

# Future Plan of Quasi-Zenith Satellite System



Office of National Space Policy, Cabinet Office,  
Government of Japan

UN ICG WGA Intersession Mtg.  
IGS Workshop 2012  
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## QZSS Overview

# Quasi-Zenith Satellite System

## ■ **Functional Capability:**

- GPS Complementary
- GPS Augmentation
- Messaging Service

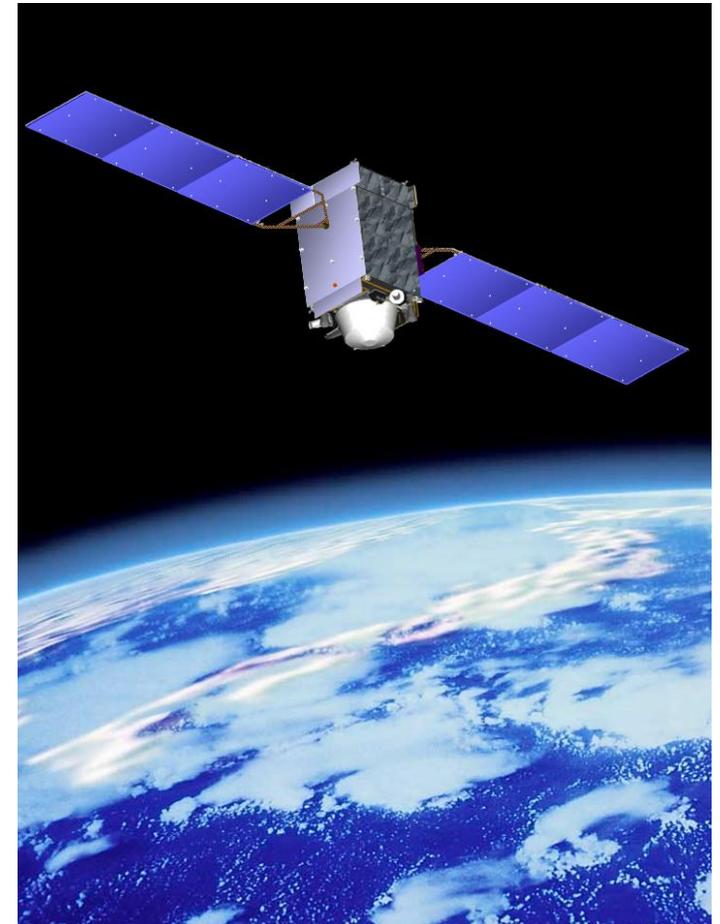
## ■ **Coverage:** Asia and Pacific region

