

Report of the Systems, Signals and Services Working Group (WG-S)

1. The International Committee on Global Navigation Satellite Systems (ICG) Working Group S (WG-S) on Systems, Signals and Services, met Monday, Tuesday and Wednesday, 04-06 December 2017, in Kyoto, Japan, under the co-chairmanship of Mr. Sergey Revniviykh, Russian Federation, and Mr. David Turner, United States of America (U.S.).
2. After brief welcoming remarks, the co-chairs reviewed and adopted the agenda. This was followed by a short review of the working group activities which took place in 2017, including two intersessional meetings: one held in Baska, Croatia in May, and the other held in Paris, France, in July. The co-chairs noted that the discussions taking place during the meeting will be based on ideas that were discussed during the intersessional meeting. The co-chair, Mr. Turner, encouraged the working group members to actively participate in the activities and meetings that occur throughout the year, and not just the annual ICG meeting.
3. The co-chairs then began the session covering **System Provider Updates** by explaining that this session was designed to offer Providers the opportunity to present any new information that was not covered during the opening Plenary Session. The European Union, Mr. Dominic Hayes, started the session with a presentation on “GALILEO I/NAV Changes”. He explained that the original GALILEO service included a “Safety of Life” service, which was meant to be real-time. However, this proved to be a big challenge which was not practical. As a result, GALILEO has extra capacity available in their message (I/NAV), and they are considering using this to make improvements in three areas: 1. Clock Ephemeris data to be downloaded more quickly; 2. Additional error correcting code (FEC2); 3. Secondary synchronization pattern. These changes could be implemented as early as 2018, and they anticipate no impact to legacy GALILEO receivers.
4. The Russian Federation continued the session with a presentation by Ms. Natalia Eremenko, “Improvement of GLONASS Accuracy with More Stable On-board Clocks”. Ms. Eremenko discussed recent GLONASS performance, noting improvement in signal-in-space errors due to clock improvements. She also discussed the status of clock development for future GLONASS K-2 satellites, and expressed that they expect future clock instability to be better than 1×10^{-14} with the new satellites.
5. The next session, **Compatibility & Spectrum: Interference Detection and Mitigation (IDM) Standards and Information Exchange**, began with a presentation from the U.S., Mr. Russell Holmes, on the GPS Interference Test Approval Process. Mr. Holmes discussed the U.S. process to facilitate GPS test approval across the Federal Government. He explained the ways in which conflicts are addressed, and the ways in which testing can be stopped. He also described the outreach effort that the U.S. Coast Guard Navigation Center undertakes to ensure that the public is fully aware of the impacts to GPS testing in the U.S., including local notice to mariners and broadcast notices issued by the Navigation Center and the Federal Aviation Administration (FAA).

6. The next presentation under IDM was made by Mr. Ken Alexander from the U.S., “Interference Between Aviation Authorities and GNSS Service Provider to Analyze Possible RFI Incidents”. This presentation was made by Mr. Alexander on behalf of Mr. Gerhard Berz from Eurocontrol, who was not able to attend the meeting. The focus of the presentation was on aviation related radio frequency interference events and Mr. Alexander explained that there are different reporting streams that exist today for reporting interference. He suggested that we should focus on short term implementable options, and offered the following recommendations for further discussion under the framework of the IDM workshops: 1. support information exchange for aviation with GNSS system operators; 2. forward aviation relevant reports to relevant entities (states, regional organizations); 3. review the process used to forward reports of aviation RFI and discuss findings at the next Compatibility Subgroup meeting. The WG-S co-chairs followed up by reminding the participants of Working Group Action 1, from the first Intersessional Meeting in May 2017: Invite ICAO to ICG-12 and Providers to brief on how national aviation authorities interface with GNSS service provider to analyze possible RFI incidents. Mr. Turner noted that this briefing covered the first part of the action (Mr. Alexander is the U.S. representative to ICAO Navigation Systems Panel), but the second part of the action remains open.
7. Mr Stanislav Kizima, from the Russian Federation, presented next on “Practical Estimation of Electromagnetic and Interference Environment at the Point of Location of Measurements in GNSS Frequency bands. Recommendation.” Mr. Kizima noted that this recommendation was first presented during the WG-S intersessional meeting in May 2017, and explained that the recommendation would establish a methodology of estimation of electromagnetic and interference environment at the point of measurements in GNSS frequency bands. The result would be to obtain general estimates about the presence of unwanted radio emissions and interference that affects the reception of GNSS signals. Mr. Kizima suggested that the IDM Task Force review this recommendation in more detail and consider whether this should be recommended to the full WG-S for adoption.
8. The session on IDM continued with a presentation from Mr. Zhen Weimin on “GNSS Interference Detection and Localization for Urban Area and Critical Infrastructure”. Mr. Zhen explained that distinguishing between the types of interference can be helpful in identifying the source. This can be done through process of elimination, and analyzing the spatial and temporal distribution of the interference can determine if an event was caused by ionospheric scintillation. Mr. Zhen noted that airports in China are considered critical infrastructure and both ground methods and aerial methods are used for identifying the sources of interference. The aerial method is especially important for airports because ground equipment does not always detect the interference.
9. The IDM session wrapped up with a presentation by the Task Force co-chair, Mr. Rick Hamilton. The presentation reviewed the work of the Task Force in 2017. In February at the 54th Session of the United Nations Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee, three presentations were made on IDM by WG-S representatives, which reached a target audience of 72 UN member countries who participated. Mr. Hamilton also summarized the presentations and recommendations from the IDM Workshop held in May 2017 in Baska, Croatia and expressed the desire of the Task Force to hold a 7th Workshop in Baska once again, in May 2018.

