International Civil Aviation Organization
North American, Central American and Caribbean Office
Second North American, Central American and Caribbean Working Group Meeting (NACC/WG/2)
Ocho Rios, Jamaica, 12-16 May 2008

Agenda Item 3 **CNS Developments**
3.2 Follow-up on the Action Pan for the Implementation of Voice and Data Air-Ground Communication
3.3 Follow-up Activities for the Implementation of Ground-Ground Communications
3.4 Follow up to GNSS Implementation and Action Plan

AMENDMENT 83 TO ANNEX 10 – AERONAUTICAL TELECOMMUNICATIONS

(Presented by the Secretariat)

SUMMARY

For planning and implementation purposes, this paper presents the Amendment 83 to Annex 10 Aeronautical Telecommunications, Volumes I and III, Parts I and II, which involving certain GNSS issues, the consideration of the Internet Protocol Suite for the ATN and the provision for 8.33 kHz offset carrier systems in VHF.

References:

- Annex 10, Vol I and III
- 183rd Session of the Air Navigation Commission

Strategic Objectives	*This working paper relates to Strategic Objectives A and D.*

1. Introduction

1.1 The Amendment 83 to Annex 10 Vol. I and III, Parts I and II has been reviewed as follows:

- On 29 November 2007, the Air Navigation Commission (AN Min. 176-9) conducted its final review (AN-WP/8271 and Addendum No. 1) of proposed amendments to Annex 10 — *Aeronautical Telecommunications* and Volume I — *Radio Navigation Aids*, resulting from proposals developed by the Navigation Systems Panel (NSP) to resolve certain navigation systems implementation issues and to reflect the evolution of existing global navigation satellite system (GNSS) and equipment. The Commission agreed that the proposed amendments, as contained in the attachments to State letter AN 7/1.3.91, AN 2/2-07/31 and as modified by the Commission, be consolidated with other amendment proposals for inclusion in Amendment 83 to Annex 10.

- On 11 December 2007, the Air Navigation Commission (AN Min. 176-11) conducted its final review (AN-WP/8281 and Addendum No. 1) of proposed amendments to Annex 2 — *Rules of the Air*, Annex 3 — *Meteorological Service for International Air Navigation*, Annex 4 — *Aeronautical Charts*, Annex 6 — *Operation of Aircraft*, Annex 10 — *Aeronautical Telecommunications*, Volume I — *Radio Navigation Aids*, Annex 11 — *Air Traffic Services*, Annex 15 — *Aeronautical Information Services* and the *Procedures for Air Navigation Services — ICAO Abbreviations and Codes* (PANS-ABC, Doc 8400) to align required navigation performance (RNP) and area navigation (RNAV) terminology with the performance based navigation (PBN) concept. The Commission agreed that the proposed amendments to Annex 10, Volume I, as contained in Attachment E to State letter AN 11/45-07/52, and as modified by the Commission, be consolidated with other amendment proposals for inclusion in Amendment 83 to Annex 10.

- On 13 December 2007, the Air Navigation Commission (AN Min. 176-12) conducted its final review (AN-WP/8282) of proposed amendments to Annex 10 — *Aeronautical Telecommunications*, Volume III — *Communication Systems*, Part I — *Digital Data Communication Systems* and Part II — *Voice Communication Systems* resulting from the first meeting of the Aeronautical Communications Panel (ACP/1) concerning the aeronautical telecommunication network (ATN) and 8.33 kHz offset carrier systems. The Commission agreed that the proposed amendments, as contained in the attachments to State letter AN 7/1.3.92-07/39 and as modified by the Commission, be consolidated with other amendment proposals for inclusion in Amendment 83 to Annex 10.

- On 7 February 2008, the Commission (AN Min. 177-5) reviewed AN-WP/8297 containing the draft report to Council on the adoption of Amendment 83 to Annex 10, Volumes I and III, Parts I and II, and approved the report.

- On March 2008, the amendment 83 was approved by the 183rd Air Navigation Commission.

1.2 The amendment 83 to Annex 10, Vol. I and III, part I and II are applicable until 20 November 2008.

2. Amendment 83 to Annex 10 Vol. I and III

2.1 The amendment 83 to Annex 10 Vol. I and III includes:

a) Resolves certain global navigation satellite system (GNSS) implementation issues and reflects the evolution of existing GNSS systems and equipment;

b) aligns the required navigation performance (RNP) and area navigation (RNAV) terminology with the performance based navigation (PBN) concept; and

c) Introduces Internet Protocol Suite (IPS) technology to the aeronautical telecommunication network (ATN) and introduces provisions for 8.33 kHz offset carrier systems in the very high frequency (VHF) double sideband-amplitude modulation (DSB-AM).

2.2 Having examined the technical circumstances associated with the implementation of the amendment, ICAO proposed an applicability date of **20 November 2008**.

Considerations and benefits:

2.3 No States identified any potential cost impacts concerning the amendment to resolve certain navigation systems implementation issues and to reflect the evolution of existing GNSS equipment.

2.4 The amendment concerning PBN terminology will not result in a financial burden to States. The overall PBN work programme and implementation effort will significantly improve ATS route structures and result in savings for the airline industry.

2.5 No States identified any potential cost impacts concerning the ATN and 8.33 kHz offset carrier systems in the VHF DSB-AM.

2.6 The proposed GNSS amendment is intended to facilitate the wider implementation of existing GNSS SARPs and the achievement of the associated safety and efficiency benefits.

2.7 The proposed PBN amendment stems from the development of the PBN concept and related guidance and has the objective of facilitating the implementation of RNAV and RNP in a globally harmonized manner, thereby addressing diverging implementation trends.

2.8 The proposed ATN amendment is to introduce the Internet Protocol Suite (IPS) in the aeronautical telecommunication network (ATN), in addition to the ageing ATN/OSI technology, which is not widely supported by Industry any more. A timely introduction of the ATN/IPS Standards and Recommended Practices (SARPs) will increase the flexibility of, and reduce the implementation costs for communication related aviation applications. The increased flexibility and readily available off-the-shelf equipment to support the ATN/IPS will also reduce the implementation costs for communication-related aviation applications. Also, the current ATN SARPs have been restructured along the principles of Assembly Resolution A35-14. The amendment concentrates on keeping high-level Standards in Annex 10 necessary to secure the global interoperability of the ATN.

2.9 The proposed 8.33 kHz offset carrier systems amendment is to introduce regulatory provisions to facilitate the use of the off-set carrier (climax) system on 8.33 kHz voice channels in the very high frequency (VHF) frequency band (117.975-137 MHz). This is a frequency-efficient technique for using VHF frequencies over large geographical areas. Introduction of regulatory provisions for 8.33 kHz off-set carrier systems, will facilitate reassignment of 25 kHz off-set carrier systems to 8.33 kHz channels, thus making more channels available for use by aviation in the already congested VHF band, in particular in Europe. The proposed provisions do not introduce cost implications for States and/or Industry.

2.10 The Amendment is shown on appendixes A and B to this Working Paper.

3. Suggested Action

3.1 The Meeting is invited to:

a) take note of the information contained in this working paper;

b) Consider this amendment in the Planning of the Implementation Action Plans.

— — — — — — — — — — — — — — — —

APPENDIX A

PROPOSED AMENDMENT TO INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

AERONAUTICAL TELECOMMUNICATIONS

ANNEX 10 TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

VOLUME I (RADIO NAVIGATION AIDS)

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

1. The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

a)	~~Text to be deleted is shown with a line through it~~.	text to be deleted
b)	New text to be inserted is highlighted with grey shading.	new text to be inserted
c)	~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

2. The sources of the proposed amendments have been indicated as follows:

Source	Annotation
Amendment arising from the Secretariat, with the assistance of the Required Navigation Performance and Special Operational Requirements Study Group (RNPSORSG), concerning performance-based navigation (PBN) terminology.	Source A
Amendment arising from the Navigation Systems Panel (NSP) concerning navigation systems implementation issues.	Source B

INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES

AERONAUTICAL TELECOMMUNICATIONS

ANNEX 10

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

VOLUME I
(RADIO NAVIGATION AIDS)

Source A

. . .

CHAPTER 1. DEFINITIONS

Area navigation (RNAV). A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Note.— Area navigation includes performance-based navigation as well as other operations that do not meet the definition of performance-based navigation.

. . .

Source B

Essential radio navigation service. A radio navigation service whose disruption has a significant impact on operations in the affected airspace or aerodrome.

. . .

Source A

Navigation specification. A set of aircraft and air crew requirements needed to support performance-based navigation operations within a defined airspace. There are two kinds of navigation specifications:

RNP specification. A navigation specification based on area navigation that includes the requirement for performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4, RNP APCH.

RNAV specification. A navigation specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.

Note.— The Performance-based Navigation Manual *(Doc 9613), Volume II, contains detailed guidance on navigation specifications.*

. . .

Performance-based navigation (PBN). Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

. . .

Source B

. . .

Radio navigation service. A service providing guidance information or position data for the efficient and safe operation of aircraft supported by one or more radio navigation aids.

. . .

CHAPTER 2. GENERAL PROVISIONS FOR RADIO NAVIGATION AIDS

Source A

. . .

2.1 Aids to approach, landing and departure

. . .

~~2.1.6 Required navigation performance (RNP) for approach, landing and departure operations~~

~~2.1.6.1 Where used, RNP for approach, landing and departure operations shall be prescribed by States.~~

~~2.1.6.2 Where RNP is prescribed for precision approach and landing operations, the RNP shall only be supported by a standard non-visual aid in accordance with 2.1.1.~~

. . .

Source B

. . .

2.8 Provision of information on the operational status of radio navigation ~~aids~~ services

2.8.1 Aerodrome control towers and units providing approach control service shall be provided ~~without delay~~ with information on the operational status of radio navigation ~~aids~~ services essential for approach, landing and take-off at the aerodrome(s) with which they are concerned, on a timely basis consistent with the use of the service(s) involved.

. . .

CHAPTER 3. SPECIFICATIONS FOR RADIO NAVIGATION AIDS

3.1 Specification for ILS

. . .

3.1.2.1.1 Facility Performance Categories I, II and III — ILS shall provide indications at designated remote control points of the operational status of all ILS ground system components, as follows:~~.~~

a) ~~*Note 1.— It is intended that*~~for all Category II and Category III ILS, the air traffic services unit involved in the control of aircraft on the final approach shall be one of the designated remote control points and shall receive~~, receiving, without delay~~ information on the operational status of the ILS, with a delay commensurate with the requirements of the operational environment~~, as derived from the monitors~~;.

b) for a Category I ILS, if that ILS provides an essential radio navigation service, the air traffic services unit involved in the control of aircraft on the final approach shall be one of the designated remote control points and shall receive information on the operational status of the ILS, with a delay commensurate with the requirements of the operational environment.

Note 1.— The indications required by this Standard are intended as a tool to support air traffic management functions, and the applicable timeliness requirements are sized accordingly (consistently with 2.8.1). Timeliness requirements applicable to the ILS integrity monitoring functions that protect aircraft from ILS malfunctions are specified in 3.1.3.11.3.1 and 3.1.5.7.3.1.

Note 2.— It is intended that the air traffic system is likely to call for additional provisions which may be found essential for the attainment of full operational Category III capability, e.g. to provide additional lateral and longitudinal guidance during the landing roll-out, and taxiing, and to ensure enhancement of the integrity and reliability of the system.

. . .

3.1.3.3.2.3 For Facility Performance Category III localizers, the minimum field strength on the ILS glide path and within the localizer course sector shall be not less than 100 microvolts per metre (minus 106 dBW/m^2) at a distance of 18.5 km (10 NM), increasing to not less than 200 microvolts per metre (minus 100 dBW/m^2) at 6 m (20 ft) above the horizontal plane containing the threshold. From this point to a further point 4 m (12 ft) above the runway centre line, and 300 m (1 000 ft) from the threshold in the direction of the localizer, and thereafter at a height of 4 m (12 ft) along the length of the runway in the direction of the localizer, the field strength shall be not less than 100 microvolts per metre (minus ~~106 BW/m^2~~ 106 dBW/m^2).

. . .

3.7 Requirements for the Global Navigation Satellite System (GNSS)

. . .

3.7.3 GNSS elements specifications

3.7.3.1 *GPS Standard Positioning Service (SPS) (L1)*

. . .

