

Report of Working Group A: Compatibility and Interoperability

1. The International Committee on Global Navigation Satellite Systems (ICG) Working Group A (WG-A) on Compatibility and Interoperability met Wednesday and Thursday, 7-8 November 2012 under the co-chairmanship of Mr. Sergey Revnivkykh, Russian Federation, and Mr. David Turner, United States of America.
2. After brief welcoming remarks, and before formally approving the agenda, the Co-chairs began Session 1 of the agenda covering system provider updates. The Co-chairs asked if there was new information to be presented that was not covered during the opening Plenary Session. Mr. Roman Fatkulín, Russian Federation, provided an update on the GLONASS space segment, including the modernization effort. No additional presentations or comments were offered.
3. Two presentations were made in **Session 2, GNSS Compatibility**. Mr. Tom Powell, from the U.S., opened the session with a presentation on the GNSS Open Service Performance Standard Template. Mr. Powell explained that the Interface Control Document (ICD) and Performance Standard are used to define civil GPS service in the U.S. The EU asked a question about what happens when GPS doesn't meet the commitment in the standard. The U.S. responded that it has never failed to meet the commitment, but there are fora (such as the Interface Control Working Group Meetings and the Civil GPS Service Interface Committee) to raise such issues and address them if it were to happen. The EU also commented that they would be in favor of the ICG developing a list of the parameters to be used, rather than using a template with too much detail.
4. Session 2 continued with a presentation by Mr. LI Jianwen from China, on the Definitions and Methods of GNSS Open Service Performance Parameters. The presentation discussed a proposed template for consideration by the Working Group (unofficial). The co-chair, Mr. Turner, noted the action from the Working Group A inter-session meeting held in July 2012. This action requested Providers to consider sharing a template. He suggested that each delegation assign a point of contact to provide feedback on the draft template to the co-chairs of the Working Group A Compatibility Subgroup for further discussion. Russia commented that templates will provide limits and restrictions, and they should be considered with a consensus that the ICG should agree on common system and user requirements. China also noted that feedback should be provided through a step by step process. The Co-chairs noted no further comments and concluded the session on compatibility.
5. The co-chairs then returned to the adoption of the meeting agenda, which was divided into the same 6 sessions held at the July inter-session meeting. Two of the six sessions were to be conducted with the participation of working groups B and D. The agenda was adopted without further modifications or objections.
6. **Session 3, Spectrum Protection**, opened with a presentation by Mr. Weimin Zhen, from China, on Comprehensive Monitoring and Information Sharing of GNSS Interference. Following the presentation, the EU commented that discussion on this subject should take into consideration the regulation of harmful interference. Mr. Dmitry Aronov, from Russia, followed with a presentation: Interference Reporting Form Currently Used in Russia. The EU noted that it would be ideal to get user input whenever interference is reported and perhaps a system where interference is automatically recorded would be most effective and efficient at accomplishing this. China commented that it will be important to establish a standard for reporting interference and this should be discussed in more detail later. Mr. Atilla Matas, representing the International Telecommunications Union (ITU), provided a

presentation on RNSS and the ITU Radio Regulations. The presentation discussed the ITU definitions of interference and types of harmful interference.