10. The meeting continued with the session on **Compatibility & Spectrum: Signal Compatibility and Spectrum Protection**. The Subgroup co-chairs, Mr. Takahiro Mitome and Mr. Dominic Hayes, began with a discussion on MEOSAR. Mr. Hayes explained that the EU has found there to be a high risk of interference between BDS and Galileo on the relay signal downlink, and would like to propose establishing a multilateral group to discuss this further and determine if this is an issue and if so, what can be done to mitigate it. The WG-S co-chair, Mr. Turner, commented that the WG-S workplan does not specifically address search and rescue, however, it could conceivably be addressed as a compatibility issue under the Compatibility and Spectrum Subgroup. The Subgroup did not create any new Recommendation related to this issue, taking into account that discussion of these issues takes place in the COSPAS-SARSAT Council. The EU recognizes that the substantive discussion takes place in COSPAS-SARSAT groups, but given the urgency, it encourages the GNSS providers to fully engage in technical discussions and then report back. As a result the Subgroup agreed to take the action to prepare a short presentation with a proposed action for WG-S/Subgroup to address this issue at a later time.
11. The Compatibility and Spectrum report continued with a review of the actions and recommendations that were discussed during the May 2017 WG-S Intersessional Meeting. The Working Group agreed that it should continue to support the UN GNSS Workshops by holding a third seminar on spectrum protection. The next workshop is tentatively scheduled for March in Cordoba, Argentina. Draft recommendation 12S.2, working with 3GPP on crowd sourcing as a way to detect sources of interference, was also discussed. Mr. Hayes offered that the capability already exists in smart phones. Mr. Turner explained that we should not be recommending that apps be developed, but the recommendation is for 3GPP to require the capability for crowd sourcing in the next 5G standard. There were no additional comments or objections to draft text for this recommendation.
12. The Compatibility and Spectrum session of the WG-S wrapped up with a recap of actions and recommendations previously discussed during the intersessional meetings. The co-chairs noted that the ICG-11 recommendation calling for UN member states to present on their spectrum protection programs at the Committee on the Peaceful Uses of Outer Space (COPUOS) Scientific and Technical Subcommittee (STSC) meeting resulted in presentations from China, Russia and the U.S. at the February 2017 meeting. Other members are encouraged to do the same at future meetings. The proposal to hold another IDM Workshop in May 2018, in conjunction with the Baska GNSS Conference in Croatia, was also endorsed.
13. The next session, **Interoperability & Service Standards: Open Service Standards**, began with a presentation given by Ms. Robyn Anderson from the U.S., describing a “Summary of Draft Changes to GPS SPS PS”. Ms. Anderson explained that the draft 5th Edition of the GPS Standard Positioning System (SPS) Performance Standard (PS) is being reviewed internally within the U.S. Government, and will cover the L2 and L5 (I5 and Q5) signals. It will be backward compatible and compliant with the GPS Interface Control Document (ICD) at the time of initial operational capability. It will include updated signal in space accuracy and integrity requirements, as well as updated PVT Performance Expectations. The U.S. has also released GPS Performance Reports for the years 2013-2016 on the website GPS.gov. The co-chair, Mr. Turner, commented that the WG-S has previously recommended that all GNSS

providers consider releasing performance reports. Mr. Hayes, from the EU, noted that Galileo has two performance reports available for download, covering recent three month periods.