## ■ **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



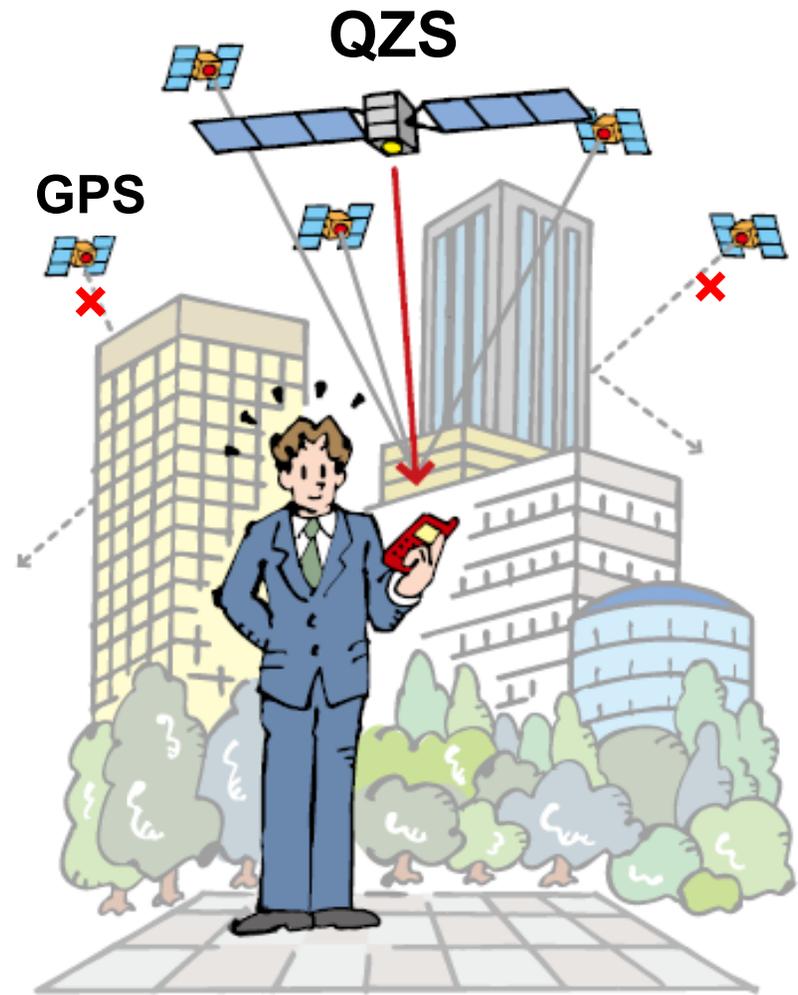
## QZSS Functional Capability 1

# GPS Complementary

**QZSS improves positioning availability time**

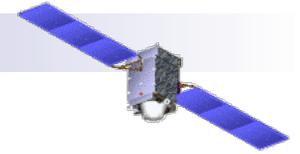
Navigation signals sent from high elevation will improve the time percentage of positioning availability from 90 % (GPS only) to 99.8 % \* (GPS + QZSS.)

\* 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 Augmentation



### QZSS improves positioning accuracy

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

#### Augmentation Data

- Acquisition Support Data
- Correction Data
- Integrity Data



QZSS

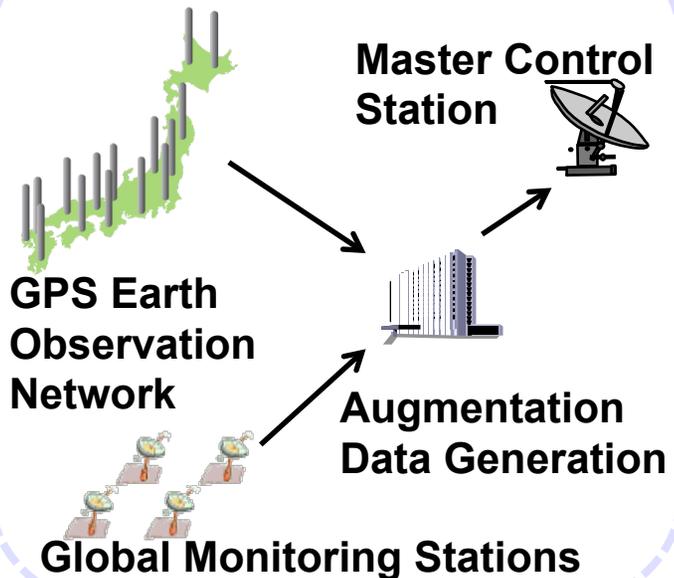
#### Navigation Signal



#### Navigation Signal and Augmentation Data

L1-SAIF (250 bps)  
LEX (2000 bps)

#### Ground Segment



#### User Segment



LEX  
centimeter

(accuracy)

L1-SAIF  
sub-meter



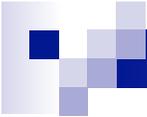
# QZSS Update

## ■ **Verification of QZS-1 MICHIBIKI**

- Technical Verification by JAXA
- Application Verification by private companies

## ■ **Basic policy on the implementation of the operational QZSS project** (*Cabinet Decision on September 30, 2011*)

- The Government of Japan has decided to accelerate the deployment of the operational QZSS as expeditiously as possible.



## ***Basic policy on the implementation of the operational QZSS project (1)***

*Cabinet Decision on September 30, 2011*

### **The QZSS will contribute to**

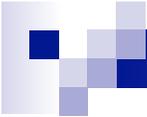
- **Welfare of the Asia and Pacific region**
- **Broad range of security including the improvement the capacity to respond to natural disasters**



## ***Basic policy on the implementation of the operational QZSS project (2)***

*Cabinet Decision on September 30, 2011*

- **GOJ has decided to accelerate the deployment of the operational QZSS as expeditiously as possible.**
- **Four satellites constellation shall be established by the late 2010s.**
- **In the future, seven satellites constellation shall be completed to enable sustainable positioning.**

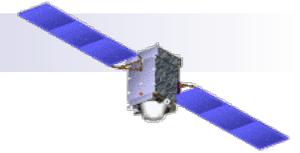


## ***Basic policy on the implementation of the operational QZSS project (3)***

*Cabinet Decision on September 30, 2011*

- **The Cabinet Office shall develop, deploy and operate the operational QZSS, based on the achievement of the first QZSS satellite MICHIBIKI, and shall submit a budget request to cover relevant cost.**
- **Legal amendments shall be made** in order for the Cabinet Office to fulfill such a role in time for budget implementation.