7. The co-chair, Mr. Turner, reviewed the recommendations from the July inter-session meeting held in Poland. For Recommendation 3.1, Education & Outreach Regarding Sources of GNSS Interference, the EU indicated that no further information is currently available. The co-chair then asked for feedback on Recommendation 3.2, ICG sponsored continuation of the IDM workshop, in conjunction with the Pacific PNT ION Conference in Hawaii, U.S., scheduled for 22-25 April 2013. Mr. Turner's focus was on reaching a consensus that the venue and dates selected for the workshop in conjunction with ION Pacific PNT 2013 could be supported. Mr. Takahiro Mitome from Japan noted that there is an ITU meeting scheduled to begin on 25 April, so it would be preferable to hold the IDM workshop earlier in the week. No additional comments to the recommendations were brought up.
8. **Session 4, Open Service Information Sharing and Service Performance Monitoring**, began with a report by Mr. Satoshi Kogure (Japan) on the Subgroup on International GNSS Monitoring and Assessment. Mr. Kogure provided a summary of the meeting which took place in July 2012 in Poland, and presented a draft Terms of Reference (ToR). Mr. Xurong Dong, China, asked about the recommendations from the subgroup, and Ms. Ruth Neilan (IGS) responded that the subgroup would be meeting later that day to discuss its inputs to the working group.
9. The co-chairs began a discussion on Recommendation 4.1 from the July inter-session meeting, International GNSS Monitoring and Assessment (IGMA) Subgroup. Mr. Turner suggested three potential options for defining the group: 1) Maintain the current Subgroup; 2) Turn the group into a Task Group reporting to WG-A, B and D; 3) Create a new working group within the ICG. Mr. Matt Higgins noted that Working D would prefer this to be a Task Group. China commented that they are flexible and would support any of the options, but want to maintain continuity to ensure that the group's work continues uninterrupted. Russian members of WG-A noted that starting a new Working Group would be unreasonable; they would prefer a subgroup with representatives from the different Working Groups (i.e. retain the subgroup structure). The EU commented that it is premature to make any decisions about this prior to the conclusion of the "future of the ICG" discussions taking place, and suggested keeping it as a subgroup for now. China suggested that the Working Group should consider how to engage with Working Groups B and D and hold off on any decisions on the structure until next year. The co-chair, Mr. Turner, wrapped up the discussion noting that the consensus seemed to be that the structure isn't as important as the content and direction of where the group will go. Any changes to the structure would be on hold for now.
10. Session 4 continued with a presentation from Mr. Qile Zhao, China, on the Positioning Performance of Beidou Satellite Navigation System. Mr. Kogure from Japan followed with an update on the Multi-GNSS Asia (MGA) Demonstration Campaign, noting that the next meeting was scheduled for December in Kuala Lumpur. Mr. Igor Silvestrov gave a presentation on the GNSS Monitoring System in Russia. Finally, Mr. Valery Tyubalin from Russia concluded the session with a presentation on Signal Quality Monitoring.
11. **Session 5, GNSS Interoperability**, began with a presentation by Ms. Xiaochun Lu from China titled Research on GNSS Interoperability Parameters. The co-chairs then brought up a review of actions related to the recommendation from the July inter-session meeting regarding a proposed user/industry workshop to be held in conjunction with the ION Pacific PNT meeting in April 2013. Mr. Jeffrey Auerbach from the U.S. presented a proposed joint-U.S./China list of potential agenda topics, with a suggested request to change the title to "Interoperability Workshop". There were no comments to

the workshop proposal and agenda topics. The recommendation was subsequently revised as enclosed 9Recommendation 5.1).

12. **Session 6, Conclusion**, was held on 08 November 2012. The co-chairs began with a final review of the recommendations, noting that the objective was to review them and reach consensus so they could be presented at the Plenary Meeting. Recommendation 4.1, International GNSS Monitoring and Assessment (IGMA) Subgroup, was modified to address the tasks of the Subgroup without taking on the issue of its hierarchical structure. In addition to modifying Recommendation 4.1, the Draft Terms of Reference document for the IGMA was updated and the name changed from “Terms of Reference” to “Proposed Work Plan” to better reflect the content.
13. In summary, five recommendations (2.1, 3.1, 3.2, 4.1 and 5.1) were approved by Working Group A, for presentation at the full Plenary Meeting. The co-chairs asked if there was any further unfinished business, and Mr. Mitome commented that the Compatibility Subgroup should include ITU participation in the future. Mr. Turner then proposed several options for the next Working Group A meeting (inter-session) and noted that a final decision on the date and location would occur after the conclusion of ICG-7. Mr. Mitome also noted that there are no current plans for the next Compatibility Subgroup meeting.

APPENDIX A:**WG-A Recommendation 2.1 for Committee Decision****Prepared by:** Working Group A**Date of Submission:** 08 November 2012**Issue Title:** IMT-GNSS Compatibility**Background/Brief Description of the Issue:**

It is already recognized that compatibility is one of the key elements to ensure interoperability between RNSS systems. In parallel it is also important to minimize non-RNSS emissions entering into RNSS spectrum so that the benefits of interoperability are not negated by reduced performance due to interference.

Because international spectrum issues are under the responsibility of the International Telecommunication Union (ITU), it is essential to keep track of activities at the ITU that could impact RNSS spectrum. In particular, when new allocations are being considered for inclusion in the Radio Regulations, it should be ensured that these do not have the potential to cause harmful interference into RNSS.

Discussion/Analyses:

At the 2012 intersessional meeting of WG-A, the Compatibility Subgroup agreed to keep monitoring the ITU activities for new spectrum for IMT (WRC-15 agenda item 1.1) to avoid potential interference into RNSS.

