



Project Overview

Quasi-Zenith Satellite System

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Q Z S System Services Inc. (QSS)

Agenda



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System Overview



Functional Capability:

GNSS Complementary

GNSS Augmentation

Messaging Service

Coverage: Asia and Pacific region

Signals(QZS-1):

L1C/A, L1C, L2C and L5

L1S (L1-SAIF) on 1575.42 MHz

L6 (LEX) on 1278.75MHz

1st QZSS satellite “MICHIBIKI”

**Four satellites constellation shall be established
and the service will start in 2018.**



Project Overview



National undertaking, “Quasi-Zenith Satellite System(QZSS)” operated by the Cabinet Office of Japan was divided to 2 divisions since end of 2012 : Satellite System (project under ministerial jurisdiction), and Operation System (PFI).

	Operation System project of QZSS (QSS/PFI project)	Satellite System project of QZSS
Term	2012~2032	2012~2016
Outline	<ul style="list-style-type: none">①Design and examination of Total System.②Promotion of QZSS Utilization③Improvement, maintenance, and management of Ground System.④Accomplishment of the Total System operation. Total 4 satellites (MICHIBIKI and 3 QZSS) will be operated.	Development of 3 QZSS (2 QZS orbit/1 geostationary orbit satellite) (project under ministerial jurisdiction)

Quasi-Zenith Satellite System (QZSS)

QZSS is positioning satellite system for complement and augment GPS.

【Contribution】 :

- GNSS capability, Asia-Pacific region
- Japan - U.S. cooperation
- Enhancement of disaster management and national security

【Plan】 :

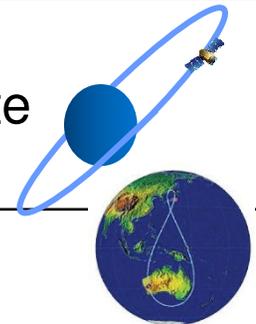
Prepare the 4 satellites constellation(3 QZS orbit + 1 Geostationary orbit) by the end of 2010s. In the future, seven satellites constellation shall be completed to enable continuous and more sustainable positioning.

【Current status】 :

System and application verification by using the first satellite, MICHIBIKI.

【Number of satellites】 (as of the beginning of 2018JFY)

QZ orbit: 3 satellites constellation, Geostationary Orbit: 1 satellite

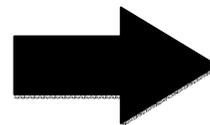


Positioning Signal of QZSS (as of Feb. 2014)



Positioning signal of QZSS					
Not only positioning complementation signal, but satellite orbit, time, and ionosphere correction information will be also transmitted as augment information					
L1C/A	1575.42MHz	Positioning	complement GPS	1st satellite	2nd to 4th satellite
L1C		Positioning	complement GPS	1st satellite	2nd to 4th satellite
L1S		Augmentation		1st satellite (L1-SAIF)	2nd to 4th satellite
L2C	1227.60MHz	Positioning	complement GPS	1st satellite	2nd to 4th satellite
L5	1176.45MHz	Positioning	complement GPS	1st satellite	2nd to 4th satellite
L5S		Augmentation Experimental Use			2nd to 4th satellite
L6	1278.75MHz	Augmentation		1st satellite (LEX)	2nd to 4th satellite

「L1C/A」 is the common signal for positioning



QZSS is the only satellite positioning system which provide the 「L1C/A」, without US-GPS.

Project Schedule



JFY	2012	2013	2014	2015	2016	2017	2018	2019	2020~
Total Project Schedule		System Design Interface Spec. (Preliminary Ver.)			End to End Test Total Evaluation Test			In-Service (QSS)	
Present MICHIBKI(No.1)		In-Operation			Transition (JAXA → QSS)				
Satellites (No.2-4)	Contract (March)	Design/Manufacture/Test				Launch	No.2,3,4 (Estimate)		
Ground System	Contract (March)	Design/Manufacture		Construction and Test					

Mission of QZSS



QZSS provides positioning- related service and messaging- related service.

Positioning- related service

① Positioning complementation service

The service to provide the same as GPS satellites in spite of urban area or mountain area.

② Sub-meter Level Augmentation Signal service

The service to provide accurate positioning around 2-3 meters. (※)

③ Centimeter Level Augmentation Signal service

The service to provide highly accurate positioning around 10 centimeters. (※)

※ Ionosphere disturbance(fluctuations), multipath and others will affect the accuracy.

