Akio Yasuda
Professor at Tokyo University of Marine Science and Technology
Co-chair, Multi-GNSS Asia (MGA)

2012/11/07@Beijin BICC
CONTENTS

- Background of Multi-GNSS Demonstration Campaign
- What is Multi-GNSS Asia?
- Framework of MGA
- Three activities of MGA
  - What is MGM?
  - 2nd Call for Joint Experiment
  - 4th AOR WS on Multi-GNSS
Visible satellite number (mask angle 30 degrees)

2020:

Asian People can use multi-GNSS signals earlier than other regions in the world

Asia Oceania Multi-GNSS Demonstration Campaign

MGA was established by JAXA in 2010.
User benefits from Multi GNSS

- Increase of usable SVs, signals and frequencies
- Enhance availability and coverage
- More robust and reliable services
- Higher accuracy in bad conditions
- Less expensive high-end services

Emerging of new applications and expansion of existing applications are expected.

This the background of Multi-GNSS Asia Campaign.
Multi-GNSS Asia (MGA)” is an international organization to promote and support activities of the “Asia Oceania Multi-GNSS Demonstration Campaign”

We started the activity by holding the first workshop in 2009.
ORGANIZATION OF MGA

MGA Member

Steering Committee

Co Chairs
Prof. Akio Yasuda, Tokyo University of Marine Science and Technology
Prof. Chris Rizos, University of New South Wales

Secretariat

Observers

JAXA

Government agencies and international organizations related to GNSS utilization in the region

Network Sub-Committee for MGM

Working Groups

Precise Positioning WG

Disaster Management WG

ITS WG

Team Tsunami Monitoring

Team GNSS Meteorology

Team Landslide Monitoring

New WG: Capacity building and Education on GNSS

in either group or committee
As for the educational organization for foreign students, we are working intensively to establish university consortium to teach following items and also seeking fund.

- GNSS, Geographic Information System, Remote Sensing, System Management
- GNSS teaching materials, such as high performance software receiver and positioning software tools are already prepared by the staffs at Tokyo University of Marine Science and Technology.
PARTICIPANTS IN MGA

- The organizations which have interests in GNSS utilization in Asia Oceania region are expected to participate:
  - Government agencies,
  - Universities, and research institutes
  - International organizations
  - Industries such as receiver manufacturer, service providers
  - GNSS providers

Please visit to
http://www.multignss.asia/howto_join_mga.html
<table>
<thead>
<tr>
<th>No</th>
<th>Organizations</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Beach Building &amp; Civil Group (BBCG)</td>
<td>Australia</td>
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<tr>
<td>2</td>
<td>RMIT University (RMIT)</td>
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<td>3</td>
<td>Japan Aerospace Exploration Agency (JAXA)</td>
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<td>4</td>
<td>University Putra Malaysia (UPM)</td>
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<td>5</td>
<td>National Cheng Kung University (NCKU)</td>
<td>Taiwan</td>
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<td>6</td>
<td>Asian Institute of Technology (AIT)</td>
<td>Thailand</td>
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<td>7</td>
<td>Chungnam National University (CNU)</td>
<td>Korea</td>
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<td>8</td>
<td>Singapore Land Authority (SLA)</td>
<td>Singapore</td>
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<td>9</td>
<td>The University of Nottingham Ningbo China (UNNC)</td>
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<td>10</td>
<td>Tokyo University of Marine Science and Technology (TUMSAT)</td>
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<td>National Electronics and Computer Technology Center (NECTEC)</td>
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<td>12</td>
<td>Ministry of Science and Technology (MOST)</td>
<td>Vietnam</td>
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<td>National Agriculture and Food Research Organization (NARO)</td>
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<td>Earthquake Research Institute, the University of Tokyo (ERI)</td>
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<td>Research Faculty of Agriculture, Hokkaido University (AGHU)</td>
<td>Japan</td>
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<td>16</td>
<td>National Space Agency of Malaysia (ANGKASA)</td>
<td>Malaysia</td>
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<td>17</td>
<td>Hanoi University of Science and Technology</td>
<td>Vietnam</td>
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</table>
**Multi-GNSS Demonstration Campaign**

**THREE MAIN ACTIVITIES**

1. **Multi-GNSS Monitoring Network**

2. **Application Demonstration**
   - Disaster Mitigation
   - Precise Positioning
   - ITS (Intelligent Transportation Systems)
   - LBS (Location-Based Services)
   - Others, ionospheric observation etc

3. **Regional Workshop**
   - 3rd Workshop, Nov. 2011 @ Jeju, Korea:
   - 2nd Workshop, Nov. 2010 @ Melbourne, Australia
   - 1st Workshop on GNSS, JAN. 2010, @ Bangkok, Thailand
Multi-GNSS Precise Orbit Clock Determination System

Multi-GNSS constellation (GPS, GLONASS, GALILEO, QZSS)

- RINEX
- Clock RINEX
- IONEX
- SINEX
- ANTEX etc.

Monitor Site

Monitor Site

Monitor Site

LEX Signal

LEX msg

QZSS Master Control Station (MCS)

Data I/F – NTRIP Caster

RINEX, IONIX, SINEX, ANTEX...