## QZSS Technical Verification of QZS-1 MICHIBIKI



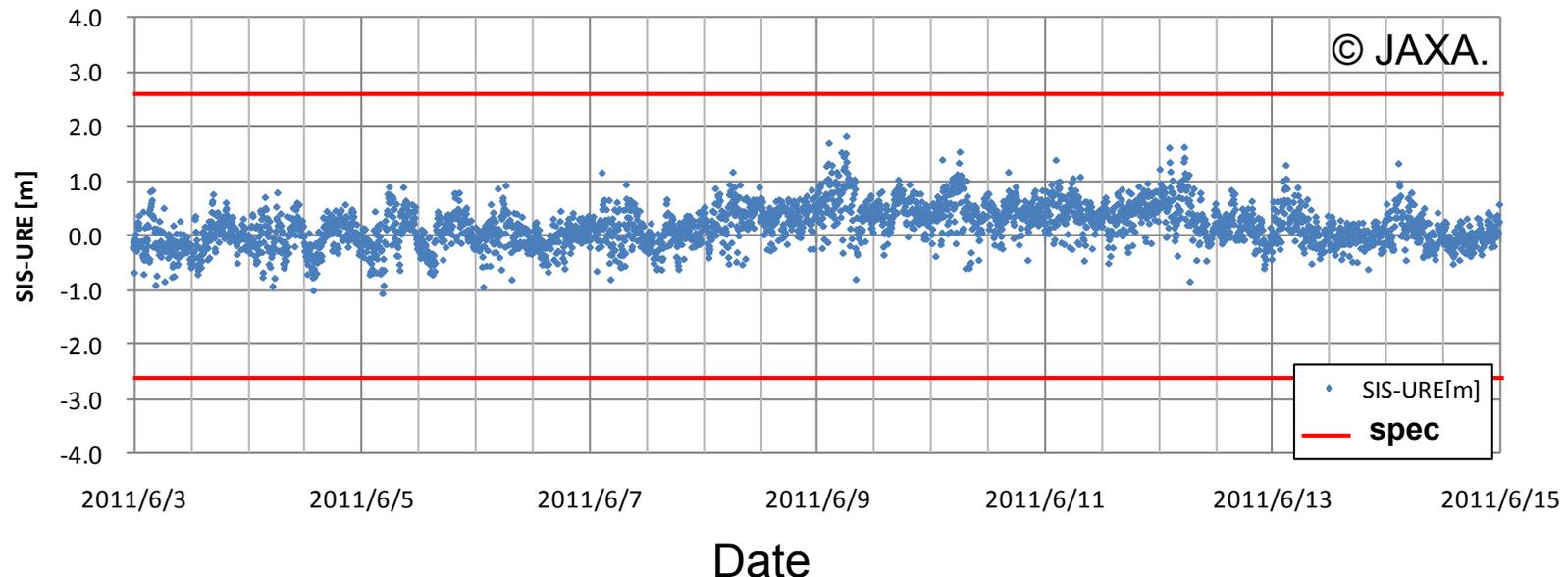
### Accuracy : Signal-in-space User Range Error (SIS-URE)

MICHIBIKI SIS-URE meets its specification, within +/- 2.6m (95%).

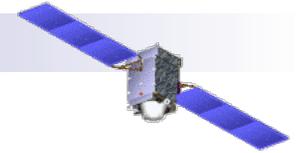
Its SIS-URE(RMS) is about 40cm and less than that of GPS, about 90cm\*.