Messaging- related service

④ Short message delivery service

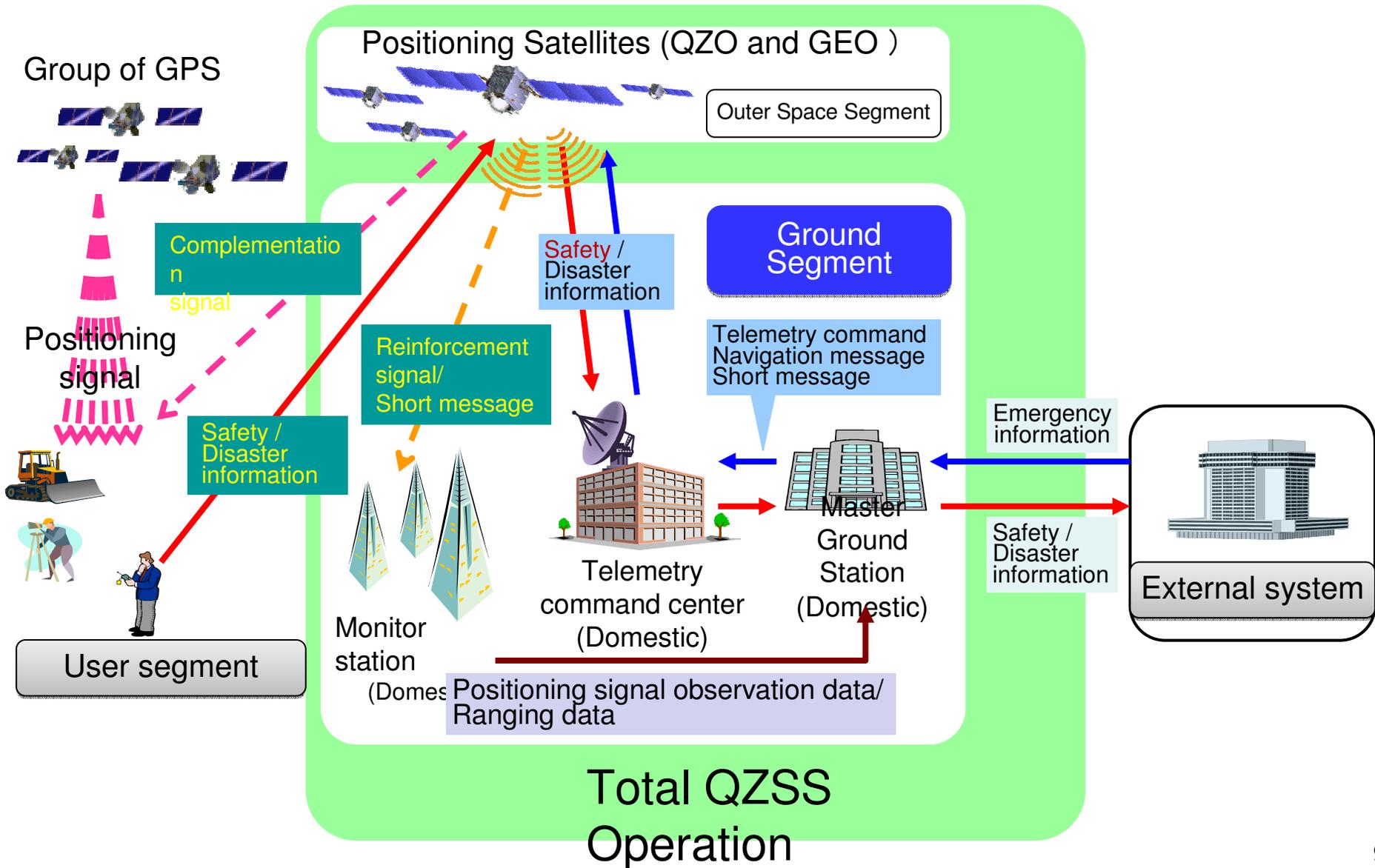
The service to provide for users in the field of disaster management and rescue .

※ Additional Service (Experimental Use) will be available on L5S Signal.

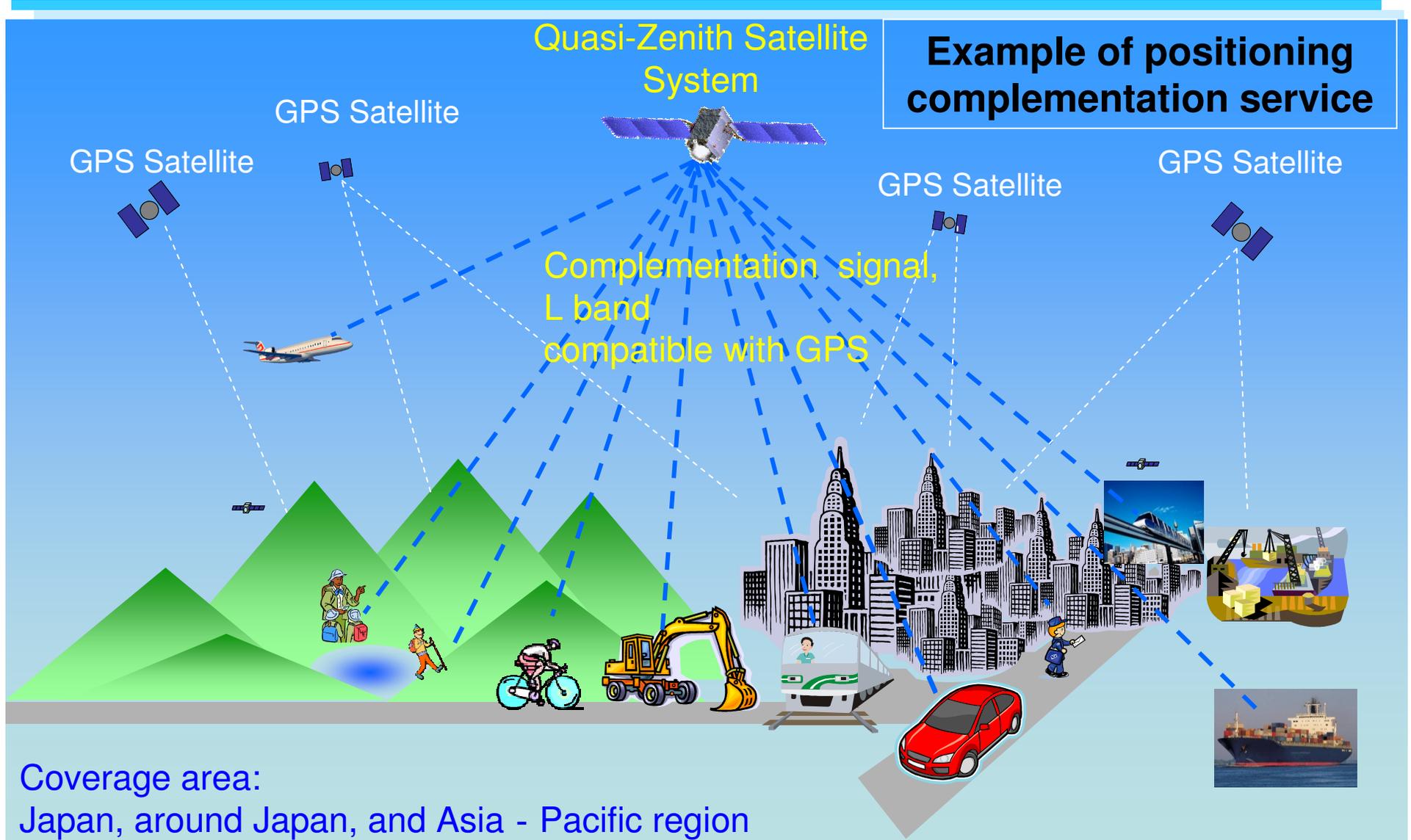
②, ③, ④ :

