International Committee on Global Navigation Satellite Systems

IGS INTERNATIONAL GNSS SERVICE

The IGS and ICG IGMA trial project

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Topics

1. International Committee on GNSS (ICG)
2. International GNSS Monitoring and Assessment (IGMA)
3. IGMA ICG joint Trial Project
4. Request to IGS
5. Challenges, Next steps
6. Summary

1. International Committee on GNSS (ICG)

- Established in 2005 under United Nations OOSA
  - To promote the use of GNSS and its integration into infrastructures, particularly in developing countries
  - To encourage compatibility, interoperability and transparency among global and regional systems
- ICG Membership:
  - Members: 9 nations & the European Union
    - China (BDS)
    - EU (Galileo/EGNOS)
    - Russian Federation (GLONASS/SDCM)
    - USA (GPS/WAAS)
    - India (IRNSS/GAGAN)
    - Japan (QZSS/MSAS)
  - State Members of the UN with an active programme in implementing or promoting a wide range of GNSS services and applications
    - Italy, Malaysia, United Arab Emirates
  - Associate Members and Observers: 21 organizations
    - International and regional organizations and associations dealing with GNSS services and applications (UN system entities, IGOs, NGOs), including IGS

1. International Committee on GNSS (ICG)

- Four Working Group (WG) and implement workplan defined by ICG Providers forum

WG-A
Systems, Signals and Services

Chaired by
U.S. and Russian Federation

WG-B
Enhancement of GNSS Performance, New Services and Capabilities

Chaired by
ESA, India and China

WG-C
Information Dissemination and Capacity Building

Chaired by UNOOSA

WG-D
Reference Frames, Timing and Applications

Chaired by IGS, IAG and FIG

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1. International Committee on GNSS (ICG)

Revised Work Plan – Related to Service Performance Monitoring (1/2)

- Consider the development and discussion of proposals to widely monitor the performance of their open signals and provide timely updates to users regarding critical performance characteristics.
- The Working Group, through the Interoperability and Service Standards Subgroup, will support this activity by translating open service performance standards into parameters for multi-GNSS monitoring. Recommendations on the necessary monitoring infrastructure and organizational approaches may be made to Providers and international organizations in coordination with other ICG working groups as necessary and appropriate.

1. International Committee on GNSS (ICG)

Revised Work Plan – Related to Service Performance Monitoring (2/2)

- When requested by a provider or providers, the Subgroup will assist in exchanging information with ICG participants to help resolve GNSS open service anomalies that impact users. The Subgroup will also facilitate cooperation and information exchanges between providers and scientific organizations that engage in open service signal quality monitoring.
- If necessary, the sub-group will establish ad hoc task forces to implement concrete tasks and reach objectives in schedule.

2. International GNSS Monitoring and Assessment (IGMA)

- International GNSS Monitoring and Assessment (IGMA) Task Force was established at ICG-6 meeting in Tokyo, 2011. (At that time it was called the IGMA Sub Group)
- Discussion through several meetings, tasks were defined and and group was re-named as IGMA Task Force of ICG WG-A with B,D at ICG-8 in Dubai. (see Rec. 8A.4.1 in next slide)

2. International GNSS Monitoring and Assessment (IGMA)

Recommendation 8A.4.1 (1/2)

- The task of the joint IGMA sub-group of WG-A, B & D will be to:
  - Determine Service Parameters to Monitor – definition and methodology to be coordinated with WG-A Compatibility sub group study
  - Determine what gaps exist in current and planned monitoring and assessment
  - Consider organizing workshop on IGMA parameters, services and methodologies
  - Recommend what should be monitored by:
    - Individual GNSS monitoring/control segments
    - Shared sites of 2 or more GNSS through bilateral agreements
    - Global monitoring of Multi-GNSS parameters

2. International GNSS Monitoring and Assessment (IGMA)

Recommendation 8A.4.1(2/2)

- Propose an Organizational Approach that:
  - Avoids Duplication
  - Coordinates and integrates the related activities for identifying parameters
  - Considers the role of the current/planned IGS and
  - Defines the Relationship of the proposed organization to ICG
- Explore methods to disseminate monitoring and assessment results, considering specific proposals from system providers