The Sub-group also agreed on continuing to watch the 700 MHz mobile service channel plan in Europe, which is related to WRC-15 agenda item 1.2, and recognized the importance of the activities to prevent potential harmonic interference into RNSS.

The Subgroup Chairs will also modify the subgroup ToR to address the investigation of unlike service interference to GNSS (RNSS) and propose text for the WG-A work plan to also address this area of work

WG-A will investigate specific IMT spectrum utilization plans (ITU-R M.1036-4) within relevant Administration's and regional groups and investigate whether interference mitigation methods already exist within the telecommunications industry.

Recommendation of Committee Action:

ICG members are encouraged to actively participate in the ITU-R and regional WRC-15 preparatory work on new IMT spectrum allocations to ensure that proposals do not impact existing and future GNSS operations. Members may also consider forming links with other satellite groups already defending satellite spectrum.

WG-A Recommendation 3.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 08 November 2012

Issue Title: Education and Outreach Regarding Sources of GNSS Interference

Background/Brief Description of the Issue:

Reception of GNSS signals can be affected by a range of different factors and many users of GNSS receivers may not be familiar with how GNSS works or even basic radio principles (like radio signals being blocked by objects). A user's expectations of GNSS reception could play a role in reducing the likelihood that interruption to GNSS reception (when entering a building for example) would cause negative effects. For this reason educating users on what to expect of their GNSS receiver in certain conditions would help promote 'responsible use' of GNSS receivers. This could similarly be extended to other types of users, (professional users for example) to mitigate against interruption to businesses that rely on GNSS reception for key activities.

Recent regulatory proposals by one administration also suggest that it may be worthwhile explaining why reception of low power level GNSS signals is unlike any other radio system and that the spectrum used by GNSS requires particular considerations when making new frequency allocations around the same range.

Discussion/Analyses:

At the 2012 Intersessional Meeting of WG-A, members, with the EU as lead, agreed to develop sample educational material on GNSS Interference to present at ICG-7. The involvement of the ITU was also to be pursued.

Recommendation of Committee Action:

The ICG should develop educational material such as a downloadable pamphlet or other web content on sources of interference to GNSS. The material should include an explanation why radio navigation satellite services (RNSS) are different than radio communications services and more vulnerable to interference.

WG-A Recommendation 3.2 for Committee Decision

Prepared by: Working Group A

Date of Submission: 08 November 2012

Issue Title: Continuation of Workshops on GNSS Spectrum Protection and Interference Detection and Mitigation

Background/Brief Description of the Issue:

At the first IDM workshop, held in Vienna on June 2012, the following conclusions were reached by consensus:

Sources of interference

1. The ICG should develop educational material such as a downloadable pamphlet or other web content on sources of interference to GNSS. The material should include an explanation why radio navigation satellite services (RNSS) are different than radio communications services and more vulnerable to interference.

RNSS Spectrum Protection

2. The ICG should recommend that its member state participants identify a suitable GNSS monitoring site or operations center to be recognized by the ITU as an official part of its International interference monitoring network.
3. ICG system providers should be reminded to adhere to the existing template for sharing information between service providers and should exchange information related to domestic spectrum management activities applicable to GNSS.

Current and future information sharing, dissemination, collaboration and standardization

4. The ICG should compare the existing ITU interference report to the reporting form used by the U.S. and other forms under development in order to develop a guideline or best practice for GNSS interference reporting.

Concepts and Techniques for Interference Detection

5. The ICG should consider initiating a process to develop guidelines for mobile GNSS device manufacturers that are interested in contributing interference detection information to national reporting authorities or automated detection networks.

Continuation of IDM Workshops

6. System providers and ICG participants should identify experts to participate in the next IDM workshop and reach a consensus on the next meeting date and location.

Discussion/Analyses:

At the 2012 Intersessional Meeting of WG-A, members agreed to provide feedback to the Co-Chairs on their ability to attend the proposed workshop and recruit desired expert attendees.

The WG-A Co-Chairs also agreed to request that the ITU-BR representative to the ICG provide the working group with the current list of ITU-recognized interference monitoring network sites. Members of the working group can then compare the existing ITU interference report to the GNSS-specific reporting form used by the U.S., Russia, and China, and other GNSS-specific forms that may be under development. At ICG-7, views were exchanged on whether a standardized form is desirable.