14. Mr. John Lavrakas from the U.S., and Mr. Alexey Bolkunov from the Russian Federation, provided an update on the recent work of the Performance Standard Team. They explained that the Team is focused on implementing an ICG recommendation from ICG-6, which calls for developing a template for defining open service performance. The Performance Standard Focus Group (“Dream Team”) was established by WG-S during the ICG-11 meeting, and the group has established a guideline document addressing minimum parameters and optional parameters. They are now focused on defining those parameters. The Team has proposed holding a Workshop in 2018, with three main objectives: 1) continue work on defining the parameters and calculation methodology; 2) increase collaboration with the International GNSS Monitoring and Assessment (IGMA) Task Force; 3) consider future challenges and the way forward, to include harmonizing different approaches. Mr. Bolkunov further explained that harmonizing the different parameters takes considerable time and effort, because of the need to get agreement from all providers. Mr. Peter Buist from the EU, described a proposal for the EU to host a combined Performance Standards and IGMA two day workshop in Noordwijk, Netherlands during the second or third week of May, 2018. It was noted that both the Performance Standard Focus Group and the IGMA TF agreed to this proposal.
15. The meeting continued with the session on **Interoperability & Service Standards: Multi-GNSS Interoperability**. A presentation on GNSS Ensemble Time was given by Mr. Werner Enderle from the European Space Agency (ESA). He described the current situation in which each GNSS has its own System Time which is linked to UTC, and time offsets are provided as relative offsets between systems. Mr. Enderle suggested that the ICG consider a Multi-GNSS Ensemble Time (MGET), which would be a common ensemble time linked to UTC, but system independent. A single institution, such as the IGS or BIPM, could provide the time, and a trial project could be established to develop and provision the concept. The co-chair, Mr. Turner, suggested that this proposal should be discussed further among the timing experts during a second timing workshop, as recommended at the WG-S intersessional meeting in July 2017.
16. Ms. Tatiana Primakina from the Russian Federation, followed with a presentation on Time Scale Interoperability Issues. She explained that time referencing in GNSS allows users to get GNSS to GNSS time offsets, based on data that is broadcast in the navigation message, namely GNSS-reference time offset parameters and GNSS-GNSS time offset parameters. There are different methods based on these broadcast parameters, and a comparison of these methods and how they are calculated can be discussed at the second timing workshop. The WG-S co-chairs then reviewed the draft recommendation regarding holding a second timing workshop in 2018. There was consensus among the working group participants that this recommendation should move forward for adoption by the full ICG.
17. The final presentation in the session on Multi-GNSS Interoperability was given by Mr. Sergey Silin, “Interoperability Assessment for Navigation Receiver Level”. Mr. Silin explained that simulation modeling utilizes navigation signal simulators and a 2030 project is working on this in different stages; stage 1 is looking at the receivers, and stage 2 will look at the navigation signal simulators. He described a proposal for the working group to consider creating program

actions for this project. The WG-S co-chair, Mr. Revnivkykh, suggested that the Interoperability Subgroup review and consider the proposal in preparation for the 2018 intersessional meeting.