3. IGMA ICG joint Trial Project

Recommendation #4 (10A/D.4.1) for ICG-10 [1 of 2]

- Recognising:
  - The need for a global GNSS monitoring and assessment capability to assist with public confidence in GNSS service provision and interoperability
  - The role the International GNSS Service (IGS) has played in producing precise GNSS products since its inception in 1994, noting the evolution of products and services over time to meet user segment requirements
  - Utilizing existing resources such as IGS and providers monitoring and assessment systems (which may include signal quality monitoring) could maximize benefits in the early stage of the IGMA roadmap
- The ICG recommends that the IGMA TF and IGS initiate a joint trial project that will demonstrate a global GNSS Monitoring and Assessment capability

3. IGMA ICG joint Trial Project

Recommendation #4 (10A/D.4.1) for ICG-10 [2 of 2]

- In advance of launching the joint trial project, the following items are to be determined:
  - ToR for the Trial Project
  - Status of Trial Project and list of participating organizations (existing monitoring systems and/or providers), operation modes
  - Short list of stations to be used in Trial Project, providing 1X coverage (to provide collecting all measurement data from all satellites of all GNSS)
  - Requirements for receivers and related equipment
  - Short list of monitored parameters for Trial Project and calculation methods for them
  - Organizational procedures (reference data validation for parameters calculations, measurement data exchange, monitoring results exchange, etc.)

