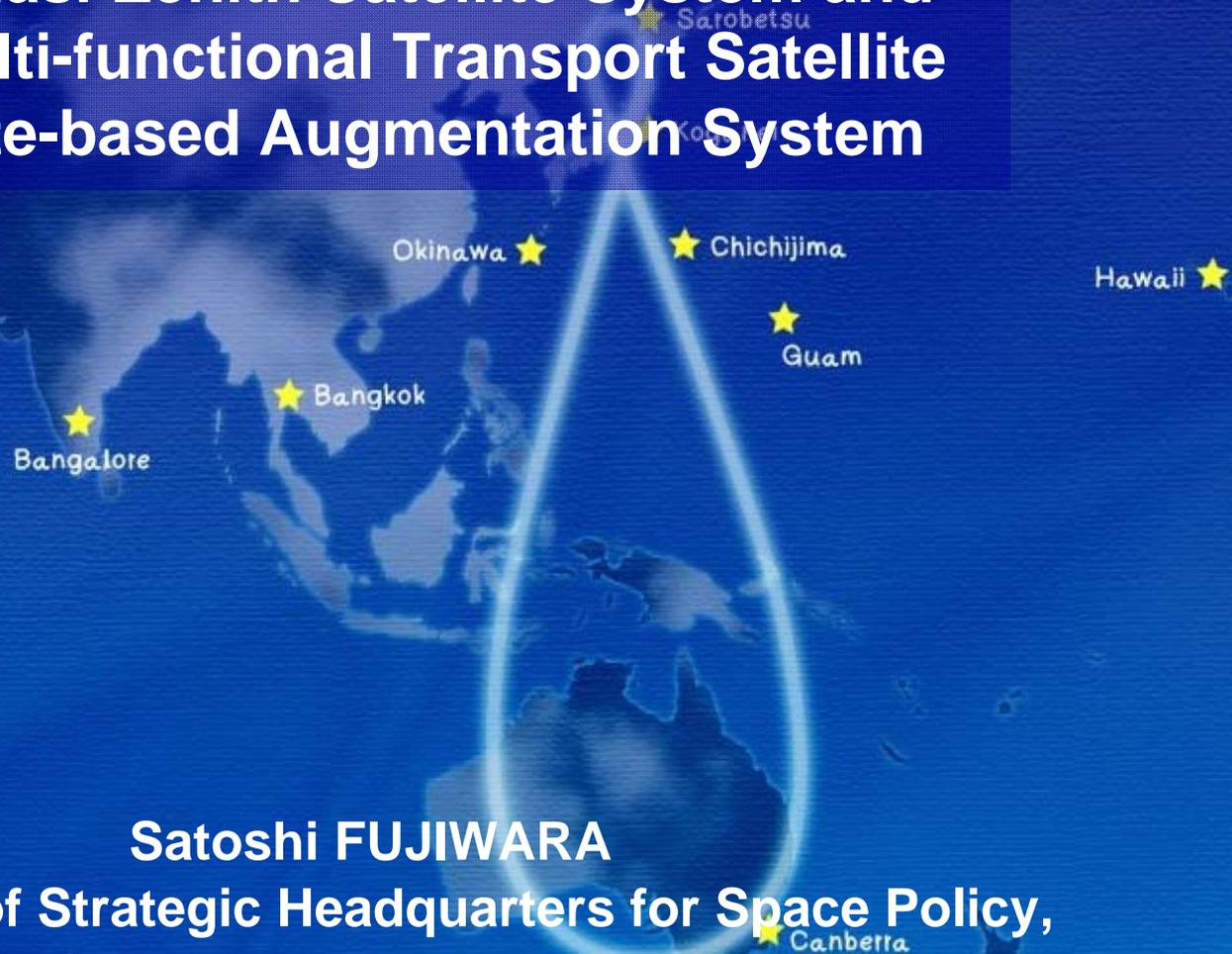


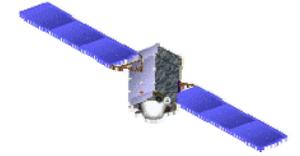
ICG-6, Tokyo Japan
September 5, 2011

QZSS and MSAS

The Quasi-Zenith Satellite System and
The Multi-functional Transport Satellite
Satellite-based Augmentation System

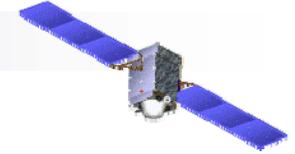


Satoshi FUJIWARA
Secretariat of Strategic Headquarters for Space Policy,
Cabinet Secretariat, Government of Japan



QZSS

Quasi-Zenith Satellite System



Quasi-Zenith Satellite System

■ **Functional Capability:**

- GPS Complementary
- GPS Reinforcement
- Short message

■ **Coverage:** Asia and Pacific region

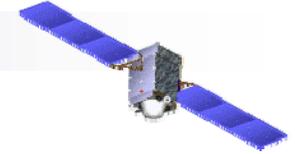
■ **Six Signals:**

- L1C/A, L1C, L2C and L5
- L1-SAIF on 1575.42 MHz
- LEX on 1278.75MHz

■ **First QZSS satellite “MICHIBIKI”:**

launched in September 2010





QZSS Update

■ ***Future Plan for QZSS under SHSP***

- QZSS project is assigned the highest priority level in the FY2012 budget for Space Development by the Special Committee for Space Policy
- The Basic Plan (functions, satellite constellation...) for the future QZSS is being arranged by QZSS Working Group, a team comprised of specialists