Recommendation of Committee Action:

- The ICG should sponsor additional GNSS Interference Detection & Mitigation (IDM) Workshops
 - System Providers and ICG participants are encouraged to identify experts to participate in the next workshop, scheduled to occur in Honolulu, Hawaii, immediately preceding the ION Pacific PNT Meeting, April 22-25, 2013
 - Specific expertise desired includes:
 - o ITU Radio Bureau officials
 - o Spectrum Regulators and other appropriate experts from System Providers and Administrations in the Asia-Pacific Region
 - o Representatives of major industrial and transportation sectors (such as mobile telecommunications, automotive electronics, aviation) utilizing GNSS
 - o IGS and GNSS reference station network developers

WG-A Recommendation 4.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 08 November 2012

Issue Title: International GNSS Monitoring and Assessment (IGMA) Subgroup

Background/Brief Description of the Issue:

The Providers Forum has agreed to 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 such as timing accuracy, positioning accuracy and service availability. As stated in its work plan, Working Group A will support this activity by focusing on potential cooperation in the development of the necessary ground infrastructure to monitor signal and service performance for open services.

To ensure the service quality, consistent with common open service performance parameters, and realize the ultimate goal of interoperable GNSS open services signals, it is desirable to carry out monitoring and assessment on GNSS open services. An important approach is to determine if international GNSS Monitoring and Assessment requires a single new system, an architecture created by several national systems, or the use of an existing global network system such as the one organized by the International GNSS Service (IGS).

Discussion/Analyses:

Several multi-GNSS monitoring network activities are underway:

- China is developing their International GNSS Monitoring and Assessment System (iGMAS) as a contribution to the ICG activity;
 - Note that China has issued a Call for Participation in their system. ICG components are encouraged to review the CfP and respond: <http://en.beidou.gov.cn/>
 - Note that China has prepared a draft version of a document on GNSS Open Service parameters to be monitored, also located at the above website
- Japan has also initiated a project known as Multi-GNSS Demonstration Campaign, which is actively seeking proposals for monitoring sites to host GPS/GLONASS/Galileo/QZSS receivers that have already been procured by JAXA (www.multignss.asia).
- IGS network upgrades currently include multi-GNSS receivers in the framework of the IGS Multi-GNSS Experiment (MGEX). These receivers are being deployed globally and IGS will analyze and produce products for the multi-GNSS constellations, similar to what it is currently accomplishing for GPS and GLONASS. IGS plans should be explored for potential to contribute this ICG task.
- The support and participation of all GNSS providers will be very beneficial for global monitoring and assessment.

To monitor and assess GNSS open services worldwide, a subgroup of WG-A, with participation from WG-B and WG-D was formed as recommended at ICG-6 to develop a proposal to optimize existing and planned capabilities, and identify additional activities necessary for international GNSS Monitoring and Assessment. This subgroup met in July 2012 on the margins of the annual IGS Workshop and the inter-sessional meeting of WG-A.

The ICG-IGMA sub-group meeting in Poland, including WG-A and WG-D members, recognized the need to focus and define the plans of the group. WG-A prepared the

recommendation (below), and the sub-group proposes a two-year work plan to meet the goals and objectives of this recommendation. This work plan is included below.

Recommendation of Committee Action:

- The task of the current IGMA sub-group of WG-A (with B & D participation) should be to:
 - Determine Service Parameters to Monitor
 - Determine what gaps exist in current monitoring
 - 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
 - Propose an Organizational Approach that:
 - Avoids Duplication
 - Considers the role of the current/planned IGS and
 - Defines the Relationship of the proposed organization to the ICG

Proposed Work Plan of ICG IGMA, 2013-2015:

Noting the recommendation and report of WG-A Intercessional Meeting in Poland, the ICG IGMA Sub-Group proposes to:

