International Civil Aviation Organization

AIR NAVIGATION SYSTEMS IMPLEMENTATION GROUP

First Meeting (ANSIG/1)
(Cairo, Egypt, 10 – 12 February 2015)

Agenda Item 4: Performance Framework for Regional Air Navigation Implementation

OUTCOME OF CNS SG/6 RELATED TO CNS IMPLEMENTATION ISSUES

(Presented by the Secretariat)

SUMMARY

This paper presents the outcome of the CNS SG/6 meeting related to the implementation of Aeronatical Fixed Services (AFS), Aeronatical Frequency issues, INFPL GNSS and ADS-B.

Action by the meeting is at paragraph 3.

REFERENCES

- CNS SG/6 Report

1. INTRODUCTION

1.1 The Sixth meeting of the MIDANPIRG Communication, Navigation and Surveillance Sub-Group (CNS SG/6) was held in Tehran, Iran 9 -11 September 2014. The meeting was attended by thirty four (34) participants, from five (5) States (Bahrain, Iran, Kuwait, Oman and United Arab Emirates) and two (2) Organizations (IATA and SITA). The meeting developed tweleve (12) draft Conclusions.

2. DISCUSSION

2.1 The CNS SG/6 meeting discussed and agreed on many subjects related to planning and implementation. The planning subjects were presented to MSG/4 and implementation subjects are presented here.

MID Aeronautical Fixed Services

2.2 The CNS SG/6 meeting recalled that in accordance with MIDANPIRG/14, Conclusion 14/21 the determination of the official Operation date of the MIDAMC is tasked to MIDAMC STG. Accordingly, the CNS SG/6 meeting, through Draft Conclusion 6/1 agreed that the first AIRAC date following the training of the MID States key users be officially declared as the date of operation of the MID-AMC.

2.3 The meeting may wish to note that the MIDAMC trainig was conducted 5-7 January 2015 at IATA premises in Amman, Jordan. The training was attended by twenty three (23) participants from (9) States. accordingly, ICAO MID Regional office issues State letter Reference AN 7/5.1 – 15/041, dated 04 February 2015 annoucing the official operation from 05 February 2015 .

2.4 The meeting may wish to note that the APAC and EUR Regions endorsed the AMHS/SITA Type X Interconnection Architecture Document. Accordingly, the CNS SG/6 meeting supported the same Architecture for the MID Region and tasked the MIDAMC STG to identify the involved COM Centres that have SITA connection, coordinate the change in the AFTN/AMHS routing tables and develop a plan to migrate to the AMHS/SITA gateway.

2.5 The meeting may wish to note that CNS SG/6 urged States to expedite their AMHS implementation and discouraged the implementation of AFTN and CIDIN Circuits specially at International level and agreed that the replacement of the AFTN or CIDIN connections between States by AMHS links shall be based on ICAO Standards and Guidance Material (ICAO Doc 9880 and the ICAO EUR DOCs 020 and 021). Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 6/3: AFTN/CIDIN AFS CONNECTIVITY AND AMHS IMPLEMENTATION

That,

a) *the establishment of new AFTN and CIDIN connections at the International level be discouraged;*

b) *the current connections based on AFTN or CIDIN standards be gradually phased out; and*

c) *States be urged to expedite their AMHS implementation.*

Aeronautical Frequency Issues

2.6 The meeting noted that the ITU WRC-15 meeting is scheduled to be held in Geneva at the end of 2015. The CNS SG/6 received a summary of the agenda items that have effect on the ICAO position to WRC-15. The ICAO position was sent to States and concerned Organization as Attachment B to State letter E 3/5.15-13/57.

2.7 The meeting recalled the poor participation and support to ICAO Position at WRC-12 by the MID States. Accordingly, the DGCA-MID/2 meeting urged States to ensure continuous coordination with their Radio Frequency Spectrum Regulatory Authorities (telecommunications authorities) and the regional groupings such as the Arab Spectrum Management Group (ASMG) for the support of the ICAO position at WRC and its preparatory meetings.

