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 Monday, Tuesday and Wednesday, 11-13 November 2013 under the co-chairmanship of Mr. Sergey Revnivykh, Russian Federation, and Mr. David Turner, United States of America.

2. After brief welcoming remarks, the co-chairs reviewed the agenda noting that it followed the same format as the June inter-session meeting; broken into 6 sessions corresponding to the Work Plan of the Working Group. It was noted that Session 4 would be a joint session, conducted with the participation of working groups B and D. The agenda was adopted without further modifications or objections.

3. The co-chairs then began **Session 1 of the agenda covering System Provider Updates** by asking if there was new information to be presented that was not covered during the opening Plenary Session. Mr. Viktor Kashenko, Russian Federation, presented on the "Prospects for Status and Development of GLONASS System Space Complex." The presentation provided an update on the GLONASS space segment and noted that there is a full constellation of GLONASS-M satellites. CDMA signals at L1 and L2 are expected to be available beginning around 2016 or 2017.

4. Mr. Grigory Stupak, Russian Federation, followed with a presentation titled "SDCM Present Status and Future GLONASS Signals Development." Mr. Stupak explained that there are currently 22 SDCM ground stations around the world with a goal of creating seamless coverage throughout Russia with LPV-200 capability. The U.S. asked a question about whether SDCM provides corrections for other constellations in addition to GLONASS. The Russian Federation explained that SDCM currently augments both GLONASS and GPS, but additional constellations could be added in the future.

5. **Session 2, GNSS Compatibility**, began with a presentation by Mr. Valery Tyubalin, Russian Federation, on "Signal Anomalies Monitoring", which compared the Stanford Method for identifying signal anomalies with a form of Gaussian estimation. This was followed by a presentation from Mr. Alexey Bolkunov, Russian Federation, on "Civil Service System Performance Standards in Russia". The presentation reviewed the main parameters of the Russian performance standard, and shared a template which could serve as a baseline for an ICG GNSS performance standard template. Mr. Jianwen LI from China continued with a presentation offering China's perspective on parameters to be included in a performance standard template. Mr. LI suggested that a common set of parameters be agreed upon first as a baseline, and then the methodology for achieving the parameters can be determined.

6. The co-chairs of the Compatibility Subgroup, Takahiro MITOME from Japan and Dominic Hayes from the EU, presented their report on the activities of the subgroup. They commented that the ITU has formed a Joint Task Group (JTG-4-5-6-7) Committee to look for additional mobile spectrum. The previous action assigned to the Sub-Group called for System Providers to identify representatives for work on open service performance templates and a comparison of the parameters. The co-chairs noted that additional work is needed to complete this action, and the identified points of contact would be meeting to discuss the plan for proceeding. The co-chairs also reported that the subgroup had no objections to Recommendation 8A.2.1, IMT-GNSS Compatibility. The recommendation was then discussed by the full Working Group and no objections were noted.

7. The WG-A co-chairs brought up Recommendation 8A.2.2, updating the content of the UN booklet on the status of current and future GNSS. There were no objections to this recommendation. Finally, the co-chairs presented an update on the status of the next

steps with regard to open service performance standard and the development of a template. The first step, identifying points of contact from each of the Providers, has been completed. The remaining steps, including meeting under the Compatibility Subgroup to agree on parameters and methodologies, will take place during future meetings. It was noted that this is considered an internal action for the working group (and subgroup), and not a recommendation for the full ICG..

8. Members from working groups B and D joined the members of WG-A **for Session 4, Open Service Information Sharing and Service Performance Monitoring**. The session began with a presentation from Mr. Oleg Denissenko, Russian Federation, on the GNSS Monitoring and Assessment System Being Developed in Russia. Mr. Denissenko discussed the goals of the system and identified a list of parameters to be monitored by the international systems. This presentation was followed by a presentation from Dr. Xurong DONG from China, on the status and latest progress of the iGMAS. Dr. DONG reported that initial operational capability (IOC) for the iGMAS is expected in June 2014. Ten tracking stations have been installed so far, and 25 additional stations are expected to be added in the future. A signal quality monitoring station has also been established in China and a new 40m antenna is expected to be installed in 2014.

9. Mr. Satoshi Kogure from Japan continued session 4 with a status update on the activities of the Subgroup on International GNSS Monitoring and Assessment (IGMA). Mr. Kogure reported that three subgroup meetings took place within the past year and the focus has been on using the U.S. Open Service Performance Monitoring Standard. The primary task has been to propose a list of parameters to monitor; additional time is needed to finalize this list. The co-chairs of WG-A suggested that a new recommendation be considered jointly from working groups A, B and D which would redefine the Subgroup as a Task Force with participation from all three working groups. A suggestion was also made for the Subgroup/Task Force to meet on the margins of the next IGS meeting, June 2014 in Pasadena, CA, U.S.