■ ***Verification of QZS-1 “MICHIBIKI”***

- Technical Verification by JAXA
- Application Verification by Private Companies

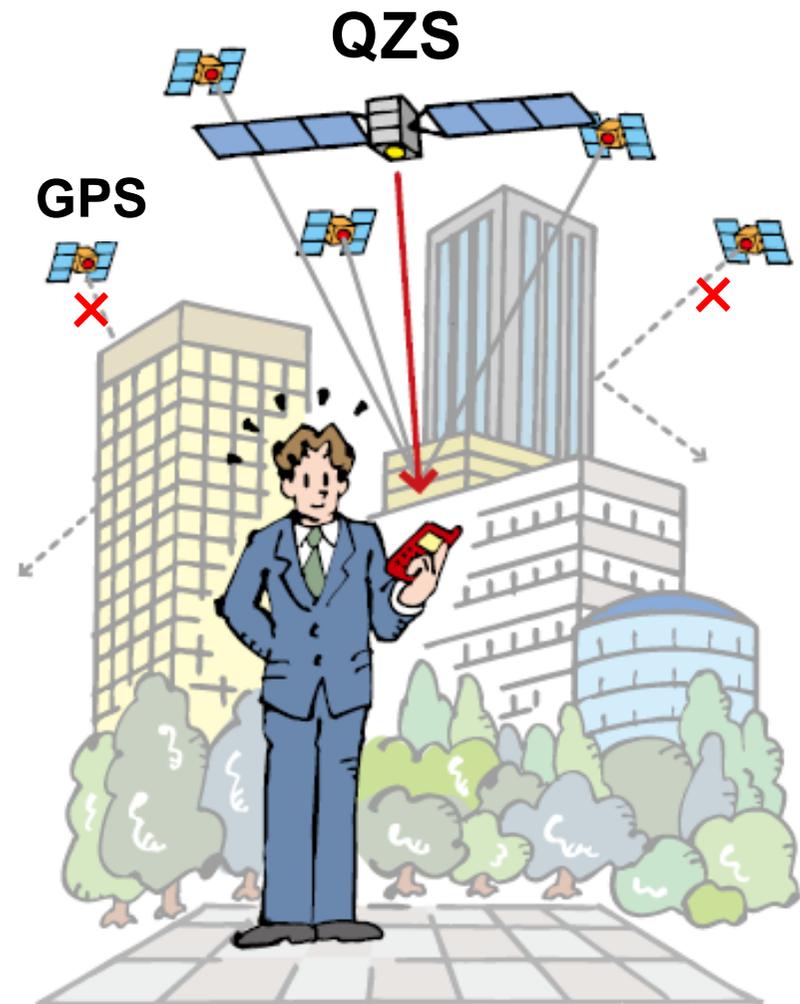
QZSS Functional Capability 1

GPS Complementary

QZSS improves positioning availability time

Complementary signals sent from high elevation will improve the time percentage of positioning availability from 90 % (GPS only) to 99.8 % * (GPS + QZSS.)

* The time percentage that the position dilution of precision (PDOP) is less than 6 when a satellite whose elevation angle is 20 degrees or over is used for positioning calculation.



QZSS Functional Capability 2

GPS Reinforcement

QZSS improves positioning accuracy

QZSS upgrades the positioning accuracy to a sub-meter or several centimeter level.

level.

Augmentation Data

- Acquisition Support Data
- Correction Data
- Integrity Data



QZSS

Navigation Signal

GPS

Galileo

GLONASS



Navigation Signal and Augmentation Data

L1-SAIF (250 bps)

LEX (2000 bps)

Ground Segment

Master Control Station



GPS Earth Observation Network

Augmentation Data Generation

Global Monitoring Stations

User Segment



LEX

centimeter

(accuracy)

L1-SAIF

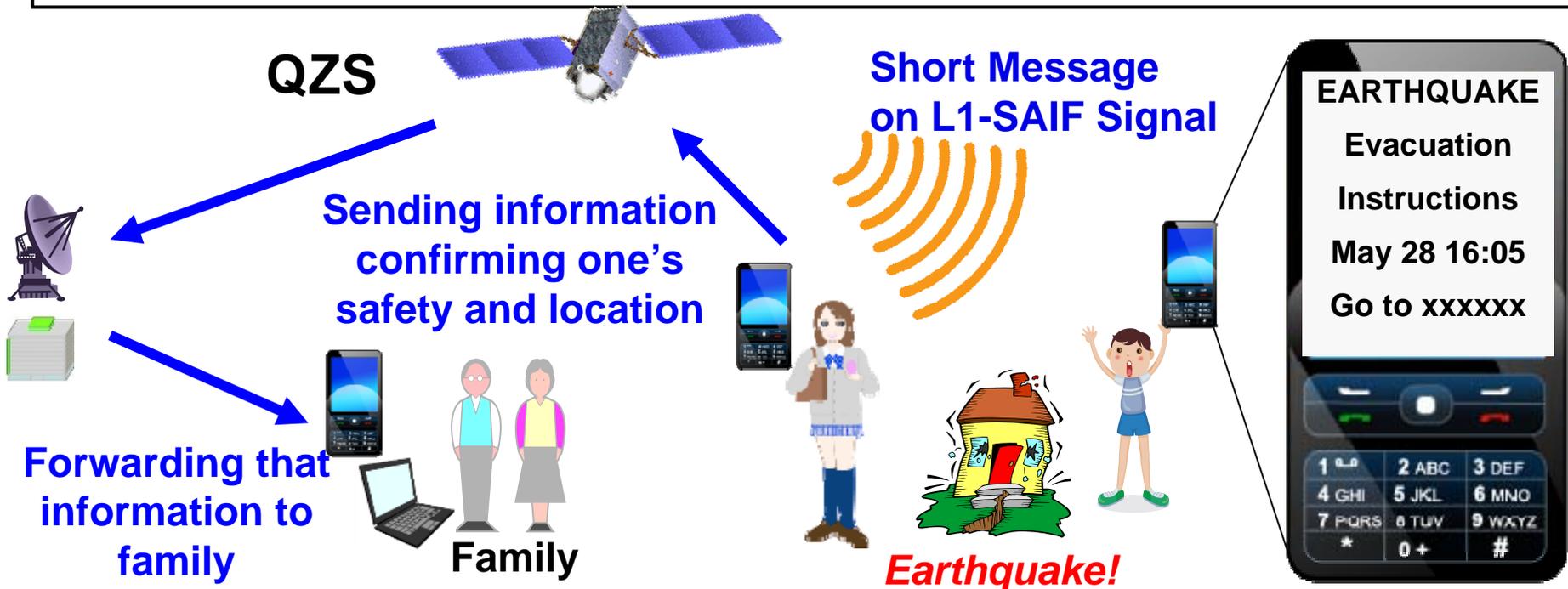
sub-meter

QZSS Functional Capability 3

Short Message and Collection of Information

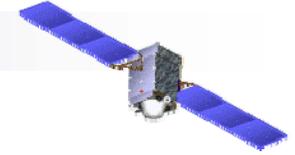
QZSS can send short messages and gather information

- QZSS can send short messages such as emergency warnings simultaneously to everyone with a mobile phone.
- We are planning to equip the future QZSS satellites with an information gathering function which will enable people to send information confirming their safety during a crisis or disaster.