(\*refer to GPS Program Update to CGSIC 2011)

[ MICHIBIKI SIS-URE (12days duration) ]

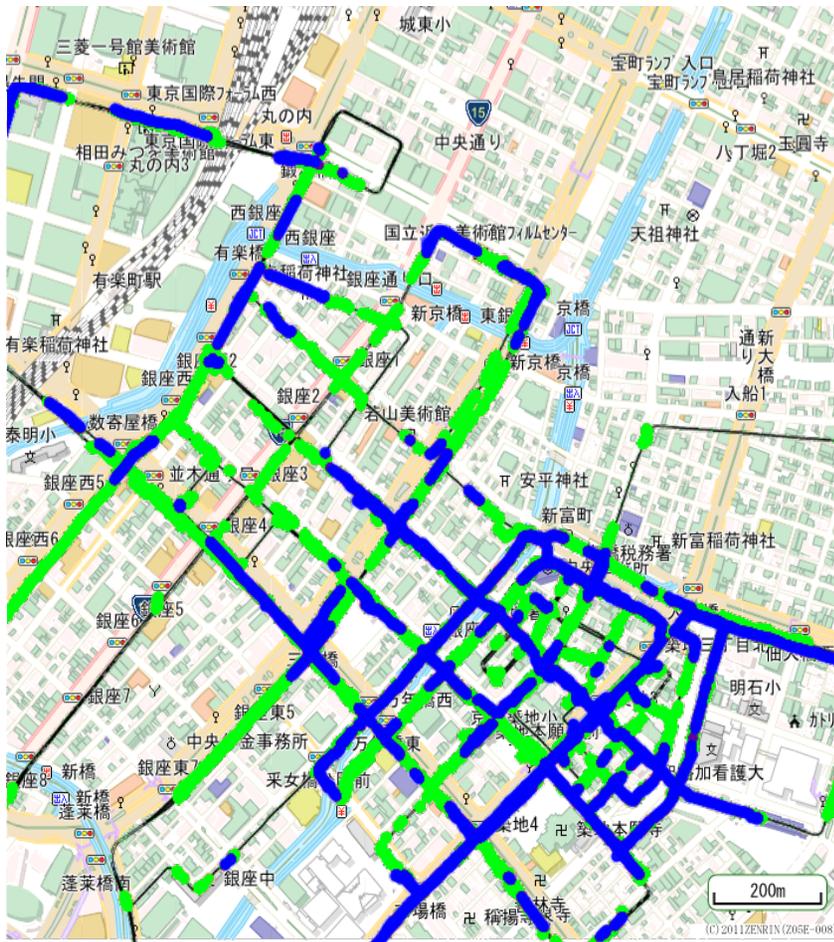


After we confirmed that MICHIBIKI performance including accuracy, integrity and availability met its specification, the L1-C/A and L2C signals were set healthy from June 22th, 2011. L5 and L1C signals were also set healthy from July 14th. MICHIBIKI has been working normally since those signals were set healthy.



# QZSS Technical Verification of QZS-1 MICHIBIKI

## Availability Improvement in Ginza, Tokyo (Feb. 19, 2011)



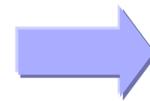
© 2011ZENRIN (Z05E-008)

- Reference route
- Positioning result of GPS stand-alone use
- Positioning result of GPS+QZSS combination use

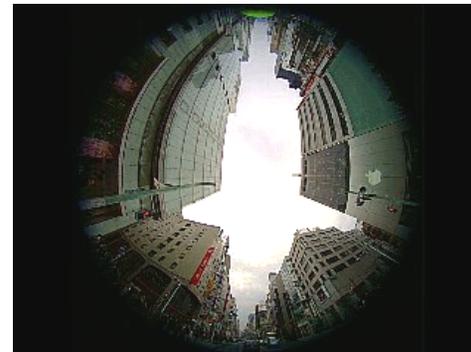
Date of Observation: 2011/2/19  
 250 minutes driving observation data during 6:00-12:30 obtained under JAXA-Melco joint research experiment

Single Frequency DGPS positioning  
 Availability

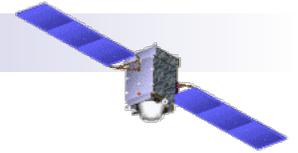
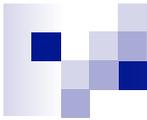
**GPS: 39.5%**