Precise Orbit/Clock Determination function (Real-time, Post-processing)

Evaluation, Analysis function. (Post-processing)

Multi-GNSS Precise Orbit Clock Determination System

MADOCA : Multi-gnss Advanced Demonstration tool for Orbit and Clock Analysis
<table>
<thead>
<tr>
<th>IGS AC</th>
<th>Analysis Software</th>
<th># of Stas</th>
<th>Orbit RMS (cm)</th>
<th>Clock (ns)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>R</td>
<td>A</td>
</tr>
<tr>
<td>MADOC 0.3.0</td>
<td>77</td>
<td>0.89</td>
<td>1.10</td>
<td>1.12</td>
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<tr>
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<td>NAPEOS 3.5</td>
<td>110</td>
<td>0.97</td>
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<tr>
<td>CODE</td>
<td>Bernese 5.1</td>
<td>231</td>
<td>1.01</td>
<td>1.36</td>
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<tr>
<td>NGS</td>
<td>arc, orb, pages, gpscom</td>
<td>199</td>
<td>0.95</td>
<td>1.46</td>
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<tr>
<td>GFZ</td>
<td>EPOS.P.V2</td>
<td>191</td>
<td>1.15</td>
<td>1.64</td>
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<td>MIT</td>
<td>GAMIT 10.33, GLOBK 5.16</td>
<td>263</td>
<td>1.37</td>
<td>2.12</td>
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<td>NRCa n</td>
<td>GIPSY/OASIS-II 5.0</td>
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<td>JPL</td>
<td>GIPSY/OASIS-II 5.0</td>
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<td>2.62</td>
<td>1.67</td>
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<td>SIO</td>
<td>GAMIT 10.20, GLOBK 5.08</td>
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<td>2.42</td>
<td>2.26</td>
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<td>GRG</td>
<td>GINS, DYNAMO</td>
<td>134</td>
<td>2.47</td>
<td>2.80</td>
</tr>
</tbody>
</table>

2011/1/1 - 12/31 (365 days), interval 900/300 s, wrt IGS Final
Multi-GNSS Monitoring Network: Current Status

33 sites have been selected, and are under constructions. (Goal: 60 sites, all over the world)

Several organizations such as **Australian Victoria, Curtin University** have been selected as monitor stations of the network with own receiver sets.

MGM may correspond to the Chinese iGMAS. Collaboration between them must enhance the efficiency of orbit/clock estimation.

Layout drawing of JAXA’s MGM-net

- QZSS MS (8)
- MGM-net Accepted [Hosting Sites] (18)
- MGM-net Accepted [Data Sharing Partner] (7)
**ACTIVITY 2: PROPOSED MULTI-GNSS JOINT EXPERIMENTS**

- 8 Experiments were endorsed to be implemented

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluation of Multi-GNSS for Precision Agriculture in Korea, Chungnam National University</td>
<td>Korea</td>
</tr>
<tr>
<td>2</td>
<td>Sustainable Resource Utilization by Precision Farming of Oil Palm</td>
<td>Malaysia</td>
</tr>
<tr>
<td></td>
<td><strong>JAXA will prepare the Multi-GNSS receivers.</strong></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Automated rice transplanter guided by using Multi-GNSS including QZSS, Agricultural Research Center, National Agriculture Research Organization</td>
<td>JAPAN</td>
</tr>
<tr>
<td>4</td>
<td>&quot;Joint QZSS/GPS positioning using L1/L5 band signals“, National Cheng Kung University,</td>
<td>Taiwan</td>
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<tr>
<td>5</td>
<td>&quot;Multi-GNSS Experiment at RMIT University in Melbourne”, RMIT University</td>
<td>Australia</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation of QZSS-LEX and L1-SAIF signals based positioning compared to DGPS and IGS PPP, positioning for Thailand</td>
<td>Thailand</td>
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<tr>
<td>7</td>
<td>Exploiting the use of QZSS and GNSS for navigational and high precision applications and their performance assessment (EQUATOR)</td>
<td>China</td>
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<tr>
<td>8</td>
<td>Development of Driver Behavior Measurement Method for Level of Safety Estimation from High Precision and High Resolution Global Positioning System with Quasi-Zenith Satellite System (QZSS)</td>
<td>Thailand</td>
</tr>
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</table>
DEVICES FOR MULTI-GNSS EXPERIMENT

- Multi-GNSS Receiver and Antenna

<table>
<thead>
<tr>
<th>GNSS</th>
<th>Tracking and Positioning</th>
<th>Tracking</th>
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</thead>
<tbody>
<tr>
<td>GPS</td>
<td>L1-C/A, L2C, L5, L1P, L2P(Y)</td>
<td>L1C</td>
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<tr>
<td>GLONASS</td>
<td>L1-C/A, L1P, L2-C/A, L2P</td>
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<tr>
<td>GALILEO</td>
<td>E1, E5a</td>
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<tr>
<td>QZSS</td>
<td>L1-C/A, L1-SAIF</td>
<td>L1C, L2C, L5</td>
</tr>
</tbody>
</table>

- Software

Calling for the Next Proposals for 2013
Purpose
Discussion about new application experiments of GNSS and Information sharing of the results of the current status of the activities of Multi-GNSS Asia.

Date 8-10th Dec. 2012
Venue Kuala Lumpur, Malaysia

We would like to invite Chinese delegate to Kualar Lumpur in next month.
Registration site open until 15th Nov. http://www.multignss.asia
THE CURRENT STATUS OF MULTIGNSS MONITORING NETWORK

Call for application has been opened continuously until enough number of sites are selected.

Selected Sites (showed in above table)

Applied and under selection process arrangement
SUMMARY

- Back Ground of Multi-GNSS
- Introduction of MGA
- Introduction of MGM
- Still calling for Monitoring Sites globally.
- 2nd Call for Joint Experiment
- The 4th AOR WS on GNSS

Thank you for your attention!

Please visit to
http://www.multignss.asia/

Key word : multignss