18. The meeting continued with the report of the **Interoperability & Service Standards Subgroup**, co-chaired by Mr. Jeffrey Auerbach from the United States and Ms. Xiaochun Lu from China. The co-chairs reviewed the significant activities from the Subgroup that took place in 2017, including the discussions that took place in the first timing workshop held in Paris in July and the recommendation to hold a second workshop in 2018. A question was asked by the EU about precise point positioning (PPP) broadcast and what is being done by providers as far interoperability among the systems. The WG-S co-chair, Mr. Revnivkykh suggested that the subgroup discuss this further and determine if it is an area for future work.
19. A joint session with Working Groups B, C and D was held on 05 December 2017, focused on **Open Service Information Sharing and Service Performance Monitoring (International GNSS Monitoring and Assessment)**. Starting off the session, Mr. Andrew Hansen from the United States, provided a U.S. Update on the ICG-IGS Trial Project. He noted that the trial project has an ambitious schedule, and initially the U.S. will only monitor the GPS open signal L1C/A. This will be done through the U.S. Monitoring Analysis Center (MAC), which will have a data repository on the U.S. Coast Guard Navigation Center (NAVCEN) website. The potential capability exists to expand and include modernized signals and other service provider signals, as well as additional monitored elements if and when the terms of reference is expanded in the future.
20. Mr. Peter Buist from the EU, followed with two presentations from the Galileo perspective. The first presentation focused on Galileo service performance monitoring. He explained that the Galileo Reference Center (GRC) has been designed to provide independent monitoring and assessment as a stand-alone capability. The GRC is scheduled to open in May 2018 in Noordwijk, Netherlands. Currently they have member state contributions from 24 organizations, covering 14 countries and they are working on performance reports for Galileo. The second presentation covered EU contributions to the International GNSS Monitoring and Assessment (IGMA) project. Mr. Buist explained that the GSA will coordinate data from monitoring stations for the EU, and the GRC will be the core facility. Initially they will be monitoring both Galileo and GPS, and hope to expand to include monitoring of other GNSS by the second quarter of 2018. They are also continuing the on-going validation of GPS signal in space errors.
21. Mr. Alexey Bolkunov from the Russian Federation continued the joint session with a presentation on the “IGMA: Challenges and Way Forward”. He described the role of the IGMA as providing parameters for monitoring and assessment, and solving existing monitoring problems. The future of the IGMA should include the following: 1) recommendations; 2) IGMA regulatory means; 3) technical means (from providers); 4) IGMA software/firmware; and 5) a trial project for demonstration. Mr. Bolkunov discussed the need for getting agreement on a roadmap for the IGMA going forward. The IGMA Task Force co-chair, Mr. Satoshi Kogure stated that the Task Force would discuss this concept during their next meeting. A question was asked about whether this proposal includes both the IGS and

MGA or is it just intended for the IGMA. Mr. Bolkunov explained that it is intended for the IGMA Task Force.

22. The session on IGMA continued with a presentation by Mr. Peter Buist from the EU on a proposal for the EU to host the IGMA and Performance Standard Workshops in 2018. This would be a follow up to 22 May 2017 workshop that was held in Shanghai, and would be open to WG-S members and Provider experts. It would also include a meeting of the IGMA Task Force. Mr. Buist explained that the EU would like to host the workshops in Noordwijk, Netherlands at the new GRC facility, in May 2018. No objections to the proposal were raised. Ms. Shuli Song from China continued the session with a presentation on Algorithms and Implementation of GNSS Basic Monitor and Assessment Parameters. She discussed three IGMA issues to consider: 1) consistency of time and reference systems, antenna offset correction and clock corrections; 2) consistency of the scope; 3) consistency of the method. These should be further discussed within the IGMA Task Force. She also presented results on different GNSS algorithm implementation, including broadcast ephemeris accuracy (orbits and clocks) and signal in space user range error.
23. The final presentation in the joint IGMA session was the report of the Task Force, given by the co-chair, Mr. Satoshi Kogure from Japan. He provided an update on the provider nomination status summary for the IGMA Trial Project, and a summary of the May 2017 workshop in Shanghai. He discussed IGS activity related to the joint ICG-IGS IGMA Trial Project that was approved in December 2016, explaining that the project officially kicked off in July 2017 at the IGS Workshop. The project is utilizing 12 IGS Analysis Centers (AC) and one IGS Analysis Center Coordinator (ACC). A joint meeting of the ICG-IGS Trial Project will be held sometime in the first of second quarter of 2018 to discuss coordination of work plans. Finally Mr. Kogure discussed the draft roadmap for the trial project. The WG-S co-chair, Mr. Turner asked a question about whether each provider will be providing data on all systems or just their own. Russia responded that they will provide data for all systems. The U.S. indicated that they will only be providing data for GPS. The EU plans to monitor all systems. Japan and China also stated that they will likely provide data for all systems. Mr. Werner Enderle from ESA further explained that it is up to each provider as to what data they provide, and service providers should nominate which stations will provide data, focusing only on the four parameters that were agreed to for the initial stage of the project. Mr. Turner also asked a question about how many of the Trial Project sites are also IGS sites. China stated that all of their sites are IGS sites. The U.S. explained that all of their sites are independent and not part of the IGS. The EU stated that they are using a mix of IGS and non-IGS sites. Russia is using one IGS site and one non-IGS site, and Japan has not officially decided yet, but may use an IGS site. Mr. Kogure finished the presentation by noting that there are no new IGMA recommendations for WG-S to consider, and he highlighted that the IGS will hold its next workshop in Wuhan, China, 28 October through 04 November, 2018. This will be followed by ICG-13, 4-9 November in Xian, China.
24. Following the joint working group session, the WG-S meeting continued with the session on **System-of System Operations**, with a focus on orbital debris mitigation guidelines. The first presentation on Galileo Satellite Disposal Plans was given by Mr. Rafael Lucas from ESA. He explained that Galileo follows guidelines recommended by the Inter-Agency Space Debris Coordination Committee (IADC) and the UN. He discussed the ESA documents that