2.8 The meeting reiterated the importance that the Civil Aviation Authorities coordinate with their respective Frequency Regulatory Authorities and attend the regional preparatory meetings and the WRC-15 to ensure that the approved ICAO Position is supported. In view of the foregoing, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 6/8: SUPPORT ICAO POSITION TO WRC-15

That, States be urged to:

a) support the ICAO Position to the WRC-15;

b) make necessary arrangements for the designated Civil Aviation Personnel to participate actively in the preparatory work for WRC-15 at the national level; and

c) *attend the preparatory regional spectrum management groups meetings and WRC-15 to support and protect aviation interests.*

2.9 The meeting may wish to note that the ICAO MID Regional Office with support from ICAO HQ will organize "Aeronautical Frequency Spectrum Workshop -WRC-15 preparation" in Cairo, 16- 17 February 2015, and back-to-back there will be the AFSM WG-F/32 meeting from 18-25 February 2015. MID States are invited to attend along with their Telecommunication Regulatory Authorities (TRAs) in order to gain in-depth knowledge on aeronautical frequency spectrum issues and seek the necessary support to the ICAO Position at the WRC-15.

Harmful Frequency Interference

2.10 The meeting noted that usually harmful interference occurs in near border of countries from adjacent aeronautical stations or other radio services such as FM broadcast stations, military systems, etc.

2.11 Considering that the elimination of the harmful interference requires coordination among States, the meeting agreed that States assign focal points for frequency matters.

2.12 Based on the above, the meeting, through Draft Conclusion 6/9, urged States to assign focal points for frequency matters. As a follow-up action, the ICAO MID Regional Office issued State Letter Ref. AN 7/5.6 – 15/040 dated 04 February 2015.

2.13 The meeting may wish to note that ICAO developed a program for managing, assessing compatibility and presenting frequency assignments called Frequency Finder. In order to use this new program training is necessary. Accordingly, the meeting may wish to agree on the following Draft Conclusiuon:

DRAFT CONCLUSION 1/XX: WORKSHOP ON THE USE OF THE ICAO FREQUENCY FINDER

That, *ICAO consider the inclusion of a Workshop on the use of the new Frequency Finder in the work programme of 2016.*

Use of Flight Plan "Converters" to Process the ICAO New FPL

2.14 The meeting recalled MIDANPIRG/14 meeting Conclusion 14/25, and ICAO MID Regional Office State Letter Ref.: AN 6/2B –14/122 dated 4 May 2014 requesting concerned States to take necessary measures to upgrade their systems and provide the ICAO MID Regional Office with an update on the action(s) undertaken not later than 30 June 2014. In this respect, the meeting noted with concern that the following States (Egypt, Iran, Iraq, Libya, Saudi Arabia, Syria and Yemen) are still using converters. Accordingly, the meeting agreed to the following Draft Conclusion:

DRAFT CONCLUSION 6/10: ACTION PLANS FOR INFPL SYSTEM UPGRADE

That, concerned States be urged to provide the ICAO MID Regional Office with their action plan for the upgrade of their systems to ensure full handling of the ICAO New Flight Plan format before 30 November 2014.

2.15 The meeting may wish to note that a follow-up email was sent to concerned States on the outcome of the CNS SG/6 and the following States (Iran, Jordan, Kuwait, and UAE) provided replies. Furthermore, the ICAO MID Regional Office issued a follow-up State Letter AN 6/2B – 15/039 dated 3 February 2015 (reminder) requesting the concerned States to provide their action plans.

GNSS Implementation in the MID Region

2.16 The meeting recognized that the introduction of GNSS multi-constellation, multi-frequency will entail number of new technical and regulatory challenges beyond those already associated with current GNSS implementation.