3.7.3.1.5.4 *Signal power level*. Each GPS satellite shall broadcast SPS navigation signals with sufficient power such that, at all unobstructed locations near the ground from which the satellite is observed at an elevation angle of 5 degrees or higher, the level of the received RF signal at the output of a 3 dBi linearly-polarized antenna is within the range of ~~–160~~ –158.5 dBW to –153 dBW for all antenna orientations orthogonal to the direction of propagation.

. . .

3.7.3.2 *GLONASS Channel of Standard Accuracy (CSA) (L1)*

. . .

3.7.3.2.1 *Space and control segment accuracy* ~~*Accuracy*~~

Note.— The following accuracy standards do not include atmospheric or receiver errors as described in Attachment D, 4.2.2.

3.7.3.2.1.1 *Positioning accuracy*. The GLONASS CSA position errors shall not exceed the following limits:

	Global average 95% of the time	Worst site ~~99.99~~95% of the time
Horizontal position error	~~28~~ 19 m (~~92~~ 62 ft)	~~140~~ 44 m (~~460~~ 146 ft)
Vertical position error	~~60~~ 29 m (~~196~~ 96 ft)	~~585~~ 93 m (~~1 920~~308 ft)

3.7.3.2.1.2 *Time transfer accuracy*. The GLONASS CSA time transfer errors shall not exceed 700 nanoseconds 95 per cent of the time.

3.7.3.2.1.3 *Range domain accuracy*. The range domain error shall not exceed the following limits:

a) range error of any satellite — 30 m (98.43 ft);

b) range rate error of any satellite — 0.04 m (0.12 ft) per second;

c) range acceleration error of any satellite — 0.013 m (0.039 ft) per second squared;

d) root-mean-square range error over all satellites — 7 m (22.97 ft).

3.7.3.2.2 *Availability*. The GLONASS CSA availability shall be ~~at least 99.64 per cent (global average).~~as follows:

a) ≥99 per cent horizontal service availability, average location (44 m, 95 per cent threshold);

b) ≥99 per cent vertical service availability, average location (93 m, 95 per cent threshold);

c) ≥90 per cent horizontal service availability, worst-case location (44 m, 95 per cent threshold);

d) ≥90 per cent vertical service availability, worst-case location (93 m, 95 per cent threshold).

3.7.3.2.3 *Reliability*. The GLONASS CSA reliability shall be ~~at least 99.98 per cent (global average).~~within the following limits:

a) frequency of a major service failure — not more than three per year for the constellation (global average); and

b) reliability — at least 99.7 per cent (global average).

3.7.3.2.4 *Coverage*. The GLONASS CSA ~~coverage~~ shall cover the surface of the earth up to an altitude of 2 000 km ~~be at least 99.9 per cent (global average)~~.

Note.— Guidance material on GLONASS accuracy, availability, reliability and coverage is given in Attachment D, 4.2.

. . .

~~3.7.6 Status monitoring and NOTAM~~

~~3.7.6.1 Changes in the current and projected status of GNSS space and ground elements that may have an impact on user performance or operational approvals shall be reported to relevant air traffic service units.~~

~~*Note 1. — Additional information is provided in Attachment D, 9.*~~

~~*Note 2. — To assess the operational impact of changes in status, a service prediction tool may be required.*~~

Table 3.7.2.4-1 Signal-in-space performance requirements

Typical operation	Accuracy horizontal 95% (Notes 1 and 3)	Accuracy vertical 95% (Notes 1 and 3)	Integrity (Note 2)	Time-to-alert (Note 3)	Continuity (Note 4)	Availability (Note 5)
En-route	3.7 km (2.0 NM) ~~(Note 6)~~	N/A	$1 - 1 \times 10^{-7}$/h	5 min	$1 - 1 \times 10^{-4}$/h to $1 - 1 \times 10^{-8}$/h	0.99 to 0.99999
En-route, Terminal	0.74 km (0.4 NM)	N/A	$1 - 1 \times 10^{-7}$/h	15 s	$1 - 1 \times 10^{-4}$/h to $1 - 1 \times$ ~~10^{8}/h~~ 10^{-8}/h	0.99 to 0.99999
Initial approach, Intermediate approach, Non-precision approach (NPA), Departure	220 m (720 ft)	N/A	$1 - 1 \times 10^{-7}$/h	10 s	$1 - 1 \times 10^{-4}$/h to $1 - 1 \times 10^{-8}$/h	0.99 to 0.99999
Approach operations with vertical guidance (APV-I)	16.0 m (52 ft)	20 m (66 ft)	$1 - 2 \times 10^{-7}$ ~~per~~ in any approach	10 s	$1 - 8 \times 10^{-6}$ ~~in any~~ per 15 s	0.99 to 0.99999
Approach operations with vertical guidance (APV-II)	16.0 m (52 ft)	8.0 m (26 ft)	$1 - 2 \times 10^{-7}$ ~~per~~ in any approach	6 s	$1 - 8 \times 10^{-6}$ ~~in any~~ per 15 s	0.99 to 0.99999
Category I precision approach (~~Note 8~~ Note 7)	16.0 m (52 ft)	6.0 m to 4.0 m (20 ft to 13 ft) (~~Note 7~~ Note 6)	$1 - 2 \times 10^{-7}$ ~~per~~ in any approach	6 s	$1 - 8 \times 10^{-6}$ ~~in any~~ per 15 s	0.99 to 0.99999

NOTES.—

. . .

4. Ranges of values are given for the continuity requirement for en-route, terminal, initial approach, NPA and departure operations, as this requirement is dependent upon several factors including the intended operation, traffic density, complexity of airspace and availability of alternative navigation aids. The lower value given is the minimum requirement for areas with low traffic density and airspace complexity. The higher value given is appropriate for areas with high traffic density and airspace complexity (see Attachment D, ~~3.4)~~ 3.4.2). Continuity requirements for APV and Category I operations apply to the average risk (over time) of loss of service, normalized to a 15 second exposure time (see Attachment D, 3.4.3).

. . .

Source A

~~6. This requirement is more stringent than the accuracy needed for the associated RNP types, but it is well within the accuracy performance achievable by GNSS.~~

Editorial Note.— The succeeding notes will be renumbered, as necessary, in the final edition.

. . .

Source B

. . .

APPENDIX B. TECHNICAL SPECIFICATIONS FOR THE GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

. . .

3. GNSS ELEMENTS

3.1 Global Positioning System (GPS) Standard Positioning Service (SPS) (L1)

. . .

3.1.1.3.3.5 *Satellite configuration summary*. Page 25 of subframe 4 shall contain a 4-bit-long term for each of up to 32 satellites to indicate the configuration code of each satellite. These 4-bit terms shall occupy bits 9 through 24 of words 3, the 24 MSBs of words 4 through 7, and the 16 MSBs of word 8, all in page 25 of subframe 4. The MSB of each 4-bit term shall indicate whether anti-spoofing is activated (MSB=1) or not activated (MSB=0).~~The first MSB of each field shall be reserved.~~ The 3 LSBs shall indicate the configuration of each satellite using the following code:

Code	Satellite configuration
~~001~~	~~Block II satellite~~
001	Block II/IIA/IIR satellite
010	Block IIR-M satellite
011	Block IIF satellite

. . .

3.2 Global navigation satellite system (GLONASS) channel of standard accuracy (CSA) (L1)

. . .

3.2.1.1 *RF CHARACTERISTICS*

3.2.1.1.1 *Carrier frequencies.* The nominal ~~value~~ values of L1 ~~and~~ carrier frequencies shall be as defined by the following expressions:

$$f_{k1} = f_{01} + k\Delta f_1$$

where

k = –7, …, 0, 1, …, ~~13~~ 6 are carrier numbers (frequency channels) of the signals transmitted by GLONASS satellites in the L1 sub-band;

. . .

Table B-16. L1 carrier frequencies

Carrier number	H^A_n (see 3.2.1.3.4)	Nominal value of frequency in L1 sub-band (MHz)
~~13~~*	~~13~~	~~1 609.3125~~
~~12~~**	~~12~~	~~1 608.7500~~
~~11~~**	~~11~~	~~1 608.1875~~
~~10~~**	~~10~~	~~1 607.6250~~
~~09~~**	~~9~~	~~1 607.0625~~
~~08~~**	~~8~~	~~1 606.5000~~
~~07~~**	~~7~~	~~1 605.9375~~
06***	6	1 605.3750
05***	5	1 604.8125
4	4	1 604.2500
	. . .	

~~* This frequency may be used for technical purposes over the Russian Federation before 2006 and is planned to be vacated after 2005.~~

~~** These frequencies are planned to be vacated after 2005.~~

~~*** These frequencies may be used for technical purposes over the Russian Federation after 2005.~~

. . .

3.2.1.1.4 *Spurious emissions*. The power of the transmitted RF signal beyond the GLONASS allocated bandwidth shall not be more than –40 dB relative to the power of the unmodulated carrier.

Note 1.— GLONASS satellites ~~that are~~ launched during 1998 to 2005 and beyond ~~will~~ use filters limiting out-of-band emissions to the harmful interference limit contained in ~~CCIR~~ Recommendation ITU-R RA.769 for the 1 660 – 1 670 MHz band.

Note 2.— GLONASS satellites ~~that are~~ launched beyond 2005 ~~will~~ use filters limiting out-of-band emissions to the harmful interference limit contained in ~~CCIR~~ Recommendation ITU-R RA.769 for the 1 610.6 – 1 613.8 MHz and 1 660 – 1 670 MHz bands.

. . .

3.5 Satellite-based augmentation system (SBAS)

. . .

3.5.5 DEFINITIONS OF PROTOCOLS FOR DATA APPLICATION

. . .

3.5.5.2.1.1 The ~~clock time error estimate~~code phase offset correction ($\delta\Delta t_{SV,i}$) for a GPS or SBAS satellite *i* at any time of day t_k is:

$$\delta\Delta t_{SV,i} = \delta a_{i,f0} + \delta a_{i,f1}\,(t_k - t_{i,LT})$$

. . .

3.5.5.5.3.2 For IPPs north of N85° or south of S85°:

Replace:

$$y_{pp} = \frac{|\phi_{pp} - \phi_1|}{10°}$$

with the following:

$$y_{pp} = \frac{|\phi_{pp}| - 85°}{10°}$$

. . .

3.5.5.6 *Protection levels*. The horizontal protection level (HPL) and the vertical protection level (VPL) are:

. . .

w_i = the inverse weight associated with satellite $i = \sigma^2_i$.

. . .

3.5.5.6.2 *Definition of fast and long-term correction error model*. If fast corrections and long-term correction/GEO ranging parameters are applied, and degradation parameters are applied:

. . .

If fast corrections and long-term corrections/GEO ranging parameters are ~~not~~ applied, ~~and~~ but degradation parameters are not applied:

$$\sigma^2_{i,flt} = [(\sigma_{i,UDRE})\,(\delta_{UDRE}) + 8\text{m}]^2$$

~~If fast corrections or long-term corrections/GEO ranging parameters are not applied to a satellite, or if an ephemeris covariance Type 28 message has not been received for the satellite but an active Type 28 message has been received for a different satellite:~~

$$\cancel{\sigma^2_{i,flt} = (60)^2 \text{m}^2}$$

. . .

3.5.5.6.2.3 *Long-term correction degradation*

3.5.5.6.2.3.1 *Core satellite constellation(s)*

3.5.5.6.2.3.1.1 For velocity code = 1, the degradation parameter for long-term corrections of satellite *i* is:

Replace:

$$\varepsilon_{ltc} = C_{ltc\_lsb} + C_{ltc\_v1} \max(0, t_{i,LT} - t, t - t_{i,LT} - I_{ltc\_v1})$$

with the following:

$$\varepsilon_{ltc} = \begin{cases} 0, & \text{if } t_{i,LT} < t < t_{i,LT} + I_{ltc\_v1} \\ C_{ltc\_lsb} + C_{ltc\_v1} \max(0, t_{i,LT} - t, t - t_{i,LT} - I_{ltc\_v1}), & \text{otherwise} \end{cases}$$

. . .