10. **Session 3, Spectrum Protection**, opened with a presentation by Mr. Jeffrey Auerbach from the U.S., on outcomes of the second ICG Interference Detection and Mitigation (IDM) workshop. Mr. Auerbach provided a short summary and resulting conclusions from the April 2013 workshop and follow-on discussions. Following the presentation, the EU noted that they are conducting a survey of professional users in Europe about privacy concerns, and perceptions and understandings of interference and jamming. The co-chairs brought up Recommendation 8A.3.1, Education and Outreach Regarding Sources of GNSS Interference. The Russian Federation volunteered to provide additional support in putting together the information, and Japan agreed to offer some related information on space weather.

11. Session 3 continued with a presentation by Mr. Stanislav Kizima, Russian Federation, which provided an overview of the International IDM System Concept. Mr. Kizima recommended the Creation of an IDM system database server to be used for monitoring GNSS facilities. He suggested identifying formalized data exchange formats for IDM. A question was asked about whether something like this already exists in Russia. Mr. Kizima responded that Russia does have an active system for monitoring interference, but not specifically for GNSS. There are some issues with the existing system because GNSS is not listed as source of interference and the technical facilities are not able to analyze parameters specific to GNSS. Hence the need for development of specific GNSS monitoring facilities. Mr. Tom Stansell from the U.S. responded that cell phones could be enabled to become individual detectors of GNSS interference, and the interference source location could be determined this way. This technique is known as crowd sourcing. Mr. Kizima noted that cell phones give information on signal power, but not measurement equipment. The co-chair, Mr. Turner, offered that the IDM Task Force has been established, and this could be a topic

for discussion at the next IDM Workshop. Mr. Atilla Matas from the ITU, recommended that a basic interference template be used.

12. China continued the session on spectrum protection with a presentation by Mr. Weimin ZHEN on a proposal to develop a template for GNSS interference detection and reporting. He suggested that a generic template specific to reporting GNSS interference be developed. The co-chair, Mr. Revnivykh, offered that this could be an action for the IDM Task Force to take up. The co-chairs reviewed Recommendation 8A.3.2, GNSS Interference Detection Reporting Procedures. Mr. Rick Hamilton & Mr. Weimin ZHEN were nominated as co-chairs for the Task Force, and the members will work on developing a workplan. Mr. Stansell suggested that the Task Force focus more a dynamic response that can identify interference within a short period of time. No objections to the recommendation were noted. The WG-A co-chair, Mr. Turner, suggested that Recommendation 8A.3.1 be assigned to the Task Force, and this was adopted without objection.

13. Mr. Rick Hamilton from the U.S. provided a presentation on "U.S. Activities in Response to the Second IDM Workshop". Mr. Hamilton noted that the U.S. has developed a draft pamphlet and some reference material on interference. This information was shared with the working group as an example of what is being done in the U.S. The co-chair, Mr. Turner, offered that the Task Force might consider reviewing and comparing what laws and regulations each System Provider has regarding interference. The co-chairs of the Task Force agreed that the date and location of the next IDM Workshop would be determined by the Task Force, along with planning and development of the agenda.

14. **Session 5, GNSS Interoperability**, began with a presentation by Mr. Auerbach on the "U.S. Outcomes and Views of the Interoperability Workshop", held in April 2013. The presentation highlighted the responses from industry to the interoperability questions that were posed in advance of the workshop, and gave some perspective on analyzing these results. The Russian Federation followed with a presentation from Mr. Sergey Silin on Russian Industry Views of the Outcomes of the Interoperability Workshop. The questions should be streamlined so that they are common and easily understood. The co-chair, Mr. Revnivykh suggested that the questions should be relevant to both Providers and industry. The Russian Federation also provided a presentation on Broadcasting System Time Scales Offsets in Navigation Messages, Assessment of Feasibility, given by Mr. Arcady Tyulyakov and Mr. Andry Druzhin. The presentation discussed how GNSS System Time offset (GGTO) is calculated and the benefit of using GGTO to generate the most accurate navigation solution.

15. Session 5 continued with a presentation from Ms. Xiaochun LU from China, on the Chinese User/Industry View on Interoperability. Ms. LU highlighted a preliminary workshop on Interoperability that China conducted in May 2013 in which some questions were posed to Chinese industry. She also presented an analysis of the inputs of interoperability, comparing the results presented by The Russian Federation at the Inter-sessional WG-A meeting in June 2013 to the results obtained from China's preliminary workshop in May 2013. Following the presentations from China, the WG-A co-chairs reviewed Recommendation 8A.5.1, Interoperability Task Force, and suggested that the Task Force consider developing a set of standard questions to be posed to industry to ensure that they are the same for each upcoming workshop. The Russian Federation noted that they may hold an interoperability workshop in in April 2014, in conjunction with the Moscow GNSS Forum. China indicated that they plan to hold an Interoperability Workshop in conjunction with the China Satellite Navigation Conference in May 2013. Both of these workshops would be supported by the ICG, and WG-A members are encouraged to participate.