These services are under investigation for overseas users.

Conceptual Scheme of QZSS Operation



Outline of Positioning-related Service



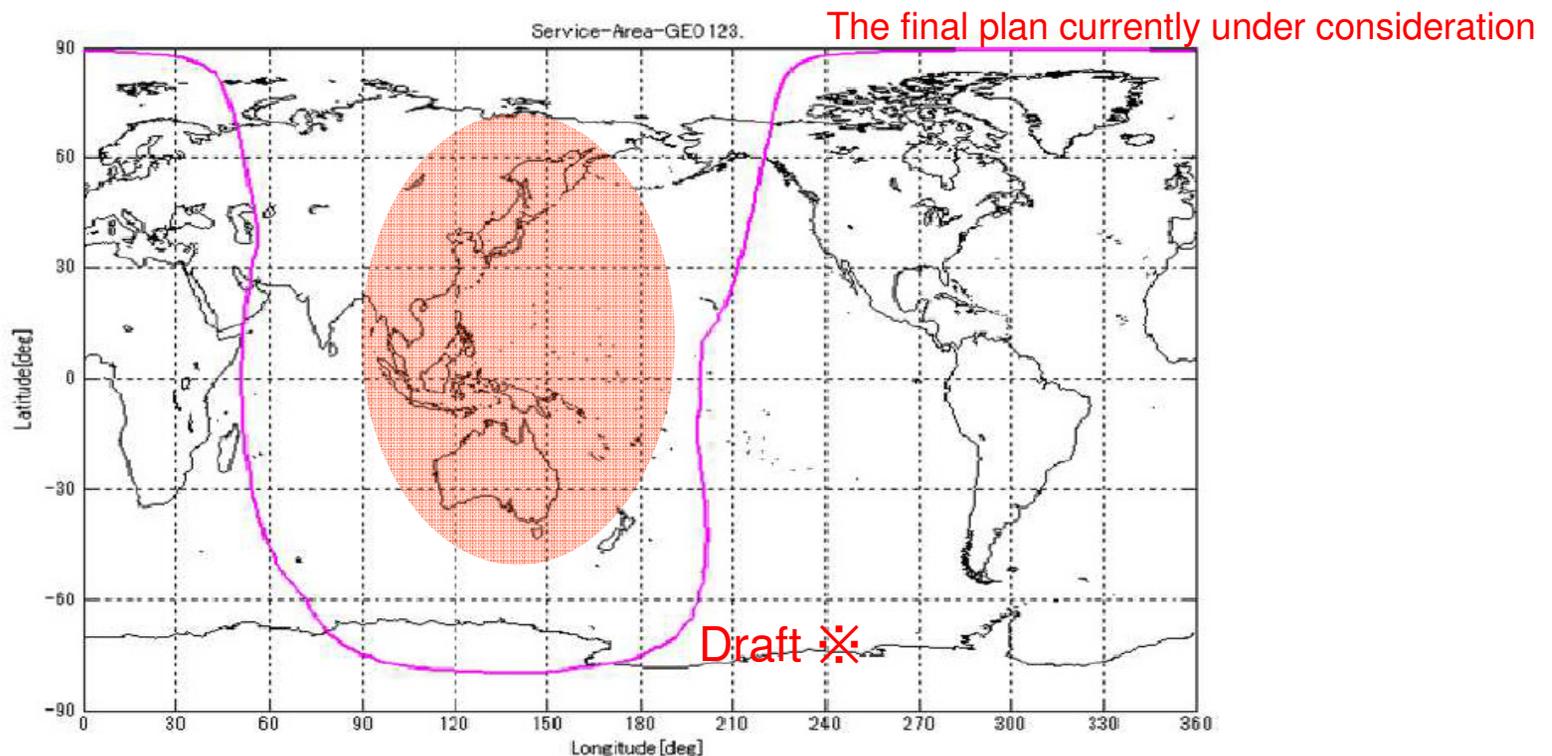
QZSS Service: Positioning related Service



