International Civil Aviation Organization

EIGHTH MEETING OF SPECTRUM REVIEW WORKING GROUP (SRWG/8)

Bangkok, Thailand, 05 – 07 March 2024

Agenda Item 8: Review the Regional Guidance Material

PROPOSED REVISIONS TO ASIA/PACIFIC REGIONAL AERONAUTICAL RADIO FREQUENCY MANAGEMENT GUIDANCE MATERIAL

(Presented by China)

SUMMARY

This paper presents proposed revisions to the Asia/Pacific Regional Aeronautical Radio Frequency Management Guidance Material.

Two versions of the Guidance Material are enclosed:
- Version in Tracking Mode (Appendix A)
- Clean Version where changes, and editorial modifications are removed (Appendix B)

1. INTRODUCTION

1.1 SRWG/4 considered the development of the regional guidance material on aeronautical frequency spectrum management in a shared way by States.

1.2 The first, second and third draft of Asia Pacific Regional Aeronautical Radio Frequency Management Guidance Material was submitted from the fifth to seventh meeting of SRWG. Information on the objective, scope, institutional framework, spectrum management and procedure of APAC region, air-ground communication and radio navigation aid frequency management has been progressively added to the Guidance Material.

1.3 A State Letter Ref.: T 8/8.9 – AP035/23 (CNS) was circulated on 22 February, 2023, to invite States/Administrations to review the Asia Pacific Regional Aeronautical Radio Frequency Management Guidance Material Edition 1.0. And three (3) replies were received without substantial comments.

1.4 The Twenty Seventh Meeting of the Communications, Navigation and Surveillance Sub-group (CNS SG/27) of Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) adopted the following Conclusion:

Conclusion CNS SG/27/05 - Asia Pacific Regional Aeronautical Radio Frequency Management Guidance Material Edition 1.0

1.5 It was agreed that the Asia Pacific Regional Aeronautical Radio Frequency Management Guidance Material will be updated further if any comments/observations were received from Member States.

2. DISCUSSION

2.1. An internal Aeronautical Spectrum Seminar initiated from China, was held in Chengdu，China, from July 4 to 12, 2023, and Mr. Robert Witzen was invited to attend in. The seminar undertook a detailed review of the Guidance Material. Most of the proposed modifications from the seminar were of an editorial nature serving the purpose to improve the consistency of this Guidance Material with other ICAO documents. Particular attention was given to VDL reduced channel spacing, backup frequencies, TIBA, and GBAS/VDB frequency assignment planning. According to the outcome of the seminar, in addition to the editorial amendments, the Guidance Material is modified as follows:

2.1.1. Change the document name to *Asia/Pacific Regional Frequency Management Manual* from *Asia/Pacific Regional Aeronautical Radio Frequency Management Guidance Material*, to improve consistency with other regional management documents.

2.1.2. Insert an article in 1.1.6.1 which is Regions and States may supplement the material in Doc 9718 or use different frequency assignment planning criteria to meet regional requirements. Because the material in Doc 9718 may not meets the specific requirements for each Region. This allows for the APAC Frequency Management Manual to add or differ from the material in Doc 9718 and thus adds flexibility for Regions and States in frequency assignments planning.

2.1.3. Insert an article in 3.2.14.6 to supply the VDL frequency assignment planning criteria, which is VDL services can be deployed on channels separated by 25 kHz subject to sufficient distance separation between transmit and receive antennas of such services on the ground, which is estimated up to about 3 NM

2.1.4. Add the guidance on the implementation and usage of backup frequencies in 3.2.15.

2.2. Based on the TIBA survey results obtained through the ICAO APAC State Letter Ref.: T 8/8.6 – AP066/23(CNS), it is suggested that:

2.2.1. Reserving 128.950 MHz for TIBA in the APAC region, although States/administrations may also re-allot this frequency to other services according to their own needs. However, any assignment for 128.950 MHz to other services should not impact the airspace which have allotted or plan to allot 128.950 MHz to TIBA. and

2.2.2. Insert an article in 3.2.3 about TIBA usage in Chapter 3 of the Frequency Guidance Material (Management Manual), and list the States/Administrations which have allotted or plan to allot 128.950 MHz to TIBA in Appendix C.

2.3. The Navigation Systems Panel (NSP) Joint Working Groups considered the proposed modifications to the ICAO Spectrum Handbook, Volume II, Chapter 6 on GBAS/VDB frequency assignment planning, and approved them for submission to FSMP for review and inclusion in the next edition of Doc 9718, Volume II. FSMP/18 (6 - 16 February 2024) agreed to create an action (ACTION ITEM 18-08) to provide comments to the NSP on the proposed changes if feasible, or if not, provide them to the FSMP/19 meeting.