**GPS+QZSS: 69.1%**

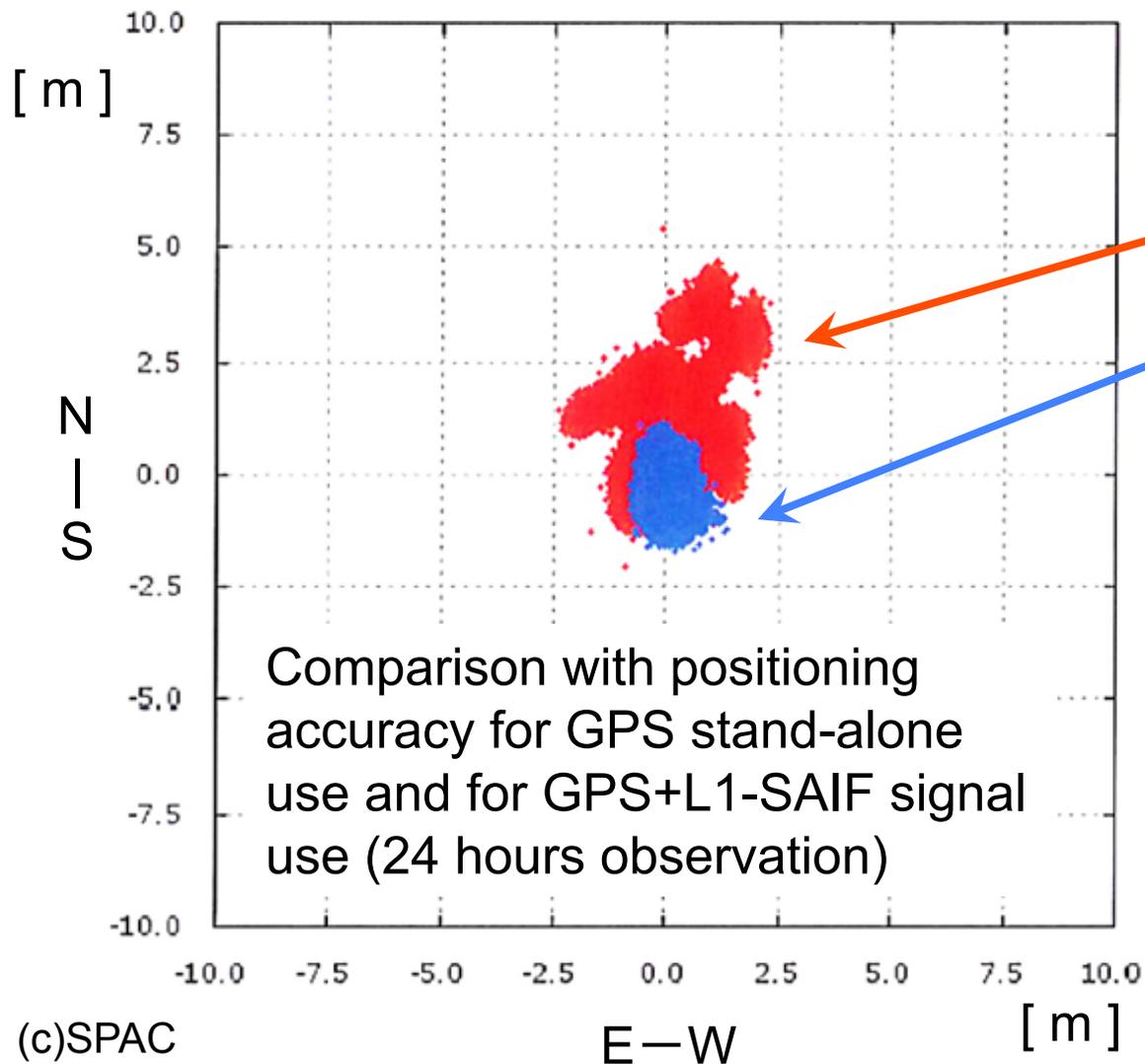


© JAXA.