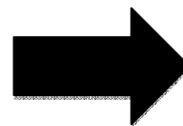
① Positioning complementation Service

【Service Range】

More than 10 degrees elevation to QZS constellation



High compatibility with
the GPS satellite



Contributing to the reduction
of positioning error

② Sub-meter Level Augmentation Signal (SLAS)



Sub-meters Level Augmentation Signal	
Transmit 「L1S」 signal which has same frequency modulation with 「L1C/A」 , in order to positioning augmentation.	
Accuracy of positioning : Sub-meter level (Ionosphere disturbance(fluctuations), multipath and others will affect the accuracy.)	
Private consumer is suitable user since dual frequencies receiver is overpriced and short battery duration	
For Private Navigation	<ul style="list-style-type: none">▪ Sightseeing, shopping information▪ Emergency point report (#110/#119)
For Public Transportation Navigation	<ul style="list-style-type: none">▪ Management of Airplane, ship/vessel, bus/taxi operation
For Disaster/Crisis Management	<ul style="list-style-type: none">▪ Searching activity, local security

② Sub-meter Level Augmentation Signal (SLAS)



【Service Range】

Japan, and around Japan (※As of Feb. 2014)

Direction of altitude is up to 10000m

(Asia-Pacific region is under consideration)

【Precise positioning】

- Region 1 : North from latitude 30 degree : 2~3m
- Region 2 : South from latitude 30 degree : ~10m

※Accuracy effects on Ionosphere

-South “Region 2” is effected area and precise positioning become lower.

Compare to GPS, Sub-meter Level Augmentation Signal service improve the positioning accuracy twice to five times.

Region	Non-active time of Ionosphere				Active time of Ionosphere			
	horizontal		vertical		horizontal		vertical	
	Sub-meters	GPS only	Sub-meters	GPS only	Sub-meters	GPS only	Sub-meters	GPS only
Region 1	2	3~12	3	6~14	Same results with Non-active rime of Ionosphere			
Region 2	3	5.5~7	4	9~10	10	16~17	10	17~20

The final plan currently under consideration

Expected scene to use

—positioning related service

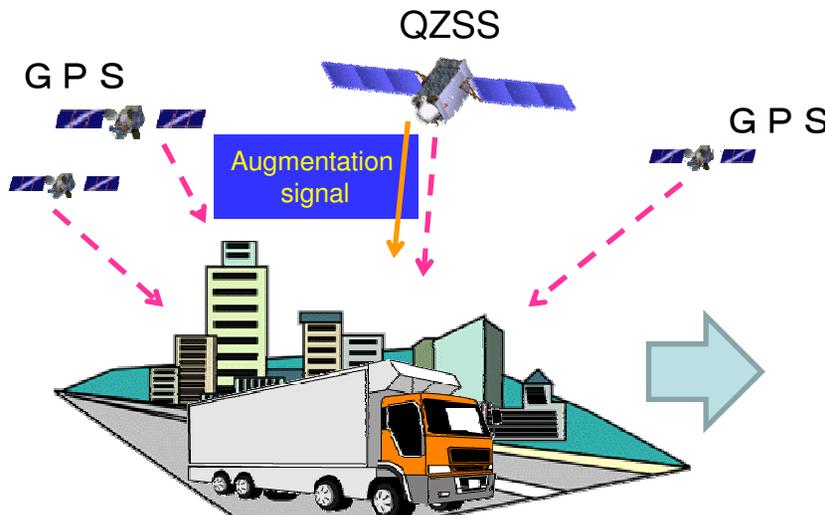


< Sub-meter Level Augmentation Service >

【Expected scene】

Logistic industry requires perfect tracking service since valuable package or priority mail needs high security.

QZSS system will provide higher positioning information compare to the tracking service with using GPS only.



Measure the positioning information and send it to the center



Center

③Centimeter Level Augmentation Signal (CLAS)



Centimeter Level Augmentation Signal (CLAS)	
Peculiar signal (frequency) which GPS satellite has not supported. This signal, 「L6」, will be transmitted for positioning augmentation. (Reference Points are necessary)	
Accuracy of positioning : Around ten-centimeter level (Reference points are necessary)	
Target user is professional who require high precision positioning	
For Driving Navigation	<ul style="list-style-type: none">▪ Computer aided construction by automatic construction machine (IT Construction)▪ Automatic agriculture machine (IT-Agriculture)
For Land Survey	<ul style="list-style-type: none">▪ Precise Land Survey

③Centimeter Level Augmentation Signal (CLAS)

