

REPORT ON THE ELEVENTH MEETING OF THE INTERNATIONAL COMMITTEE ON GLOBAL NAVIGATION SATELLITE SYSTEMS (ICG-11)

Sochi, Russia, November 2016

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INTRODUCTION

The Eleventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Sochi, Russia from 7 to 11 November 2016. The ICG has been formed as a result of recommendations of the UN Committee on the Peaceful Use of Outer Space (COPUOS), as ratified by the General Assembly of the UN. The International Federation of Surveyors (FIG) is an Associate Member of the ICG. I was there as the FIG representative to UNOOSA. Unfortunately, Neil Weston could not be present but he is FIG's co-chair for Working Group D on Reference Frames, Timing and Applications. This meeting was attracted almost 150 people attended the meeting with representatives from all of the GNSS/RNSS providers. There were also many representatives from other countries and non-government organisations.

JOINT STATEMENT FROM ICG-11

At the end of each meeting, the ICG issues a Joint Statement outlining the highlights of the broad scope of work across the ICG. Various presentations were made at the plenary sessions and working group sessions of the meeting and they form a very useful snap shot of the state of the art with the various GNSS and also with issues across key user groups. The Joint Statement from ICG-11, Working Group Reports and all presentations are available on the ICG Information portal. The joint statement is also included as Appendix A.

MAJOR FINDINGS FROM THE MEETING

There were many other presentations, discussions and decisions at the meeting and the following is an outline of some that the author found particularly interesting:

- Each provider presented on their status and their respective progress.
- The FIG/IAG/ICG Technical Seminars are seen as successful and useful. It was decided that ICG will continue with its support also during 2017 with the technical seminar to be held in Kobe, Japan.
- The UN resolution on Global Geodetic Reference Frame for sustainable development was presented and progress noted.
- The new ITRF realisation was presented by Zuheir Altamimi
- User perspective and applications describe through several presentations

MEETINGS OF WORKING GROUP D AND ITS TASK FORCES ON GEODETIC AND TIMING REFERENCES

The working group had two meetings during the week. The minutes from Working Group D and other Working Groups will be available from the ICG web portal in due course as well as other official documents as e.g. recommendations and all presentations.

The Working Group noted significant continued progress on the geodetic and timing references by the ICG GNSS Providers. Specific progress was noted: (1) the availability of the new release of the International Terrestrial Reference Frame (ITRF2014) and the significant contribution of GNSS data, (2) the refinement of the alignments of GNSS associated reference frames to the ITRF, and (3) the information on the GNSS timing references, the BIPM publications and the inter-comparisons of GNSS time offsets.

Working Group D has contributed and will continue to contribute to the IGMA initiative and in particular through the IGMA trial project and the joint International GNSS Service (IGS) - IGMA Call for Participation.

The Working Group D noted lack of progress on two specific recommendations, number 12 and 23: one in relation to the provision to the IGS of GNSS data of Providers' tracking stations, and one on the possible provision by GNSS Providers of satellite data that would help improving orbit modelling and accuracy. The Working Group D Providers Members are solicited to follow up the implementation of the recommendations.

NEXT MEETINGS OF THE ICG

Japan agreed to host ICG-12 in December, 2017.

APPENDIX A

**Eleventh Meeting of the
International Committee on Global Navigation Satellite Systems
7 – 11 November 2016
Sochi, Russian Federation
JOINT STATEMENT**

The Eleventh Meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Sochi, Russian Federation, from 7 to 11 November 2016 to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to address recent developments in their organizations and associations with regard to GNSS services and applications. ICG also addressed high precision GNSS applications in various fields of the world economy.

The Designer General and Deputy Director of the Roscosmos State Corporation for Space Activities, the Mayor of the Sochi City delivered opening speeches on behalf of the Russian Federation. The Director of the Office for Outer Space Affairs also addressed the Meeting.

The Meeting was hosted by the Russian Federation and organized by the Roscosmos State Corporation for Space Activities. The Meeting was attended by representatives of China, India, Italy, Japan, the Russian Federation, the United Arab Emirates, the United States and the European Union, as well as the following intergovernmental and non-governmental organizations: Arab Institute of Navigation, Asia-Pacific Space Cooperation Organization, Civil Global Positioning System Service Interface Committee, European Space Agency, European Space Policy Institute, European Position Determination System, Interagency Operations Advisory Group, International Aeronautical Federation, International Association of Geodesy Reference Frame Sub-Commission for Europe, International Association of Institutes of Navigation, International Bureau of Weights and Measures (BIPM), International Union of Radio Science, International Federation of Surveyors, International Earth Rotation and Reference Systems. Representatives of the Office for Outer Space Affairs and the International Telecommunication Union also participated. Korea was invited to attend as observer.

ICG recalled that the General Assembly, in its draft resolution (A/C.4/71/L.2), had noted with satisfaction the continuous progress made by ICG towards achieving compatibility and interoperability among global and regional space based positioning, navigation and timing systems and in the promotion of the use of GNSS and their integration into national infrastructure, particularly in developing countries. The Assembly had noted with appreciation that ICG had held its Eleventh Meeting in Sochi, Russian Federation from 6 to 11 November 2016.

