

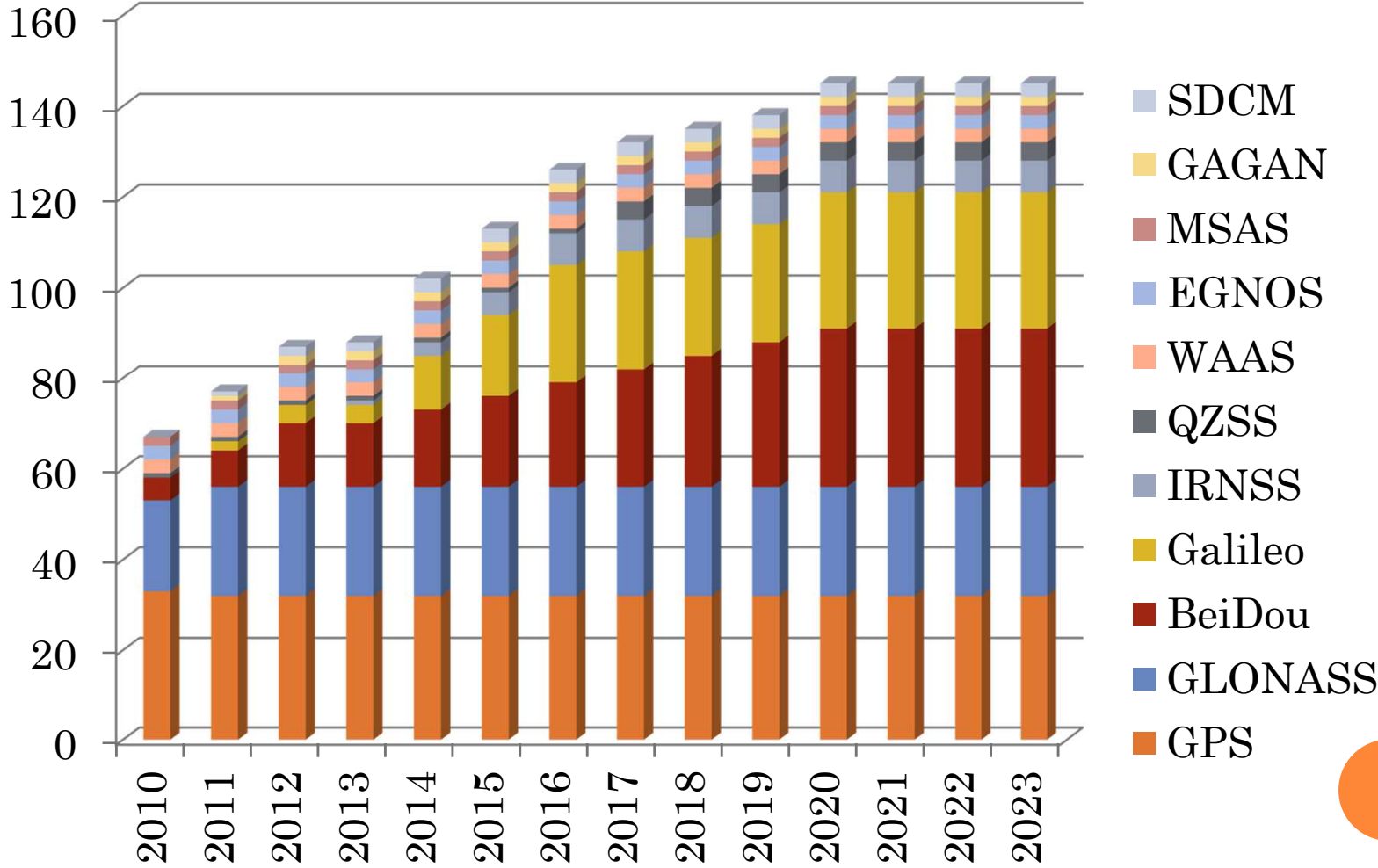
REPORT ON A MULTI-GNSS DEMONSTRATION PROJECT IN THE ASIA/OCEANIA REGION

SUMMARY OF 5TH ASIA OCEANIA REGIONAL WORKSHOP ON GNSS

1

**Hiroaki Tateshita
Multi-GNSS Asia Secretariat
10 June, 2014
PF-12, Vienna, Austria**