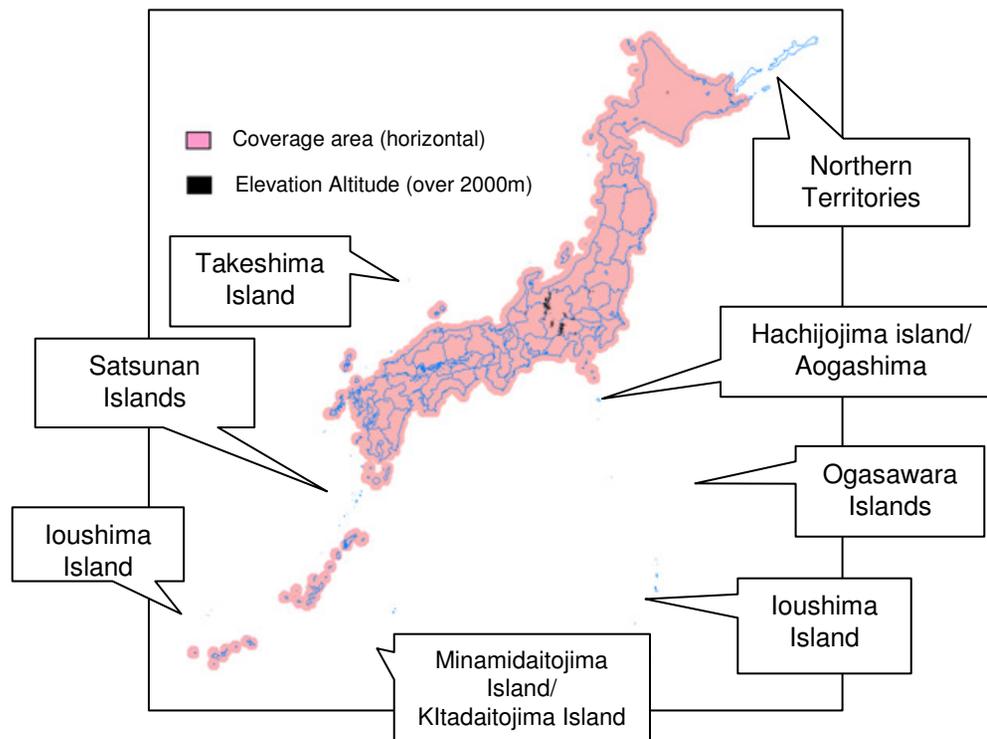


< Centimeter Level Augmentation Service >

【Coverage Area】

Within 20km radius from GNSS-based station which placed all over Japan
Up to 2000m of altitude direction is available

(Service for Asia-Pacific region is under consideration)



As of October 2013
Accuracy improvement and coverage enlargement is under investigation

③Centimeter Level Augmentation Signal (CLAS)

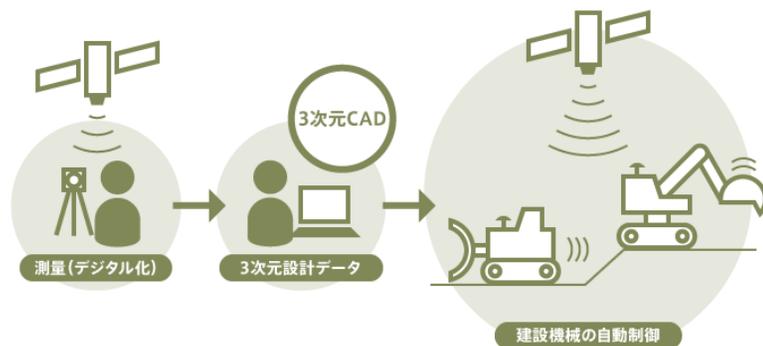


【Expected scene to use】

High positioning accuracy is available since distances from the GNSS-based stations are calculated using data from these control station.

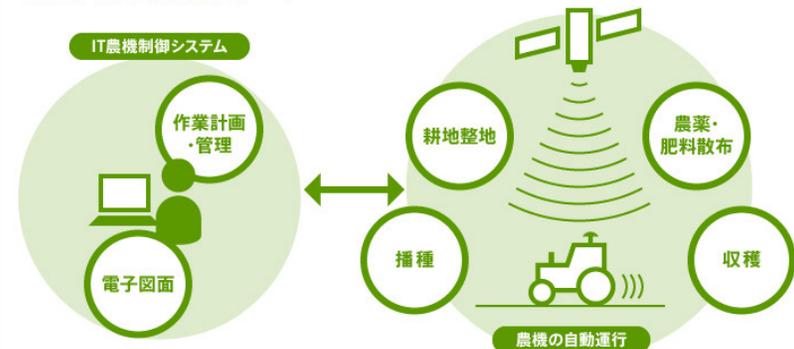
It is expected to use for intelligent construction and precision farming as well.

情報化施工イメージ



測量から本工事まで準天頂衛星システムが有効にサポート。
機械の自動化・少人数化で大幅な効率化が可能に。

衛星システムと農業イメージ



IT農業では単なる農機の自動運行による省力化のみならず、場所ごとに異なる
土壌に合わせた農薬・肥料散布等により生産量向上も図る。

Comparison of Augmentation information



Comparison of augmentation information (with 8 visible satellites)

	L1C/A With	Horizontal positioning (approximately)		Correction for Ionospheric reflection	Trouble Alarm	permanent GPS monument
Single positioning (1 frequency)	-	Only GPS	10m	×(None)	No Alarm	unnecess ary
		GPS+QZS	5m			
Correction for Ionospheric reflection of L1C/A signal	-	Only GPS	3m	○ (Augmentation information)		
		GPS+QZS	2m			
Single positioning (Dual frequencies)	L2C or L5	Only GPS	2m	◎ (self calculation)		
		GPS+QZS	1m			
Single positioning RAIM (Dual frequencies)		Only GPS	1m		Less than 0.1 sec	
		GPS+QZS	0.4m			
Sub-meters Level Augmentation	L1S	2m		○ (Augmentation information)	6 seconds	
Centimeters Level Augmentation Signal	L6	~10 cm (few cm fluctuations)			10 seconds	necessar y

Horizontal Positioning Accuracy is a number of mainland Japan for, Region 1

QZSS Service: Positioning related Service

④ Short message (Disaster/Risk management report) delivery service



By using reserve space of 「L1S」 signal, **Short message (Disaster/Risk management report) can be transmitted.**