QZSS Constellation Plan 1

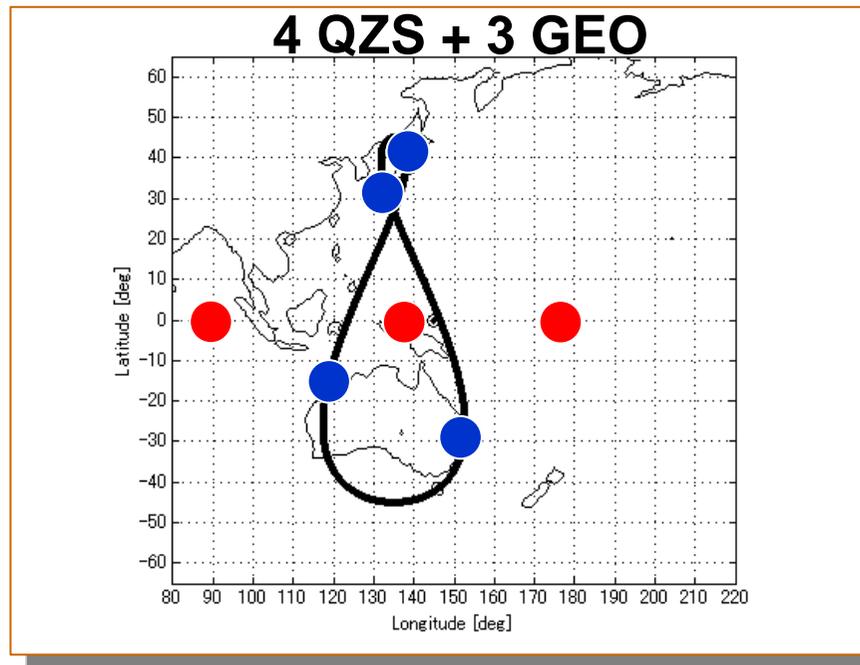
Planned Satellite Constellation



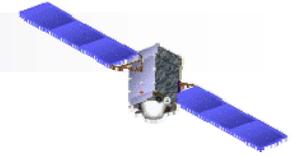
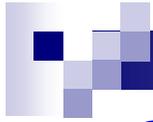
There are several QZSS satellite constellation plans.

The total number of satellites is 4 to 7 including Quasi-zenith orbit and Geostationary orbit satellites.

Case of 7 Satellites

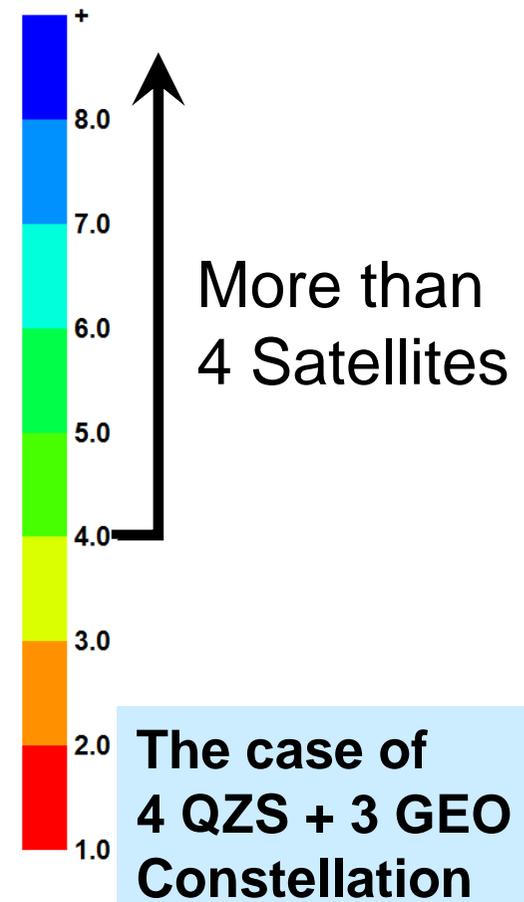
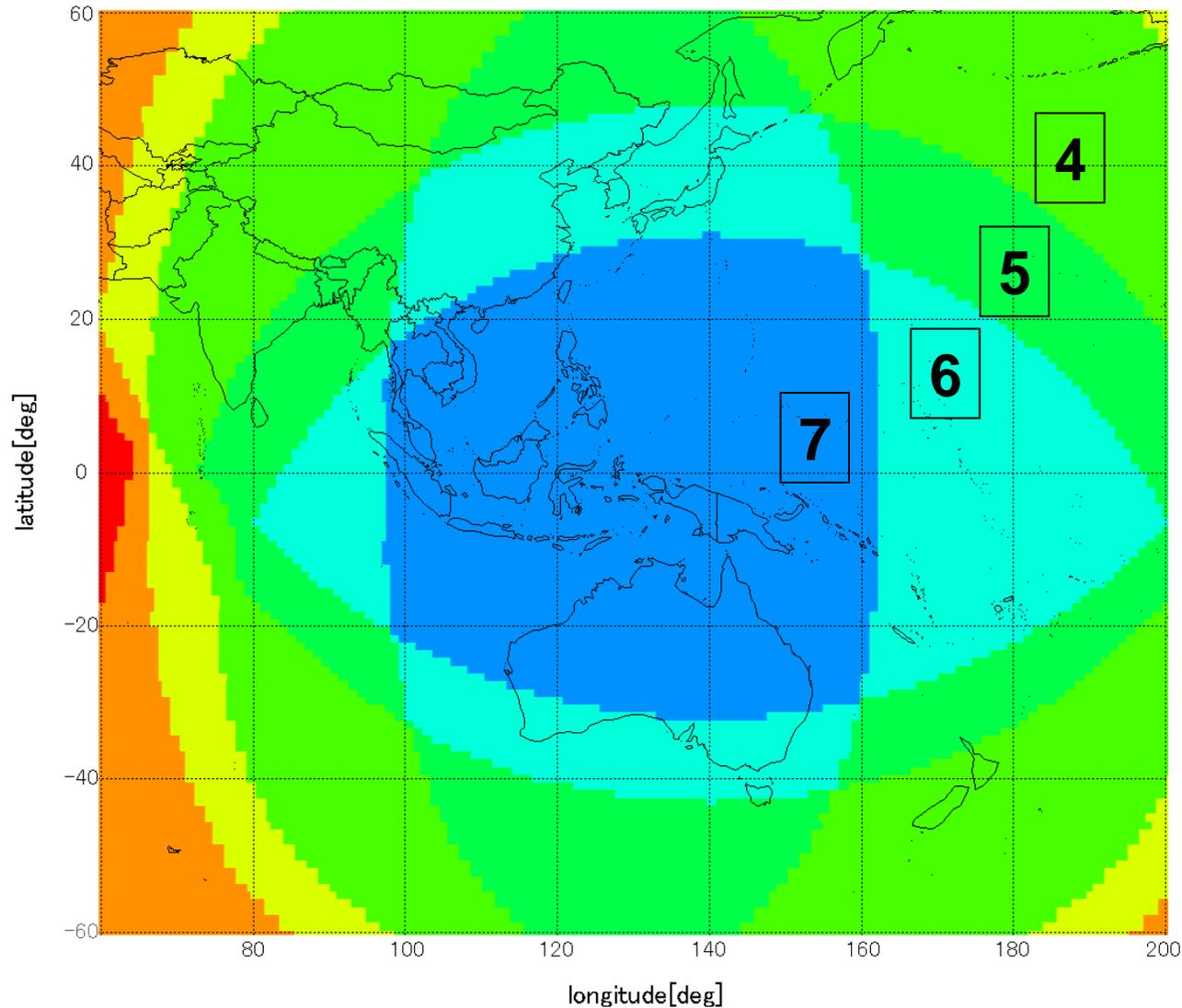