2.17 The meeting noted that IATA does not support the Satellite Based Augmentation Systems (SBAS) as the onboard avionic and that the Aircraft Based Augmentation System (ABAS) used today, already achieve the accuracy provided by SBAS.

2.18 The meeting supported the proposal emanating from the PBN SG/1 meeting (Cairo, Egypt, 1-3 April 2014) that the ICAO MID Regional Office organize jointly with ACAC a GNSS Seminar in April 2015. The meeting invited States and IATA to participate actively in the Seminar and supported the PBN SG/1 Draft Conclusion 1/5:

DRAFT CONCLUSION 1/5: GNSS SEMINAR

That, the ICAO MID Regional Office organize, Seminar on GNSS covering the augmentation systems (ABAS, GBAS and SBAS), and Multi-constellations during 2015.

2.19 The meeting may wish to note that the Seminar is tentatively scheduled to be held from 20 to 21 April 2015. Coordination is still going on with ACAC to agree on the exact date and venue.

2.20 The meeting recognized that frequency interference-free operation of GNSS is essential, and that the frequency band 1 559 - 1 610 MHz, is used for elements of GNSS and recalled that the International Telecommunication Union (ITU) process, allows under footnotes No. 5.362B and 5.362C the operation of fixed service in some States on a secondary basis until 1 January 2015.

2.21 The meeting noted that the following States (Iraq, Jordan, Qatar, Saudi Arabia, Sudan, Syria and Yemen) still have their names in the footnotes 5.362B and/or 5.362C. In this regard, the meeting recalled MIDANPIRG/13, Conclusion 13/44: Protection of GNSS Signal, and urged the concerned States to delete their name from these footnotes.

2.22 The meeting was informed that EUR FMG carried out a review of potential sources of non-intentional GNSS Radio Frequency Interference (RFI) that may affect GNSS frequencies. It was noted that future GNSS multi-constellation/dual-frequency receivers are expected to provide significant mitigation against GNSS vulnerability. However, it will not provide a full mitigation and it is important to assess and address all vulnerabilities to threats that may impact safety of GNSS-based operations.

2.23 In view of the above, the FMG conducted a review of existing and new material on GNSS vulnerabilities. As a result, some guidance material was collated as at **Appendix A**, that would provide guidance to States when establishing and enforcing their regulatory provisions on the use of GNSS, in particular regulating the use of pseudolites and GNSS repeaters that may have potential safety impact on GNSS. In addition, GNSS jammers and spoofers are seen as significant threats to GNSS.

2.24 Based on the above, the meeting agreed to utilize the guidance material in **Appendix A** to mitigate potential GNSS radio frequency interference through appropriate legislation/regulation, and agreed to the following Draft Conclusion:

DRAFT CONCLUSION 6/6: GNSS RADIO FREQUENCY INTERFERENCE ISSUES

*That, States be invited to use the guidance at **Appendix A** for the development/amendment of their regulatory provisions related to the use of GNSS in particular those related to pseudolites and GNSS repeaters.*

ADS-B Implementation in the MID Region

2.25 The meeting noted that the ADS-B is one of the technologies included in the GANP which supports many ASBU Modules in particular SURF, ASUR, SNET, ASEP, OPFL.

2.26 Based on the above, the meeting encouraged States to implement ADS-B out. The meeting reviewed the Draft Template at **Appendix B** to be used for the monitoring of the ADS-B out implementation and agreed that States and users provide their comments on the Template to the ICAO MID Regional Office for the consolidation of a final version which may be included in volume III of the MID eANP

2.27 The meeting may wish to note that, in accordance with MIDANPIRG/14 Conclusion 14/27, the MSG/4 meeting reiterated that States share surveillance data and mainly the ADS-B when available to enhance safety, increase efficiency and achieve seamless surveillance. Accordingly, the MSG/4 meeting, through Conclusion 4/15, encouraged States to plan/implement ADS-B and provide the ICAO MID Regional Office with their plans/progress reports.