3.5.5.6.2.3.2 *GEO satellites.* The degradation parameter for long-term corrections is:

Replace:

$$\varepsilon_{ltc} = C_{geo\_lsb} + C_{geo\_v} \max(0, t_{0,GEO} - t, t - t_{0,GEO} - I_{geo})$$

with the following:

$$\varepsilon_{ltc} = \begin{cases} 0, & \text{if } t_{0,GEO} < t < t_{0,GEO} + I_{GEO} \\ C_{geo\_lsb} + C_{geo\_v} \max(0, t_{0,GEO} - t, t - t_{0,GEO} - I_{geo}), & \text{otherwise} \end{cases}$$

where t = the current time.

Note.— When long-term corrections are applied to a GEO satellite, the long-term correction degradation is applied and the GEO navigation message degradation is not applied.

3.5.5.6.2.4 *Degradation for en-route through non-precision approach*

$$\varepsilon_{er} = \begin{cases} 0, & \text{if neither fast nor long-term corrections have timed out for precision approach/approach with vertical guidance} \\ C_{er}, & \text{if fast or long-term corrections have timed out for precision approach/approach with vertical guidance} \end{cases}$$

. . .

3.5.6 MESSAGE TABLES

. . .

Table B-42. Type 9 ranging function message

Data content	Bits used	Range of values	Resolution
~~Spare~~Reserved	8	—	—
. . .			

. . .

Table B-45. Type 17 GEO almanac message

Data content	Bits used	Range of values	Resolution
For each of 3 satellites ~~Spare~~Reserved	2	~~—~~0	—
. . .			

. . .

Table B-54. Data broadcast intervals and supported functions

Data type	Maximum broadcast interval	Ranging	GNSS satellite status	Basic differential correction	Precise differential correction	Associated message types
. . .						
Fast corrections	I_{fc}/2~~60 s~~ (see Note 4)		R*	R	R	2 to 5, 24
. . .						

Notes.—
1. "R" indicates that the data must be broadcast to support the function.
2. "R" indicates special coding as described in 3.5.7.3.3.*
3. Type 12 messages are only required if data are provided for GLONASS satellites.
4. I_{fc} refers to the PA/APV time-out interval for fast corrections, as defined in Table B-57.

. . .

3.5.7.5.4 *Ionospheric integrity data*. For each IGP for which corrections are provided, SBAS shall broadcast GIVEI data such that the integrity requirement in 3.5.7.5.1 is met. If the ionospheric correction or $\sigma^2_{i,GIVE}$ exceed their coding range, SBAS shall indicate the status ~~that the IGP is unhealthy~~ "Do Not Use" (designated in the correction data, 3.5.4.6) for the IGP. If $\sigma^2_{i,GIVE}$ cannot be determined, SBAS shall indicate that the IGP is "Not Monitored" (designated in the GIVEI coding).

. . .

3.5.8.1.1 *Conditions for use of data*. The receiver shall use data from an SBAS message only if the CRC of this message has been verified. Reception of a Type 0 message from an SBAS satellite shall result in deselection of that satellite and all data from that satellite shall be discarded for at least 1 minute. For GPS satellites, the receiver shall apply long-term corrections only if the IOD matches both the IODE and 8 least significant bits of the IODC. For GLONASS satellites, the receiver shall apply long-term corrections only if the time of reception (t_r) of the GLONASS ephemeris is inside the following IOD validity interval, as defined in 3.5.4.4.1:

$$t_{LT} - L - V \leq t_r \leq t_{LT} - L$$

Note 1.— For SBAS satellites, there is no mechanism that links GEO ranging function data (Type 9 message) and long-term corrections.

Note 2.— This requirement does not imply that the receiver has to stop tracking the SBAS satellite.

. . .

~~3.5.8.1.1.6 For GPS satellites, the receiver shall apply long-term corrections only if the IOD matches both the IODE and 8 LSBs of the IODC.~~

~~*Note.— For SBAS satellites, there is no mechanism that links GEO ranging function data (Type 9 message) and long-term corrections.*~~

3.5.8.1.1.~~7~~6 In the event of a loss of four successive SBAS messages, the receiver shall no longer support SBAS-based precision approach or APV operations.

3.5.8.1.1.~~8~~7 The receiver shall not use a broadcast data parameter after it has timed out as defined in Table B-56.

. . .

Table B-57. Fast correction time-out interval evaluation

Fast correction degradation factor indicator (ai_i)	NPA time-out interval for fast corrections (I_{fc})	PA/APV time-out interval for fast corrections (I_{fc})

. . .

Editorial Note.— The remaining paragraphs will be renumbered, as necessary, in the final edition.

. . .

3.5.8.4.2 *Precision approach and APV operations*

3.5.8.4.2.1 The receiver shall compute and apply long-term corrections, fast corrections, range rate corrections and the broadcast ionospheric corrections. For GLONASS satellites, the ionospheric corrections received from the SBAS shall be multiplied by the square of the ratio of GLONASS to GPS frequencies $(f_{GLONASS}/f_{GPS})^2$.

3.5.8.4.2.2 The receiver shall use a ~~general~~ weighted-least-squares position solution.

. . .

3.6.7.1.3 *Continuity of service*

3.6.7.1.3.1 *Continuity of service for Category I precision approach and APV.* The GBAS ground subsystem continuity of service shall be greater than or equal to 1 – ~~3.3~~ 8.0× 10^{-6} ~~during any~~ per 15 seconds.

Note.— The GBAS ground subsystem continuity of service is the average probability ~~that during any~~ per 15-second period that the VHF data broadcast transmits data in tolerance, VHF data broadcast field strength is within the specified range and the protection levels are lower than the alert limits, ~~unless~~ including configuration changes that occur due to the space segment. This continuity of service requirement is the entire allocation of the signal-in-space continuity requirement from Chapter 3, Table 3.7.2.4-1, and therefore all continuity risks included in that requirement must be accounted for by the ground subsystem provider.

. . .

3.7 Resistance to interference

. . .

Table B-86. Interference thresholds for pulsed interference

	GPS and SBAS	GLONASS
Frequency range	1 575.42 MHz ± 10 MHz	1 592.9525 MHz to 1 609.36 MHz
Interference threshold (Pulse peak power)	~~–10~~ -20 dBW	~~–10~~ -20 dBW
Pulse width	≤125 µs~~, ≤1 ms*~~	~~≤1 ms~~≤250 µs
Pulse duty cycle	≤~~10%~~1%	≤~~10%~~1%

~~* Applies to GPS receivers without SBAS.~~

. . .

ATTACHMENT D. INFORMATION AND MATERIAL FOR GUIDANCE IN THE APPLICATION OF THE GNSS STANDARDS AND RECOMMENDED PRACTICES

. . .

2. General

Standards and Recommended Practices for GNSS contain provisions for the elements identified in Chapter 3, 3.7.2.2. Additional implementation guidance is provided in the *Global Navigation Satellite System (GNSS) Manual* (Doc 9849).

. . .

3. Navigation system performance requirements

Source A

3.1 Introduction

3.1.1 Navigation system performance requirements are defined in the ~~*Manual on Required Navigation Performance (RNP)*~~*Performance-based Navigation Manual* (Doc 9613) for a single aircraft and for the total system which includes the signal-in-space, the airborne equipment and the ability of the aircraft to fly the desired trajectory. These total system requirements were used as a starting point to derive GNSS signal-in-space performance requirements. In the case of GNSS, degraded configurations which may affect multiple aircraft are to be considered. Therefore, certain signal-in-space performance requirements are more stringent to take into account multiple aircraft use of the system.

. . .

Source B

3.3 Integrity and time-to-alert

. . .

3.3.5 For APV and precision approach operations, integrity requirements for GNSS signal-in-space requirements of Chapter 3, Table 3.7.2.4-1, were selected to be consistent with ILS requirements.

Insert new text as follows:

3.3.6 The approach integrity requirements apply in any one landing and require a fail-safe design. If the specific risk on a given approach is known to exceed this requirement, the operation should not be conducted. One of the objectives of the design process is to identify specific risks that could cause misleading information and to mitigate those risks through redundancy or monitoring to achieve a fail-safe design. For example, the ground system may need redundant correction processors and to be capable of shutting down automatically if that redundancy is not available due to a processor fault.

3.3.7 A unique aspect of GNSS is the time-varying performance caused by changes in the core satellite geometry. A means to account for this variation is included in the SBAS and GBAS protocols through the protection level equations, which provide a means to inhibit use of the system if the specific integrity risk is too high.

3.3.8 GNSS performance can also vary across the service volume as a result of the geometry of visible core constellation satellites. Spatial variations in system performance can further be accentuated when the ground system operates in a degraded mode following the failure of system components such as monitoring stations or communication links. The risk due to spatial variations in system performance should be reflected in the protection level equations, i.e. the broadcast corrections.

3.3.9 GNSS augmentations are also subject to several atmospheric effects, particularly due to the ionosphere. Spatial and temporal variations in the ionosphere can cause local or regional ionospheric delay errors that cannot be corrected within the SBAS or GBAS architectures due to the definition of the message protocols. Such events are rare and their likelihood varies by region, but they are not expected to be negligible. The resulting errors can be of sufficient magnitude to cause misleading information and should be mitigated in the system design through accounting for their effects in the broadcast parameters (e.g. σ_{iono_vert} in GBAS), and monitoring for excessive conditions where the broadcast parameters are not adequate. The likelihood of encountering such events should be considered when developing any system monitor.

3.3.10 Another environmental effect that should be accounted for in the ground system design is the errors due to multipath at the ground reference receivers, which depend on the physical environment of monitoring station antennas as well as on satellite elevations and times in track.

End of new text.

3.4 Continuity of service

. . .

3.4.3 *Approach and landing*

3.4.3.1 For approach and landing operations, continuity of service relates to the capability of the navigation system to provide a navigation output with the specified accuracy and integrity during the approach, ~~assuming~~ given that it was available at the start of the operation. In particular, this means that loss of continuity events that can be predicted and for which NOTAMs have been issued do not have to be taken into account when establishing compliance of a given system design against the SARPs continuity requirement. The occurrence of navigation system alerts, either due to rare fault-free performance or to failures, constitute continuity failures. In this case, the continuity requirement is stated as a probability for a short exposure time.

3.4.3.2 The continuity requirements for approach and landing operations represent only the allocation of the requirement between the aircraft receiver and the non-aircraft elements of the system. In this case, no increase in the requirement is considered necessary to deal with multiple aircraft use of the system. The continuity value is normally related only to the risk associated with a missed approach and each aircraft can be considered to be independent. However, in some cases, it may be necessary to increase the continuity values since a system failure has to be correlated between both runways (e.g. the use of a common system for approaches to closely-spaced parallel runways).

Insert new text as follows:

3.4.3.3 For GNSS-based APV and Category I approaches, missed approach is considered a normal operation, since it occurs whenever the aircraft descends to the decision altitude for the approach and the pilot is unable to continue with visual reference. The continuity requirement for these operations applies to the average risk (over time) of loss of service, normalized to a 15 second exposure time. Therefore, the specific risk of loss of continuity for a given approach could exceed the average requirement without necessarily affecting the safety of the service provided or the approach. A safety assessment performed for one system led to the conclusion that, in the circumstances specified in the assessment, continuing to provide the service was safer than withholding it.

3.4.3.4 For those areas where the system design does not meet the average continuity risk specified in the SARPs, it is still possible to publish procedures. However, specific operational mitigations should be put in place to cope with the reduced continuity expected. For example, flight planning may not be authorized based on a GNSS navigation means with such a high average continuity risk.

End of new text.

. . .

4.2 GLONASS

Note.— Additional information concerning GLONASS can be found in the GLONASS Interface Control Document *published by Scientific Coordination Information Center, Russian Federation Ministry of Defence, Moscow.*

4.2.1 ~~*Satellite selection*. The performance standard definitions are based upon the assumption that the channel of standard accuracy (CSA) receiver will select satellites based on the minimum PDOP every 5 minutes, or whenever a satellite used in the position solution sets below the mask angle.~~*Assumptions.* The performance standard is based upon the assumption that a representative channel of standard accuracy (CSA) receiver is used. A representative receiver has the following characteristics: designed in accordance with GLONASS ICD; uses a 5-degree masking angle; accomplishes satellite position and geometric range computations in the most current realization of the PZ-90 and uses PZ-90 – WGS-84 transformation parameters as indicated in Appendix B, 3.2.5.2; generates a position and time solution from data broadcast by all satellites in view; compensates for dynamic Doppler shift effects on nominal CSA ranging signal carrier phase and standard accuracy signal measurements; excludes GLONASS unhealthy satellites from the position solution; uses up-to-date and internally consistent ephemeris and clock data for all satellites it is using in its position solution; and loses track in the event that a GLONASS satellite stops transmitting standard accuracy code. The time transfer accuracy applies to a stationary receiver operating at a surveyed location.

