

ICG WORKING GROUP A

**GNSS COMPATIBILITY &
INTEROPERABILITY**

ICG-6

7 & 8 September 2011

Mita Kaigisho, Tokyo



ICG International Committee on
Global Navigation Satellite Systems

AGENDA

- SESSION 1 — GNSS Updates from System Providers
- SESSION 2 — GNSS Compatibility
- SESSION 3 — Spectrum Protection - Interference Detection, and Mitigation
- SESSION 4 — Open Service Information Sharing & Service Performance Monitoring
- SESSION 5 — Interoperability



International Committee on
Global Navigation Satellite Systems
• SESSION 6 — Conclusion

Mandate of Working Group A (current work plan)

Compatibility and Interoperability

- Global and regional system providers agree that at a minimum, all GNSS signals must be **compatible**. To the maximum extent possible, open signals and services should also be **interoperable, in order to maximize benefit to all GNSS users**.
- **The Committee and associated Providers Forum will consider guidelines and standards developed by existing standard-setting bodies** applicable to GNSS service provision and use
- In order to **assist the Providers Forum in accomplishing its objectives**, as described in the Terms of Reference, and in order to further the work of the committee focused on compatibility and interoperability, Working Group A will ...



SESSION 1 – System Updates (as required)

- China
- EU
- Japan
- Russia
- United States



SESSION 2 – COMPATABILITY

- Report of the Sub-group on Organizational Models and Procedures for Multilateral Coordination of GNSS Compatibility

Takahiro MITOME (Japan), Fredric BASTIDE (EC)

- Approval of proposed ICG-6 Recommendation 2.1: Continuation of WG-A compatibility subgroup



Work Plan - Compatibility

- Considering the principle of compatibility and its definition, the working group will:
 - In particular, review existing ITU regulations and recommendations related to the avoidance of harmful interference;
 - Seek common understanding on appropriate methods to determine compatibility among all GNSS; and,
 - If necessary, propose new questions or studies for ITU consideration, through appropriate mechanisms, to further protect the noise floor impacting all GNSS, and to define methodology used between GNSS providers to ensure compatibility.



RECOMMENDATION



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2.1 Continuation of WG-A Compatibility subgroup (1)

Background/Brief Description of the Issue:

- In June 2010, a Providers-only workshop on compatibility was conducted and a sub-group was formed to investigate organizational models relevant to multilateral coordination of GNSS compatibility. At ICG-5, the Committee recommended to continue the work of the sub-group on organizational models and procedures for multilateral discussions on GNSS compatibility.

Discussion/Analyses:

- Following ICG-5, the subgroup met twice on 25 February 2011 in Geneva and on 8 June 2011 in Vienna. During its last meeting, the subgroup developed draft terms of reference (see the annex) and presented them at the ICG WG-A meeting on 9 June 2011. WG-A members agreed on the relevance of those ToR and on the usefulness of continuing the work of the subgroup.



2.1 Continuation of WG-A Compatibility subgroup (2)

Recommendation of ICG WG-A Action:

- To continue the activities of the WG-A Compatibility subgroup in accordance with the ToR as attached.
- The subgroup will assess compatibility issues to support the development of Common Signal Characteristics Reference Assumptions, which are recommended by ICG-5 Recommendation 6.



SESSION 3 - Spectrum Protection - Interference Detection, and Mitigation

- IDM for GNSS Open Service in China

Mr. Weimin ZHEN (China)

- Joint Japan-U.S. Proposal for a Spectrum Protection/Interference Detection and Mitigation Workshop

Jeff AUERBACH/Rick HAMILTON (USA)

- Approval of proposed ICG-6 recommendation 3.1: Workshop on GNSS Spectrum Protection and Interference Detection and Mitigation
- Consideration of **NEW** ICG-6 recommendation 3.2: Proposed joint lab on GNSS Interference Detection and Mitigation for ICG Providers Forum Member Consideration:



Work Plan – Spectrum Protection

- The Providers Forum has agreed to pursue the protection of radionavigation satellite service (RNSS) spectrum through appropriate domestic and international regulation.
 - When necessary and appropriate, the Working Group will facilitate Provider discussions on their individual views and actions related to RNSS spectrum issues and agenda items under consideration by the ITU and its Working Parties.
- The Working Group will develop a strategy for ICG support of mechanisms to detect and mitigate sources of electromagnetic interference, taking existing regulatory mechanisms into consideration. This could lead to concrete proposals for detecting interference.