## QZSS Technical Verification of QZS-1 MICHIBIKI

### Accuracy Improvement using augmentation signal L1-SAIF from MICHIBIKI



Positioning Error(RMS)

#### Horizontal

GPS Only

1.56m

GPS+  
L1-SAIF

0.46m

#### Vertical

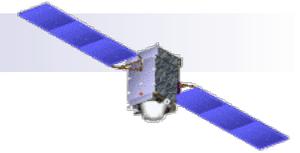
GPS Only

3.85m

GPS+  
L1-SAIF

0.57m

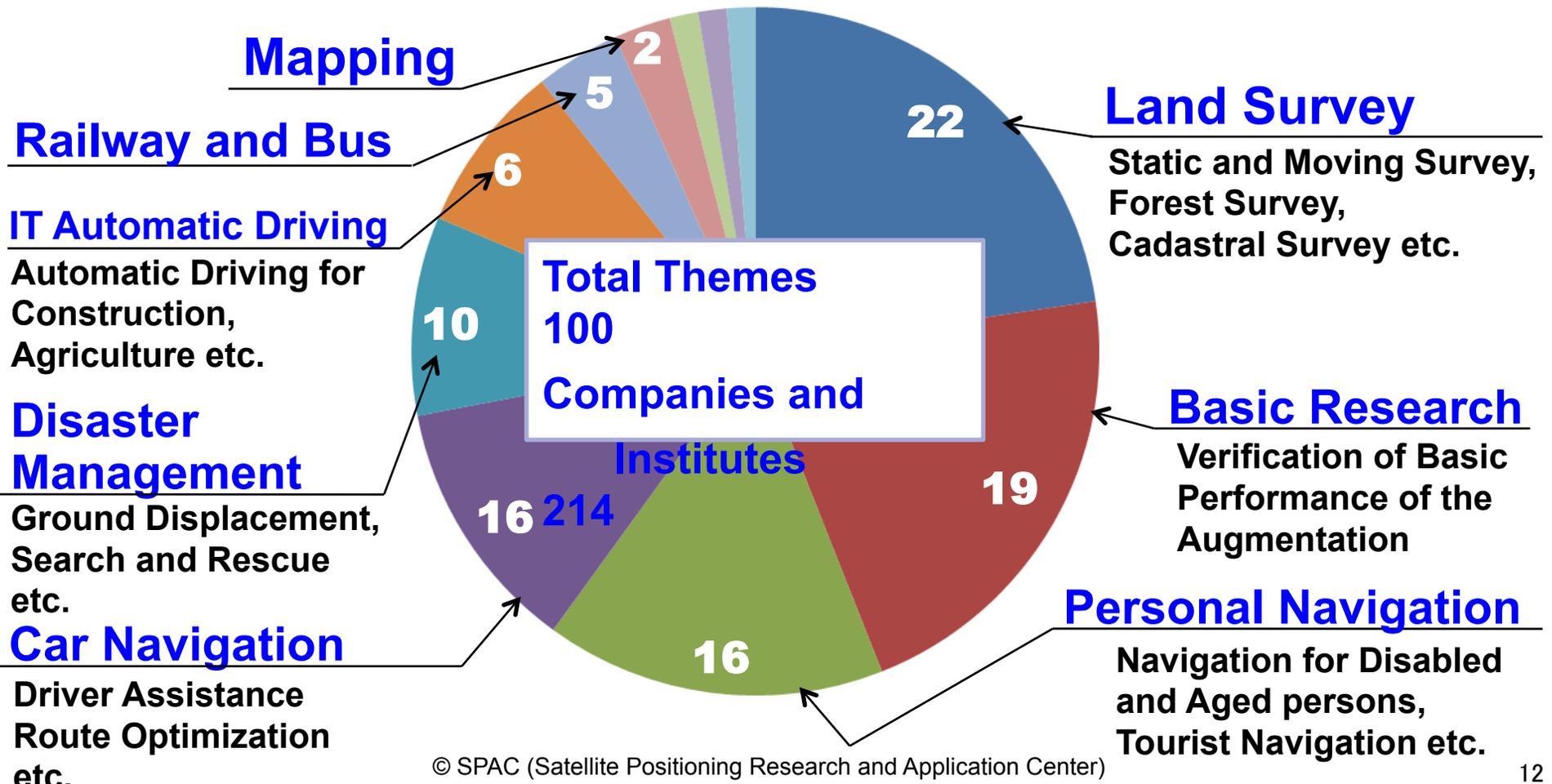
\*Observation Point  
GPS-based control station  
in Kawagoe, Japan, 5/3/2011

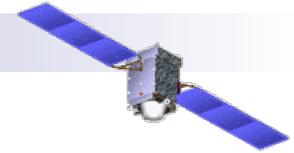
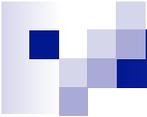


## QZSS Application Verification by private companies

# QZSS Application Verification Themes

Using augmentation signals L1-SAIF and LEX from QZSS, over 200 private companies have been verifying their applications under the coordination of SPAC.