ICG noted that the working groups had focused on the following issues: systems, signals, services; enhancement of GNSS performance, new services and capabilities; information dissemination and capacity-building; and reference frames, timing and applications.

The Working Group on Systems, Signals and Services (Working Group S), completed its first year of activities using its updated organizational structure approved by the Committee at the tenth meeting of the ICG. This structure includes a subgroup on Compatibility and Spectrum Protection and a subgroup on Interoperability and Service Standards. The Compatibility and Spectrum Protection subgroup decided to continue addressing the need for worldwide GNSS spectrum protection through an updated recommendation for ICG member administrations to encourage protection of Radio Navigation Satellite Service (RNSS) spectrum from the unwanted emissions. Efforts to encourage reporting on domestic RNSS spectrum protection through the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space will also continue, and an Experts Seminar on GNSS spectrum will be held in December 2016 in conjunction with a United Nations regional workshop on GNSS in Kathmandu, Nepal. The Interference Detection and Mitigation (IDM) task force working under the subgroup organized and completed the fifth ICG IDM workshop in Changsha, China in May 2016. The 6th workshop focusing on both network-based and sensor-based (crowd sourcing) IDM capabilities will be held in May 2017 in conjunction with the Baska (Croatia) GNSS Conference.

The Subgroup on Interoperability and Service Standards held a meeting in Vienna, Austria in June 2016 to discuss follow-up work on performance standards and interoperability. The discussions on interoperability based on previous system provider workshops resulted in two recommendations, one related to open service signal patents, and the second related to system time aspects of interoperability among multiple GNSS. The International GNSS Monitoring and Assessment (IGMA) task force conducted several meetings in 2016, and initiated a joint trial project with the International GNSS Service (IGS) to demonstrate a global GNSS monitoring and assessment capability, by monitoring a limited set of GNSS parameters. A related recommendation to conduct an IGMA workshop in conjunction with the China Satellite Navigation Conference (CSNC) in 2017 in Shanghai, China was adopted by the Committee. Finally, the working group briefly discussed a new area of possible future work included in its work plan focused on system-of-systems operations such as orbital debris mitigation and orbit deconfliction, taking note of a presentation made in the Providers' Forum by the Russian Federation.

The Working Group on the Enhancement of GNSS Performance, New Services and Capabilities (Working Group B), is progressing significantly in establishing an interoperable GNSS Space Service Volume (SSV). Joint simulations conducted by the group provide clear evidence that for space users at high altitude close to the geostationary orbit or higher, no single constellation can provide a sufficient level of GNSS signal availability. Exploiting the interoperability between all systems allows achievement of GNSS signal availability very close to 100%. Members of Working Group will conduct outreach activities on the interoperable GNSS SSV including the publication of an ICG SSV booklet, conference sessions and papers together with supporting illustrative video material. Future areas of work in relation to the interoperable GNSS SSV are identified. All service providers are involved in the SSV activities.

Search and Rescue (SAR) services will be implemented by Galileo, the Global Navigation Satellite Systems (GLONASS) and Global Positioning System (GPS) according to the

International Satellite System for Search and Rescue (COSPAS SARSAT) standards. Assessments are ongoing regarding the future evolution of BeiDou SAR functions.

In relation to new services and capabilities, feedback is provided on scientific experiments exploiting high precision on-board clocks that show the potential to significantly improve the measurement accuracy of the gravitational red-shift. Future integrity concepts based on Advanced Receiver Autonomous Integrity Monitoring (ARAIM) will continue to be studied with the objective of exploiting the interoperability between the different systems for safety of life applications.

Space Weather aspects will continue to be addressed showing improvements that are achievable by advanced ionospheric modelling and receiver technologies.

The Application Subgroup of Working Group B continued its work and presented an Application Catalogue together with an initial version of an online questionnaire to collect future user needs. The Application Subgroup will work with the final objective to issue a report based on the feedback collected through the online questionnaire.

The Working Group on Information Dissemination and Capacity-building (Working Group C) reviewed the implementation status and follow-up to its recommendations and noted the continuous progress made in 2016 by the Working Group with the support of the Office for Outer Space Affairs in the promotion of the use of GNSS. Additional work carried out by the Office for Outer Space Affairs in support of the ICG, including the regional GNSS workshops, have been carried out satisfactorily.

The Working Group emphasized that the Regional Centres for Space Science and Technology Education, affiliated to the United Nations, which also serve as information centres for ICG and its Providers' Forum, have been working towards the establishment of a network of institutions involved or interested in GNSS. With support of the GNSS Providers, they have also identified new applications that could be developed in the regions on the basis of GNSS services.

The Working Group on Reference Frames, Timing and Applications (Working Group D) noted significant continued progress on the geodetic and timing references by the ICG GNSS Providers. Specific progress was noted: (1) the availability of the new release of the International Terrestrial Reference Frame (ITRF2014) and the significant contribution of GNSS data, (2) the refinement of the alignments of GNSS associated reference frames to the ITRF, and (3) the information on the GNSS timing references, the BIPM publications and the inter-comparisons of GNSS time offsets.

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