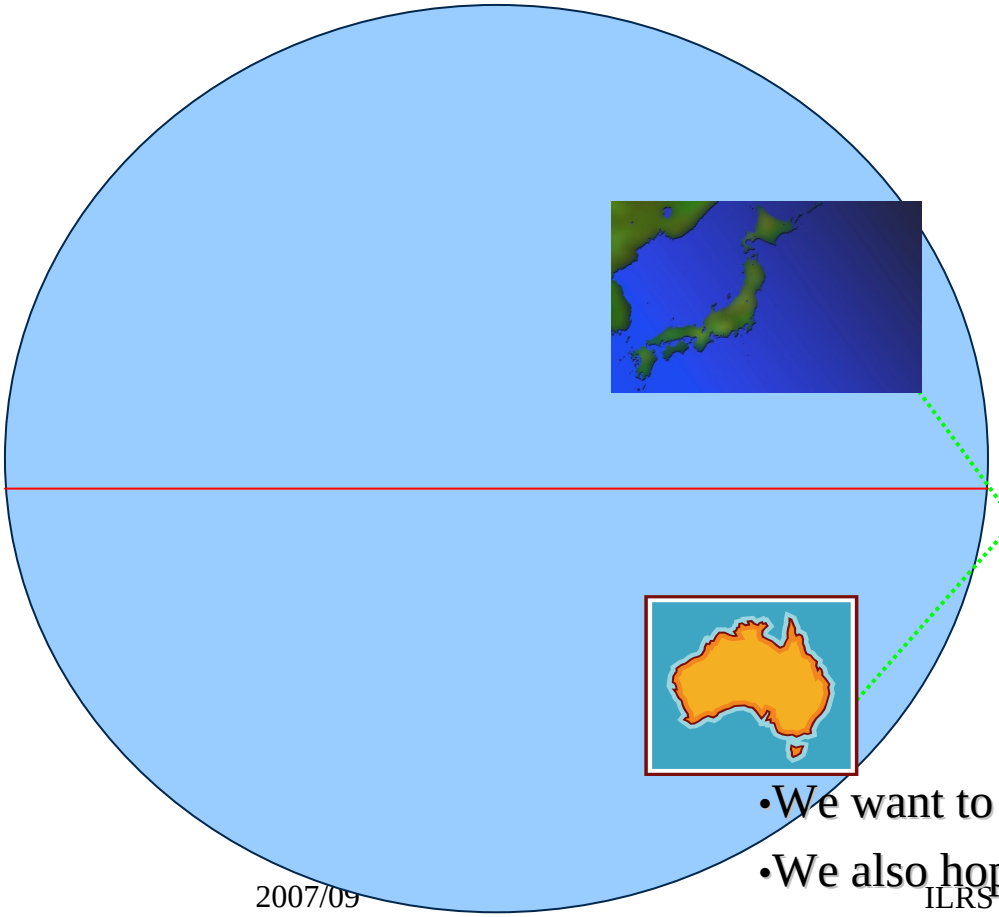


Image of Ranging

•Worst Case :

• From Australia to QZS,
which is located at north hemisphere.



Too long range

•SLR for QZS is more challenging than SLR for ETS-VIII.

•Because of eccentricity and Inclination.

•We want to perform tracking for QZS successfully.

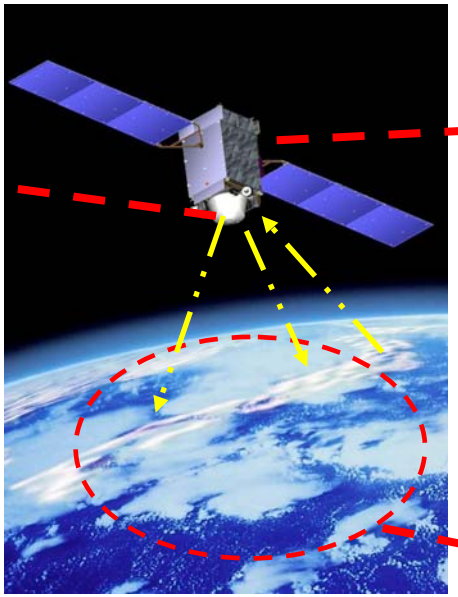
•We also hope that we will report tracking results on ILRS.

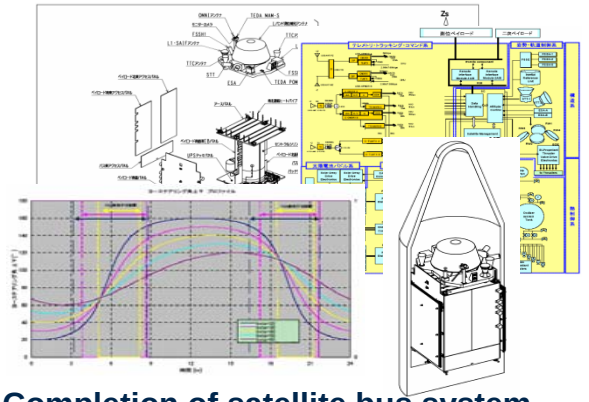
Current Status and Future Plan

Current Development Status

Thermal Vacuum Test of L-band Antenna Engineering Model (February 2007)【JAXA】

Thermal Vacuum Test of Navigation Payload Engineering Model (April 2007）JAXA】





Completion of satellite bus system basic design（August 2007）【JAXA】

Conducting Site surveys of Monitor Stations and TTC station (2006 – 2007)

Current Status and Future Plan
Request for QZS-1 SLR Tracking

JAXA hopes the following 2 stages SLR tracking on Western Pacific Ocean Network;

➢1st stage

•Purpose : confirmation of precise orbit determination, estimation of bias for each monitor stations, QZS-1 LRE checkout

•Priority : High

•Frequency : every 6 months　　In particular, Two months of SLR tracking after the mission orbit injection

➢2nd stage

•Purpose : increasing orbit determination accuracy of ordinary operation

•Priority : low

•Frequency : all day

Current Status and Future Plan
Launch schedule

- The QZS-1 will be launched by H-IIA launch vehicle from Tanegashima Space Center in Japan.
- Target launch year is now in 2009.