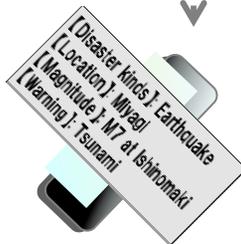


Able to use 「L1S」 receiver.
(GPS/Michibiki receiver)

Message Sample

【Disaster】 : Earthquake
【Location】 : Miyagi
【Magnitude】 : M7 at
Ishinomaki
【Warning】 : Tsunami

Short message :
Earthquake, Tsunami, Volcano
Explosion of factory, Mountain fire
Terrorist attack, Large accident



**This service is under investigation
for overseas users.**

Positioning Demonstration Platform



Positioning Demonstration Platform

Provide an application demonstration opportunity for high-precision satellite positioning technology of the next generation.
(L5S)

Function, Interface Specification and details will be released with IS-QZSS.

QZSS Program Status



- ***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.
 - Four satellites constellation shall be established by the 2018JFY.
 - In the future, seven satellites constellation shall be completed to enable sustainable positioning.
- ***Verification of QZS-1 MICHIBIKI***
 - Technical Verification by JAXA.
 - Application Verification by private companies.

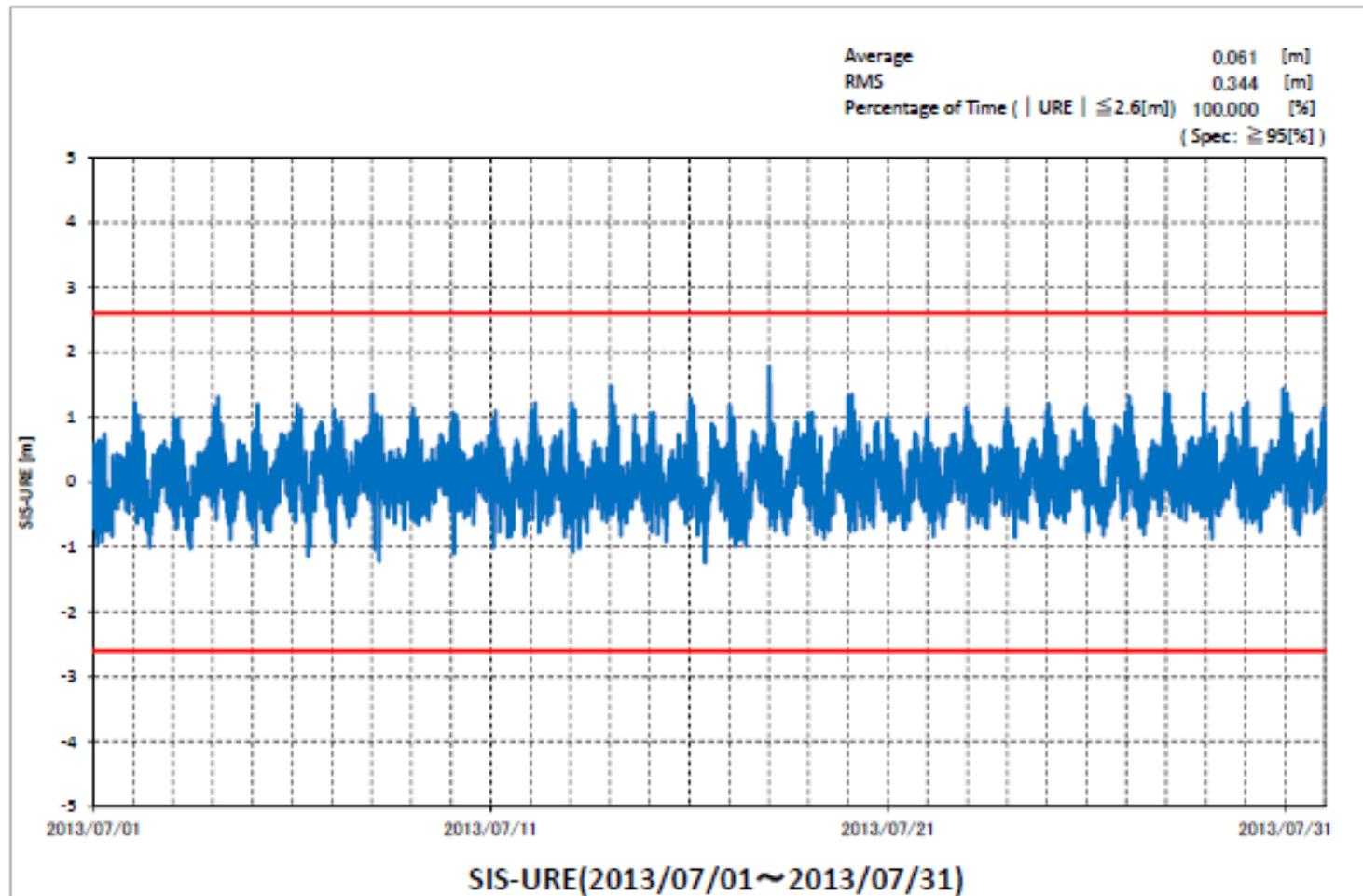
QZSS Technical Verification of QZS-1 MICHIBIKI

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 & less than that of GPS's target, about 90cm*.