complement the international guidelines, including the ESA Policy documents on Orbit Debris Mitigation and the ESA Space Debris Mitigation Compliance Mitigation Guidelines. The disposal strategy for Galileo is based on a graveyard orbit, at a preferably higher altitude than nominal orbit, and with minimum eccentricity growth. ESA is continuing with additional research on maximum eccentricity growth, targeting re-entry in less than 100 years.

25. China continued the discussion on orbital debris mitigation guidelines with a presentation given by Ms. Xinuo Chang, on “Orbital Stability Analysis and Safety Guidelines of BDS Satellite End-of-Life Disposal”. Ms. Chang noted that China has carried out three geostationary (GEO) end of life disposals for BDS satellites, following IADC guidelines. Their analysis shows no interference with these satellites and other MEO constellations for at least 200 years. Current IADC guidelines do not cover satellites in medium-earth orbit (MEO). They are considering several factors with these satellites and satellites in an inclined geostationary (IGSO) orbit, including: propellant margin, stability of IGSO and MEO satellite disposal orbits, and setting the proper value of Argument of Perigee. Ms. Chang suggested that further discussion is needed on whether restrictions should be established by individual systems or whether all systems should work together to form common guidelines. China published a paper on this topic in a magazine in 2017, and may have another paper released in 2018 that can be shared.
26. The final presentation on the topic of orbital debris mitigation was given by Ms. Mari Yuzawa from Japan, on “QZSS Operation Orbit Area vs GEO Protected Regions”. Ms. Yuzawa discussed the current QZSS constellation and the Geo protected region. She explained that the QZSS disposal specification has no interference with both protected regions of GEO and QZSS for the next 100 years. She proposed that in order to ensure sustainable operation in the geo vicinity, providers should: 1) make GNSS data available on operational and disposal orbits in a standardized format; 2) increase awareness of this data to minimize interference; 3) further discuss modifications or additional rules to current disposal requirements.
27. The WG-S co-chairs, Mr. Revnivykh and Mr. Turner, commented that there are many questions which still exist about orbital debris and guidelines. They proposed the following new action for the working group: 1) Each provider should identify a point of contact (POC), and exchange information among the provider POC’s; 2) The POC’s should prepare a report for WG-S to be presented at the 2018 intersessional meeting. Mr. Turner further explained that the intent is not to interfere with IADC work on debris guidelines.
28. The **Concluding Session** was held on 06 December 2017. The Working Group co-chairs began by reviewing the recommendations, noting that the objective was to reach consensus for presentation to the full ICG during the Plenary Session. No objections were noted to the recommendations on RNSS Protection Criteria and 3GPP Crowd Sourcing for IDM. For the Recommendation on the Timing Workshop, the EU commented that the Working Group D has proposed a recommendation on timing, and WG-S should consider this in the wording for its recommendation. The co-chairs suggested that the recommendation text be modified to reflect cooperation with Working Group D and that the workshop not be limited to discussion about timing offsets. There were no objections to these modifications to the recommendation.