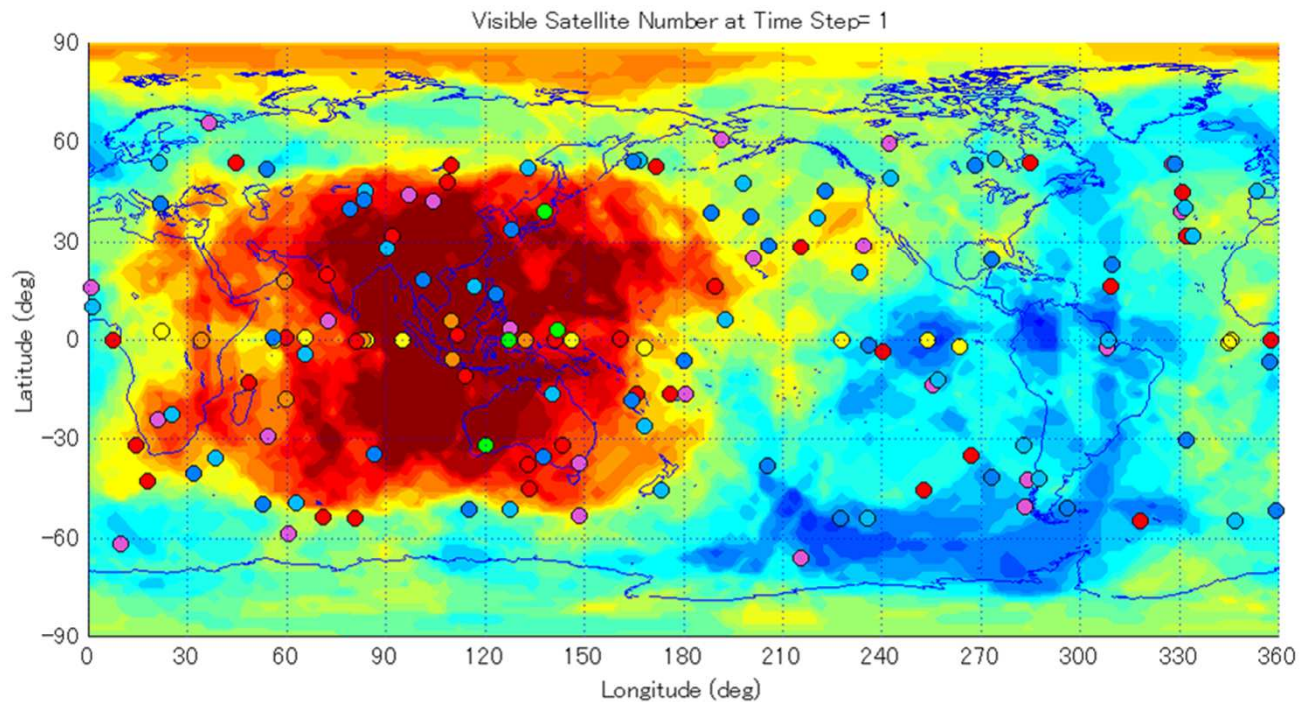
SATELLITE NUMBERS IN MULTIPLE CONSTELLATIONS





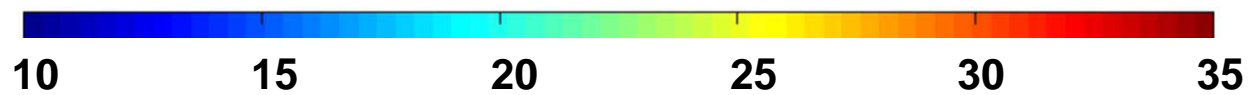
ASIA OCEANIA REGION IS SHOWCASE OF MULTI-GNSS APPLICATION

Visible satellite number (mask angle 30 degrees)