2.4. Based on the proposed changes to DOC 9718, Volume II on GBAS frequency assignment planning, the proposed modifications in Management Manual are:

2.4.1. Clarifications and corrections of the DOC for the GBAS/VDB;

2.4.2. Optional use of the Airborne Contribution Factor (ACF) in frequency assignment planning;

2.4.3. Add missing data of Table 4.10 *on the Co- and adjacent channel protection requirements for GBAS/VDB receivers*; and

2.4.4. Reserving the minimum separation distances between the edge of coverage (DOC) of a desired GBAS/VDB facility and the location of an undesired VOR or Localizer only in Table 4.12, where ACF is not taken into account.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper and the **Appendices**;

b) review and adopt the proposed modifications as shown in the **Appendices** to this paper for inclusion in the next edition of the Guidance Material (Management Manual);

c) encourage States/Administrations to provide more comments/observations for the Management Manual; and

d) discuss any relevant matter as appropriate.

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~~Asia/Pacific Regional Aeronautical Radio Frequency Management Guidance Material~~

Asia/Pacific Regional Frequency Management Manual

Edition 1.1~~0~~

International Civil Aviation Organization

AMENDMENTS

Amendments are announced in the supplements to the *Publications Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS, CORRIGENDA AND ADDENDA

AMENDMENTS			CORRIGENDA / ADDENDA		
No.	Date	Entered by	No.	Date	Entered by
1.1	**TBD**	**ICAO APAC Regional office**			

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ABBREVIATIONS

~~**AOC** Aeronautical operational control~~
~~**AM(R)S** Aeronautical Mobile (Route) Service~~
~~**ANSP** Air Navigation Service Provider~~
~~**ARNS** Aeronautical Radionavigation Service~~
~~**ATC** Air Traffic Control~~
~~**CAA** Civil Aviation Authority/Administration~~
~~**CNS** Communications, Navigation and Surveillance~~
~~**DME** Distance Measuring Equipment~~
~~**DOC** Designated Operational Coverage~~
~~**EIRP or e.i.r.p** Equivalent Isotropically Radiated Power or Effective Isotropic Radiated Power~~
~~**FSMP** Frequency Spectrum Management Panel (successor of ACP WG/F (frequency))~~
~~**GBAS** Ground-Based Augmentation System~~
~~**HF** High Frequency~~
~~**ICAO** International Civil Aviation Organization~~
~~**ILS** Instrument Landing System~~
~~**ITU** International Telecommunication Union~~
~~**ITU-R** ITU Radiocommunication Sector~~
~~**MIFR** Master International Frequency Register (ITU)~~
~~**NDB** Non-directional radio Beacon~~
~~**PAR** Precision Approach Radar~~
~~**RR** Radio Regulations (ITU)~~
~~**SARPs** Standards and Recommended Practices~~
~~**TIBA** Traffic Information Broadcasts by Aircraft~~
~~**VDB** VHF Data Broadcast (used with GBAS)~~
~~**VDL** VHF Digital Link~~
~~**VHF** Very High Frequency~~
~~**VOLMET** Meteorological Information for aircraft in flight~~
~~**VOR** VHF Omnidirectional Radio Range~~

AAC Aeronautical Administrative Communications
ACC Area Control Centre
ADF Automatic Direction Finder
AFIS Aerodrome Flight Information Service
AM(R)S Aeronautical Mobile (Route) Service
ANP Air Navigation Plan (for APAC)
ANSP Air Navigation Service Provider
AOC Aeronautical Operational Control
APAC Asia and Pacific
APANPIRG Asia/Pacific Air Navigation Planning and Implementation Regional Group
APP Approach Control Service
ARNS Aeronautical Radionavigation Service
AS Aerodrome Surface Communications
ATC Air Traffic Control
ATIS Automatic Terminal Information Service
ATS Air Traffic Service
CAA Civil Aviation Authority/Administration
CNS Communications, Navigation and Surveillance
COM Communications
CPM Conference Preparatory Meetings (ITU)
CSC Common Signaling Channel
D/U Wanted/ Unwanted Signal Ratio
DME Distance Measuring Equipment