RECOMMENDATION(S)



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3.1 Workshop on GNSS Spectrum Protection and Interference Detection and Mitigation

Background/Brief Description of the Issue:

- ICG Terms of Reference work plan includes the means to: “establish, as mutually agreed and on an ad hoc basis, working groups to investigate specific areas of interest, cooperation and coordination.” Also, the work plan of the Providers Forum contains the provision to consider GNSS Interference detection and mitigation. This proposal (attached), sets forth the description of a workshop focused on spectrum protection and interference detection and mitigation for GNSS.

Discussion/Analyses:

- As current and emerging GNSS systems become more and more useful for world-wide economic benefit and efficiencies in operations, so it is becoming more important that Providers work together to protect users of these GNSS signals from harmful interference.
- A Proposed Agenda has been developed based on experience and concerns related to GNSS IDM. The issues to be addressed include regulatory, policy, operational and technical aspects.



3.1 Workshop on GNSS Spectrum Protection and Interference Detection and Mitigation

Recommendation of ICG WG-A Action:

- It is recommended that ICG conduct a two day workshop, with another half-day to finalize recommendations, focusing on GNSS Spectrum Protection and Interference Detection and Mitigation. The location of the proposed workshop, to be conducted no earlier than March 2012, is to be determined. It is also recommended that follow-up meetings or workshops may be discussed and agreed upon as a result of this initial workshop.



Proposed ICG-6 Recommendation Additional Actions

- Interested ICG participants are asked to provide points of contact for this activity to the ICG Secretariat and the Identified Points of Contact as soon as possible
- Experts should be identified that can address the proposed agenda items
- Potential hosts and venues for the workshop should be identified as soon as possible



NEW - 3.2 Proposed joint lab on GNSS Interference Detection and Mitigation (1)

Background/Brief Description of the Issue:

- ICG Terms of Reference work plan includes the means to: “establish, as mutually agreed and on an ad hoc basis, working groups to investigate specific areas of interest, cooperation and coordination.” Also, the work plan of the Providers Forum contains the provision to consider GNSS Interference Detection and Mitigation. Japan and US have recommended to conduct a workshop focusing on GNSS spectrum protection and interference detection and mitigation. In order to bring into operation, we suggest that an international joint lab be established for IDM.



NEW - 3.2 Proposed joint lab on GNSS Interference Detection and Mitigation (2)

Discussion/Analyses:

- As current and emerging GNSS systems become more and more useful for world-wide economic benefit and efficiencies in operations, it is becoming more important that Providers work together to protect users of these GNSS signals from harmful interference. The proposed topic has been developed based on experience and concerns related to GNSS IDM joint lab. It includes joint GNSS IDM monitoring, communication and sharing of results, development of (recommended) standard of interference detection device, development of coordinated mechanism of interference source monitoring and mitigation in the ICG framework and sharing space weather forecasting and effects information.

Recommendation of Committee Action:

- It is recommended that ICG establish a joint lab, which will focus on the following items:
 - Conduct joint research on GNSS IDM schemes in the ICG framework;
 - Exchange and share interference monitoring data and information;
 - Define (recommended) standard of interference detection device and other related standards;
 - Conduct joint research on space weather (forecast and effects) and related activities.



SESSION 4 – Open Service Information Sharing and Service Performance Monitoring

- International GNSS Monitoring and Assessment Service (iGMAS) for OS

Mr. Xurong DONG (China)

- Update on the Multi-GNSS Asia (MGA) Demonstration Campaign

Satoshi KOGURE (Japan)

- GNSS Performance Monitoring System in Russia

Sergey REVNIVYKH (Russia)

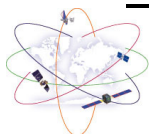


SESSION 4 – Open Service Information Sharing and Service Performance Monitoring

- International GNSS Service (IGS) Multi-GNSS Activities and Plans

Chris RIZOS (IAG)

- Approval of proposed ICG-6 Recommendation 4.2: International GNSS Monitoring and Assessment
- Approval of REVISED ICG-6 Recommendation 4.1: Consensus on Open Service GNSS performance parameters [including definitions and calculations]



Work Plan – Open Service Information Sharing

- Consistent with the principle of transparency in the provision of open services, each individual Provider will strive to publish and disseminate all signal and system information necessary to allow manufacturers to design and develop GNSS receivers on a non-discriminatory basis. The Working Group will develop a template to promote common terminology and definitions in individual GNSS Open Service Signal Specifications.
- The Working Group will also develop a template that each individual GNSS provider may consider using in their publication of signal and system information, the policies of provision, and the minimum levels of performance offered for open services.
- As requested by a provider or providers, the working group will assist in exchanging information with ICG participants important to resolving GNSS open service anomalies that impact users.