4.2.2 *Accuracy*. ~~Accuracy is conditioned by coverage, availability and reliability standards, and a measurement interval of 24 hours for any point on the earth.~~ Accuracy is measured with a representative receiver and a measurement interval of 24 hours for any point within the coverage area. The positioning and timing accuracy are for the signal-in-space (SIS) only and do not include such error sources as: ionosphere, troposphere, interference, receiver noise or multipath. The accuracy is derived based on the worst two of 24 satellites being removed from the constellation and a 7-metre constellation RMS SIS user range error (URE).

4.2.3 ~~*Time transfer accuracy*. Time transfer accuracy is conditioned by coverage, availability and reliability standards and a measurement interval of 24 hours for any point on the earth. It is based upon the GLONASS CSA receiver time as computed using the output of the position solution. Time transfer accuracy is defined with respect to Universal Coordinated Time as maintained by the National Time Service of Russia (UTC(SU)).~~ *Range domain accuracy*. Range domain accuracy is conditioned by the satellite indicating a healthy status and transmitting standard accuracy code and does not account for satellite failures outside of the normal operating characteristics. Range domain accuracy limits can be exceeded during satellite failures or anomalies while uploading data to the satellite. Exceeding the range error limit constitutes a major service failure as described in 4.2.6. The range rate error limit is the maximum for any satellite measured over any 3-second interval for any point within the coverage area. The range acceleration error limit is the maximum for any satellite measured over any 3-second interval for any point within the coverage area. The root-mean-square range error accuracy is the average of the RMS URE of all satellites over any 24-hour interval for any point within the coverage area. Under nominal conditions, all satellites are maintained to the same standards, so it is appropriate for availability modelling purposes to assume that all satellites have a 7-metre RMS SIS URE. The standards are restricted to range domain errors allocated to space and control segments.

4.2.4 *Availability*. ~~Availability is conditioned by coverage and a typical 24-hour interval (defined using an averaging period of 60 days) averaged over the earth.~~ Availability is the percentage of time over any 24-hour interval that the predicted 95 per cent positioning error (due to space and control segment errors) is less than its threshold, for any point within the coverage area. It is based on a 44-metre horizontal 95 per cent threshold and a 93-metre vertical 95 per cent threshold, using a representative receiver and operating within the coverage area over any 24-hour interval. The service availability assumes the worst combination of two satellites out of service.

4.2.4.1 *Relationship to augmentation availability.* The availability of ABAS, GBAS and SBAS does not directly relate to the GLONASS availability defined in Chapter 3, 3.7.3.2.2. Availability analysis is based on an assumed satellite constellation and the probability of having a given number of satellites. Twenty-four operational satellites are available in orbit with 0.95 probability (averaged over any day), where a satellite is defined to be operational if it is capable of, but is not necessarily transmitting, a usable ranging signal. At least 21 satellites in the 24 nominal plane/slot positions must be set healthy and must be transmitting a navigation signal with 0.98 probability (yearly averaged).

4.2.5 *Reliability*. ~~Reliability is conditioned by coverage, service availability, 200 m not to exceed predictable horizontal reliability threshold, a maximum of 18 hours of major service failure behaviour over the sample interval, and a measurement interval of one year, average of daily values over the earth.~~ Reliability is the percentage of time over a specified time interval that the instantaneous CSA SIS URE is maintained within the range error limit, at any given point within the coverage area, for all healthy GLONASS satellites. The reliability standard is based on a measurement interval of one year and the average of daily values within the coverage area. The single point average reliability assumes that the total service failure time of 18 hours will be over that particular point (3 failures each lasting 6 hours).

~~4.2.5.1~~4.2.6 *Major service failure*. A major service failure is defined ~~as a departure from the normal ranging signal characteristics in a manner that can cause a reliability or availability service failure. Specifically, a major service failure is defined as a departure from the normal ranging signal characteristics in one of the following ways:~~

~~a) a statistical departure from nominal system ranging accuracy that causes the CSA instantaneous ranging error to exceed 70 m; or~~

~~b) a fault in a CSA ranging signal, navigation message structure or navigation message content that impacts the CSA receiver's minimum ranging signal reception or processing capabilities.~~

as a condition over a time interval during which a healthy GLONASS satellite's ranging signal error (excluding atmospheric and receiver errors) exceeds the range error limit of 30 m (as defined in Chapter 3, 3.7.3.2.1.3 a)) and/or failures in radio frequency characteristics of the CSA ranging signal, navigation message structure or navigation message contents that deteriorate the CSA receiver's ranging signal reception or processing capabilities.

4.2.~~6~~7 *Coverage*. ~~Coverage is conditioned by the probability of four or more satellites in view over any 24-hour interval averaged over the earth, a PDOP of 6 or less from four satellites, a 5-degree mask angle, and a constellation of twenty-four operational satellites as defined in the almanac.~~ The GLONASS CSA supports the terrestrial coverage area, which is from the surface of the earth up to an altitude of 2 000 km.

Editorial Note.— The remaining paragraphs will be renumbered, as necessary, in the final edition.

. . .

6. Satellite-based augmentation system (SBAS)

. . .

Source A

. . .

6.2 SBAS coverage area and service areas

6.2.1 It is important to distinguish between the coverage area and service areas for an SBAS. A coverage area comprises one or more service areas, each capable of supporting operations based on some or all of the SBAS functions defined in Chapter 3, 3.7.3.4.2. These functions can be related to the operations that are supported as follows:

a) *Ranging*: SBAS provides a ranging source for use with other augmentation(s) (ABAS, GBAS or other SBAS);

b) *Satellite status and basic differential corrections*: SBAS provides en-route, terminal, and non-precision approach service. Different operations (e.g. ~~RNP types~~ performance-based navigation operations) may be supported in different service areas;

. . .

Source B

. . .

6.4 RF characteristics

6.4.1 ~~*SBAS pseudo-random noise (PRN) codes*. RTCA/DO-229C, Appendix A, provides two methods for SBAS PRN code generation.~~ *Minimum GEO signal power level*. When planning for the introduction of new operations based on SBAS, States are expected to conduct an assessment of the signal power level as compared to the level interference from RNSS or non-RNSS sources. The minimum aircraft equipment (e.g. RTCA/DO-229D) is required to operate with a minimum signal strength of -158.5 dBW in the presence of non-RNSS interference (Appendix B, 3.7) and an aggregate RNSS noise density of -173 dBm/Hz. Receivers may not have reliable tracking performance for a signal strength between -158.5 dBW and -161 dBW (minimum signal strength as specified in the SARPs) in the presence of interference from RNSS or non-RNSS sources.

. . .

6.4.4 *Message timing.* The users' convolutional decoders will introduce a fixed delay that depends on their respective algorithms (usually 5 constraint lengths, or 35 bits), for which they must compensate to determine SBAS network time (SNT) from the received signal.

Insert new text as follows:

6.4.5 S*BAS signal characteristics*. Differences between the relative phase and group delay characteristics of SBAS signals, as compared to GPS signals, can create a relative range bias error in the receiver tracking algorithms. The SBAS service provider is expected to account for this error, as it affects receivers with tracking characteristics within the tracking constraints in Attachment D, 8.11. For GEOs for which the on-board RF filter characteristics have been published in RTCA/DO229D, Appendix T, the SBAS service providers are expected to ensure that the UDREs bound the residual errors including the maximum range bias errors specified in RTCA/DO229D. For other GEOs, the SBAS service providers are expected to work with equipment manufacturers in order to determine, through analysis, the maximum range bias errors that can be expected from existing receivers when they process these specific GEOs. This effect can be minimized by ensuring that the GEOs have a wide bandwidth and small group delay across the pass-band.

6.4.6 *SBAS pseudo-random noise (PRN) codes*. RTCA/DO-229D, Appendix A, provides two methods for SBAS PRN code generation.

End of new text.

6.5 SBAS data characteristics

6.5.1 *SBAS messages.* Due to the limited bandwidth, SBAS data is encoded in messages that are designed to minimize the required data throughput. ~~RTCA/DO-229C~~ RTCA/DO-229D, Appendix A, provides detailed specifications for SBAS messages.

6.5.2 *Data broadcast intervals.* The maximum broadcast intervals between SBAS messages are specified in Appendix B, Table B-54. These intervals are such that a user entering the SBAS service broadcast area is able to output a corrected position along with SBAS-provided integrity information in a reasonable time. For en-route, terminal and NPA operations, all needed data will be received within 2 minutes, whereas for precision approach operations, it will take a maximum of 5 minutes. The maximum intervals between broadcasts do not warrant a particular level of accuracy performance as defined in Chapter 3, Table 3.7.2.4-1. In order to ensure a given accuracy performance, each service provider will adopt a set of broadcast intervals taking into account different parameters such as the type of constellations (e.g. GPS with SA, GPS without SA) or the ionospheric activity.

~~6.5.2.1 For fast corrections, Table B-54 allows the maximum broadcast interval to be 60 seconds. Table B-56 gives data time-out intervals for the various data messages with reference to Table B-57 which shows the fast corrections time-out intervals as a function of the fast correction degradation factor indicator (ai_i). However, if the service provider chose 60 seconds for the fast corrections broadcast interval and the ai_i was 15, the user, due to data time-out prior to the next broadcast, would not have current fast corrections for 42 seconds of every minute for NPA and APV-I and for 48 seconds of every minute for APV-II and PA. In order to ensure that the aircraft element processes valid fast corrections without such interruptions, the maximum broadcast interval for fast corrections has to be set at a value that is one third of the NPA and APV-I time-out interval for fast corrections and one-half of the APV-II and PA time-out interval for fast corrections as determined by ai_i.~~

~~*Note.— Maximum fast corrections broadcast intervals for each ai_i can be found in RTCA/DO-229C, Table A-8.*~~

. . .

8. Signal quality monitor (SQM) design

. . .

8.11.6 For aircraft receivers using double-delta correlators and tracking GPS satellites, the precorrelation bandwidth of the installation, the correlator spacing and the differential group delay are within the ranges defined in Table D-13.

. . .

Replace Table D-13 with the following new table:

Table D-13. GPS tracking constraints for double-delta correlators

Region	3 dB precorrelation bandwidth, BW	Average correlator spacing range (chips), X	Instantaneous correlator spacing range (chips)	Differential group delay
1	(-50 × X) + 12 < BW < 7 MHz	0.1 – 0.2	0.09 – 0.22	≤ 600 ns
	2 < BW ≤ 7 MHz	0.2 – 0.6	0.18 – 0.65	
2	(-50 × X) + 12 < BW < (40 × X) + 11.2 MHz	0.045 – 0.07	0.04 – 0.077	≤ 150 ns
	(-50 × X) + 12 < BW < 14 MHz	0.07 – 0.1	0.062 – 0.11	
	7 < BW ≤ 14 MHz	0.1 – 0.24	0.09 – 0.26	
3	14 < BW ≤ 16 MHz	0.07 – 0.24	0.06 – 0.26	≤ 150 ns

. . .

Source A

. . .

ATTACHMENT G. INFORMATION AND MATERIAL FOR GUIDANCE IN THE APPLICATION OF THE MLS STANDARDS AND RECOMMENDED PRACTICES

. . .

15. Application of simplified MLS configurations

15.1 While SARPs for basic and expanded MLS configurations state a single signal-in-space standard, a simplified MLS configuration is defined in Chapter 3, 3.11.3.4 to permit the use of MLS in support of ~~RNP-based approach and departure~~ performance-based navigation operations ~~(Chapter 2, 2.1.6)~~.

. . .