2020:

- GPS(32)+
- Glonass(24)+
- Galileo(30)+
- BeiDou(35)+
- QZSS(4)+
- IRNSS(7)+
- SBAS(13)



ASIA OCEANIA MULTI-GNSS DEMONSTRATION CAMPAIGN



- Campaign consists of three main activities:

Multi-GNSS Monitoring Network

The diagram illustrates a global network of GNSS monitoring stations. It features several GNSS satellites in orbit, with blue arcs representing signal paths to ground stations located across the globe. A server rack is shown at the bottom right, indicating data processing and storage. A small inset photo shows a ground station antenna in a field.

Application Demonstration

Disaster Mitigation

Precise Positioning

ITS

LBS

Other, ionospheric observation etc

Regional Workshop

4th Workshop, Dec. 2012
@ Kuala Lumpur, Malaysia

3rd Workshop, Nov. 2011 @
Jeju, Korea:

2nd Workshop, Nov. 2010
@ Melbourne, Australia

1st Workshop, JAN. 2010, @
Bangkok, Thailand

Multi-GNSS Demonstration Campaign



ORGANIZATION: WHAT IS MGA?

- “Multi GNSS Asia (MGA)” is an international organization to promote and support activities of the “Asia Oceania Multi-GNSS Demonstration Campaign”
- MGA was established in September 4th, 2011 in Tokyo