2.28 Based on the above, the ICAO MID Regional Office sent State letter AN 8/4.2.1-14/345 dated 29 December 2014. Sudan and UAE are the only States that provided replies.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) endorse the CNS SG/6 Draft Conclusions: 6/3, 6/6, 6/8 and 6/10;

b) endorse the Draft Conclusion 1/XX at para 2.13;

c) urge States to attend the Aeronautical Frequency Spectrum Workshop;

d) urge States to actively participate in the GNSS Seminar; and

e) encourage States to expedite the implmentation of ADS-B.

Use of GNSS pseudolites and repeaters

1. Introduction

1.1 As for all systems using the radio frequency spectrum, GNSS is vulnerable to interference and measures (radio regulatory) are in place through the provisions of the ITU Radio Regulations to protect GNSS systems from harmful interference. Technical measures such as the specification of the GNSS receiver interference mask are in Annex 10.

1.2 Despite various regulatory mechanisms being in place, including those agreed at European (CEPT) level. In the recent years harmful interference that was either caused intentionally or unintentionally has been experienced to GNSS systems.

1.3 In addition to interference caused by RF emissions, GNSS signals are also vulnerable to ionospheric scintillation which may cause loss of GNSS signals in particular in equatorial and auroral regions.

1.4 Detailed material on GNSS vulnerability and GNSS interference is in the ICAO GNSS Manual (Doc. 9849) which is currently being revised by the Navigation Systems Panel. Relevant (draft) material on interference from this Manual is reproduced in **Appendix A**

1.5 Of concern to aviation is the protection of the frequency bands 1559 – 1610 MHz, used by GLONASS and GPS and the band 1164 – 1215 MHz which is foreseen to be used by GLONASS and GPS. Also the European Galileo system and the Chinese BEIDOU system are planning to use these bands to provide GNSS signals for use by aviation. Various satellite based augmentation systems are operating in the frequency band 1559 – 1610 MHz.

2. Interference

2.1 Unintentional interference.

2.1.1 Unintentional interference is normally caused by equipment authorized to operate on GNSS frequencies under strict conditions that are aimed at not causing harmful interference to the reception of GNSS signals. Problematic is that not in all cases such equipment is being used in accordance with these conditions, thus resulting in causing harmful interference.
Equipment that can cause such interference include GNSS repeaters and GNSS Pseudolites

2.1.2 In Europe provisions were developed by the ECC/CEPT to avoid harmful interference by inappropriate use of GNSS pseudolites and GNSS repeaters. These provisions and other relevant material is available from the website of the European Communications Office (ECO) in the following Reports and Recommendation:

ECC Report 129: Technical and operational provisions required for the use of GNSS repeaters
ECC Report 145: Regulatory framework for Global Navigation Satellite System (GNSS) repeaters
ECC Recommendation (10)02, A framework for authorization regime of Global Navigation Satellite System
ECC Report 128: Compatibility Studies between Pseudolites and Services in the frequency bands 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz
ECC REC (04)01, which declares jammers as illegal.
ECC Report 183, Regulatory Framework for Outdoor Pseudolites

2.1.3 In addition various ITU-R Recommendations provide relevant information on the compatibility and use of RNSS networks, including:

Recommendation ITU-R M.1904: Characteristics, performance requirements and protection criteria for receiving stations of the radionavigation-satellite service (space-to-space) operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz

Recommendation ITU-R M.1901: Guidance on ITU-R Recommendations related to systems and networks in the radionavigation-satellite service operating in the frequency bands 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz, 5 000-5 010 MHz and 5 010-5 030 MHz

Recommendation ITU-R M.1787: Description of systems and networks in the radionavigation-satellite service (space-to-Earth and space-to-space) and technical characteristics of transmitting space stations operating in the bands 1 164-1 215 MHz,1 215-1 300 MHz and 1 559-1 610 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.1318: Evaluation model for continuous interference from radio sources other than in the radionavigation-satellite service to the radionavigation-satellite service systems and networks operating in the 1 164-1 215 MHz, 1 215-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz bands

Recommendation ITU-R M.2030: Evaluation method for pulsed interference from relevant radio sources other than in the radionavigation-satellite service to the radionavigation-satellite service systems and networks operating in the 1 164-1 215 MHz, 1 215-1 300 MHz and 1 559-1 610 MHz frequency bands

ITU R M.2220 which provides criteria to determine compatibility between DME and GNSS L5.