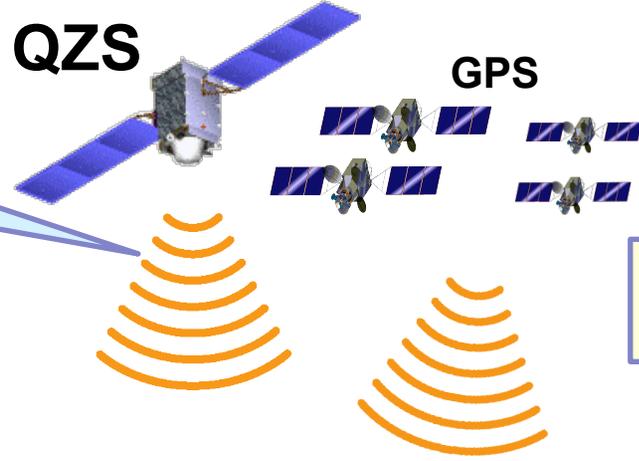


# QZSS Application Verification by private companies

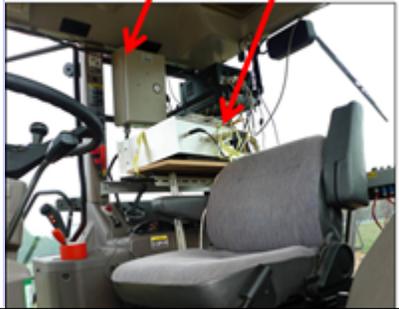
## Precision Agriculture based on IT Automatic Driving