1st meeting of MGA Steering Committee



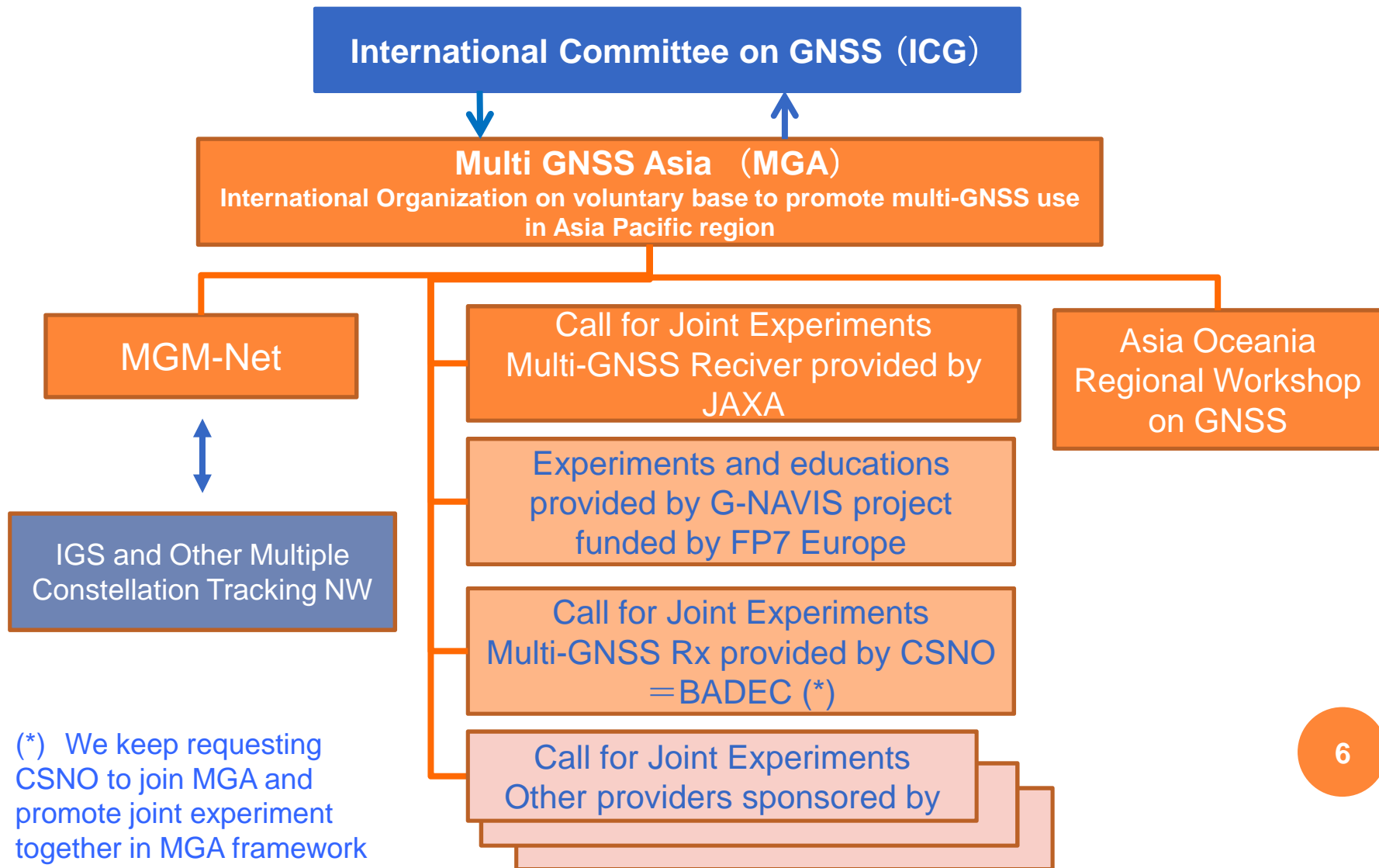
public website: www.multignss.asia



site for members only



WORK STRUCTURE FOR MGA



MGA PARTICIPATING ORGANIZATIONS



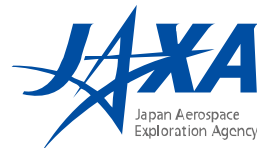
No	Organizations	Countries/Regions
1	Beach Building & Civil Group (BBCG)	Australia
2	RMIT University (RMIT)	Australia
3	Japan Aerospace Exploration Agency (JAXA)	Japan
4	University Putra Malaysia (UPM)	Malaysia
5	National Cheng Kung University (NCKU)	Taiwan
6	Asian Institute of Technology (AIT)	Thailand
7	Chungnam National University (CNU)	Korea
8	SINGAPORE LAND AUTHORITY (SLA)	Singapore
9	The University of Nottingham Ningbo China (UNNC)	China
10	Tokyo University of Marine Science and Technology (TUMST)	Japan
11	National Electronics and Computer Technology Center (NECTEC)	Thailand
12	Ministry of Science and Technology (MOST)	Vietnam
13	National Agriculture and Food Research Organization (NARO)	Japan
14	Earthquake Research Institute, the University of Tokyo (ERI)	Japan
15	Research Faculty of Agriculture, Hokkaido University (AGHU)	Japan
16	Toyama National College of Technology (TNCT)	Japan
17	National Space Agency of Malaysia (ANGKASA)	Malaysia
18	Hanoi University of Science and Technology (HUST)	Vietnam
19	Growing NAVIS (GNAVIS)	Europe
20	Malaysian agricultural research and development institute (MARDI)	Malaysia
21	University of New South Wales (UNSW)	Australia
22	Keio University	Japan
23	Burdwan University	India
24	Electronic Navigation Research Institute (ENRI)	Japan
25	SOARTECH SYSTEMS Sdn Bhd (SSSB)	Brunei
26	Industrial Geodetic Systems	Russia
27	GNSS.asia	Europe
28	KUgeomatic	Australia
29	Chulalongkorn University	Thailand
30	Satellite Positioning Research and Application Center (SPAC)	Japan
31	Research Institute of Geodesy, Topography and Cartography	Czech
32	St. Petersburg National Research University of Informational Technology, Mechanics, and Optics	Russia

32 organizations from
14 countries/regions

If you have interest
to join MGA,
please visit
www.multignss.asia



5th Asia Oceania Regional Workshop on GNSS was held very successfully on December 1-3, 2013 at Hanoi University of Science and Technology, Hanoi, Vietnam



The 5th Asia Oceania Regional Workshop on GNSS



- 160 participants from many organizations including universities, institutes, government agencies, International organizations and companies gathered from 14 countries.