3. IGMA ICG joint Trial Project

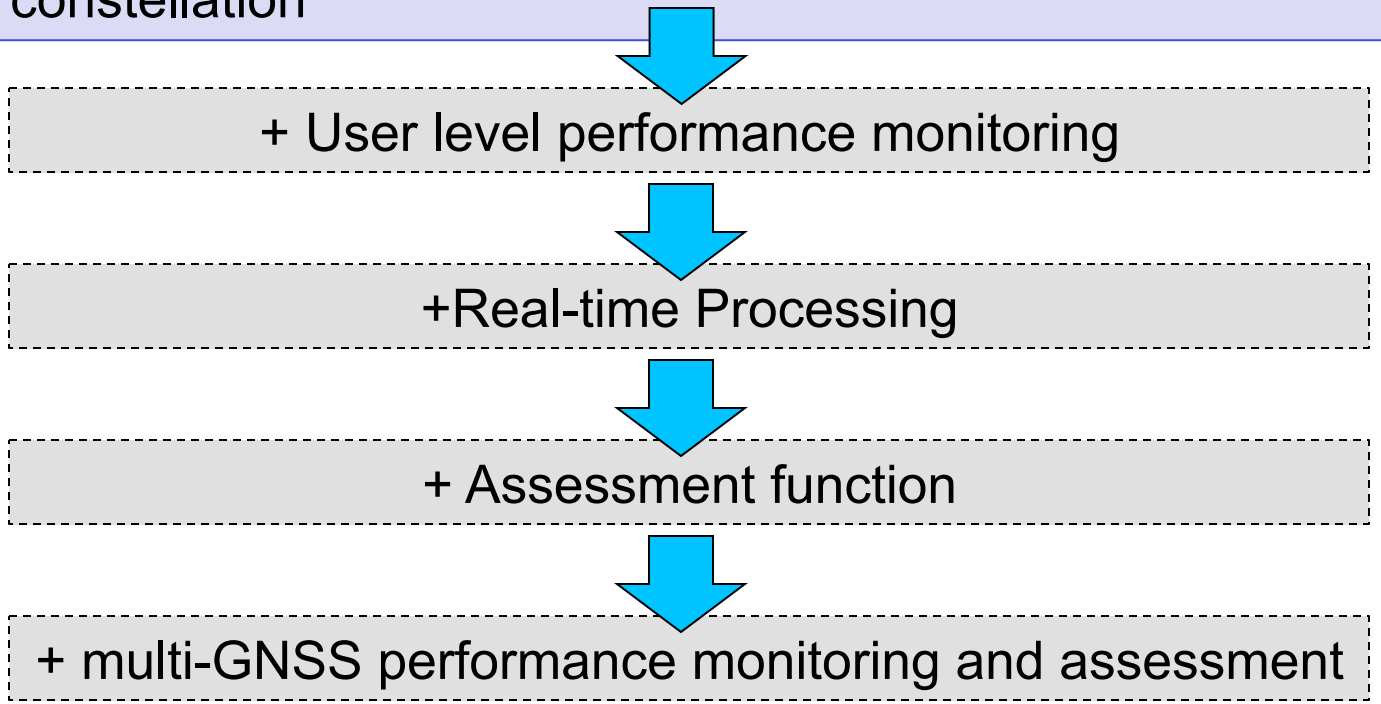
Basic Idea of the Trial Project

- To launch the project as earlier as possible,
  - The Trial Project will be phased and starts with monitoring of a limited set of parameters.
    - Post processing
    - System level performance monitoring for each single constellation
  - Subsequent phases would expand in monitoring/ assessment capabilities based on the Trial Project progress and ICG review.
    - Real-time processing
    - User level performance monitoring including combined use of multiple constellation
    - Combined product and assessment function

3. IGMA ICG joint Trial Project

ToR was created as a proposal to IGS by IGMA TF

Initial phase of the Trial Project
Post Processing
System level performance monitoring with limited parameters for each single constellation