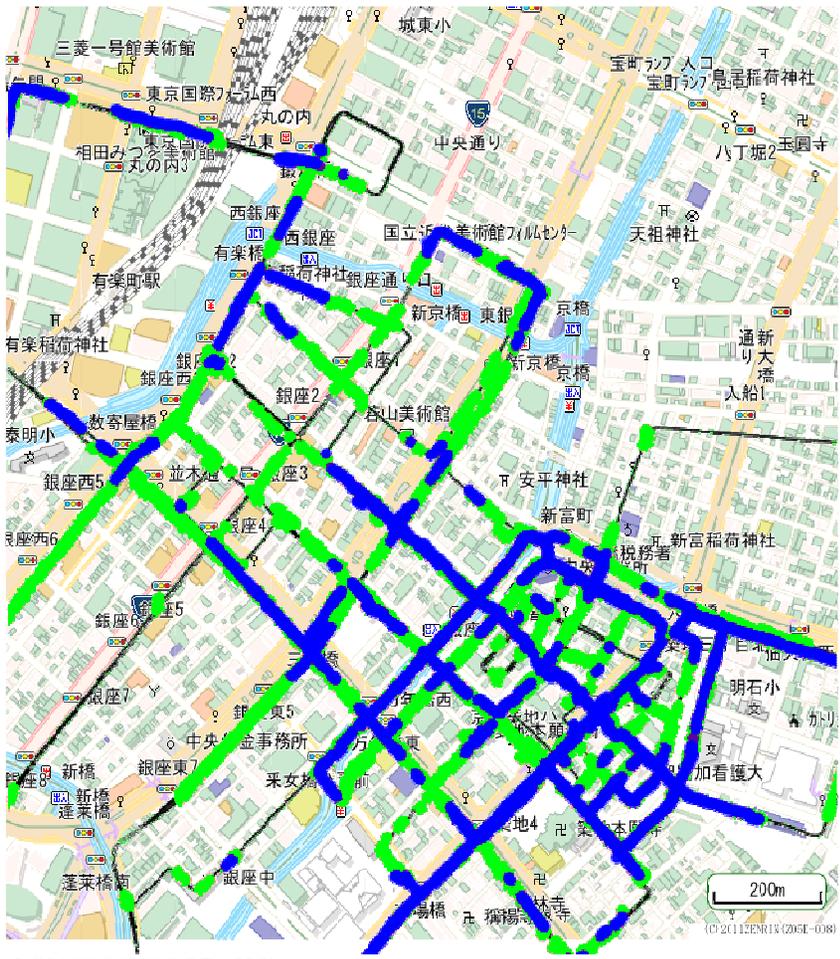
(*refer to GPS Program Update to CGSIC 2011)



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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

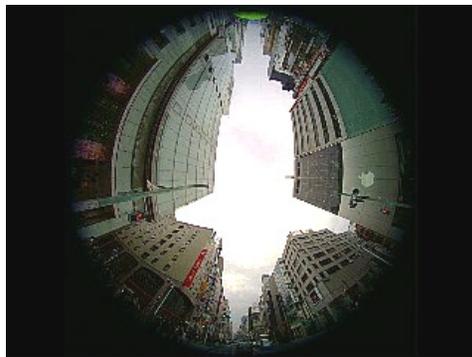
Date of Observation: 2011/2/19
 250 minutes driving observation data during 6:00-12:30 obtained under JAXA-Melco joint research experiment

Single Frequency DGPS positioning Availability

GPS : 39.5%



GPS+QZSS : 69.1%



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QZSS Commercial Application : Precision Farming