DOC	Designated Operational Coverage
DOH	Designated Operational Height
DOR	Designated Operational Range
DVOR	Doppler VHF Omni-Directional Range
EIRP or e.i.r.p	Equivalent Isotopically Radiated Power or Effective Isotropic Radiated Power
FIS	Flight Information Service
FSMP	Frequency Spectrum Management Panel (successor of ACP WG/F (frequency))
GBAS	Ground-Based Augmentation System
GPIP	Glide Path Intersection Point
HF	High Frequency
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
ILS	Instrument Landing System
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
LTP	Landing Threshold Point
MIFR	Master International Frequency Register (ITU)
MOPS	Minimum Operational Performance Standards
NDB	Non-directional Radio Beacon
NSP	Navigation Systems Panel (ICAO)
PAR	Precision Approach Radar
PIRGs	Planning and Implementation Groups
RR	Radio Regulations (ITU)
SARPs	Standards and Recommended Practices
SRWG	the Spectrum Review Working Group of APANPIRG
SST	The Supersonic Transport
TIBA	Traffic Information Broadcasts by Aircraft
TRD	True Radiation Direction
TWR	Aerodrome Control Tower
VDB	VHF Data Broadcast (used with GBAS)
VDL	VHF Digital Link
VHF	Very High Frequency
VOLMET	Meteorological Information for Aircraft in Flight
VOR	VHF Omnidirectional Radio Range
WRC	World Radiocommunication Conference (ITU)

Chapter 1

INTRODUCTION

This manual ~~guidance material~~ has been developed under a recommendation from the fourth meeting of the Spectrum Review Working Group (SRWG/4) of APANPIRG which was held via video conferencing from 09 to 10 June 2020. It is for States/Administrations in the APAC region to implement the frequency assignments in a coordinated manner with ANSP, CAA and national frequency Authorities to satisfy future operational needs or the introduction of new technologies, with emphasis on communication and navigation systems. ~~(SRWG-4 Final report)~~

1.1 OBJECTIVE and SCOPE

1.1.1 Aeronautical services are recognized internationally to be prime users of radio frequencies. ~~[DOC9718, Vol 1,1.2]~~ The civil aviation community must accordingly develop and present, as necessary, its agreed policies and its quantified and qualified statements of requirement for radio frequency spectrum to ensure the continuing availability of adequate radio spectrum and, ultimately, the ongoing viability of air navigation services throughout the world. ~~[DOC9718, Vol 1,1.4]~~

1.1.2 For the APAC Region, the Secretariat is developing, with the support of ICAO contracting states, materials to support frequency assignment planning in the region.

1.1.3 In accordance with above, the prime objectives of this document are:

a) to provide background information on the international spectrum management institutional framework.

b) to provide a convenient record for important frequency planning principles and coordination procedure.

c) to provide frequency assignment planning criteria to secure that aeronautical radio communication and navigation systems are protected from harmful interference on a uniform basis.

1.1.4 This manual ~~guidance material~~ describes general references in aeronautical frequency management of APAC region, including the introduction and relationships between the main participants, overview of the framework and process of aeronautical spectrum management, etc.

1.1.5 This manual~~document~~ is suitable for national authorities, telecommunication authorities (or telecommunication administrations), ATCs, aerodromes, and airlines which will manage or use aeronautical frequencies.

1.1.6 This ~~Guidance Material~~manual is not intended to and shall not replace the relevant requirements stipulated in Annex 10 and Doc 9718. In the event of any inconsistency or conflict between this document and Annex 10 and Doc 9718, Annex 10 and Doc 9718 shall take precedence.

~~1.1.5.1~~1.1.6.1 Regions and States may supplement the material in Doc 9718 or use different frequency assignment planning criteria to meet regional requirements.

Chapter 2

BACKGROUND

2.1 Institutional framework

2.1.1 ITU

2.1.1.1 The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs). To facilitate international connectivity in communications networks, ITU allocate global radio spectrum and satellite orbits to specific users, develop the technical standards that ensure networks and technologies seamlessly interconnect.

Note: Other specialized agencies, such as ICAO, would not be barred from any kind of work touching upon aeronautical telecommunications including standardization activities.

2.1.1.2 The legal framework of ITU comprises the basic instruments of the Union, which have treaty status and are binding on ITU Member States. These instruments are the Constitution and Convention of the International Telecommunication Union and the Administrative Regulations, which complement the Constitution and the Convention. The Radio Regulations (RR) form an integral part of the Administrative Regulations.