Work Plan - Service Performance Monitoring

- 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.
- 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, recognizing that the actual implementation of this infrastructure is subject to the budgetary limitations of each system provider, and the completion of provider-to-provider agreements as necessary and appropriate.



RECOMMENDATIONS



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4.2 International GNSS Monitoring and Assessment (1)

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 through the use of an existing global network such as the one utilized by the International GNSS Service (IGS).



4.2 International GNSS Monitoring and Assessment (2)

Discussion/Analyses:

- Several multi-GNSS monitoring network activities are underway. For example, Preliminary experience includes BeiDou monitoring and assessment, the long-term successful operation of IGS, and the achievements in GNSS signal monitoring and assessment made by Stanford University, DLR, Information Analysis Center of Roscosmos, and others.
- China is developing the International GNSS Monitoring and Assessment System (iGMAS).
- 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.
- Future plans for IGS network upgrades to include multi-GNSS receivers should also be investigated, and the support and participation of all GNSS providers will be very beneficial for global monitoring and assessment



4.2 International GNSS Monitoring and Assessment (3)

Recommendation of ICG WG-A Action:

- To monitor and assess GNSS open services worldwide, a team of interested members of WG-A should be formed to develop a proposal to optimize existing and planned capabilities, and identify additional activities necessary for international GNSS Monitoring and Assessment.



4.1 Consensus on Open Service GNSS performance parameters (1)

Background/Brief Description of the Issue:

- According to the current work plan, the working group will develop a template that individual GNSS providers may consider using in their publication of signal and system information, the policies of provision, and the minimum levels of performance offered for open services. Before a template for open service performance can be developed, the goal is to reach consensus on a minimum set of parameters common to all GNSS open services.

Discussion/Analyses:

- Parameters of each Performance Document (PD) will address the Open Service (OS) provided by each provider.
- The numerical values of the parameters for each individual system will be determined by each system provider.
- The OS PD values may change over time – as determined by the GNSS provider.
- Providers may chose to define additional parameters for their respective open services or for additional services they intend to provide.



4.1 Consensus on Open Service GNSS performance parameters (2)

Recommendation of ICG WG-A Action:

- An ad hoc team of interested system provider representatives will be formed to initiate the necessary discussions and collaboration. Names should be provided to WG-A as soon as possible.

Proposed revised text addresses:

- The need to consider differences between the system providers current definitions and calculation methods for performance parameters in order to reach a consensus on common parameters



SESSION 5 - INTEROPERABILITY

- Relationship between Visible Satellite Number and receiver Noise Floor

Ms. Xiachun LU (China)

- Status of implementing ICG-5 recommendations
 - Recommendation 2: User Community Views on Interoperability
 - Recommendation 3: Time and Geodesy Aspects of Interoperability
 - Recommendation 4: Participation in the Multi-GNSS Demonstration Campaign
- Group Discussion on WG-B and/or WG-D on recommendations related to Interoperability



Work Plan - Interoperability

- Consistent with the principle of interoperability and its definition, the working group will consider the perspective of various user applications and equipment manufacturers, and will:
 - continue efforts to survey industry and user community experts and may require sponsoring and participating in workshops and meetings designed to solicit GNSS user input. It may also require elaboration of an approach for quantitative interoperability evaluation.
 - support measures to promote the interoperability of regional ground-based DGNSS in cooperation with Working Group D.
- The Working Group will assist Providers in drafting individual reports on their respective planned or operating systems and the policies and procedures that govern their service provision, consistent with the Providers Forum template for information sharing.
 - The reports will be consolidated and maintained by the ICG Secretariat on behalf of the Providers, and updates will be provided at least annually in preparation for each major meeting of the ICG.
 - The reports will emphasize each Providers current and planned efforts to ensure compatibility and interoperability among the global, regional, and augmentation system components of the global system of navigation satellite systems.