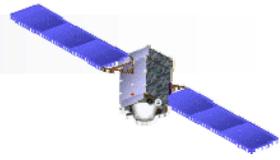
- Quasi-Zenith satellite (QZS)
- Geostationary satellite (GEO)



QZSS Constellation Plan 2

Number of visible QZSS satellites

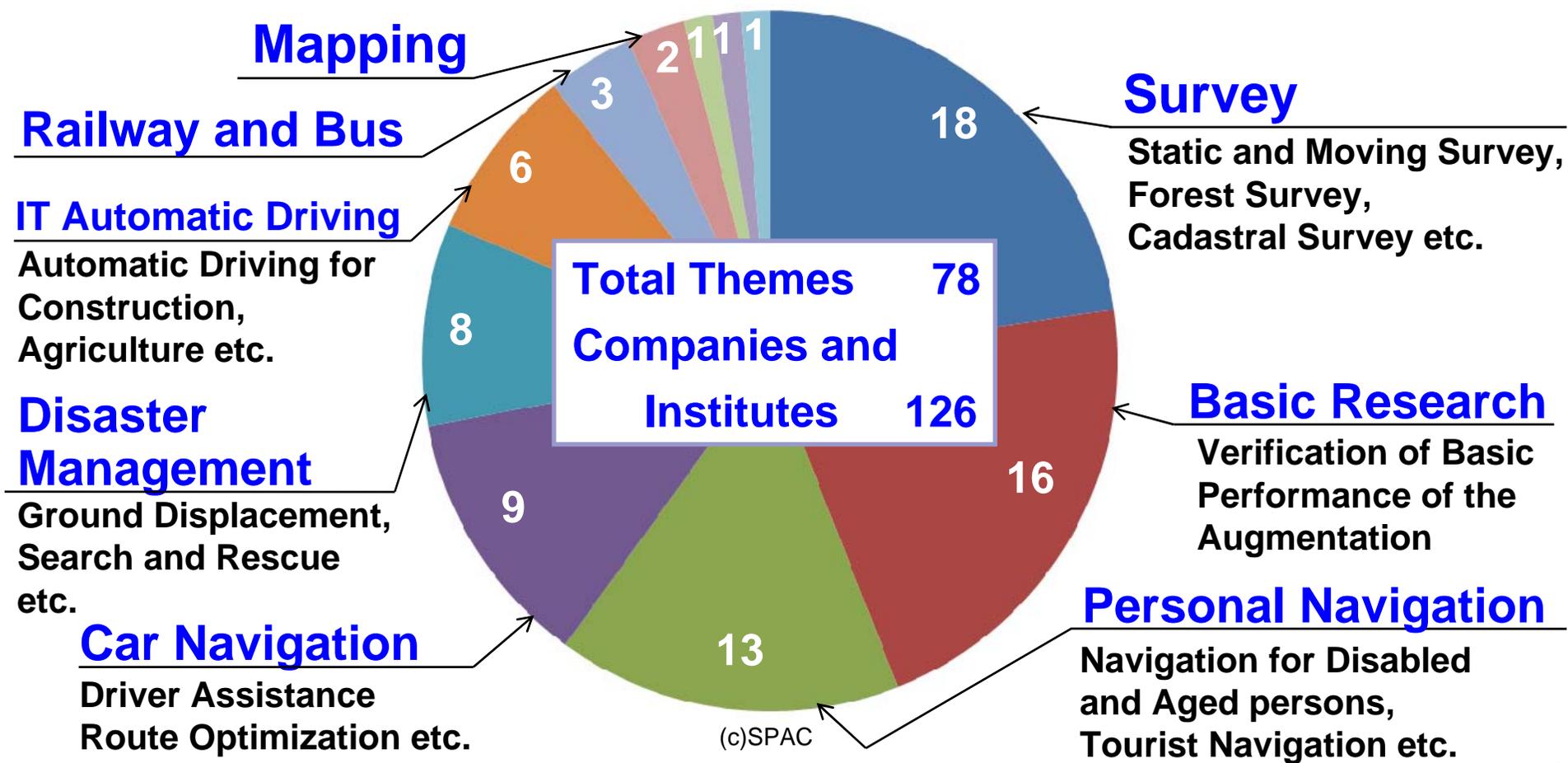


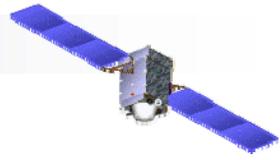


QZSS Application Verification by Private Companies

QZSS Application Verification Themes

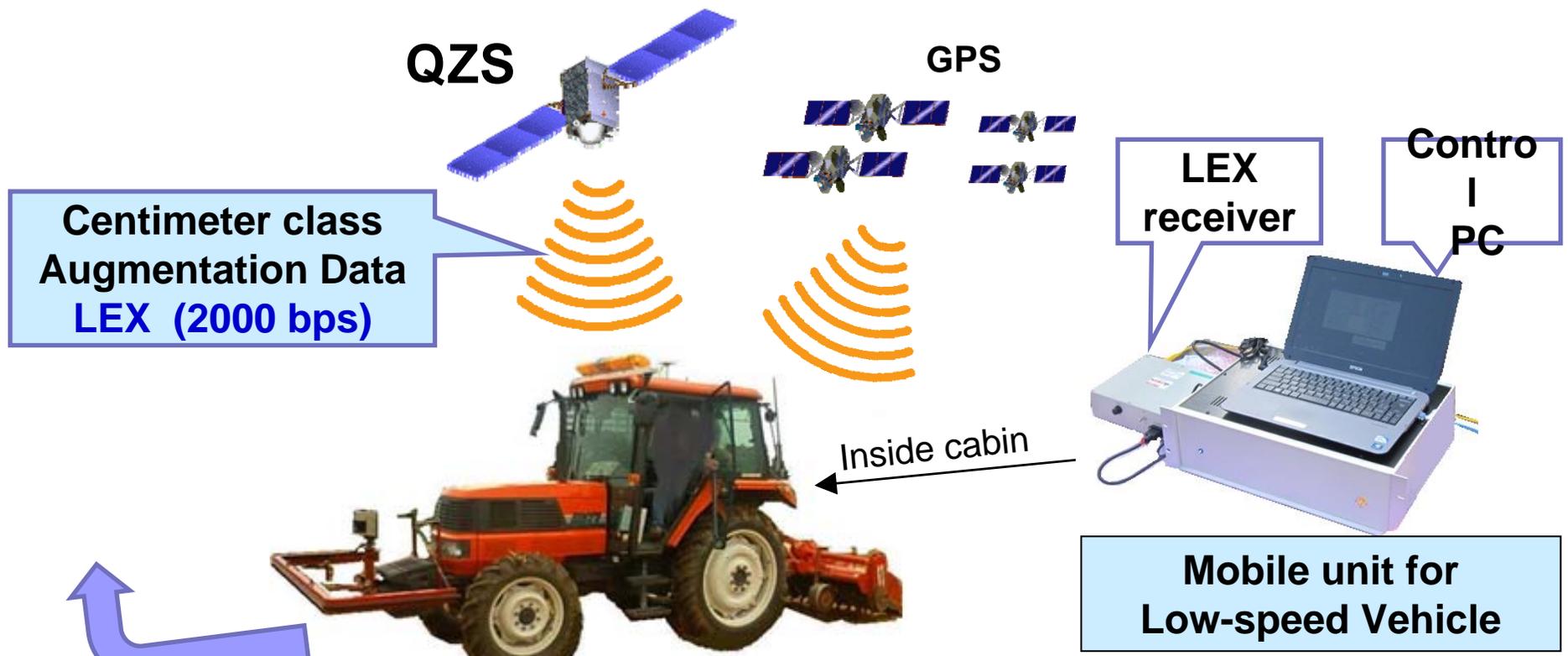
Using reinforcement signals L1-SAIF and LEX from QZSS, over 120 private companies have been verifying their applications under the coordination of SPAC.



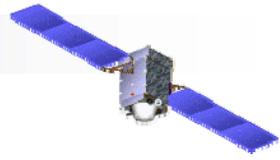


QZSS Application Verification by Private Companies ***Precision Agriculture based on IT Automatic Driving***

Precision agriculture based on IT automatic driving is one of the prospective applications using the LEX signal.