16. **Session 6, Conclusion**, was held on 13 November 2013. The co-chairs began with a final review of the recommendations, noting that the objective was to review them and reach consensus for presentation to the full ICG at the Plenary Meeting. No changes or objections were noted for Recommendations 8A.2.1, 8A.2.2, 8A.3.1, and 8A.4.1. For Recommendation 8A.3.2 (IDM Task Force), the list of participant members was updated to include the co-chairs, Mr. Rick Hamilton from the U.S. and Mr. Weimin ZHEN from China. For Recommendation 8A.5.1 (Interoperability Task Force), the list of participant members was updated to include the co-chairs, Mr. Jeffrey Auerbach from the U.S. and Ms. Xiaochun LU from China. In summary, six recommendations (2.1, 2.2, 3.1, 3.2, 4.1 and 5.1) were approved by Working Group A, for presentation at the full Plenary Meeting.

17. The co-chairs brought up for discussion the selection of a time and venue for the WG-A inter-session meeting in 2014. The ITU offered to host the meeting in Geneva possibly in July 2014, and no objections to this offer were noted. The resulting potential schedule of 2014 WG-A related meetings/events is as follows:

- Russia Interoperability Workshop, April 2014
- China Interoperability Workshop, May 2013
- IDM Workshop, May 19-20, Nanjing, China
- IGMA Meeting/Workshop, June 22-26, Pasadena, CA, U.S.
- WG-A Inter-session Meeting, Geneva, Switzerland
  (possible dates: 16-18 July 2014)
- ICG-9, Prague, November 10-14, 2014

The co-chairs also noted that key members of each Task Force should plan to participate in the workshops, and reminded members of the working group that the official language for the workshops should be English. If it is necessary for speakers to present in their native languages; some translation capability will need to be made available.

The full set of WG-A recommendations as adopted by the Committee at ICG-8 are enclosed in the pages that follow.

Recommendation 8A.2.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 13 November 2013

Issue Title: IMT-GNSS Compatibility (Revision to 7A.2.1)

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. At the 2013 intersessional meeting, it was recognized that potential concern on the protection of RNSS spectrum from new IMT allocations still exists, since some of the candidate bands for IMT currently being discussed within ITU Joint Task Group (JTG) 4-5-6-7 may affect the existing RNSS allocations. These include the 1300-1400, 1518-1559, and 1610-1660.5 MHz bands.

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.

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 (including JTG 4-5-6-7 until August 2014), 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.

Recommendation 8A.2.2 for Committee Decision

Prepared by: Working Group A

Date of Submission: 13 November 2013

Issue Title: Providers Update to Current and Future System

Background/Brief Description of the Issue:

In 2010, the ICG Providers Forum members put together a publication titled "Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentation Systems" in an effort to provide the user community and receiver-producing industry with a clear and consistent description of the systems. The publication indicates that the information will be updated as necessary to reflect changes to the information.

Discussion/Analyses:

At the 2013 Intersessional Meeting of WG-A, the meeting participants agreed that some of the information in the publication has changed, and therefore a recommendation should be developed to update the publication prior to ICG-10 in 2015.

Recommendation of Committee Action:

System Providers should provide updated information regarding global and regional navigation satellite systems and augmentations in time for the publication of a new edition of the Providers Forum's Current and Planned Global and Regional Navigation Satellite Systems and Satellite-Based Augmentation Systems before ICG-10. The updated information should include observed or expected open service performance.

Recommendation 8A.3.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 13 November 2013

Issue Title: Education & Outreach Regarding Sources of GNSS Interference (Revision to 7A.3.1)

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.

The second Workshop on Interference Detection and Mitigation in 2013 discussed the role of GNSS on a country's critical infrastructure. At the 2013 Intersessional Meeting of WG-A, the participants reviewed the recommendation 7A.3.1 and agreed that the recommendation requires further work and that the information material should emphasize the importance of GNSS to critical infrastructure.

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, and will emphasize the importance of GNSS services to critical public and private sector functions, infrastructure, and economic activity.

Recommendation 8A.3.2 for Committee Decision

Prepared by: Working Group A

Date of Submission: 13 November 2013

Issue Title: GNSS Interference Detection Reporting Procedures

Background/Brief Description of the Issue:

Receiving reports of GNSS interference is important to system providers and GNSS users alike. The information received from these reports can be used in a variety of ways, from maintaining the integrity of the system to being able to warn users of potential outages. Exchange of this information between states could be a valuable tool for helping to mitigate interference events and could also alert system providers of potential issues.