Robot Tractor

Robot controller

QZSS receiver



Antenna of QZSS



Soil preparation



Weeding



Transplanting



Tillage



Fertilizing and planting



Chemical splaying



Puddling



Harvesting

Overall travel accuracy of the robot tractor using correction signal by QZSS-LEX



	Lateral error (m)
Path #	QZSS
1	0.035
2	0.027
3	0.036
4	0.031

Summary of Precision farming



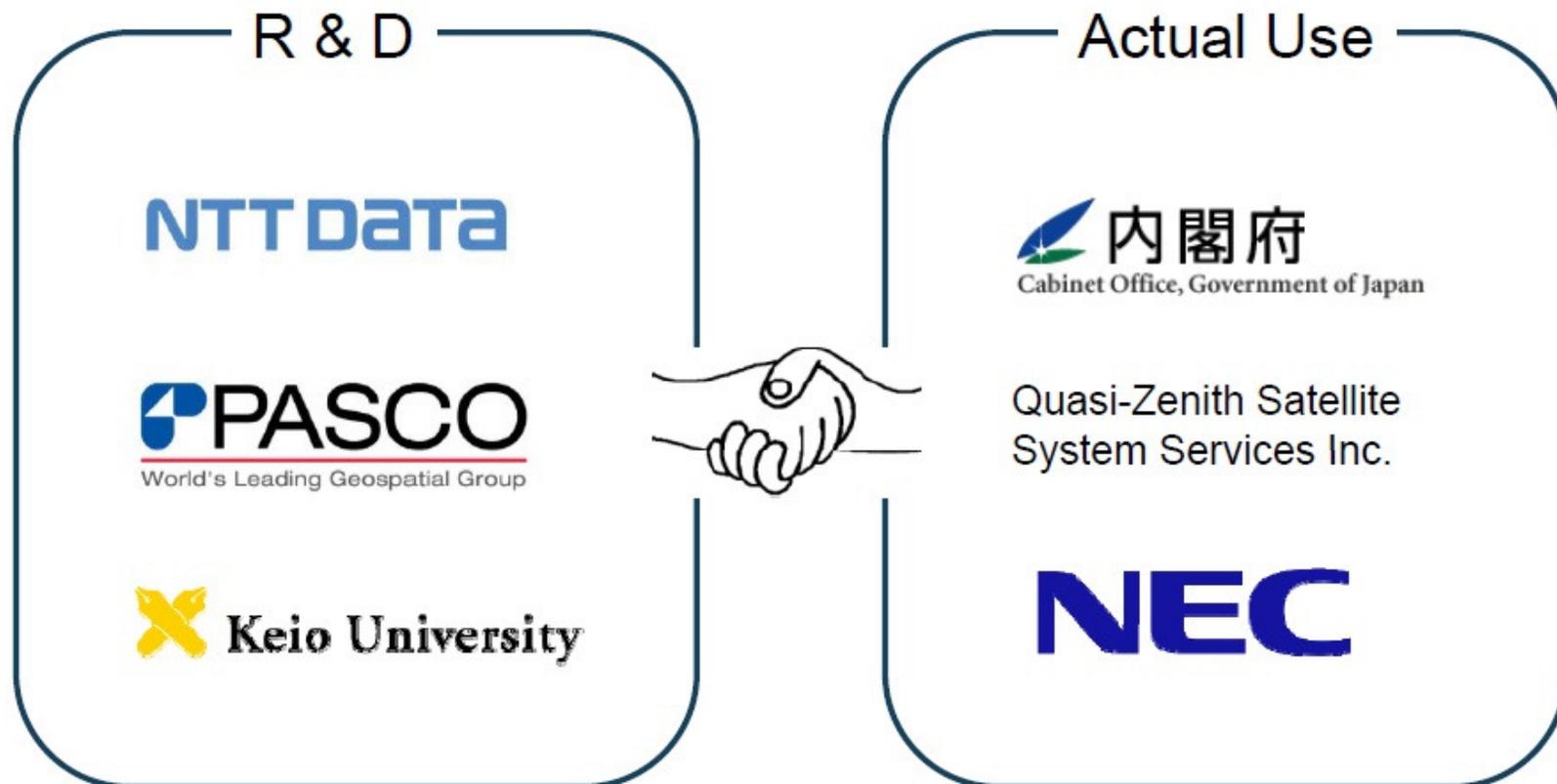
- ✓ Precision farming is important technology for sustainable development.
- ✓ Robot farming systems will be adopted in Japan within three years.
- ✓ Utilization of a QZSS-LEX for navigation of a robot tractor and a robot combine harvester. It showed satisfying performance and big potential for farm use.

Red Rescue: Alert Message Service



Development of Alert Message Service with QZSS

Red Rescue Project: Real-time Disaster Response using Location Data and wide-area small-capacity data.



Alert Message is Personalized with QZSS Satellite



QZSS Satellite

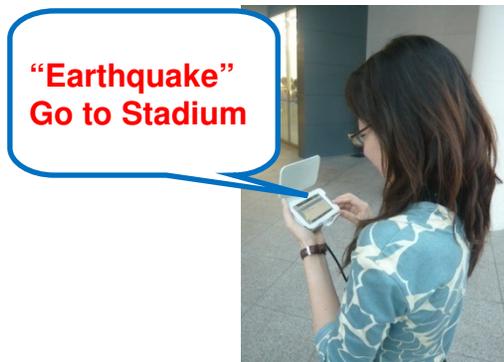


Location / Service DB



Navigation
Signal

Alert
Message



In front of a Building



At Stadium

Data (Map, Contents ..)
Location Data



Disaster Management Center

Alert Message

Promotion of QZSS Utilization



1 Information Service

- Collect opinions and demands from users, industries, and research institutions
- Generate appropriate information for service enlargement

2 Promotion of Operational Test

- Plan the various tests and provide test results and technology information

3 Standardization

- Promote standardization of QZSS signal and receiver I/F (Domestic/International)

4 Propagate QZSS use to the Asia-Pacific region

- Collect opinions and demands for QZSS utilization
- Provide valuable information
- Technical support, support for operation test

5 System Improvement (Function / Quality)

- Enhancement activity based on user's opinions and requests

For more information, please visit our web site

<http://www.qzs.jp/en/>

Quasi-Zenith Satellite System (QZSS) Service

Japanese

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Brochure (PDF)

準天頂衛星システムが導く、
あたらしい社会

Illustration (JPEG)

Leading the way towards a new society with QZSS

Automobiles (Navigation)

Automobiles (Logistics and Passenger Transport)

Railways

Personal Use

Construction and Agriculture

Ships and Aircraft

These days, in their everyday lives people confirm positions using signals from satellites, and also search for routes to their destinations. QZSS makes satellite positioning services even easier to use and more precise. This system can be used even in locations where positioning signals from satellites did not reliably reach in the past.

The environment related to satellite positioning services

Navigation functions—such as those used in car navigation systems, smartphones, and mobile phones—have come into



- A large circle illustrated “Q” as Quasi-Zenith Satellite System
- Green and blue circle composes 8 shapes; the coverage area of QZSS and they are represented earth and satellite.
- Blue line symbolized precise positioning information as well as enlargement of brand new service to society.
- Color of green stands for environment and safety, and blue stands for space and technology.



Q Z S System Services Inc.

<http://www.qzs.jp/en/>

System Configuration of QZSS