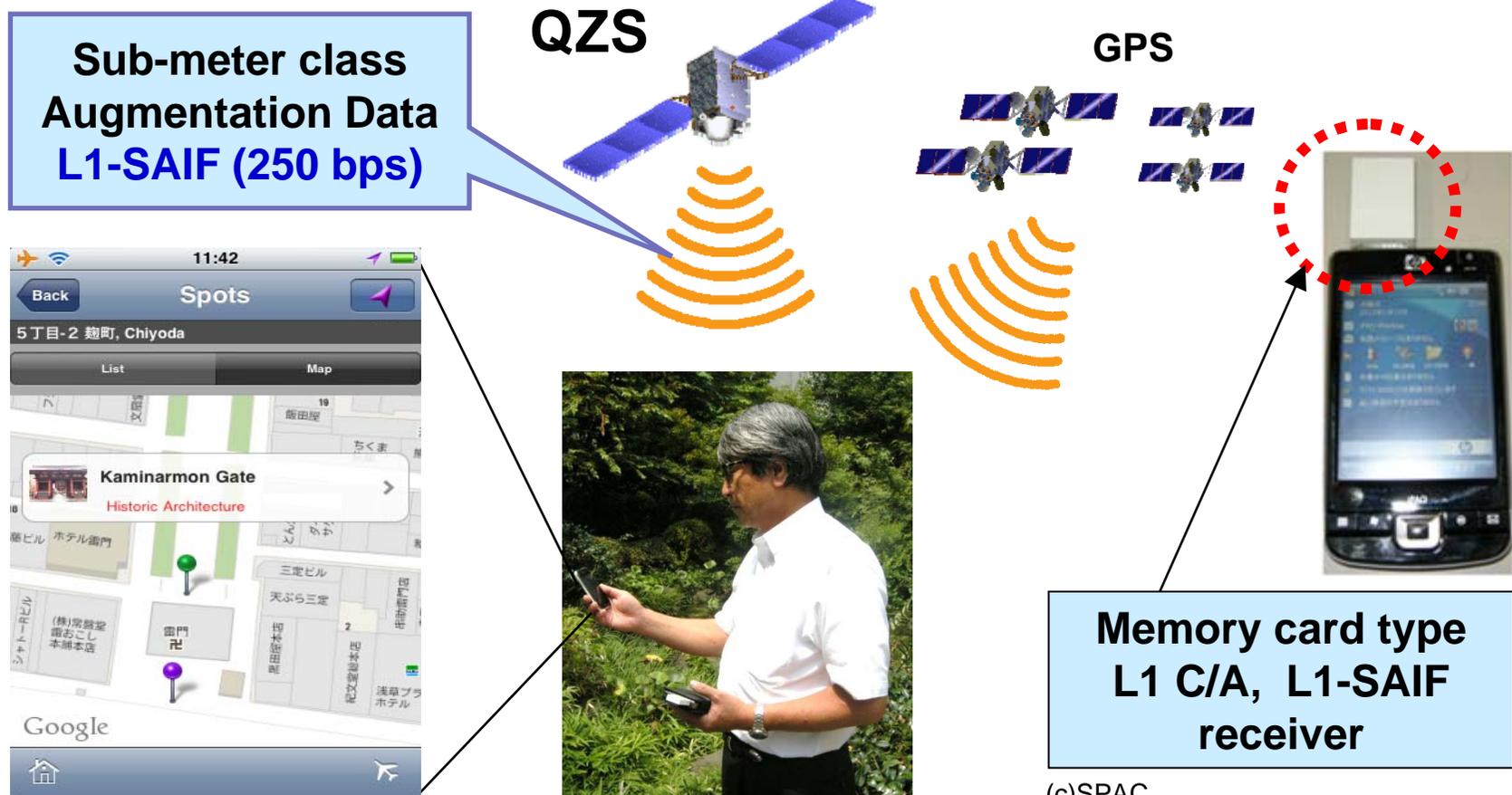
(c)SPAC

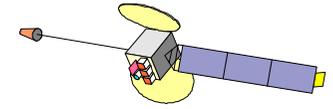


QZSS Application Verification by Private Companies

Tourist Navigation

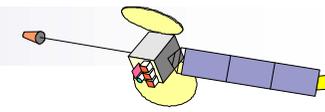
A memory card type receiver is used to receive L1 C/A and L1-SAIF signals.