Discussion/Analyses:

At the first Workshop on Interference Detection and Mitigation (IDM) in 2012, the concept of developing a guideline or best practice for GNSS interference reporting was discussed. The participants agreed that this is an important topic and continued the discussion at the second IDM Workshop in 2013. At the 2013 Intersessional Meeting of WG-A, the participants agreed that a smaller group should discuss this in more detail to develop a common set of guidelines to be considered for reporting GNSS interference.

Recommendation of Committee Action:

Working Group A should form a Task Force on GNSS Interference Detection reporting procedures and system development.

- *Initially, the task force will focus on developing a common set of information to be reported to GNSS civil service centers.*

- *Next, the task force will focus on establishing routine communications among the centers.*

- *Finally the task force will develop guidelines for common capabilities to be considered in the development of future national IDM networks.*

Recommendation 8A.4.1 for Committee Decision

Prepared by: IGMA Sub-Group (Working Group A, B and D)

Date of Submission: 12 November 2013

Issue Title: Update Recommendation on IGMA ICG-7A4.1 for its Further Development

Background/Brief Description of the Issue:

Considering that:

IGMA was established as a joint ICG sub-group by recommendation of WG-A (see appended recommendation ICG-7 4.1, which includes the IGMA work plan and charter).

ICG approved recommendations from WG-D to endorse MGA (ICG-4, WG-D #5) and IGS MGEX (ICG-6 WG-D #13).

Recognizing the on-going activities of the IGS, MGA/MGMNet, iGMAS, and Russian Monitoring and assessment system, those networks and systems are expanding their monitoring capability to track and monitor multiple constellations.

The Subgroup had three meetings and collected proposals on the parameters set to be monitored by IGMA.

Discussion/Analyses:

Due to sub-group discussions and activities over the past year, progress against the approved work plan is evident. Increasing interest by the wider ICG and discussions at ICG-8 indicated updates to recommendation A7 4.1 were necessary. Therefore, the sub-group has agreed to:

- Reaffirm the 2013-2015 work plan of IGMA and distribute to ICG members, associates and observers and other interested groups

- Share study progress on OS PS with WG-A Compatibility Subgroup and iterate investigation on the parameters

- Seek contribution to IGMA activities by the broader ICG community

- Promote closer cooperation of the identified IGMA organizations (IGS, MGA, iGMAS, Russia)

- Study how to disseminate monitoring and assessment results, such as the concept of "Service Net" proposed by China

- Encourage participation in the IGMA plenary and splinter sessions during the IGS 20th Anniversary Symposium, June 22-26, 2014 in Pasadena, CA, USA

Recommendation of Committee Action:

Recommendation 7A.4.1 is proposed to be updated as follows;

- *Redefine the current IGMA joint sub-group of WG-A, B & D as an ICG Task Force. Their task 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 a 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*
- *Propose an Organizational Approach that:*
  - *Coordinates and integrates the related activities for identifying parameters*
  - *Avoids Duplication*
  - *Considers the role of the current/planned IGS and*
  - *Defines the Relationship of the proposed organization to the ICG*
- *Explore methods to disseminate monitoring and assessment results, considering specific proposals from system providers*

Recommendation 8A.5.1 for Committee Decision

Prepared by: Working Group A

Date of Submission: 13 November 2013

Issue Title: Interoperability Task Force

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 was carried forward at the WG-A 2012 intersessional meeting, and a recommendation to hold an interoperability workshop was put forth to be attended by key technical experts. This workshop was held in April 2013 in conjunction with the ION Pacific Conference. Industry participants were presented with a series of questions in advance of the workshop, and had an opportunity to explain and expand upon their answers.

Discussion/Analyses:

At the 2013 Intersessional Meeting of WG-A, the participants discussed preliminary results of the workshop and agreed that holding these workshops was a successful way for the WG-A members to get feedback about user and industry views on interoperability. The members of WG-A agreed that the results of the workshop and questionnaire should be compiled for further analysis through the formation of a task force consisting of Provider representatives. Each of the Providers should also consider hosting a workshop to get further feedback from industry.

Recommendation of Committee Action:

Consistent with the principle of interoperability and its definition, and the implementation of previous ICG recommendations related to interoperability, Working Group A should form a task force to complete efforts to collect and analyze user community and industry views on interoperability

- *The task force will analyze the results of the April 2013 interoperability workshop and adjust the questions for industry accordingly, in preparation for additional workshops to be hosted by each system provider*

- *The results of each workshop will be consolidated and analyzed by the Task Force in preparation for the 2014 intersessional meeting of Working Group A and ICG-9*