2.1.4 States are invited to consult this material with the view to develop national regulations that will enforce the operation of GNSS Pseudolites and Repeater in a manner that harmful; interference to the reception of GNSS signals by aviation is prevented. Particular attention should be given to the practicality to enforce these provisions.

2.2 Intentional interference

Intentional interference is caused by equipment of which the user has the intention to cause harmful interference to the reception of GNSS signals, either on a local (e.g. less than 100 m) scale or a large scale (e.g. in the order of 100 – 200 NM).

Equipment used to cause intentional interference includes jammers and spoofers (intentional interference that may result in an aircraft to follow a false flight path).

The sale and use for jammers developed to cause Intentional interference, (e.g. to avoid tracking of vehicles) and spoofers should be forbidden. Although difficult, these systems should not be allowed on any market (national or international).

2.3 ICAO Electronic Bulletin on Interference to GNSS Signals.

ICAO has drawn the attention of States to the need to ensure protection of GNSS signals from interference and point to the need of cooperation between national aeronautical and telecommunication authorities in the introduction and enforcement of appropriate regulations (Electronic Bulletin EB 2011/56 from 21 November refers). This Electronic Bulletin is, for the ease of reference, reproduced in **Appendix B**

3. Cooperation with ITU

3.1 Interference to GNSS systems can affect international civil aviation and [in some cases] international coordination may be required to solve such interference. A framework for cooperation in the

format of a Memorandum of Understanding between the ITU and ICAO has been established with the prime view to maximize the joint efforts of the ITU and ICAO to eliminate cases of harmful interference. This Memorandum is reproduced in Appendix C

4. Fixed Service

4.1 The frequency band 1559 – 1610 MHz is shared with the (terrestrial) Fixed Service. Use of this band by both the Radionavigation Satellite Service and the Fixed service in a compatible manner is not feasible. Although the allocation to the Fixed Service is on a secondary basis, attention is drawn to the fact that the Fixed Service may cause harmful interference to the reception of GNSS signals. In 2015 the allocation to the Fixed Service is expected to be withdrawn from the Radio Regulations and attention should be given to the need to secure that any operation of the Fixed Service in this band will cease by that time.

5. Summary

5.1 This information material highlights a number of cases where harmful interference can be caused to the reception of GNSS signals by aviation. Measures to prevent such interference are recommended together with an operational evaluation of the interference risks.
Work on the assessment of RF interference (intentional and unintentional) is ongoing in the Navigation Systems Panel.

APPENDIX A of the ICAO GNSS Manual (Doc. 9849)

Source: GNSS Manual – Chapter 5

5.8 GNSS VULNERABILITY

5.8.1 General

5.8.1.1. The most notable GNSS vulnerability lies in the potential for interference, which exists in all radionavigation bands. As with any navigation system, the users of GNSS navigation signals should be protected from harmful interference resulting in the degradation of navigation performance.

5.8.1.2 The GNSS SARPs require a specified level of performance in the presence of levels of interference as defined by the receiver interference mask. These interference levels are generally consistent with the International Telecommunication Union (ITU) regulations. Interference at levels above the mask may cause degradation or even loss of service, but such interference is not allowed to result in hazardously misleading information (HMI).