— — — — — — — — — — —

APPENDIX B

PROPOSED AMENDMENT TO

**INTERNATIONAL STANDARDS
AND RECOMMENDED PRACTICES**

AERONAUTICAL TELECOMMUNICATIONS

**ANNEX 10
TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION**

**VOLUME III
(COMMUNICATION SYSTEMS)**

**PART I
(DIGITAL DATA COMMUNICATION SYSTEMS)
AND
PART II
(VOICE COMMUNICATION SYSTEMS)**

NOTES ON THE PRESENTATION OF THE PROPOSED AMENDMENT

1. The text of the amendment is arranged to show deleted text with a line through it and new text highlighted with grey shading, as shown below:

a)	~~Text to be deleted is shown with a line through it~~.	text to be deleted
b)	New text to be inserted is highlighted with grey shading.	new text to be inserted
c)	~~Text to be deleted is shown with a line through it~~ followed by the replacement text which is highlighted with grey shading.	new text to replace existing text

2. The source of the proposed amendment, which concerns the introduction of Internet Protocol Suite (IPS) to the aeronautical telecommunication network (ATN) and the introduction of provisions for 8.33 kHz offset carrier systems for very high frequency (VHF) band voice, is from the Aeronautical Communications Panel (ACP).

INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES

AERONAUTICAL TELECOMMUNICATIONS

ANNEX 10

TO THE CONVENTION ON INTERNATIONAL CIVIL AVIATION

VOLUME III (COMMUNICATION SYSTEMS)

PART I — DIGITAL DATA COMMUNICATION SYSTEMS

CHAPTER 1. DEFINITIONS

Note 1.— All references to "Radio Regulations" are to the Radio Regulations published by the International Telecommunication Union (ITU). Radio Regulations are amended from time to time by the decisions embodied in the Final Acts of World Radiocommunication Conferences held normally every two to three years. Further information on the ITU processes as they relate to aeronautical radio system frequency use is contained in the Handbook on Radio Frequency Spectrum Requirements for Civil Aviation including statement of approved ICAO policies *(Doc 9718).*

Note 2.— This Part of Annex 10 includes Standards and Recommended Practices for certain forms of equipment for communication systems. While the Contracting State will determine the necessity for specific installations in accordance with the conditions prescribed in the relevant Standard or Recommended Practice, review of the need for specific installation and the formulation of ICAO opinion and recommendations to Contracting States concerned, is carried out periodically by Council, ordinarily on the basis of recommendations of Regional Air Navigation Meetings (Doc 8144, Directives to Regional Air Navigation Meetings and Rules of Procedure for their Conduct*).*

Note 3.— This chapter contains general definitions relevant to communication systems. Definitions specific to each of the systems included in this volume are contained in the relevant chapters.

Note 4.— Material on secondary power supply and guidance material concerning reliability and availability for communication systems is contained in Annex 10, Volume I, 2.9 and Volume I, Attachment F, respectively.

Aeronautical administrative communications (AAC). Communications necessary for the exchange of aeronautical administrative messages (see Annex 10, Volume II, 4.4.1.1.7).

Aeronautical operational control (AOC). Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons (see Annex 6, Part I, Chapter 1 – Definitions).

Aeronautical telecommunication network (ATN). ~~An~~ A global internetwork architecture that allows ground, air-ground and avionic data subnetworks to ~~interoperate by adopting common interface services and protocols based on the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model~~ exchange digital data for the safety of air navigation and for the regular, efficient and economic operation of air traffic services.

Aircraft address. A unique combination of twenty-four bits available for assignment to an aircraft for the purpose of air-ground communications, navigation and surveillance.

Aircraft earth station (AES). A mobile earth station in the aeronautical mobile-satellite service located on board an aircraft (see also "GES").

Air traffic service. A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service) (see Annex 11, Chapter 1 – Definitions).

Automatic dependent surveillance — contract (ADS-C). A means by which the terms of an ADS-C agreement will be exchanged between the ground system and the aircraft, via a data link, specifying under what conditions ADS-C reports would be initiated, and what data would be contained in the reports (see Annex 11, Chapter 1 – Definitions).

Automatic terminal information service (ATIS). The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof (see Annex 11, Chapter 1 – Definitions).

Data link-automatic terminal information service (D-ATIS). The provision of ATIS via data link.

Voice-automatic terminal information service (Voice-ATIS). The provision of ATIS by means of continuous and repetitive voice broadcasts.

Bit error rate (BER). The number of bit errors in a sample divided by the total number of bits in the sample, generally averaged over many such samples.

. . .

Circuit mode. A configuration of the communications network which gives the appearance to the application of a dedicated transmission path.

Controller pilot data link communications (CPDLC). A means of communication between controller and pilot, using data link for ATC communications (see Annex 11, Chapter 1 – Definitions).

Data link flight information services (D-FIS). The provision of FIS via data link (see Annex 11, Chapter 1 – Definitions).

Doppler shift. The frequency shift observed at a receiver due to any relative motion between transmitter and receiver.

. . .

Equivalent isotropically radiated power (e.i.r.p). The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna *(absolute or isotropic gain)*.

Flight information service (FIS). A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights (see Annex 11, Chapter 1 – Definitions).

Forward error correction (FEC). The process of adding redundant information to the transmitted signal in a manner which allows correction, at the receiver, of errors incurred in the transmission.

. . .

Mode S subnetwork. A means of performing an interchange of digital data through the use of secondary surveillance radar (SSR) Mode S interrogators and transponders in accordance with defined protocols.

~~***Packet.*** The basic unit of data transfer among communications devices within the network layer.~~

~~***Packet layer protocol (PLP).*** A protocol to establish and maintain a connection between peer level entities at the network layer, and to transfer data packets between them. In the context of this standard, the term refers to the protocol defined by the ISO 8208 standard used in this document.~~

Point-to-point. Pertaining or relating to the interconnection of two devices, particularly end-user instruments. A communication path of service intended to connect two discrete end-users; as distinguished from broadcast or multipoint service.

Slotted aloha. A random access strategy whereby multiple users access the same communications channel independently, but each communication must be confined to a fixed time slot. The same timing slot structure is known to all users, but there is no other co-ordination between the users.

~~***Switched virtual circuit (SVC).*** The primary circuit management technique provided within the ISO 8208 protocol. The network resources are dynamically allocated when needed and released when no longer required.~~

. . .

CHAPTER 3. AERONAUTICAL TELECOMMUNICATION NETWORK

Note 1.— Detailed technical specifications for ATN/OSI applications are contained in the Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN) using ISO/OSI standards and protocols *(Doc 9880) and in the* Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN) *(Doc 9705).*

Note 2.— Detailed technical specifications for ATN/IPS applications are contained in the Manual for the ATN using IPS standards and protocols *(Doc 9896) (available electronically on the ICAO-Net at* http://icao.int/icaonet*).*

3.1 DEFINITIONS

~~*Note 1.— The following definitions were taken from ISO/IEC 7498-1,* Information technology — Open Systems Interconnection — Basic Reference Model *(Reference: ITU-T Rec. X.200 (1994)) and from ICAO Doc 9705* — Manual of Technical Provisions for the Aeronautical Telecommunication Network (ATN).~~

~~*Note 2.— ICAO Doc 9705 has evolved through multiple editions. Each sub-volume of that document indicates the evolution of the provisions between successive editions.*~~

~~*Note 3.— Sub-volume I of ICAO Doc 9705 provides a cross-reference chart between versions (i.e. embedded software capabilities) and editions (i.e. technical provisions).*~~

~~***Accounting management.*** An ATN systems management facility to monitor users for use of network resources and to limit the use of those resources.~~

~~***ADS application.*** An ATN application that provides ADS data from the aircraft to the ATS unit(s) for surveillance purposes.~~

~~***Aeronautical administrative communication (AAC).*** Communication used by aeronautical operating agencies related to the business aspects of operating their flights and transport services. This communication is used for a variety of purposes, such as flight and ground transportation, bookings, deployment of crew and aircraft or any other logistical purposes that maintain or enhance the efficiency of over-all flight operation.~~

~~***Aeronautical operational control (AOC).*** Communication required for the exercise of authority over the initiation, continuation, diversion or termination of flight for safety, regularity and efficiency reasons.~~

~~***Aeronautical passenger communication (APC).*** Communication relating to the non-safety voice and data services to passengers and crew members for personal communication.~~

~~***AIDC application.*** An ATN application dedicated to exchanges between ATS units (ATSUs) of air traffic control (ATC) information in support of flight notification, flight coordination, transfer of control, transfer of communication, transfer of surveillance data and transfer of general data.~~

~~***Air traffic service.*** A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).~~

~~***Application.*** The ultimate use of an information system, as distinguished from the system itself.~~

Application entity (AE). An AE represents a set of ISO/OSI communication capabilities of a particular application process (see ISO/IEC 9545 for further details). ~~Part of an application process that is concerned with communication within the OSI environment. The aspects of an application process that need to be taken into account for the purposes of OSI are represented by one or more AEs.~~

~~***Application information.*** Refers to the application names (e.g. AE qualifiers such as ADS and CPC), version numbers, and addresses (the long or short TSAP, as required) of each application.~~

~~***ATIS application.*** A FIS application that supports the D-ATIS.~~

~~***ATN directory services (DIR)***. A service which provides the capability for an application entity or user in the ATN community to query a distributed directory data base and retrieve addressing, security and technical capabilities information relating to other users or entities within the ATN community.~~

ATN security services. A set of information security provisions allowing the receiving end system or intermediate system to unambiguously identify (i.e. authenticate) the source of the received information and to verify the integrity of that information.

~~***ATN systems management (SM).*** A collection of facilities to control, coordinate and monitor the resources which allow communications to take place in the ATN environment. These facilities include fault management, accounting management, configuration management, performance management and security management.~~

~~***ATSC class.*** The ATSC class parameter enables the ATSC user to specify the quality of service expected for the offered data. The ATSC class value is specified in terms of ATN end-to-end transit delay at 95 per cent probability.~~

~~***ATS communications (ATSC).*** Communication related to air traffic services including air traffic control, aeronautical and meteorological information, position reporting and services related to safety and regularity of flight. This communication involves one or more air traffic service administrations. This term is used for purposes of address administration.~~

ATS interfacility data communication (AIDC). Automated data exchange between air traffic services units in support of flight notification, flight coordination, transfer of control and transfer of communication.~~, particularly in regard to co-ordination and transfer of flights.~~

. . .

~~***ATS unit (ATSU).*** A generic term meaning variously, air traffic control unit, flight information centre or air traffic services reporting office.~~

~~***Authentication***. A process used to ensure the identity of a person/user/network entity.~~

Authorized path. A communication path ~~that the administrator(s) of the routing domain(s) has pre-defined as~~ suitable for a given ~~traffic type and~~ message category.

~~***Automatic dependent surveillance (ADS).*** A surveillance technique in which aircraft automatically provide, via a data link, data derived from on-board navigation and position-fixing systems, including aircraft identification, four-dimensional position, and additional data as appropriate.~~

~~***Automatic terminal information service (ATIS)***. The automatic provision of current, routine information to arriving and departing aircraft throughout 24 hours or a specified portion thereof.~~

~~*Data link-automatic terminal information service (D-ATIS)*. The provision of ATIS via data link.~~

~~*Voice-automatic terminal information service (Voice-ATIS)*. The provision of ATIS by means of continuous and repetitive voice broadcasts.~~

~~***Configuration management.*** An ATN systems management facility for managers to change the configuration of remote elements.~~

~~***Context management (CM) application.*** An ATN application that provides a log-on service allowing initial aircraft introduction into the ATN and a directory of all other data link applications on the aircraft. It also includes functionality to forward addresses between ATS units.~~

~~*Note.— Context management is a recognized OSI presentation layer term. The OSI use and the ATN use have nothing in common.*~~

~~***Context management (CM) server.*** An ATS facility that is capable of providing application information relating to other ATSUs to requesting aircraft or ATSUs.~~

~~***Controller pilot data link communication (CPDLC).*** A means of communication between controller and pilot, using data link for ATC communications.~~

~~***CPDLC application***. An ATN application that provides a means of ATC data communication between controlling, receiving or downstream ATS units and the aircraft, using air-ground and ground-ground subnetworks, and which is consistent with the ICAO phraseology for the current ATC voice communication.~~

~~***Data integrity.*** The probability that data has not been altered or destroyed.~~

Data link initiation capability (DLIC). A data link application that provides the ability to exchange addresses, names and version numbers necessary to initiate data link applications (see Doc 4444).

Directory service (DIR). A service, based on the ITU-T X.500 series of recommendations, providing access to and management of structured information relevant to the operation of the ATN and its users.