ICG-5 Recommendation - 2

- Interested members of WG-A will develop a new approach to continued collection of user and industry views on interoperability
 - Potential specific topics to include in new questionnaire:
 - Value of a common third open service signal
 - Importance of DOP improvement with the addition of 2nd, 3rd, 4th, Nth global constellation
 - Plan for conducting interviews in association with the questionnaires
 - Consider organizing a large user/industry summit to be attended by key technical experts



ICG-5 Recommendation - 3

- Continue to investigate system time and geodetic reference frame aspects of interoperability within the WG-D task forces on time and geodesy
 - First task is the completion of time and geodetic reference frame templates by all system providers
 - Other specific methods to potentially improve interoperability could be addressed afterwards
 - Inclusion of multi-constellation, multi-frequency tracking in the IGS network
 - Monitor and disseminate offsets between each system time



ICG-5 Recommendation - 4

- Interested ICG participants are encouraged to interact with receiver manufacturers and encourage participation in the Asia-Oceania Multi-GNSS Demonstration Campaign
 - An opportunity to test and experiment with multi-system receivers and demonstrate the benefits of interoperability
 - Also an opportunity to develop potential new GNSS applications enabled by multiple systems
 - Industry, users, and system providers should all benefit



WG-B ICG-6 Recommendation: Optimizing navigation message content in new signals to achieve the highest possible level of multi-GNSS interoperability

- **Background/Brief Description of the Issue:** Most system providers have “locked-in” many of their signal structures. However individual systems plans for L5, i.e. definition of the navigation data message are less fixed. Therefore there is potential for the ICG to identify characteristics of L5 message that can optimize the level of interoperability. One example presented by the FAA is to include ARAIM Integrity Support Message parameters in SBAS L5.
- **Discussion/Analyses:** The above consideration could be also extended to the definition of the navigation data messages (i.e. spare capacity) of the other new signals coming from GPS, Galileo, COMPASS, GLONASS, QZSS, IRNSS.
- **Recommendation of ICG WG-B Action:** That the ICG consider a cross working group workshop involving system providers and key user groups to identify opportunities in existing or planned spare capacity of the navigation messages that will achieve the most benefit for users from a truly interoperable system of systems.



WG-B ICG-6 Recommendation: ARAIM Parameter Development in response to Work plan action B3

- **Background/Brief Description of the Issue:** As presented at the meeting by L. Eldredge (FAA), ARAIM based on multiple GNSS constellations is dependent on a number of parameters which need to be broadcast to the users.
- **Discussion/Analyses:**
 - The parameters reported in the presentation are: Probability of Satellite Failure P_{sat} , Probability of Constellation Failure P_{const} , User Range Accuracy (URA), Bias (b).
 - Standards for ARAIM use by aviation worldwide will eventually need to be adopted by ICAO. Prior consensus on the definition of these parameters among the GNSS providers would facilitate the ICAO standard-setting process.
- **Recommendation of ICG WG-B Action:** To encourage to research a consensus on the definition of broadcast parameters necessary to enable multi-constellation ARAIM.