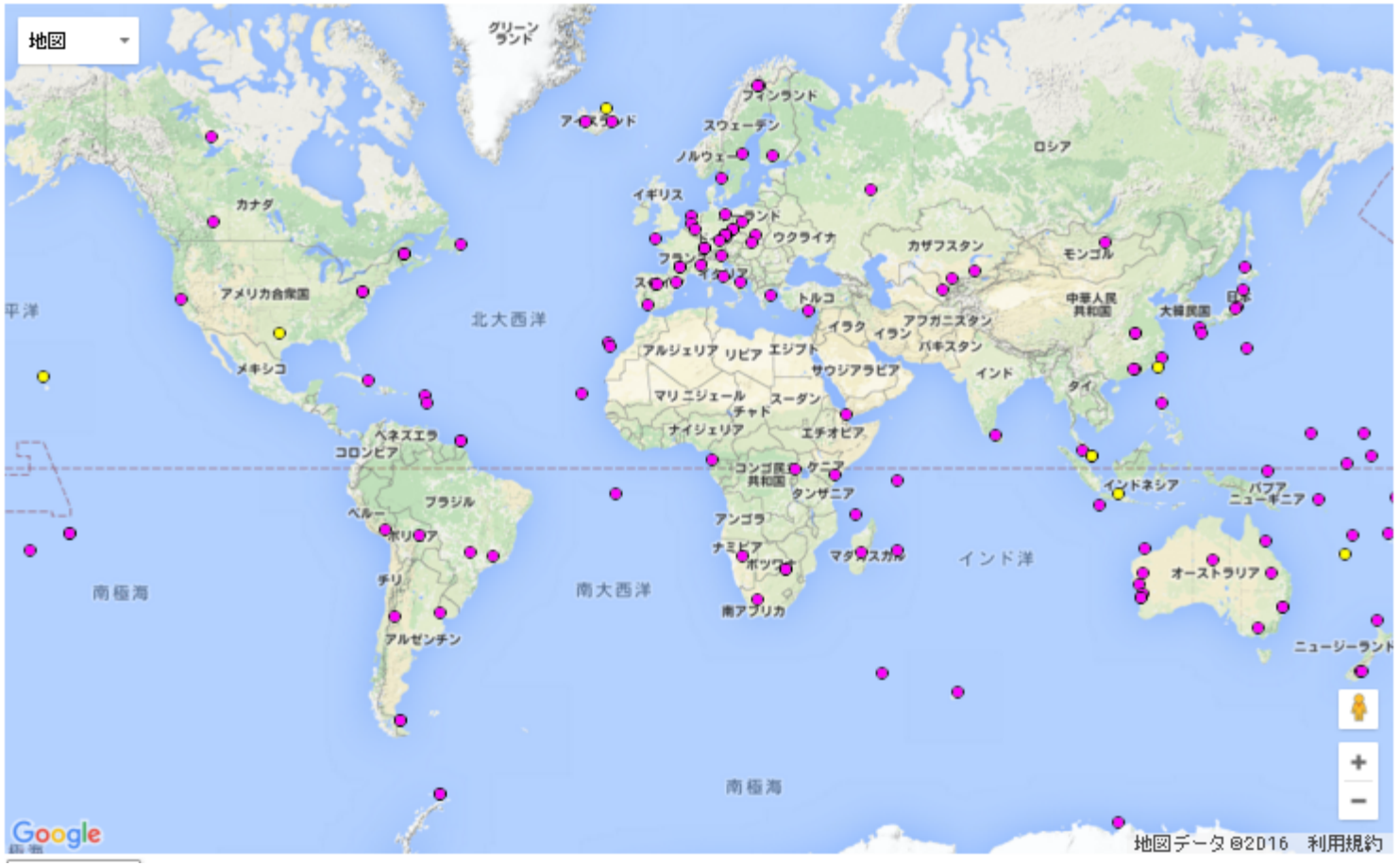
3. IGMA ICG joint Trial Project

Objectives of Trial Project

- To implement a monitoring system for all participating GNSS
  - Monitoring a limited number of parameters
  - Using existing monitoring infrastructures
  - Developing a set of requirements for monitoring system(s) in subsequence phases of the project
- To demonstrate user benefits of
  - Consolidated monitoring system products
  - Combined use of multi-constellations
- To promote trust in GNSS via an ICG endorsed monitoring system

3. IGMA ICG joint Trial Project

Existing monitoring infrastructure: IGS MGEX network



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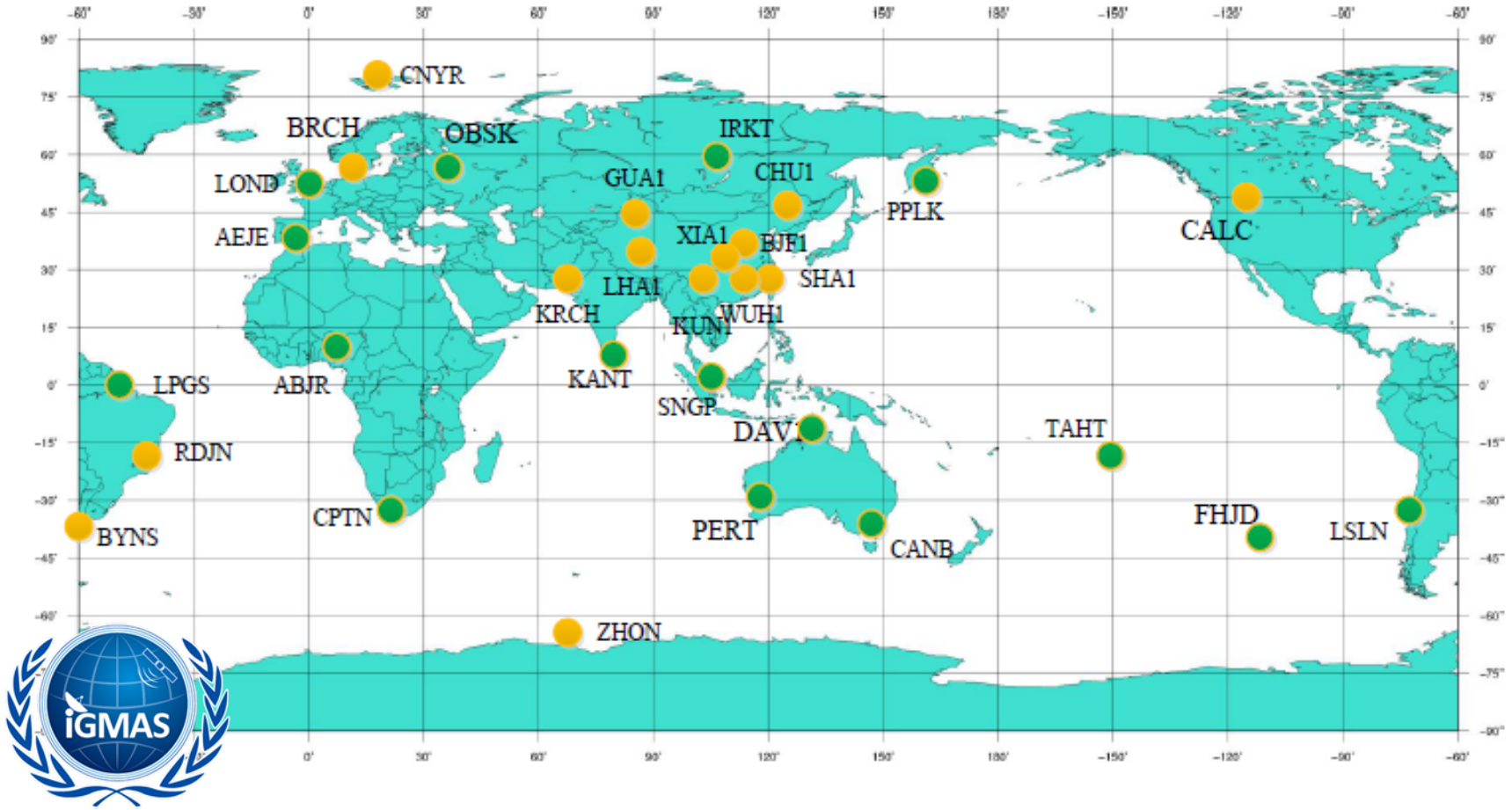
3. IGMA ICG joint Trial Project