5.8.1.3 GPS and Global Navigation Satellite System (GLONASS) have filings with the ITU to operate, using spectrum allocated to the Radionavigation Satellite Service (RNSS) in the 1 559 – 1 610 MHz and 1 164 – 1 215 MHz bands. The RNSS allocation in these bands is shared with the Aeronautical Radionavigation Service (ARNS). SBAS also has a filing under the RNSS allocation in the former band. GBAS is operated in the 108 – 117.975 MHz band, shared with ILS and VOR (ARNS).

5.8.2 Sources of Vulnerability

5.8.2.1 There are a number of sources of potential interference to GNSS from both in-band and out-of-band sources. Of particular concern is the use of the 1 559 – 1 610 MHz band by point-to-point microwave links that are allowed by a number of States. The use of these links, as stated in footnotes 5.362B and 5.362C in the Radio Regulations of the ITU, is due to be phased out starting in 2005 and completed by no later than 2015. In addition, no new links should be permitted.

5.8.2.2 *Unintentional interference*. The likelihood and operational effect of interference vary with the environment. Unintentional interference is not considered a significant threat provided that States exercise proper control and protection over the electromagnetic spectrum for both existing and new frequency allocations. Furthermore, the introduction of GNSS signals on new frequencies will ensure that unintentional interference does not cause the complete loss of GNSS service (outage) although enhanced services depending upon the availability of both frequencies might be degraded by such interference.

5.8.2.3 *Intentional interference*. The risk of intentional interference depends upon specific issues that must be addressed by States. For States that determine that the risk is unacceptable in specific areas, operational safety and efficiency can be maintained by adopting an effective mitigation strategy through a combination of on-board mitigation techniques (e.g. use of inertial navigation system (INS)), procedural methods and terrestrial navigation aids.

5.8.2.4 *Ionosphere*. Scintillation can cause loss of GNSS satellite signals in the equatorial and auroral regions, but is unlikely to cause complete loss of GNSS service and will be mitigated with the addition of new GNSS signals and satellites. Ionospheric changes may limit the SBAS and GBAS services that can be

provided in the equatorial region using a single GNSS frequency. These changes must be considered when designing operations based on the augmentation systems.

5.8.2.5 *Other vulnerabilities*. System failure, operational errors and discontinuation of service could be significantly mitigated by independently managed constellations, funding and robust system design. Spoofing, the intentional corruption of signals to cause an aircraft to deviate and follow a false flight path, is mitigated through normal procedures and independent ground and collision avoidance systems.

5.8.2.6 States should assess the GNSS vulnerability in their airspace and select appropriate mitigations depending on the airspace in question and the operations that must be supported. These mitigations can ensure safe operations and enable States to avoid the provision of new terrestrial navigation aids, reduce existing terrestrial navigation aids, and discontinue them in certain areas. Fault detection features such as RAIM are built into GNSS receivers, which eliminate the risk of position errors posing threat to navigation availability. To date, no vulnerabilities have been identified that compromise the ultimate goal of a transition to GNSS as a global system for all phases of flight. The assessment of GNSS vulnerability aspects and mitigation alternatives should continue.

5.8.3 Evaluating GNSS vulnerabilities

5.8.3.1 There are three principal aspects to be considered in the evaluation of GNSS vulnerabilities.

a) Interference and atmospheric (ionosphere) effects are of primary concern. Operational experience is the best way to assess the likelihood of unintentional interference. Each State must consider the motivation to intentionally interfere with GNSS based on the potential safety and economic impacts on aviation and non-aviation applications. Atmospheric effects are unlikely to cause a total loss (outage) of GNSS but may impact some services (e.g. approaches with vertical guidance in equatorial regions). The likelihood of specific effects can be categorized as negligible, unlikely or probable.

b) All operations and services dependent on GNSS should be identified and considered together, since GNSS interference can potentially disrupt all GNSS receivers at the same time over a certain area. GNSS is used for navigation services as well as other services such as precision timing with communications and radar systems, and may also be used for ADS services. In these cases, GNSS represents a potential common point of failure.

c) The impact of a GNSS outage on an operation or service should be assessed by considering the types of operations, traffic density, availability of independent surveillance and communications and other factors. The impact can be categorized as none, moderate or severe.