DISCUSSION & POSSIBLE RECOMMENDATIONS

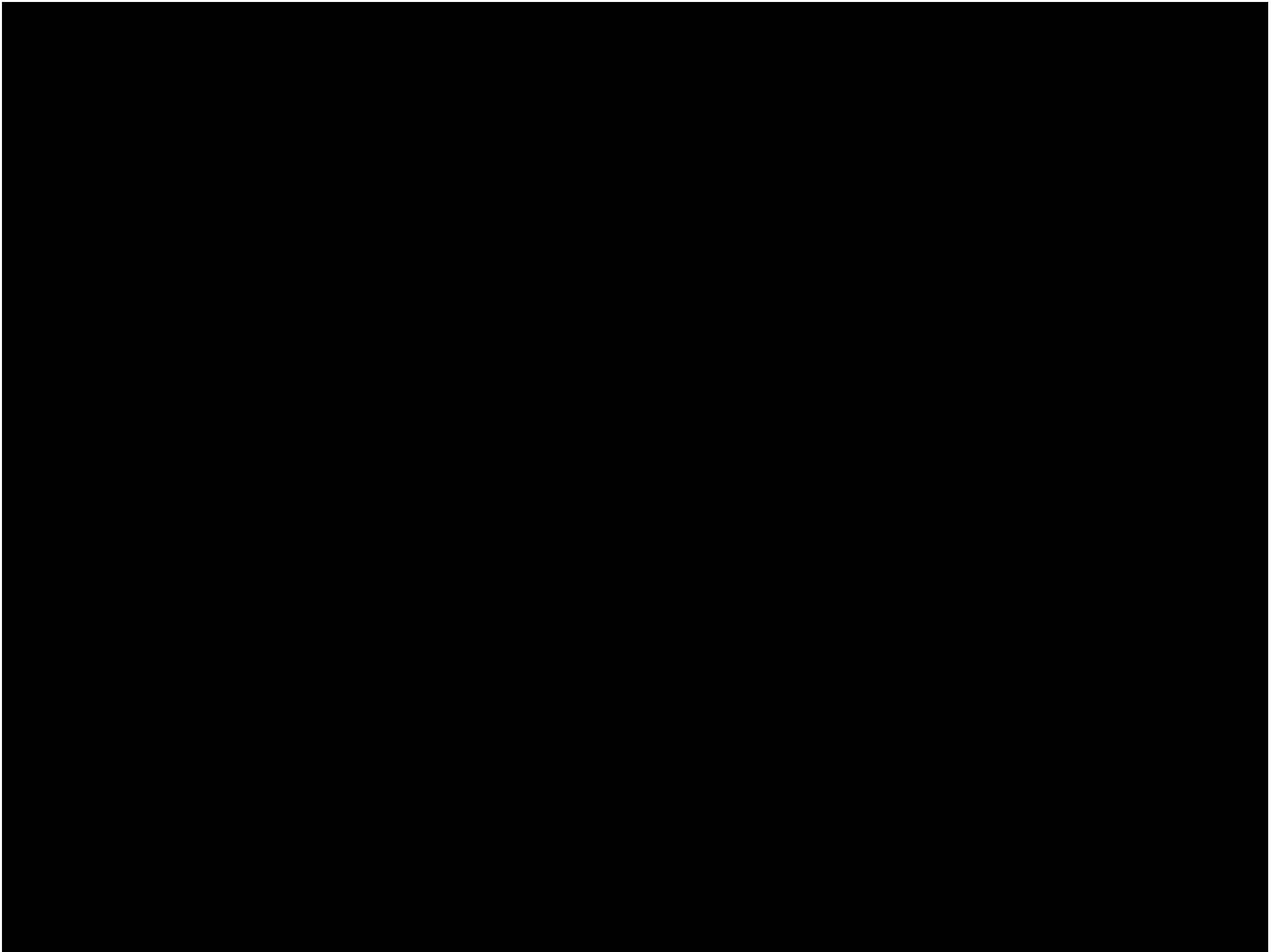


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SESSION 6 - CONCLUSION

- Any unfinished business
- Final review of recommendations and WG-A Plenary Presentation
- Closing remarks
- Adjourn





ICG-5 RECOMMENDATIONS



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COMPATIBILITY



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ICG-5 Recommendation – 5

- Continue the Work of the Sub-group on Organizational Models and Procedures for Multilateral ***Discussions*** on GNSS Compatibility
 - Define the needs and the scope of multilateral discussions on GNSS compatibility
 - Recommend continued study of appropriate organizational models
 - Assess applicability to GNSS
 - Select the most relevant models and the appropriate role of the ICG



ICG-5 Recommendation – 6

- Prepare for discussions on adoption of common reference assumptions with the following priority actions:
 - Common conventions for specified maximum received power*, as a step toward additional common conventions and assumptions
 - Conventions for link budgets to any point on the earth's surface, when used to define maximum received power
 - Definition of transmit antenna gain model

* *The maximum received power is the largest of the received powers over all points on the earth's surface.*



Additional Discussions related to recommendation 6

- Maximum Received Power Conventions:
 - Transmit power equal to or greater than that needed to meet minimum received power commitments
 - Conventional loss due to free space propagation
 - 0 dB atmospheric loss
 - 0 dBic lossless reference receive antenna
 - Transmit antenna gain versus angle off nadir, as a mean value over azimuth cuts and satellites*
 - Mean orbital radius for circular orbits and perigee for elliptical orbits*

* *Further Study Required*



SPECTRUM PROTECTION & INTERFERENCE DETECTION



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ICG-5 Recommendation - 1

- Interested members of WG-A should focus on proposals to address interference detection and mitigation
 - Draft a study plan for consideration by the ICG
- ICG participants are asked to provide points of contact for this activity to the WG-A co-chairs as soon as possible, recognising the multidisciplinary nature of the task