Existing monitoring infrastructure: iGMAS network



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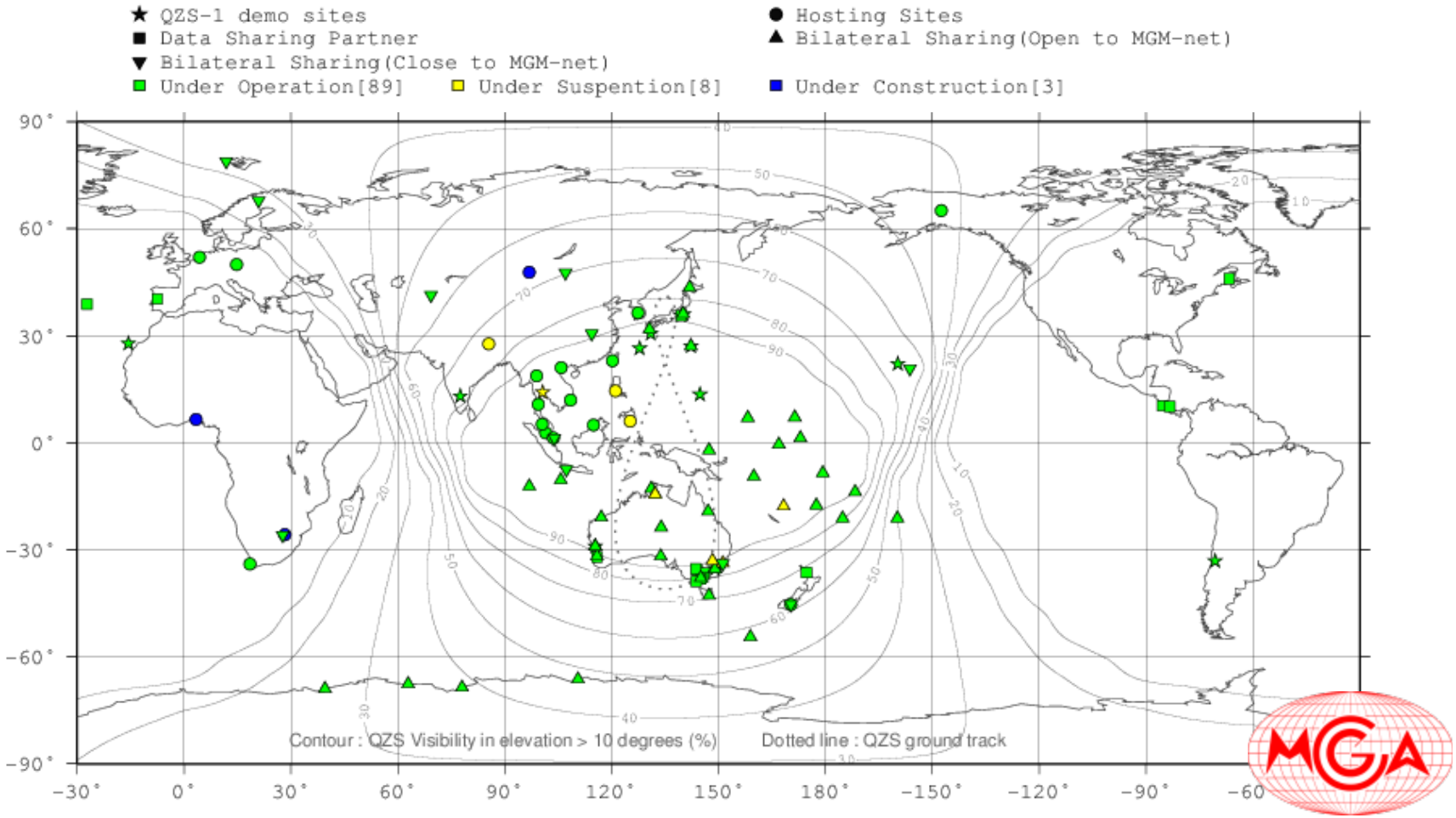
3. IGMA ICG joint Trial Project