5.8.3.2 By considering these aspects as a function of airspace characteristics, air navigation service providers can determine whether mitigation is required and, if so, at what level. Appendix D provides examples of assessments. Mitigation is most likely to be required for vulnerabilities with major impacts that have a moderate to high likelihood of occurrence.

5.8.4 Reducing the Likelihood of Unintentional Interference

5.8.4.1 On-aircraft interference can be prevented by proper installation of GNSS equipment, its integration with other aircraft systems (e.g. shielding, antenna separation and out-of-band filtering) and restrictions on the use of portable electronic devices on board aircraft.

5.8.4.2 *Spectrum management*. Effective spectrum management is the primary means of mitigating unintentional interference from man-made transmitters. Operational experience has indicated that the threat of unintentional interference can be virtually eliminated by applying effective spectrum management. There are three aspects of effective spectrum management, namely:

a) creation of regulations/laws that control the use of spectrum;

b) enforcement of those regulations/laws; and

c) vigilance in evaluating new radio frequency (RF) sources (new systems) to ensure that they do not interfere with GNSS.

APPENDIX B of the ICAO GNSS Manual (Doc. 9849)
ELECTRONIC BULLETIN EB 2011/56 AN 7/5 FROM 21 NOVEMBER 2011

INTERFERENCE TO GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) SIGNALS

1. Aviation operations increasingly rely on the global navigation satellite system (GNSS) to improve navigation performance and to support air traffic control surveillance functions.

2. However, the full benefits of GNSS can only be achieved if GNSS signals are adequately protected from electromagnetic interference which can cause loss or degradation of GNSS services.

3. Potential sources of interference to GNSS include both systems operating within the same frequency bands as GNSS and systems operating outside those bands. Interference can be intentional ("jamming") or unintentional.

4. ICAO Member States have an essential role in ensuring protection of GNSS signals from interference. This can be achieved through cooperation of national aviation and telecommunication authorities in the introduction and enforcement of appropriate regulations controlling the use of the radio spectrum.

5. Attachment A briefly describes some sources of interference to GNSS and discusses regulatory means available to States to deal with them. Attachment B contains a list of documents that can be used as guidance for States in developing a regulatory framework.

Enclosures:
A — Sources of interference to GNSS
B — References

ATTACHMENT A to EB 2011/56

SOURCES OF INTERFERENCE TO THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

1. INTERFERENCE TO GNSS CAUSED BY SYSTEMS TRANSMITTING IN GNSS FREQUENCY BANDS

1.1 GNSS repeaters and pseudolites

1.1.1 Certain non-aeronautical systems transmit radio signals intended to supplement GNSS coverage in areas where GNSS signals cannot be readily received (e.g. inside buildings). These systems include GNSS repeaters and pseudolites.

1.1.2 GNSS repeaters (also known as "re-radiators") are systems that amplify existing GNSS signals and re-radiate them in real-time. Pseudolites are ground-based systems that generate ranging signals similar to those transmitted by GNSS satellites.

1.1.3 When these systems do not operate under appropriate conditions, harmful interference may be caused to the reception of the original GNSS signals by aircraft and other aeronautical systems (such as the reference receivers used in augmentation systems). This may disrupt a wide range of GNSS applications.

1.1.4 To prevent this disruption, a State needs to create a regulatory framework for the sale, ownership and operation of these systems. The framework must include regulations to ensure that use of the systems be permitted only where they have a legitimate application and their operation is not harmful to existing primary users of GNSS-based services. Additional measures may be necessary when repeaters and pseudolites are used on or in the vicinity of airports (e.g. in hangars, for testing/maintenance purposes).
1.1.5 Attachment B contains a list of documents that can be used as guidance for States developing a regulatory framework. They include interference analyses and examples of regulations currently in force in Europe and the United States.