~~***D-METAR.*** The symbol used to designate data link aviation weather report service.~~

~~***End system (ES)***. A system that contains the OSI seven layers and contains one or more end user application processes.~~

~~***End-to-end.*** Pertaining or relating to an entire communication path, typically from (1) the interface between the information source and the communication system at the transmitting end to (2) the interface between the communication system and the information user or processor or application at the receiving end.~~

~~***Entity.*** An active element in any layer which can be either a software entity (such as a process) or a hardware entity (such as an intelligent I/O chip).~~

~~***Fault management.*** An ATN systems management facility to detect, isolate and correct problems.~~

~~***FIS application.*** An ATN application that provides to aircraft information and advice useful for the safe and efficient conduct of flights.~~

~~***Flight information service (FIS).*** A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.~~

~~***Inter-centre communications (ICC).*** ICC is data communication between ATS units to support ATS, such as notification, coordination, transfer of control, flight planning, airspace management and air traffic flow management.~~

~~***Intermediate system (IS).*** A system which performs relaying and routing functions and comprises the lowest three layers of the OSI reference model.~~

~~***Internet communications service.*** The internet communications service is an internetwork architecture which allows ground, air-to-ground and avionics data subnetworks to interoperate by adopting common interface services and protocols based on the ISO/OSI reference model.~~

~~***METAR application***. A FIS application that supports the D-METAR.~~

~~***Open systems interconnection (OSI) reference model***. A model providing a standard approach to network design introducing modularity by dividing the complex set of functions into seven more manageable, self-contained, functional layers. By convention these are usually depicted as a vertical stack.~~

~~*Note.— The OSI reference model is defined by ISO/IEC 7498-1.*~~

~~***Performance management.*** An ATN systems management facility to monitor and evaluate the performance of the systems.~~

Required communication performance (RCP). A statement of the performance requirements for operational communication in support of specific ATM functions (see *Manual on Required Communications Performance (RCP)* (Doc 9869)).

~~***Security management.*** An ATN systems management facility for access control, authentication and data integrity.~~

~~***Subnetwork.*** An actual implementation of a data network that employs a homogeneous protocol and addressing plan and is under control of a single authority.~~

~~***System level requirement.*** The system level requirement is a high-level technical requirement that has been derived from operational requirements, technological constraints and regulatory constraints (administrative and institutional). The system level requirements are the basis for the functional requirements and lower-level requirements.~~

~~***Transit delay.*** In packet data systems, the elapsed time between a request to transmit an assembled data packet and an indication at the receiving end that the corresponding packet has been received and is ready to be used or forwarded.~~

~~***Upper layers (UL) communications service.*** A term pertaining to the session, presentation and application layers of the OSI reference model.~~

3.2 INTRODUCTION

~~3.2.1 The aeronautical telecommunication network (ATN) comprises application entities and communication services which allow ground, air-to-ground and avionics data subnetworks to interoperate by adopting common interface services and protocols based on the International Organization for~~

~~Standardization (ISO) open systems interconnection (OSI) reference model. The conceptual model of the ATN is shown in Figure 3-1.*~~

~~3.2.2 The ATN and the associated application processes have been designed in support of the communications, navigation, surveillance and air traffic management (CNS/ATM) systems.~~ The ATN~~:~~

~~a)~~ is specifically and exclusively intended to provide digital data communications services to air traffic service provider organizations and aircraft operating agencies in support of :~~supporting the following types of communications traffic:~~

~~1~~a) air traffic services communications (ATSC) with aircraft;

b) air traffic services communications between ATS units;

~~2~~c) aeronautical operational control communications (AOC); and

~~3~~d) aeronautical administrative communications (AAC).~~; and~~

~~4) aeronautical passenger communication (APC);~~

~~b) provides, in a manner transparent to the user, a reliable end-to-end communications service essential to support the provision of safe and efficient air traffic services, between:~~

~~1) airborne systems and ground systems; and~~

~~2) multiple ground systems;~~

~~c) provides a data communication service which is capable of meeting the security and safety requirements of the users;~~

~~d) is based on internationally recognized data communications standards which will facilitate the development of compliant systems and encourage the competitive provision of network services;~~

~~e) accommodates differing types/categories/classes of service (including preferred/selected air-ground subnetwork) required by the various applications;~~

~~f) defines an architecture that enables the integration of public and private subnetworks, both air-ground and ground-ground. This allows the use of existing/planned infrastructure and network technologies, as well as giving implementors the freedom to scale the network to meet the increasing needs of the users; and~~

~~g) efficiently uses the bandwidth limited air-ground sub-networks and consequently reduces the associated costs.~~

~~3.2.3 The ATN applications presently defined have been developed to provide aeronautical communication, surveillance, and information services. These applications are intended to support the following air traffic management services:~~

~~a) air traffic services (ATS);~~

~~1) air traffic control service;~~

~~2) flight information service (FIS); and~~

~~3) alerting service.~~

~~b) air traffic flow management (ATFM); and~~

~~c) airspace management.~~

~~3.2.4 This chapter contains broad and general provisions for the ATN. The detailed technical provisions are found in Doc 9705. The remainder of this chapter is organized to address the following requirements and functions:~~

~~a) general;~~

~~b) system level requirements;~~

~~c) ATN applications requirements;~~

~~d) ATN communications service requirements;~~

~~e) ATN naming and addressing;~~

~~f) ATN systems management requirements; and~~

~~g) ATN security requirements.~~

3.3 GENERAL

Note — The Standards and Recommended Practices in sections 3.4 to 3.8 below define the minimum required protocols and services that will enable the global implementation of the aeronautical telecommunication network (ATN).

~~3.3.1 The aeronautical telecommunication network (ATN) shall provide data communication services and application entities in support of:~~

~~a) the delivery of air traffic services (ATS) to aircraft;~~

~~b) the exchange of ATS information between ATS units; and~~

~~c) other applications such as aeronautical operational control (AOC) and aeronautical administrative communication (AAC).~~

~~*Note 1. — Provisions have been made to accommodate the exchange of information such as weather, flight plans, notices to airmen and dynamic real time air traffic flow management between aircraft operating agencies' ground-based systems and ATS units.*~~

~~*Note 2.— Provisions have also been made to accommodate aeronautical passenger communication (APC).*~~

~~3.3.2 When the ATN is used in support of air traffic services, it shall conform with the provisions of this chapter.~~

3.3.1 ATN communication services shall support ATN applications.

3.3.~~3~~2 Requirements for implementation ~~use~~ of the ATN shall be made on the basis of regional air navigation agreements. These agreements shall specify the area in which the communication standards for the ATN/OSI or the ATN/IPS are applicable.

~~3.3.4 **Recommendation.—** *Civil aviation authorities should co-ordinate, with national authorities and aeronautical industry, those implementation aspects of the ATN which will permit its world-wide safety, interoperability and efficient use, as appropriate.*~~

3.4 GENERAL ~~SYSTEM LEVEL~~ REQUIREMENTS

~~*Note.— The system level requirements are high-level technical requirements that have been derived from operational requirements, technological constraints and regulatory constraints (administrative and institutional). These system level requirements are the basis for the functional requirements and lower-level requirements.*~~

3.4.1 The ATN shall either use International Organization for Standardization (ISO) communication standards for open systems interconnection (OSI) or use the Internet Society (ISOC) communications standards for the Internet Protocol Suite (IPS).

Note 1.— Interoperability between interconnecting OSI/IPS networks shall be arranged prior to implementation.

Note 2.— Guidance material on interoperability between ATN/OSI and ATN/IPS is contained in the ATN/IPS manual.

~~3.4.2 The ATN shall provide a means to facilitate migration to future versions of application entities and/or the communication services.~~

~~*Note.— It is an objective that the evolution towards future versions facilitates the backward compatibility with previous versions.*~~

3.4.~~3~~2 The AFTN/AMHS gateway shall ensure the interoperability of AFTN and CIDIN stations and networks with the ATN ~~shall enable the transition of existing AFTN/CIDIN users and systems into the ATN architecture~~.

~~*Note.— The transition from the AFTN or from the CIDIN to the ATN is handled by AFTN/AMHS and CIDIN/AMHS gateways respectively, which are defined in Doc 9705, Sub-volume III.*~~

~~3.4.4 The ATN shall make provisions whereby only the controlling ATS unit may provide ATC instructions to aircraft operating in its airspace.~~

~~*Note.— This is achieved through the current and next data authority aspects of the controller-pilot data link communications (CPDLC) application entity.*~~

3.4.~~5~~3 An authorized path(s)~~The ATN~~ shall be defined on the basis of ~~accommodate routing based on~~ a predefined routing policy.

3.4.4 The ATN shall transmit, relay and (or) deliver messages in accordance with the priority classifications and without discrimination or undue delay.

3.4.~~6~~5 The ATN shall provide means to define data communications that can be carried only over authorized paths for the traffic type and category specified by the user.

3.4.~~7~~6 The ATN shall provide communication in accordance with the prescribed required communication performance (RCP) (see *Manual on Required Communications Performance (RCP)* (Doc 9869). ~~offer ATSC classes in accordance with the criteria in Table 3-1.*~~

~~*Note 1.— When an ATSC class is specified by an ATN application, packets will be forwarded in the ATN internet communications service on a best effort basis. Best effort basis means that when a route is available of the requested ATSC class, the packet is forwarded on that route. When no such route is available, the packet will be forwarded on the first known route of the ATSC class higher than that requested, or if there is no such route, first known route of the ATSC class lower than that requested.*~~

~~*Note 2.— The ATN communications service will not inform application entities if the requested ATSC class was not achieved. It is the responsibility of the application entity to determine the actual transit delay achieved by local means such as time stamping.*~~

3.4.~~8~~7 The ATN shall operate in accordance with the communication priorities defined in Table ~~3-2~~ 3-1* and Table ~~3-3~~ 3-2.

3.4.~~9~~8 The ATN shall enable exchange of application information when one or more authorized paths exist.

3.4.~~10~~9 The ATN shall notify the appropriate application processes when no authorized path exists.

~~3.4.11 The ATN shall provide means to unambiguously address all ATN end and intermediate systems.~~

~~3.4.12 The ATN shall enable the recipient of a message to identify the originator of that message.~~

~~3.4.13 The ATN addressing and naming plans shall allow States and organizations to assign addresses and names within their own administrative domains.~~

~~3.4.14 The ATN shall support data communications to fixed and mobile systems.~~

~~3.4.15 The ATN shall accommodate ATN mobile sub-networks as defined in this Annex.~~

3.4.~~16~~10 The ATN shall make provisions for the efficient use of limited bandwidth subnetworks.

* ~~All tables are located at the end of this chapter.~~ Tables 3-1 and 3-2 are located at the end of this chapter.

3.4.~~17~~11 **Recommendation.** *The ATN ~~shall~~ should enable an aircraft intermediate system (router) to ~~be connected~~ connect to a ground intermediate system (router) via different ~~concurrent mobile~~ subnetworks.*

3.4.~~18~~12 **Recommendation.** *The ATN ~~shall~~ should enable an aircraft intermediate system (router) to ~~be connected~~ connect to different ~~multiple~~ ground intermediate systems (routers).*

3.4.~~19~~13 The ATN shall enable the exchange of address information between ~~application~~ applications ~~entities~~.

~~3.4.20 The ATN shall support the context management (CM) application when any of the other air-ground applications are supported.~~

~~3.4.21 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the context management (CM) application.~~

~~3.4.22 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the automatic dependent surveillance (ADS) application.~~

~~3.4.23 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the controller-pilot data link communications (CPDLC) application.~~

~~3.4.24 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the automatic terminal information service (ATIS) application.~~

~~3.4.25 The ATN shall be capable of establishing, maintaining, releasing and aborting application associations for the ATS message handling service (ATSMHS) application.~~

~~3.4.26 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the ATS interfacility data communication (AIDC) application.~~

3.4.~~27~~14 Where the absolute time of day is used within the ATN, it shall be accurate to within 1 second of coordinated universal time (UTC).

Note.— The ~~A~~ time accuracy value ~~may result~~ results in synchronization errors of up to two seconds. ~~times the stated accuracy value~~.