Existing monitoring infrastructure: MGM net



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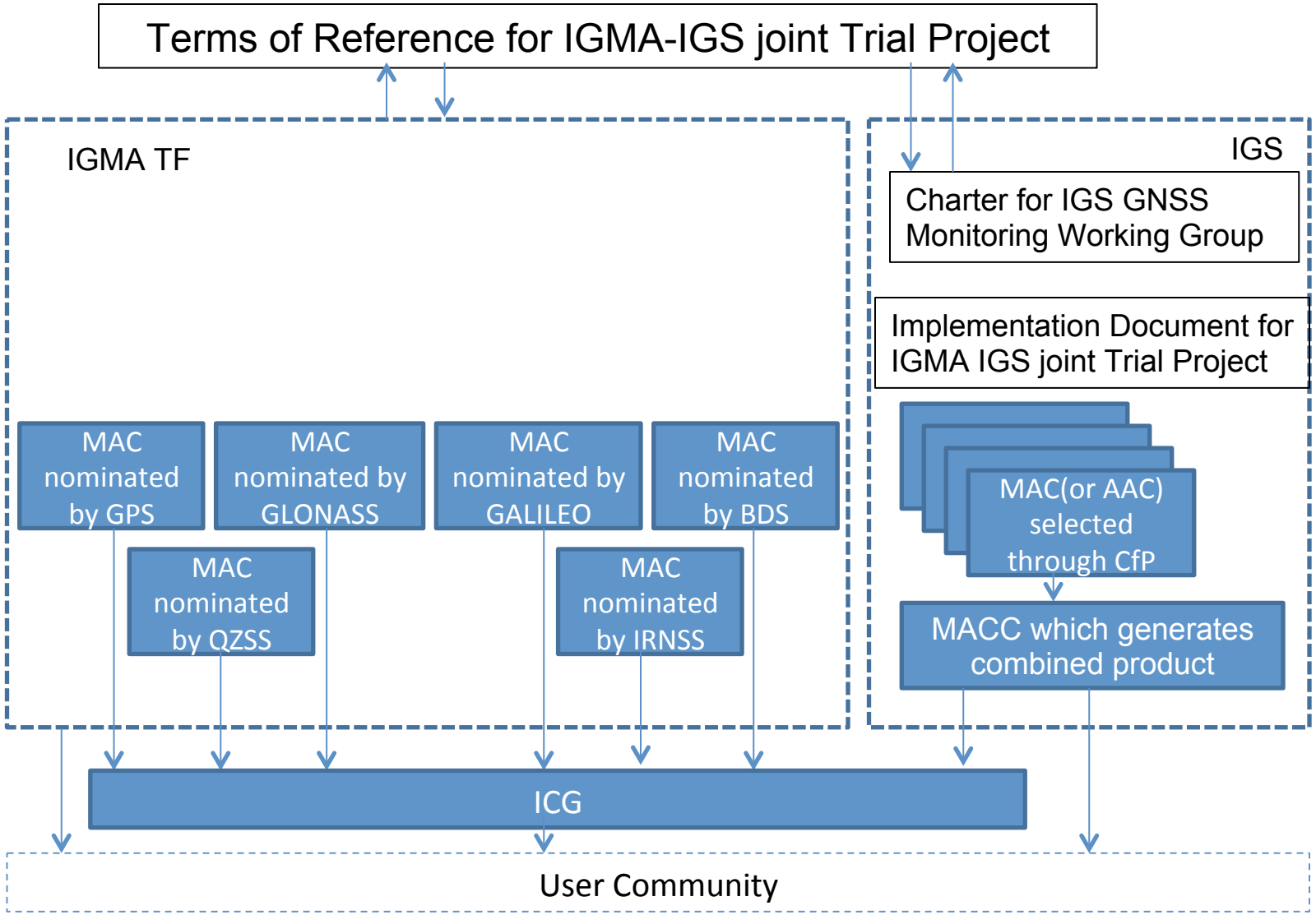
3. IGMA ICG joint Trial Project