A mobile smartphone shows pin-point location on the application and provides detailed map and contents.





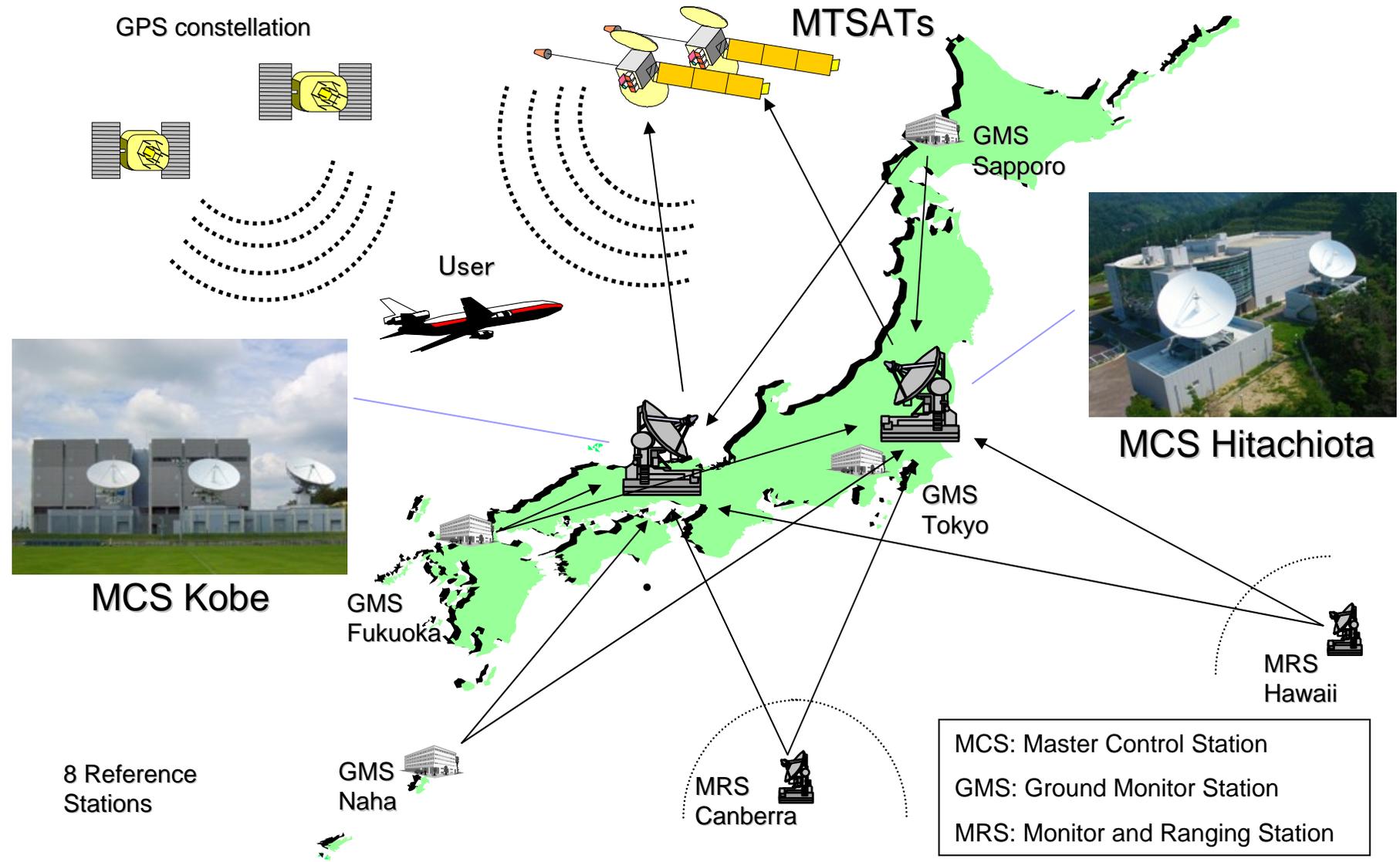
MSAS

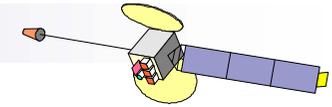
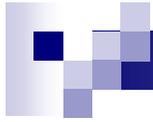
Multi-functional Transport Satellite
Satellite-based Augmentation System