29. The co-chairs continued the closing session with a review and discussion about proposed dates and locations for the 2018 WG-S intersessional meeting, and subgroup/task force meetings and workshops. The Working Group reached consensus on holding its intersessional meeting in June 2018, in conjunction with the COPUOS and UNISPACE+50 meeting in Vienna, Austria. The proposal to hold a 7th IDM Workshop in Baska, Croatia in May was also adopted, along with the EU proposal to hold the IGMA and Performance Standard Workshops in Noordwijk, Netherlands, also in May. Finally, it was agreed that the timing workshop would be held in Vienna, in conjunction with the intersessional meeting in June 2018.
30. The meeting concluded with a review of the Co-chairs Presentation to the ICG Plenary. This led to a short discussion on potential future work of the Working Group, based on the discussions and presentations from this meeting. The Compatibility and Spectrum Protection Subgroup agreed to consider future discussions on MEOSAR downlink Signal Compatibility in Coordination with COSPAS-SARSAT. The Interoperability and Service Provision Subgroup agreed to consider further discussions on multi-system receiver investigation, as well as service anomaly information exchange. These topics fall within the scope of the current WG-S workplan. The co-chairs offered concluding remarks before officially adjourning.

The full set of WG-S recommendations, as adopted by the Committee at ICG-12, are enclosed.

WG-S RECOMMENDATION #1 (12S.1)

Prepared by: Working Group S
Date of Submission: 06 December 2017
Issue Title: RNSS Protection Criteria

Background/Brief Description of the Issue:

It is widely recognized that it is important to minimize non-RNSS emissions to RNSS so that the full benefits of RNSS are not negated by reduced performance due to interference.

International Telecommunication Union Radiocommunications (ITU-R) is responsible for managing international radio-frequency spectrum. Protection criteria for RNSS receivers operating in frequency bands allocated to RNSS are specified in ITU-R Recommendations. Adjacent Band Compatibility and unwanted emissions issues concern the interference emissions from non-RNSS sources outside of the RNSS frequency allocations. RNSS receivers are not fully able to avoid getting affected due to the proximity and high-power of adjacent band interference. It would be beneficial to quantify RNSS protection criteria for the above types of interference.

Discussion/Analyses:

At the 11th meeting of International Committee on Global Navigation Satellite Systems (Sochi, Russian Federation, November 2016), Recommendation 11S.1 «International Mobile Telecommunications (IMT)-GNSS Compatibility» was approved based on the theoretical and experimental studies assessing the potential impact from unwanted emission from IMT stations in the frequency bands below 3 GHz. These studies showed that there is a possible adverse impact of unwanted emission (including out-of-band, spurious and harmonic interference) from IMT stations on the RNSS frequency bands (1164 – 1300 MHz and 1559 – 1610 MHz). In these studies, RNSS protection criteria was taken from the following ITU-R Recommendations:

- Recommendation ITU-R M.1902 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 215-1 300 MHz».
- Recommendation ITU-R M.1903 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) and receivers in the aeronautical radionavigation service operating in the band 1 559-1 610 MHz».
- Recommendation ITU-R M.1905 «Characteristics and protection criteria for receiving earth stations in the radionavigation-satellite service (space-to-Earth) operating in the band 1 164-1 215 MHz».

WG-S held two intersessional meetings in 2017 in preparation for ICG-12 (Kyoto, Japan, December 2017).. Adjacent Band Compatibility study was presented at the first WG-S intersessional meeting (Baska, Croatia, May 2017). As a result of this presentation, WG-S

learned that the RNSS protection criteria specified in ITU-R Recommendations was not fully recognized for protecting RNSS from such interference mechanism. Thus, at the second intersessional meeting of WG-S (Paris, France, July 2017), WG-S agreed to create an ICG Recommendation to endorse of the applicability of RNSS protection criteria to adjacent band interference.

Within ITU-R, the protection criteria from unwanted emissions are usually more stringent than the criteria from co-frequency emissions. Therefore, it should be recognized that interference from non-RNSS services in the bands adjacent to RNSS is fairly treated when applying the same levels between the criteria for emissions from non-RNSS interference in the adjacent band and the criteria for the co-frequency emissions.