~~3.4.28 The end system shall make provisions to ensure that the probability of not detecting a 255-octet message being mis- delivered, non-delivered or corrupted by the internet communication service is less than or equal to 10^{-8} per message.~~

~~*Note.— It is assumed that ATN subnetworks will ensure data integrity consistent with this system level requirement.*~~

~~3.4.29 ATN end systems supporting ATN security services shall be capable of authenticating the identity of peer end systems, authenticating the source of application messages and ensuring the data integrity of the application messages.~~

~~*Note.— Application messages in this context include messages related to ATS, systems management and directory services.*~~

~~3.4.30 ATN ground and air-ground boundary intermediate systems supporting ATN security services shall be capable of authenticating the identity of peer boundary intermediate systems, authenticating the source of routing information and ensuring the data integrity of routing information.~~

~~3.4.31 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the exchange of directory information.~~

~~3.4.32 ATN systems supporting ATN systems management shall facilitate enhanced continuity of ATN operations, including the monitoring and maintenance of the quality of the communications service.~~

~~3.4.33 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the systems management (SM) application.~~

~~3.4.34 The ATN shall be capable of establishing, maintaining, releasing and aborting peer-to-peer application associations for the aviation routine weather report service (METAR) application.~~

3.5 ATN APPLICATIONS REQUIREMENTS

~~*Note 1. Implementation of ATN application(s) within a State or region does not imply implementation of all of the ATN applications defined below.*~~

~~*Note 2. The implementation of pre-defined subsets of the ATN application technical provisions are allowed as detailed in Doc 9705.*~~

3.5.1 System applications

Note.— System applications provide services that are necessary for operation of the ATN ~~*air-ground applications, ground- ground applications and/or ATN communication services*~~*.*

3.5.1.1 The ATN shall support the data link initiation capability (DLIC) applications as contained in the *Manual on Air Traffic Services Data Link Applications* (Doc 9694, Part I) when air-ground data links are implemented.

~~3.5.1.1 CONTEXT MANAGEMENT (CM) APPLICATION~~

~~*Note. The CM application provides the capability for an aircraft to log on with an ATS ground system; in some instances the ground system will request the aircraft to contact a specific ground system. Once an appropriate connection is established, CM provides for the exchange of information on each supported ATN application including the network address of each, as appropriate. For ATN systems supporting security services, CM also obtains and exchanges key and key usage information. CM also provides the capability to update log-on information and the capability for an ATS ground system to forward log-on information to another ATS ground system. The registration function of the CM allows the sharing of information with other applications on the ground or on the aircraft.*~~

~~3.5.1.1.1 The ATN shall be capable of supporting the following CM application functions:~~

~~a) log-on;~~

~~b) contact;~~

~~c) update;~~

~~d) CM server query;~~

~~e) CM server update;~~

~~f) ground forwarding; and~~

~~g) registration.~~

~~*Note.— The technical provisions for the CM application are defined in Doc 9705, Sub-volume II.*~~

~~3.5.1.2 ATN DIRECTORY SERVICES (DIR)~~

3.5.1.2~~.1~~ The ATN/OSI end-system shall ~~be capable of supporting~~ support the following directory services (DIR) application functions when AMHS and/or security protocols are implemented (see ITU-T X.500 series):

~~a) directory bind;~~

~~b~~a) directory information retrieval; and

~~c~~b) directory information modification ~~change~~.

~~*Note 1.— The ATN Directory Service provides a capability for an application or user to query a distributed directory data base and to retrieve addressing, security and technical capabilities information. Directory Service provides a capability to special, authorized users to add, delete and modify parts of the directory data base for which they are responsible. The Directory Service is offered over the ATN to all applications and users complying with the technical provisions of Doc 9705, Sub-volume VII .*~~

~~*Note 2.— Directory bind is the function of establishing an association between two directory components that support other directory functions. Directory bind sets up the application contexts and underlying communications connections for use in other directory functions.*~~

~~3.5.1.3 OTHER SYSTEM APPLICATIONS~~

~~(to be developed)~~

3.5.2 Air-ground applications

~~*Note.— The ground components of air-ground applications include functionality to support the forwarding of the contents of air-to-ground messages along ground-ground communications paths.*~~

~~3.5.2.1 AUTOMATIC DEPENDENT SURVEILLANCE (ADS) APPLICATION~~

~~*Note.— The ADS application comprises an airborne and ground component. The airborne ADS application component is capable of automatically providing, via the ATN communications service, to the ground component data derived from on-board navigation systems (e.g. aircraft identification, four-dimensional position, intent, and additional data as appropriate). The ADS application provides service based on contracts established between its air and ground components (i.e. demand contract, periodic contract, event contract and emergency contract) and between two ADS ground components (i.e. forward contract).*~~

3.5.2.1~~.1~~ The ATN shall be capable of supporting one or more of the following ~~ADS application~~ applications, in accordance with the provisions of Doc 9694 ~~functions~~:

a) ~~demand contracts~~ADS-C;

b) ~~periodic contracts~~CPDLC; and

c) ~~event contracts~~FIS (including ATIS and METAR).~~;~~

d) ~~emergency contracts; and~~

~~e) forward contracts.~~

~~*Note.— The technical provisions for the ADS application are defined in Doc 9705*, *Sub-volume II.*~~

~~3.5.2.2 CONTROLLER-PILOT DATA LINK COMMUNICATIONS (CPDLC) APPLICATION~~

~~*Note.— The CPDLC application, comprising an airborne and ground component, provides capability for data link communications between ATS units and aircraft under their control and/or aircraft about to come under their control. The CPDLC application has the capability to establish, manage, and terminate CPDLC dialogues for controller-pilot message exchange and for ground message forwarding.*~~

~~3.5.2.2.1 The ATN shall be capable of supporting the following CPDLC application functions:~~

~~a) controller-pilot message exchange;~~

~~b) transfer of data authority;~~

~~c) downstream clearance; and~~

~~d) ground forward.~~

~~*Note.— The technical provisions for the CPDLC application are defined in Doc 9880,* Manual on Detailed Technical Specifications for the Aeronautical Telecommunication Network (ATN).~~

~~3.5.2.3 FLIGHT INFORMATION SERVICE (FIS) APPLICATIONS~~

~~*Note.— FIS applications provide flight information services to airspace users from ground FIS systems.*~~

~~3.5.2.3.1 *AUTOMATIC TERMINAL INFORMATION SERVICE (ATIS) APPLICATION*~~

~~3.5.2.3.1.1 The ATN shall be capable of supporting the following ATIS application functions:~~

~~a) aircraft-initiated FIS demand contracts;~~

~~b) aircraft-initiated FIS update contracts; and~~

~~c) both an aircraft- and ground-initiated FIS cancellation of contracts.~~

~~*Note.— The technical provisions for the ATIS application are defined in Doc 9705, Sub-volume II.*~~

~~3.5.2.3.2 *AVIATION ROUTINE WEATHER REPORT SERVICE (METAR) APPLICATION*~~

~~3.5.2.3.2.1 The ATN shall be capable of supporting the METAR application function for aircraft-initiated FIS demand contracts.~~

~~*Note.— The technical provisions for the METAR application are defined in Doc 9705, Sub-volume II.*~~

~~3.5.2.3.3 *OTHER FIS APPLICATIONS*~~

~~(to be developed)~~

~~3.5.2.4 OTHER AIR-GROUND APPLICATIONS~~

~~(to be developed)~~

3.5.3 Ground-ground applications

~~*Note.— Ground-ground applications are defined as those ATN applications resident in ground-based systems which solely exchange information with peer applications also resident in ground-based systems.*~~

~~3.5.3.1 INTER-CENTRE COMMUNICATIONS (ICC)~~

~~*Note.— The inter-centre communications applications set enables the exchange of information between air traffic service units.*~~

~~3.5.3.1.1 *ATS INTERFACILITY DATA COMMUNICATION (AIDC)*~~

~~*Note.— AIDC is an ATN application that is used by two air traffic service units to enable the exchange of ATS information for active flights related to flight notification, flight coordination, transfer of control, surveillance data and free (i.e. unstructured) text data.*~~

3.5.3.1~~.1.1~~ The ATN shall be capable of supporting the following ~~AIDC application~~ applications: ~~functions:~~

a) ATS interfacility data communication (AIDC), as contained in Doc 9694; and

b) ATS message handling services applications (ATSMHS).

~~a) flight notification;~~

~~b) flight coordination;~~

~~c) transfer of control;~~

~~d) transfer of communications;~~

~~e) transfer of surveillance data; and~~

~~f) transfer of general data.~~

~~*Note.— The technical provisions for the AIDC application are defined in Doc 9705, Sub-volume III.*~~

~~3.5.3.2 ATS MESSAGE HANDLING SERVICE (ATSMHS) APPLICATION~~

~~*Note.— The ATS message handling service (ATSMHS) application enables ATS messages to be exchanged between service users through the provision of generic message services. The ATSMHS application includes the definition of AFTN/ATN and CIDIN/ATN gateways.*~~

~~3.5.3.2.1 The ATN shall be capable of supporting the ATS message handling service application (ATSMHS).~~

~~*Note.— The technical provisions for the ATSMHS application are defined in Doc 9705, Sub-volume III.*~~

~~3.5.3.3 OTHER GROUND-GROUND APPLICATIONS~~

~~(to be developed)~~

3.6 ATN COMMUNICATIONS SERVICE REQUIREMENTS

~~*Note.— The ATN communication service requirements define the requirements for layers 3 through 6, as well as part of layer 7, of the OSI reference model. These services take information produced by one of*~~

~~*the individual ATN applications and perform the end-to-end communication service using standard protocols. These communication service requirements are divided into two parts. The upper layer communications service defines the standards for layers 5 through 7. The Internet communications service defines standards for layers 3 and 4. The requirements for layers 1 and 2 are outside the scope of ATN SARPs.*~~

~~3.6.1 Upper layer communications service~~

~~3.6.1.1 The upper layer communications service shall include the:~~

~~a) session layer;~~

~~b) presentation layer;~~

~~c) application entity structure;~~

~~d) association control service element (ACSE);~~

~~e) security application service object (ASO), for ATN systems supporting security services; and~~

~~f) control function (CF).~~

~~*Note 1. The technical provisions for the upper layer communications service for all ATN applications, except the ATS message service function of the ATSMHS application, are defined in Doc 9705, Sub-volume IV.*~~

~~*Note 2. The technical provisions for the upper layer communications service for the ATS message service function of the ATSMHS application are defined in Doc 9705, Sub-volume III.*~~

3.6.1 ATN/IPS upper layer communications service

3.6.1.1 An ATN host* shall be capable of supporting the ATN/IPS upper layers including an application layer.

3.6.2 ATN/OSI upper layer communications service

3.6.2.1 An ATN/OSI end-system (ES)* shall be capable of supporting the OSI upper layer communications service (ULCS) including session, presentation and application layers.

3.6.3 ATN/IPS communications service

3.6.3.1 An ATN host shall be capable of supporting the ATN/IPS including the:

* An ATN host is an ATN end-system in OSI terminology; an ATN end-system is an ATN host in IPS terminology.

a) transport layer in accordance with RFC 793 (TCP) and RFC 768 (UDP); and

b) network layer in accordance with RFC 2460 (IPv6).

3.6.3.2 An IPS router shall support the ATN network layer in accordance with RFC 2460 (IPv6) and RFC 4271 (BGP), and RFC 2858 (BGP multiprotocol extensions).

3.6.~~2~~4 ATN/OSI ~~Internet~~ communications service

~~*Note.- The ATN Internet communications service requirements are applicable to the end system and intermediate system functional entities which together provide the ATN Internet communications service. The ATN Internet communications service is provided to its user (i.e. the upperlayers) via the transport layer service interface.*~~

3.6.~~2.~~4.1 An ATN/OSI end-system ~~(ES)~~ shall be capable of supporting the ATN ~~Internet~~ including the:

a) transport layer in accordance with ISO/IEC 8073 (TP4) and optionally ISO/IEC 8602 (CLTP); and

b) network layer in accordance with ISO/IEC 8473 (CLNP).

3.6.~~2.~~4.2 An ATN intermediate system (IS) shall support the ATN network layer in accordance with ISO/IEC 8473 (CLNP) and ISO/IEC 10747 (IDRP).~~provisions as appropriate to the class of ATN is under consideration.~~

~~*Note — A number of different classes of ATN intermediate systems for which network layer profiles are defined are contained in Doc. 9705, Sub-volume V.*~~

3.7 ATN NAMING AND ADDRESSING REQUIREMENTS

Note.— The ATN naming and addressing scheme supports the principles of unambiguous identification of intermediate systems (routers) and end systems (hosts) ~~information objects~~ and provides global address standardization.