- *Prepare a charter for subgroup activities for a two-year period until ICG-9. The charter will be based upon a modified ToR draft stemming from discussions at meetings in Vienna, Austria, in December 2011, and in Olsztyn, Poland in July 2012 (see attachment).*
- *Request each system provider, Working Group B and D, and appropriate Associate Members and Observers, to provide a point of contact for this activity, and to be members of the sub-group.*
- *Conduct a survey of providers and users, in cooperation with WG-A, WG-B, and WG-D to:*
 - *define the purpose for monitoring and assessing the parameters,*
 - *determine what parameters are necessary to be monitored for individual systems and inter-GNSS,*
 - *define responsibilities for monitoring and assessment,*
 - *determine what level and methods are needed,*
 - *prioritize the importance of the parameters to be monitored*
- *Develop a functional requirements document for ICG GNSS monitoring and assessment.*
- *Determine what currently exists, based on the functional requirements of individual systems, and what may be available and applicable to multi-GNSS monitoring.*
- *Identify plans and capabilities of various GNSS monitoring components that may meet any of the functional requirements.*
- *Determine what needs to be developed; identify potential candidates to develop and implement.*
- *Develop a schedule for this ICG IGMA sub-group activity by February 2013.*
- *Report to ICG-9 and include a summary of the findings and potentially, a proposed approach for collective ICG GNSS monitoring and assessment, along with a proposed implementation plan and schedule.*
- *Provide an interim report at ICG-8 on progress.*

Attachment**ICG International GNSS Monitoring and Assessment
First Draft of ICG IGMA Charter, 2013-2015
(Working Document)****Background**

To ensure the service quality and realize the ultimate goal of interoperable GNSS open services signals, it is desirable to carry out monitoring and assessment on GNSS open services. The Providers Forum of ICG-4 has agreed to 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 such as timing accuracy, positioning accuracy and service availability.

To monitor and assess GNSS open services worldwide, the subgroup on International GNSS Monitoring and Assessment was formed at ICG-6 to support activities and develop proposals to optimize existing and planned capabilities, and identify additional necessary activities.

Objective

The objective of the subgroup is to actively advance the international GNSS monitoring and assessment by promoting the sharing of the global monitoring resource and carrying forward international cooperation.

Main tasks

The subgroup will support related activities by focusing on potential cooperation in the following (including but not limited to):

1. Promote the sharing of existing resources such as data and infrastructure to monitor signal and service performance for open services.
2. Determine parameters to be included.
3. Discuss the standards of monitoring and assessment
4. Discuss the sharing methods of monitoring and assessment resources

Activities

The activities shall include but not limited to the following:

1. A work plan will be developed and progress will be reported to the WG-A and ICG plenary (reporting sub-group vs. task group)

Subgroup meetings may be held as needed to share the information and experience, to discuss the specific items which GNSS providers and users are concerned with. Persons interested in the topic are welcomed to attend

WG-A Recommendation 5.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 08 November 2012

Issue Title: Interoperability Workshop

Background/Brief Description of the Issue:

At the ICG-5 meeting of WG-A, the co-chairs presented a summary report of user community views on interoperability, with the following findings:

- Priorities include common carrier frequencies, common time scale & reference systems, common modulation, and collocation of reference stations
- Service-related assurances viewed as important by almost all respondents
- It is difficult to draw more detailed conclusions -many respondents did not appear to understand the underlying issues
- ICG Principle of Interoperability and its definition seems valid - No substantial changes to definition required
- Benefits of interoperability include better availability, accuracy, and ability to support RAIM
- Interviews probably were needed

As a result of this presentation, the ICG recommended that interested members of WG-A develop a new approach to the continued collection of user and industry views on interoperability. This new approach should include interviews with industry and users and the organization of a large user/industry summit to be attended by key technical experts

Discussion/Analyses:

No follow-on recommendation related to interoperability was made at ICG-6, and the recommended summit has not yet occurred. However, WG-A renewed discussion on the subject at the 2012 intersessional meeting, and completed the recommendation enclosed below. WG-A system provider members agreed to provide the Co-Chairs with a point of contact for developing the agenda and web site material for the proposed Interoperability workshop to be held in conjunction with ION Pacific PNT 2013.

It was also proposed that the identified team would begin developing a draft agenda and other web-based material for consideration by the Committee at ICG-7.

Recommendation of Committee Action:

- Consistent with the principle of interoperability and its definition, and the implementation of previous ICG recommendations related to interoperability, the ICG should conduct an interoperability workshop in conjunction with the ION Pacific PNT meeting, April 22-25, 2013.
- The ICG will request inputs from potential participants prior to the workshop through existing web sites related to GNSS information dissemination, conferences, major PNT organizations and events.
- The following interoperability subjects may be addressed:
 - Potential for a common third open service signal
 - Frequency diversity vs. frequency commonality

- DOP improvement with the addition of 2nd, 3rd, 4th, Nth global constellation
- System provider time and geodetic reference frame implementation as described by the ICG WG-D templates
- Potential opportunities to utilize existing or planned spare capacity in civil/open service or SBAS navigation messages in order to increase multi-GNSS interoperability