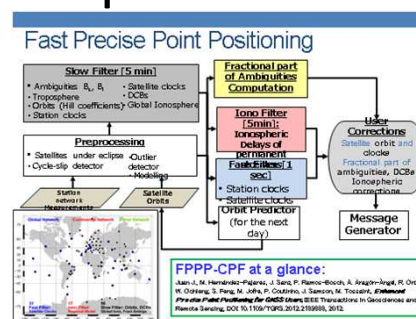
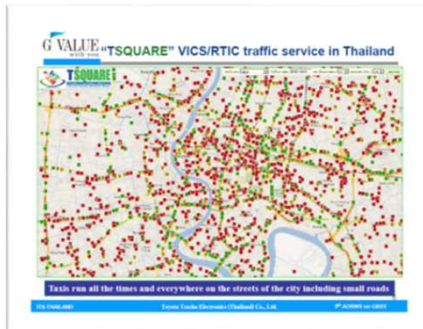
- Dec. 1st
 - GNSS Tutorial Session by G-NAVIS and JAXA
- Dec. 2nd
 - Welcome and Keynote Speech
 - What's New about GNSS
 - Status Report of the Multi-GNSS Joint Experiments
 - GNSS Applications /Network Session (1)
- Dec. 3rd
 - GNSS Applications /Network Session (2)
 - Discussion Session
 - QZSS Demonstration
 - Closing Session



Multi-GNSS Joint Experiment

8 Final results of Joint Experiment 2011 including improvement of positioning by Multi-GNSS were shared

Preliminary results and next steps of joint experiments 2012 were shared. Final results of these experiments are expected to be reported in next workshop.



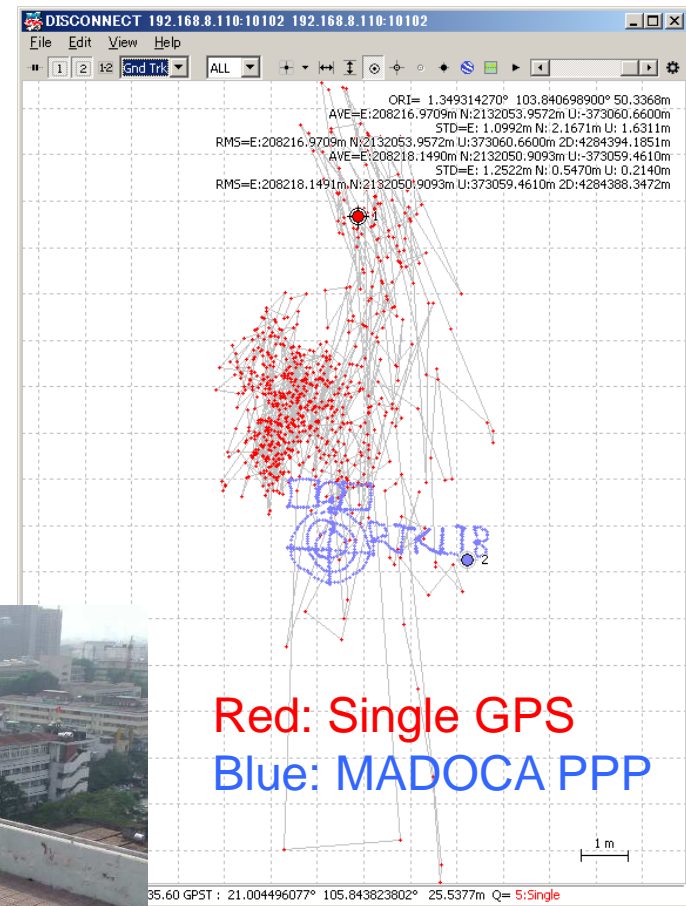
Geometry-free & Ionosphere-free (GFIF) observables for bias and noise studies