Recognizing:

- a) that Recommendations ITU-R M.1902, 1903, 1905 contain protection criteria of RNSS from non-RNSS sources;
- b) that the interference protection criterion of C/No degradation of 1 dB (equivalent to I/N of -6 dB) is used for the Adjacent Band Compatibility assessment in one country;
- c) that existing studies regarding interference from unwanted emissions use protection criteria referenced in recognizing a);
- d) that the criterion in the above recognizing b) is consistent with the protection afforded by the application of Recommendations in recognizing a),

Recommendation:

ICG members should encourage national regulators to use the protection criteria in the relevant ITU-R Recommendations in recognizing a), in order to protect GNSS from non-RNSS interference sources, including unwanted emissions.

WG-S RECOMMENDATION #2 (12S.2)

Prepared by: Working Group S
Date of Submission: 06 December 2017
Issue Title: 3GPP Crowd Sourcing for IDM

Background/Brief Description of the Issue:

The Working Group on Systems, Signals and Services of the International Committee on GNSS (ICG) has been discussing spectrum protection and interference detection and mitigation (IDM) for over 10 years, and has collected a great deal of information about this subject.

The Interference Detection and Mitigation (IDM) task force working under the Compatibility and Spectrum subgroup organized and completed the 6th IDM workshop focusing on both network-based and sensor-based (crowd sourcing) IDM capabilities in May 2017 in Baška.

WG-S participants have discussed how device-based, crowd-sourced GNSS interference detection could be made possible using the large number of active smartphones, most with GNSS. Based on the results of the workshop, and the subgroup meeting, WG-S proposes to engage with the leading smartphone standards developer, 3GPP, to incorporate such capabilities into their mobile device standards and enable access for crowd sourced applications.

Discussion/Analyses:

All System Providers have governmental and/or industrial members of the 3rd Generation Partnership Project (3GPP) that participate through one or more of the 7 telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC)

WG-S participants have been seeking the views of their 3GPP members on the establishment of specifications for device-based GNSS interference detection.

Some access to the required chipset data is already possible in the most recent Android versions, but standards or specifications may be needed to enable sharing of the required data to enable authorized entities to determine where interference to GNSS occurs. September 2018 is a key milestone in the process of establishing 5G standards. The four step process is: Discussion Paper; Study Item – with the endorsement of 4 companies/members; Technical Report; Work Item – to modify specifications

Recommendation:

System Provider delegations to the ICG should use the Providers Forum to reach consensus on whether or not to formally endorse a device-based detection standard through a communication to the 3GPP Technical Specifications Group (TSG) – February or June 2018

If device-based detection is endorsed by Providers, the ICG should:

- *consider presenting this recommendation to the appropriate Plenary-level 3GPP Meeting*
- *consider how data from device-based detection can be integrated into national/governmental mitigation efforts – September 2018 and beyond*

WG-S RECOMMENDATION #3 (12S.3)

Prepared by: Working Group S
Date of Submission: 06 December 2017
Issue Title: 2nd ICG WG-S Timing Workshop

Background/Brief Description of the Issue:

ICG WG-S (WG-A) system provider (5 of 6) participants conducted five workshops on interoperability between 2013 and 2015. These workshops were designed to receive industry feedback on the technical aspects of GNSS interoperability. Among the different topics that were addressed through questions to industry were the use of GNSS time offsets between systems to maintain interoperable service provision. The feedback received led to more in depth discussion within the WG-S Interoperability and Service Standards Subgroup in 2015 and 2016. WG-S Recommendation 4 from ICG-11 led to a timing workshop that was held in Paris in conjunction with the WG-S intersessional meeting in July 2017.

Discussion/Analyses:

At the 2017 Workshop, the participants concluded that all System Providers should continue to improve the alignment of their individual system times with UTCk to benefit users. It was also recognized that currently, the only GNSS to GNSS system time offsets (G2GTOs) that are being broadcast are relative to GPS system time. The participants identified a number of possible approaches for system time interoperability, including:

1. System time offsets are calculated at the user receiver level – No Action from System Providers;
2. System Providers broadcast additional GNSS to GNSS system time offsets (G2GTOs);
3. The development of a GNSS Ensemble time, such as the MGET proposal, with the broadcast of individual system time offsets relative to the ensemble time;

and agreed to hold a second workshop in 2018 focused on assessing possible approaches.

Recommendation:

Working Group S, under the direction of the Interoperability Subgroup, should conduct a second System Time Workshop in 2018, in coordination with WG-D.