1.2 GNSS jammers

1.2.1 GNSS jammers are devices which intentionally generate harmful interference to GNSS signals to impair or deny their reception. They may be employed for various reasons, typically with the intent of disabling devices that record and/or relay GNSS position information (e.g. for tracking or fee collection purposes). However, the interference they generate can potentially affect all users of GNSS, not only the intended targets of the jamming. Thus, they may have an impact far greater than intended by their operator.

1.2.2 Usage of GNSS jammers may proliferate further if GNSS-based fee collection or tracking services are not adequately designed, e.g. if the simple use of a jamming device enables the avoidance of the charge or tracking.

1.2.3 To prevent degradation of GNSS services due to GNSS jammers, States should implement and enforce policies and regulations that forbid the sale, export, purchase, ownership and use of GNSS jammers, and they should prohibit all actions that lead to an interruption of GNSS signals[1].
Adequate means of enforcement of such policies and regulations require the availability of GNSS signal monitoring capabilities. Furthermore, GNSS-based services should be designed in such a way that simple jamming does not result in denial of the service.

2. INTERFERENCE TO GNSS CAUSED BY SYSTEMS TRANSMITTING OUTSIDE THE GNSS FREQUENCY BANDS

2.1 In addition to the threats described above, systems operating outside the GNSS frequency bands that are not properly designed or are inappropriately regulated and operated may interfere with GNSS.

2.2 GNSS frequencies are protected by international agreements (ICAO *Convention on International Civil Aviation* and ITU Radio Regulations), and enable aviation services that have significant economical and societal benefits. However, there is also significant demand for electromagnetic spectrum for new applications, such as mobile phone and broadband data services, which may compromise spectrum compatibility. States should require that any such application will not interfere with GNSS signals through execution of adequate spectrum management practices.

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1 In some States, military authorities test their equipment by occasionally transmitting jamming signals that deny service in a specific area. This activity should be coordinated with State spectrum authorities and air navigation service providers to enable them to determine the airspace affected, advise aircraft operators and develop any required contingency procedures.

ATTACHMENT B to EB 2011/56

REFERENCES

ECC Report 129: "Technical and operational provisions required for the use of GNSS repeaters", Dublin, January 2009 (available at: http://www.ecodocdb.dk/, see under "ECC Reports")

ECC Report 145: "Regulatory framework for Global Navigation Satellite System (GNSS) repeaters", St. Petersburg, May 2010 (available at: http://www.ecodocdb.dk/, see under "ECC Reports")

ECC Recommendation (10)02, "A framework for authorization regime of Global Navigation Satellite System (GNSS) repeaters" (available at: http://www.ecodocdb.dk/, see under "ECC Recommendations")

United States National Telecommunications and Information Administration (NTIA) Manual of Regulations and Procedures for Federal Radio Frequency Management (Redbook), sections 8.3.28 – 8.3.30 (available at: http://www.ntia.doc.gov/page/2011/manual-regulations-and-procedures-federalradio-frequency-management-redbook)

Note.— The relevant sections of the NTIA Redbook only apply to the United States Federal Government users. Use of repeaters by non-government users is prohibited in the United States.

APPENDIX B

ADS-B OUT implementation

State	Mandate	Ground Station Capabilities	Flight Level	ATC Procedure	Data sharing Protocol	Data sharing States
Bahrain						
Egypt						
Iran						
Iraq						
Jordan						
Kuwait	April 2016	ADS-B GS Accept DO260,DO260A,DO260B	Will Be Implemented by April 2016	Will be Published by April 2016	ASTERIX (Cat 21 Ver 0.26)	N/A
Lebanon						
Libya						
Oman						
Qatar						
Saudi Arabia						
Sudan						
Syria						
UAE						
Yemen						

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