$$\begin{aligned} \frac{f_1 P_1 + f_2 P_2}{f_1 + f_2} - \frac{f_1 \phi_1 - f_2 \phi_2}{f_1 - f_2} &= \left(\frac{f_1 b_1 + f_2 b_2}{f_1 + f_2} + \lambda_{12} (B_{12} + N_{12}) \right) + \sigma_{p12} \quad (1) \\ \frac{f_2 P_2 + f_3 P_3}{f_2 + f_3} - \frac{f_2 \phi_2 - f_3 \phi_3}{f_2 - f_3} &= \left(\frac{f_2 b_2 + f_3 b_3}{f_2 + f_3} + \lambda_{23} (B_{23} + N_{23}) \right) + \sigma_{p23} \quad (2) \\ \frac{f_1^2 P_1 - f_2^2 P_2}{f_1^2 - f_2^2} - \frac{f_1^2 \phi_1 - f_2^2 \phi_2}{f_1^2 - f_2^2} &= \left(\frac{f_1^2 b_1 - f_2^2 b_2}{f_1^2 - f_2^2} + \lambda_{u1} (B_u + N_u) + \frac{f_1^2 \lambda_{12}}{f_1^2 - f_2^2} (B_{12} + N_{12}) \right) + \sigma_{p12} \quad (3) \\ \frac{f_1}{f_1 - f_2} \frac{f_2 \phi_2 - f_1 \phi_1}{f_2 - f_1} - \frac{f_1}{f_1 - f_2} \frac{f_1 \phi_1 - f_2 \phi_2}{f_1 - f_2} &= \left(-\frac{f_1^2 \lambda_{12}}{f_1^2 - f_2^2} - \frac{f_1 \lambda_{u1}}{f_1 - f_2} (B_{12} + N_{12}) + \frac{f_1^2 \lambda_{u1}}{f_1^2 - f_2^2} (B_u + N_u) \right) + \sigma_{u1} \quad (4) \end{aligned}$$

$\lambda_{u1} = 10.7\text{cm}$, $\lambda_{u12} = 0.8619\text{m}$, $\lambda_{u23} = 5.86\text{m}$
 B= UPD, b=UCD, N= integer ambiguity



Precise Point Positioning (PPP)
 Demonstration by using
 augmentation data created by using
 MADOCA (Multi-GNSS Advanced
 Demonstration tool for Orbit and
 Clock Analysis) via QZSS LEX signal



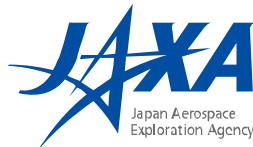


- MGA Steering Committee endorsed the implementation of the following 5 proposed experiments
 1. **"Autonomous rice transplanter guided by GNSS with QZS-LEX"**, *National Agriculture and Food Research Organization, Japan [PP]*
 2. **"Smart strategy for a large number of offshore oil and gas platforms deformation monitoring"**, *University of Technology PETRONAS, Malaysia [PP]*
 3. **"Experiment proposal of the evaluation of position accuracy achievable Industrial Geodetic Systems, Russia by single-frequency Multi-GNSS receiver using various of correction information"**, *Industrial Geodetic Systems, Russia [DMM]*
 4. **"The evaluation of the QZSS's positioning augmentation functionality for the vehicular traffic management within the low-altitude region in South East Asia"**, *Mitsubishi Heavy Industries, Ltd., Japan [ITS]*
 5. **"Multi-GNSS-PPP Navigation System in Vehicle Safety Monitoring"**, *National Electronics & Computer Technology Center and Chulalongkorn Univ., Thailand [ITS]*



6th Asia Oceania Regional Workshop on GNSS will be held on 9-11 October, 2014 at Phuket, Thailand. The Detail information will be available on MGA website:

<http://www.multignss.asia>





SUMMARY

- Multi-GNSS Asia (MGA) was introduced. The Active Participation in MGA be highly welcomed!!
- As results of the 5th Asia Oceania Regional Workshop on GNSS, Five proposed Multi-GNSS Joint Experiments were endorsed to be implemented.
- 6th Asia Oceania Regional Workshop on GNSS will be held on 9-11 October, 2014 at Phuket, Thailand.

Detail Information: www.multignss.asia

Thank you for your kind attention!