3.7.1 The ATN shall provide provisions for unambiguous application identification. ~~entity naming~~.

3.7.2 The ATN shall provide provisions for unambiguous ~~network and transport~~ addressing.

~~*Note. — The technical provisions for ATN application entity naming are defined in Doc 9705, Sub-volume IV, the provisions for network and transport addressing are defined in Sub-volume V, and the provisions for registration services are defined in Sub-volume IX of the same document.*~~

3.~~4.11~~7.3 The ATN shall provide means to unambiguously address all ATN end-systems (hosts) and intermediate systems (routers).

3.~~4.13~~7.4 The ATN addressing and naming plans shall allow States and organizations to assign addresses and names within their own administrative domains.

~~3.8 ATN SYSTEMS MANAGEMENT REQUIREMENTS~~

~~*Note 1.— The ATN systems management (SM) application provides the capability for an SM manager to exchange information with an SM agent and/or another SM manager.*~~

~~*Note 2.— Support for the ATN SM services technical provisions may be required on a State or regional basis.*~~

~~3.8.1 The ATN shall be capable of supporting the following systems management application functions:~~

~~a) fault management;~~

~~b) configuration management;~~

~~c) accounting management;~~

~~d) performance management; and~~

~~e) security management.~~

~~*Note.— The technical provisions for ATN Systems Management are defined in Doc 9705, Sub-volume VI.*~~

~~3.8.1.1 ATN end systems and intermediate systems that support the ATN systems management application and SM managers shall support access to managed objects.~~

~~*Note.— The SM application managed object definitions and access provisions are defined in Doc 9705, Sub-volume VI.*~~

3.~~9~~8 ATN SECURITY REQUIREMENTS

3.~~4.4~~8.1 The ATN shall make provisions whereby only the controlling ATS unit may provide ATC instructions to aircraft operating in its airspace.

Note.— This is achieved through the current and next data authority aspects of the controller-pilot data link communications (CPDLC) application ~~entity~~.

3.~~4.12~~8.2 The ATN shall enable the recipient of a message to identify the originator of that message.

3.~~4.29~~8.3 ATN end-systems supporting ATN security services shall be capable of authenticating the identity of peer end-systems, authenticating the source of ~~application~~ messages and ensuring the data integrity of the ~~application~~ messages.

~~3.9.1 The security of the ATN shall be achieved based on a combination of technical provisions, local physical security measures, and procedural security measures.~~

~~*Note 1.— The technical provisions for ATN security are defined in Doc 9705, and the physical and procedural security measures are defined in Annex 17 and the Security Manual.*~~

~~*Note 2.— Support for the ATN security services technical provisions may be required on a State or regional basis.*~~

~~3.9.1.1~~ **~~Recommendation.—~~** ~~*The following physical and procedural techniques should be used to provide security for ATN end systems, intermediate systems, network managers, directory servers and subnetworks:*~~

~~*a) restricted physical access to ATN end systems, intermediate systems, SM workstations, directory servers and subnetwork switches, network managers, and other essential network sub-systems;*~~

~~*b) restricted user access to ATN end systems, intermediate systems, directory servers and SM workstations to only authorized personnel; and*~~

~~*c) non-use, or restricted use, of remote access to ATN ground end system, intermediate systems and SM workstations.*~~

~~3.9.2 ATN security policy~~

~~*Note.— Communication monitoring and third party traffic analysis do not constitute safety hazards and are not considered security threats for the ATSC. However, some ATS and/or non-ATS users and applications may have local, or organizational, policies wherein communication monitoring and third party traffic analysis would be considered security threats based on other concerns, such as economic considerations.*~~

~~3.9.2.1 ATS messages shall be protected from masquerade, modification and replay.~~

~~*Note 1.— This means that for data messages exchanged among ATN entities there will be a high level of assurance that a message comes from where it claims, has not been tampered with, and is not a repeat of an obsolete message.*~~

~~*Note 2.— The level of protection may vary by the type of security threat and by the level of ATN security service selected by the user or application process.*~~

~~3.9.2.2 A request for protection of ATS messages shall be honoured.~~

Note.— ~~*A request for non-use of protection may be honoured. This means that the*~~ *The use of security is the default however its implementation* ~~*and negotiation to non-use*~~ *is based on local policy.*

3.~~9.2.3~~8.4 The ATN services ~~that support messages to and from the aircraft~~ shall be protected against ~~denial of~~ service attacks to a level ~~of probability~~ consistent with the ~~required~~ application service requirements~~availability as determined by local policies~~.

~~*Note 1.— The term "denial of service" describes a condition where legitimate access to information or other ATN resources is deliberately impeded.*~~

~~*Note 2.— This may mean having alternative communications paths available in case one path is subject to denial of service.*~~

TABLES FOR CHAPTER 3

~~Table 3-1. Transit delays for ATSC Classes~~

~~*Maximum one-way ATN* end-to-end transit delay at 95% probability (seconds)~~	~~ATSC Class~~
~~Reserved~~	~~A~~
~~4.5~~	~~B~~
~~7.2~~	~~C~~
~~13.5~~	~~D~~
~~18~~	~~E~~
~~27~~	~~F~~
~~50~~	~~G~~
~~100~~	~~H~~
~~No value specified~~	~~no preference~~

~~*Note 1. The value for the ATN end-to-end transit delay represents approximately 90% of the value for the total end-to-end transit delay between the ultimate users of the system.*~~

~~*Note 2. The 95% probability is based on the availability of a route conforming to the requested ATSC class.*~~

Table 3-~~2~~1. Mapping of ATN communication priorities

Message categories	*ATN application*	*Corresponding protocol priority*	
		Transport layer priority	*Network layer priority*
Network/systems management	~~SM~~	0	14
Distress communications		1	13
Urgent communications		2	12
High-priority flight safety messages	CPDLC, ~~ADS~~ ADS-C	3	11
Normal-priority flight safety messages	AIDC, ATIS	4	10
Meteorological communications	METAR	5	9
Flight regularity communications	~~CM~~ DLIC, ATSMHS	6	8
Aeronautical information service messages		7	7
Network/systems administration	~~SM,~~ DIR	8	6
Aeronautical administrative messages		9	5
<unassigned>		10	4
Urgent-priority administrative and U.N. Charter communications		11	3
High-priority administrative and State/Government communications		12	2
Normal priority administrative communications		13	1
Low priority administrative communications and aeronautical passenger communications		14	0

Note.— The network layer priorities shown in the table apply only to connectionless network priority and do not apply to subnetwork priority.

Table 3-~~3~~2. Mapping of ATN network priority to mobile subnetwork priority

		Corresponding mobile subnetwork priority (see Note 4)					
Message categories	*ATN network* layer priority	AMSS	VDL Mode 2	VDL Mode 3	VDL Mode 4 ~~(see Note 5)~~	SSR Mode S	HFDL
Network/systems management	14	14	see Note 1	3	~~high~~14	high	14
Distress communications	13	14	see Note 1	2	~~high~~13	high	14
Urgent communications	12	14	see Note 1	2	~~high~~12	high	14
High-priority flight safety messages	11	11	see Note 1	2	~~high~~11	high	11
Normal-priority flight safety messages	10	11	see Note 1	2	~~high~~10	high	11
Meteorological communications	9	8	see Note 1	1	~~medium~~9	low	8
Flight regularity communications	8	7	see Note 1	1	~~medium~~8	low	7
Aeronautical information service messages	7	6	see Note 1	0	~~medium~~7	low	6
Network/systems administration	6	5	see Note 1	0	~~medium~~6	low	5
Aeronautical administrative messages	5	5	not allowed	not allowed	not allowed	not allowed	not allowed
<unassigned>	4	unassigned	unassigned	unassigned	unassigned	unassigned	unassigned
Urgent-priority administrative and U.N. Charter communications	3	3	not allowed	not allowed	not allowed	not allowed	not allowed
High-priority administrative and State/Government communications	2	2	not allowed	not allowed	not allowed	not allowed	not allowed
Normal-priority administrative communications	1	1	not allowed	not allowed	not allowed	not allowed	not allowed
Low-priority administrative communications and aeronautical passenger communications	0	0	not allowed	not allowed	not allowed	not allowed	not allowed

Note 1.— VDL Mode 2 has no specific subnetwork priority mechanisms.

Note 2.— The AMSS SARPs specify mapping of message categories to subnetwork priority without explicitly referencing ATN network layer priority.

Note 3.— The term "not allowed" means that only communications related to safety and regularity of flight are authorized to pass over this subnetwork as defined in the subnetwork SARPs.

Note 4.— Only those mobile subnetworks are listed for which subnetwork SARPs exist and for which explicit support is provided by the ATN boundary intermediate system (BIS) technical provisions.

~~Note 5.— The VDL Mode 4 subnetwork provides support for surveillance applications (e.g. ADS).~~

. . .

PART II — VOICE COMMUNICATION SYSTEMS

. . .

CHAPTER 2. AERONAUTICAL MOBILE SERVICE

. . .

2.2 SYSTEM CHARACTERISTICS OF THE GROUND INSTALLATION

2.2.1 Transmitting function

2.2.1.1 *Frequency stability.* The radio frequency of operation shall not vary more than plus or minus 0.005 per cent from the assigned frequency. Where 25 kHz channel spacing is introduced in accordance with Volume V, the radio frequency of operation shall not vary more than plus or minus 0.002 per cent from the assigned frequency. Where 8.33 kHz channel spacing is introduced in accordance with Volume V, the radio frequency of operation shall not vary more than plus or minus 0.0001 per cent from the assigned frequency.

Note.— The above frequency stability requirements ~~tolerances~~ will not be ~~suitable~~ sufficient for offset carrier systems using 25 kHz channel spacing or higher.

2.2.1.1.1 Offset carrier systems in 8.33 kHz, 25 kHz, 50 kHz and 100 kHz channel spaced environments. The stability of individual carriers of an offset carrier system shall be such as to prevent first-order heterodyne frequencies of less than 4 kHz and, additionally, the maximum frequency excursion of the outer carrier frequencies from the assigned carrier frequency shall not exceed 8 kHz. Offset carrier systems for 8.33 kHz channel spacing shall be limited to two-carrier systems using a carrier offset of plus and minus 2.5 kHz.~~shall not be used on 8.33 kHz spaced channels.~~

Note.— Examples of the required stability of the individual carriers of offset carrier systems may be found at Attachment A to Part II.

. . .

2.3 SYSTEM CHARACTERISTICS OF THE AIRBORNE INSTALLATION

. . .

2.3.2.2 SENSITIVITY

. . .

2.3.2.4 *Effective acceptance bandwidth for 8.33 kHz channel spacing receiving installations*. When tuned to a channel designated in Volume V, as having a width of 8.33 kHz, the receiving function shall

~~provide an adequate audio output when the signal specified at 2.3.2.2 above has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency. Further information on the effective acceptance bandwidth is contained in the Attachment to Part II.~~ensure an effective acceptance bandwidth as follows:

a) in areas where offset carrier systems are employed, the receiving function shall provide an adequate audio output when the signal specified in 2.3.2.2 has a carrier frequency of plus or minus 2.5 kHz of the assigned frequency; and

b) in areas where offset carrier systems are not employed, the receiving function shall provide an adequate audio output when the signal specified in 2.3.2.2 has a carrier frequency within plus or minus 0.0005 per cent of the assigned frequency. Further information on the effective acceptance bandwidth is contained in Part II, Attachment A.

Note 1.— The effective acceptance bandwidth includes Doppler shift.

Note 2.— When using offset carrier systems (ref. 2.3.2.3 and 2.3.2.4), receiver performance may become degraded when receiving two or more similar strength offset carrier signals. Caution is therefore advised with the implementation of offset carrier systems.

. . .

2.3.2.7 **Recommendation.—** *In the case of receivers complying with 2.3.2.3 or 2.3.2.4 used in areas where offset carrier systems are in force, the characteristics of the receiver should be such that:*

a) the audio frequency response precludes harmful levels of audio heterodynes resulting from the reception of two or more offset carrier frequencies;

b) the receiver muting circuits, if provided, operate satisfactorily in the presence of audio heterodynes resulting from the reception of two or more offset carrier frequencies.

. . .

ATTACHMENT TO PART II. GUIDANCE MATERIAL FOR COMMUNICATION SYSTEMS

. . .

1.2 Offset carrier system in 25 kHz, 50 kHz and 100 kHz spaced channels

. . .

— — — — — — — —