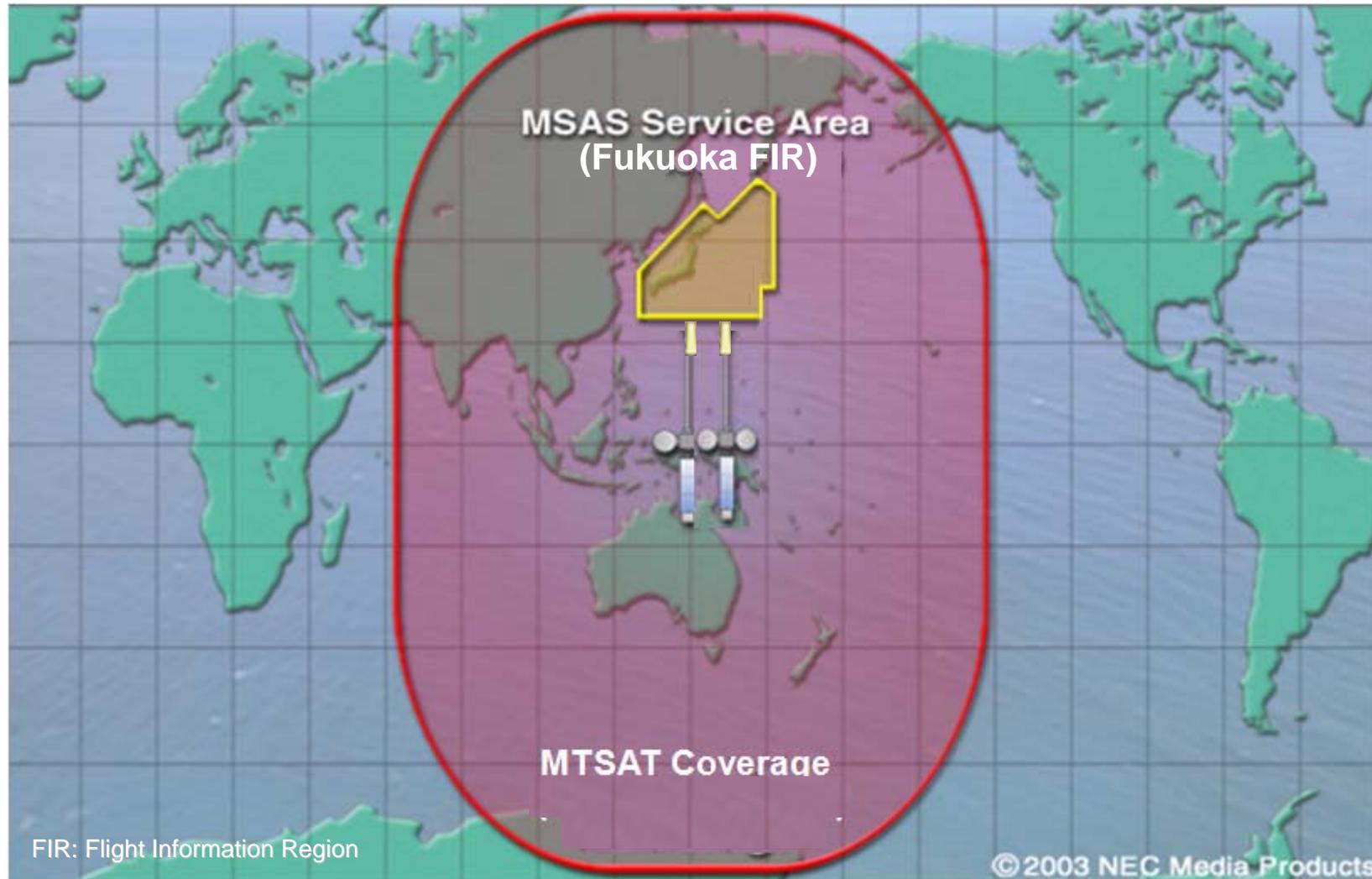
MSAS configuration

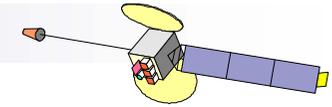
-Overall-





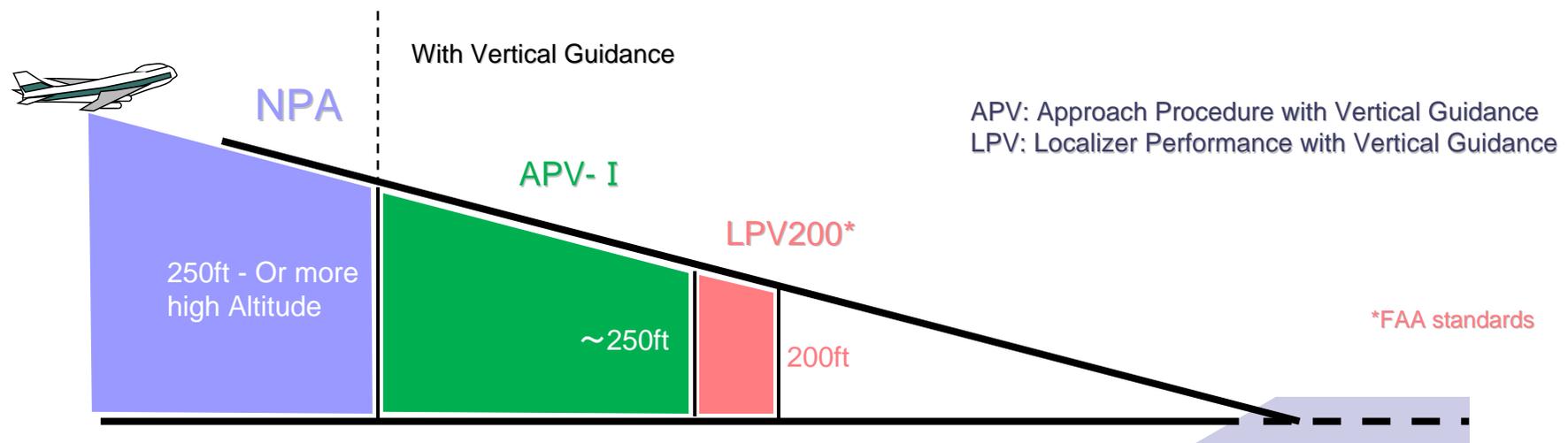
Coverage & Service Area

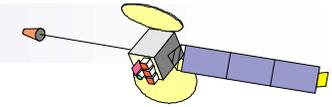




Current MSAS status

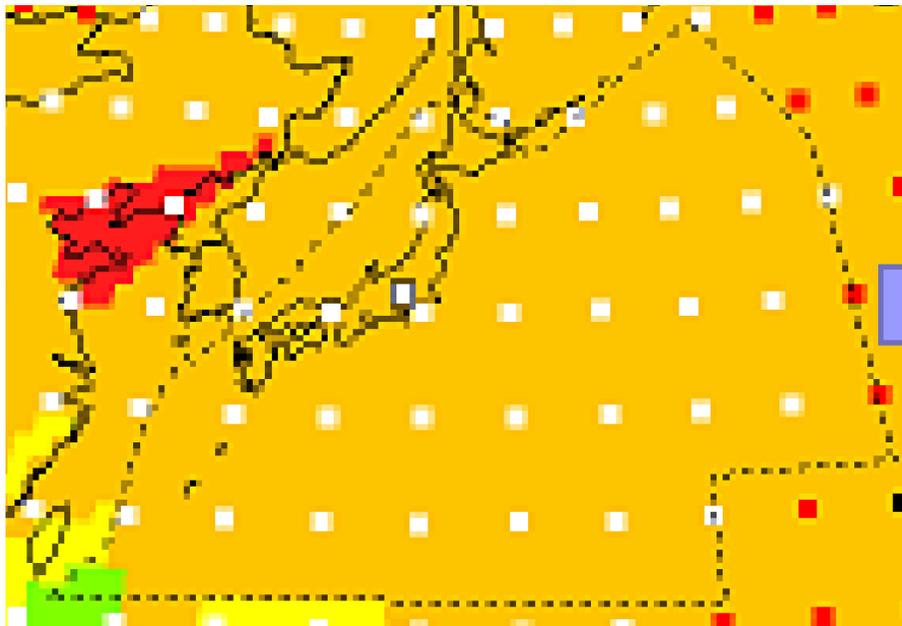
- MSAS is put into operation
 - Sep. 27, 2007
- MSAS provides air navigation service
 - For En-route to NPA (Non-Precision Approach)
 - Within Fukuoka FIR (Flight Information Region)