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3. IGMA ICG joint Trial Project

- Parameters

  ① Broadcast Ephemeris Accuracy (Orbits and Clocks)

  ② SIS User Range Error

  ③ SIS UTC Offset Error

  ④ PDOP

  for GPS, GLONASS, GALILEO, BDS and QZSS,

  (IRNSS could be a potential participant in future)

- Processing Methodology
  - Apply post processed monitoring for the initial phase
  - Produce periodic, common format, performance reports of monitored parameters
  - Prepare criteria for potential real-time monitoring to be considered for subsequent phases of the Trial Project

3. IGMA ICG joint Trial Project

Monitoring Analysis Center N

GNSS Parm	GPS	GLONASS	BDS	Galileo	QZSS
Parm1					
Parm2	1.234	1.244	1.230	1.231	1.239

Monitoring Analysis Center 2

GNSS Parm	GPS	GLONASS	BDS	Galileo	QZSS
Parm1					
				1.231	1.239

Monitoring Analysis Center 1

GNSS Parm	GPS	GLONASS	BDS	Galileo	QZSS
Parm1					
Parm2	1.234	1.244	1.230	1.231	1.239
…					
ParmN					

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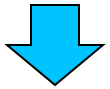
3. IGMA ICG joint Trial Project

- Milestone
  - Draft ToR for the Trial Project (Feb. 2016:IGMA TF)
  - Submission the Trial Project proposal to IGS Governing Board (Feb. 2016: Co-chairs IGMA TF)
  - Accepting of the Trial Project proposal and its ToR (Feb. 2016:IGS GB)
  - Nomination of IGS MAC through IGS processes
  - Nomination of GNSS provider MAC
  - ToR finalizing (Jun/Jul 2016@ICG WGA Intersessional meeting: IGMA TF)
  - Roadmap (long-term plan of IGMA) establishment (Jul 2016:IGMA TF)
  - Launch the Trial Project (October/November 2016: IGMA TF & ICG)
  - Report the Trial Project Implementation status to ICG (Nov. 2016@ICG-11: IGMA TF & ICG)

4. Request to IGS

- Launch, join IGMA-IGS joint Trial Project
  - Data provision
    - Obs, NAV data at specific stations
    - As a first step, RINEX (non-real time data), but RT data stream for the future step
  - AC/AACs on MGEX participation and product provision
    - Join as a MAC for the Trial Project
    - provide reference or benchmark orbits and clocks for broadcast ephemeris accuracy and SIS-URE calculation for not only GPS and GLO but also BDS, GAL, QZSS (post processing, combined final product in the first step)



Charter for IGS Monitoring Working Group, and Implementation document for the Trial Project are now being prepared for IGS approval process. Following step is a CfP, if the proposal would be accepted

5. Challenges, Next steps

Next steps

- IGS acceptance with the joint Trial Project proposal
- IGS and ICG will nominate or select participants of the project

Challenges

- Harmonization between ToR and IGS Charters
- Establish effective and appropriate management and implementation manner
- Create common definitions and calculation methodologies for monitoring parameters which are agreed by all participants

6. Summary

- ICG recommends that the IGMA TF and IGS initiate a joint Trial Project that will demonstrate a global GNSS Monitoring and Assessment capability
- IGMA TF created ToR for IGMA-IGS joint Trial Project as a proposal to IGS
- The Trial Project is to be launched with a limited number of parameters, using existing monitoring infrastructures
- IGS participation is absolutely necessary for the project implementation

Thank you for your attention
Questions?