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

**Centimeter class Augmentation Data LEX (2000 bps)**

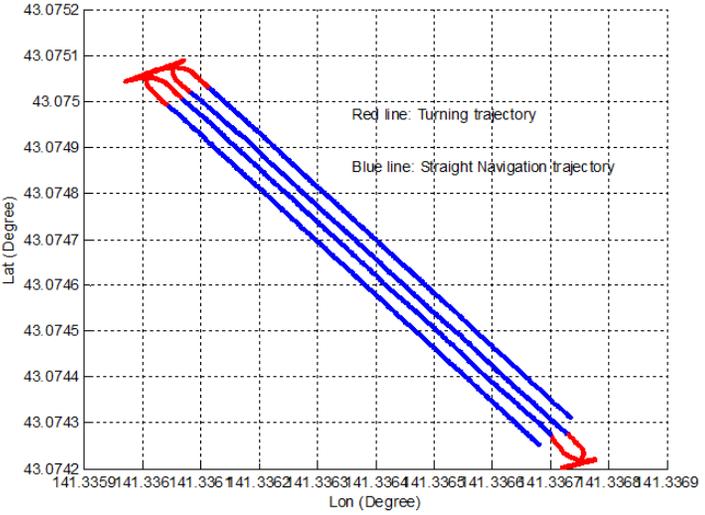


**Controller**      **LEX receiver**



Inside cabin

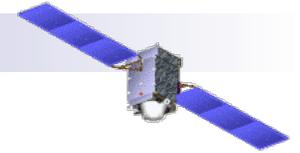
**Mobile unit for Low-speed Vehicle**



**Navigation map (target paths) for tillage by the robot tractor**



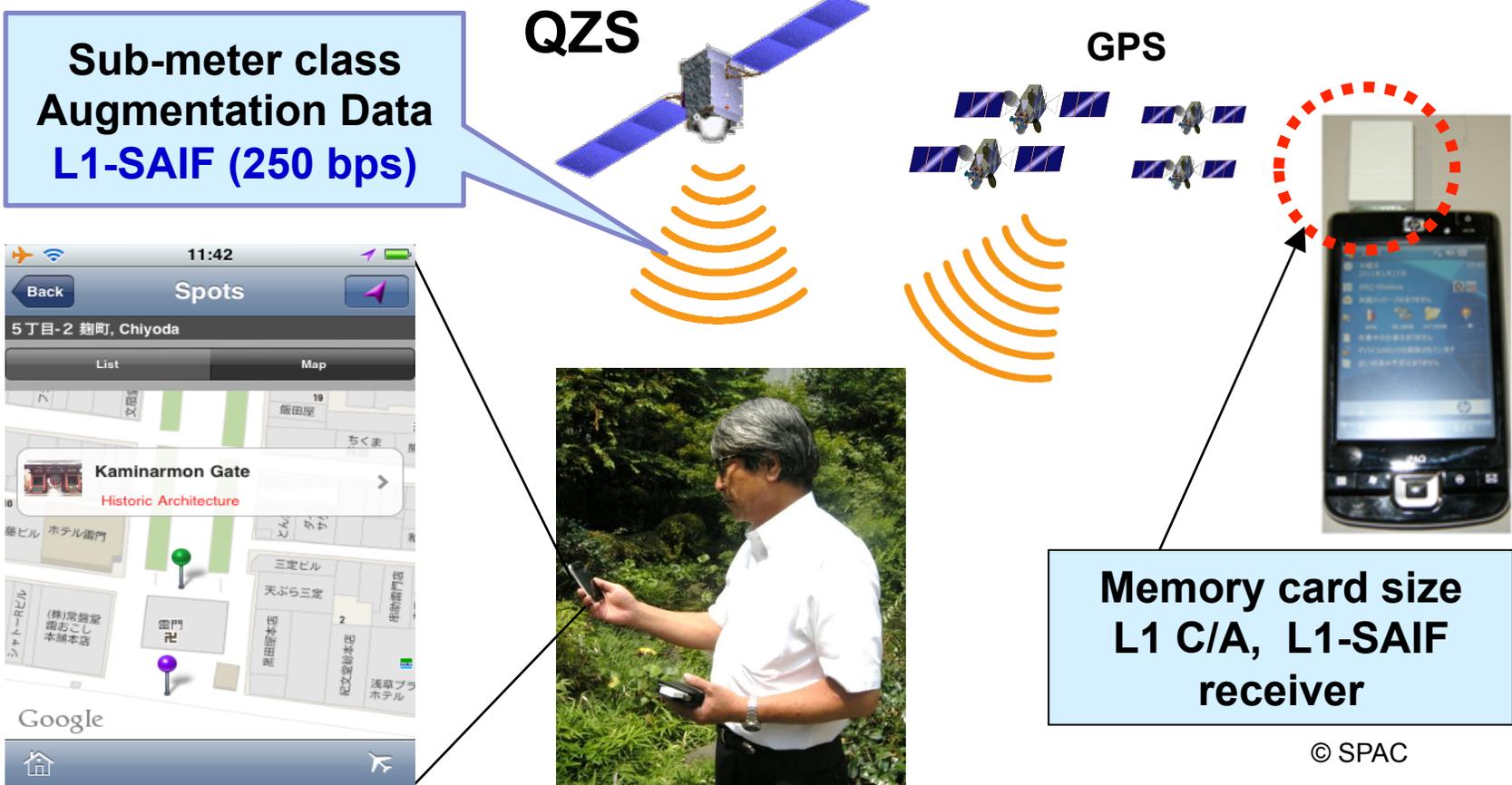
© SPAC

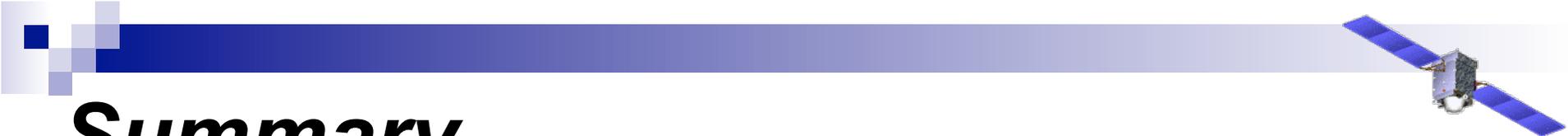


# QZSS Application Verification by private companies

## Tourist Navigation

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





# ***Summary***

- **QZSS is a regional space-based PNT system covers the Asia and Pacific region and transmits six civil PNT signals.**
- **The cabinet decided basic policy on the implementation of the operational QZSS project.**
- **GOJ has decided to accelerate the deployment of the operational QZSS as expeditiously as possible. Four satellites constellation shall be established by the late 2010s.**
- **Technical & applications verification of QZSS are being conducted continuously.**