 - Currently provides horizontal guidance only



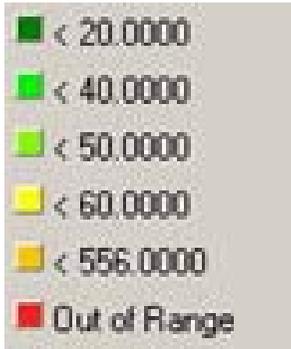
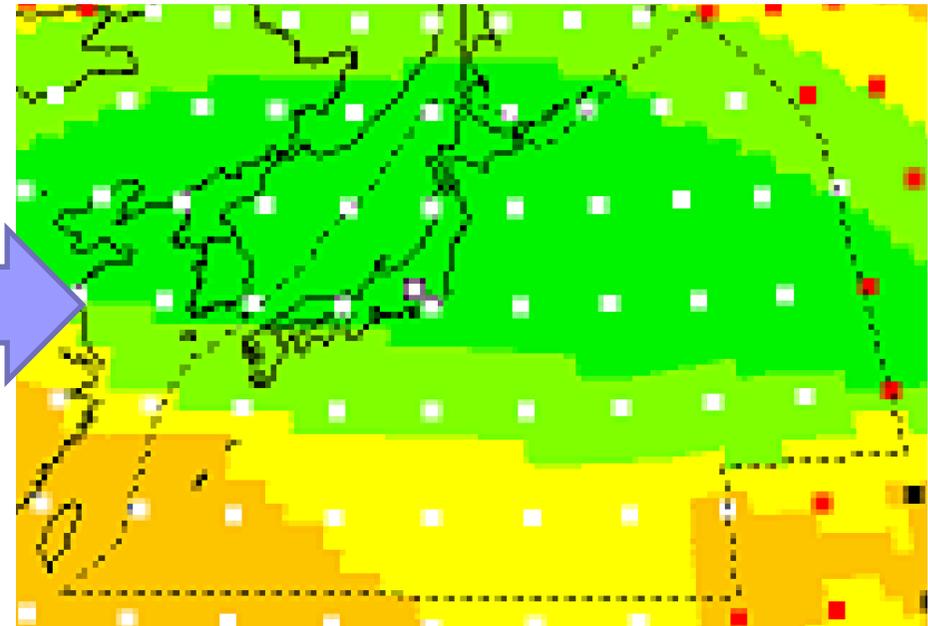


Current MSAS Performance

GPS Service Volume (NPA)



MSAS Service Volume (NPA)



HPL(m)

HPL: Horizontal Protection Level

The radius of a circle centered at the true aircraft position that is guaranteed to contain the indicated horizontal position within the specified integrity requirement. (e.g. 10^{-7} per flight hour for en route)

Dashed black line Fukuoka FIR