2.1.1.3 The RR include allocations, provisions on licensing, interference resolution, safety and distress procedures and other aspects. Within the RR, the finite useable radio spectrum, from approximately 8.3 kHz to 275 GHz, is allocated to user services in response to their recognized demands, and among three ITU world Regions in accordance with the major regional spectrum requirements for these services in the relevant region. ~~[DOC9718, Vol 1,3.3]~~ To enable new technologies and changes in spectrum usage, an ITU World Radiocommunication Conference (WRC) is held every 4 years where parts of the Radio Regulations are revised and updated.

2.1.1.4 Aviation services are recognized important users of radio spectrum to create safe and expeditious conditions to support air operations. The AM(R)S, the ARNS and their satellite service counterparts are important components in the mobile and radiodetermination families of users with (normally) exclusive allocations made on a worldwide basis to ensure global harmonization. The RR are used as the framework for the relevant ICAO Annexes and the Standards and Recommended Practices (SARPs) contained therein. ~~[DOC9718, Vol 1, 3.5]~~

2.1.2 ICAO

2.1.2.1 Pursuant to the provisions in Art 37 of the Convention on International Civil Aviation, ICAO develops Standards and Recommended Practices (SARPs) for Communication, (radio) Navigation and Surveillance (CNS) systems. These standards include technical characteristics and protection requirements to secure interference free operation of these systems and are incorporated in Annex 10. ~~[DOC 9718, V1, 5.1]~~

2.1.2.2 In order to provide for more detailed guidance material on the provisions in Annex 10 for CNS systems, ICAO has developed Doc 9718. Doc 9718 is (currently) published in two parts:

- Volume I which contains material relevant to the allocation and use of aeronautical frequency bands by the ITU.
- Volume II which contains material relevant to the frequency assignment planning for CNS systems.

~~2.1.2.2~~2.1.2.3 ICAO is accorded observer status at relevant ITU WRCs and also participates at meetings of the ITU-R study groups, including the Conference Preparatory Meetings (CPMs) which prepare the technical and regulatory basis for WRCs. ~~[DOC 9718, V1, 5.2]~~ Within ICAO, the necessary activity to support these ITU-generated functions exists at two levels:

a) At the worldwide level, through the work of the Air Navigation Commission, with the assistance of the FSMP (and communication divisional meetings or air navigation conferences, as required), to prepare the coordinated ICAO policies, spectrum estimates and technical inputs for ITU conferences and ITU-R study groups. The ICAO spectrum strategy, policy statements and the ICAO Position for WRCs are approved by the Council; and

b) At the regional level, by the ICAO Regional Offices, through coordination of frequency assignment plans with states/administrations, using agreed ICAO planning criteria. This activity is supported by the Regional Planning and Implementation Groups (PIRGs).

~~2.1.2.3~~2.1.2.4 At a Regional level, Air Navigation Plans have been developed. These ANPs contain, based on Regional Air Navigation Agreements, provisions that States have agreed to apply on the use of aeronautical radio communication, navigation and surveillance systems, including material relevant to frequency assignment planning.

2.1.3 National and regional authorities

2.1.3.1 Within ITU Member States, the telecommunication authorities / administrations normally control and operate the mechanism which develops the national proposals for amending the Radio Regulations for submission to the ITU WRCs. ~~[Doc 9718 volume 1 3.4]~~ The outcome of these discussions in the WRCs normally results in material being incorporated in the ITU Radio Regulations or in ITU-R Recommendations and subsequently being applied through national regulation by national telecommunication authorities. ~~[DOC9718, Vol 1,5.2]~~

2.1.3.2 To develop and maintain the ICAO Spectrum Strategy and Policy on Radio Frequency Spectrum, a coordinated aeronautical position (the ICAO Position) and other materials must be established for every ITU WRC to support the update of the ITU Radio Regulations (RR). All ICAO Member States and relevant international organizations are encouraged to present proposals to develop the ICAO Position.

2.1.3.3 National and international (regional) preparatory committees function as the coordination medium to which the aeronautical requirements and proposals, either from ICAO coordinated or nationally derived, are presented by the national aviation authorities for consideration. ~~[Modify from DOC9718, Vol 1, 3.4]~~

2.1.3.4 It is essential that aeronautical participation in these national and regional activities be ensured in order to support and defend aviation requirements. ~~[DOC9718, Vol 1, 3.4]~~

2.1.4 Relationship between ITU RR and ICAO SARPS

2.1.4.1 The Radio Regulations have treaty status, and there is an inherent obligation on States to comply, unless an exception is stated and embodied in the Final Acts of the Conference which created the regulation. Aeronautical services are obliged to operate within the framework established by the Radio Regulations.

2.1.4.2 ICAO is recognized internationally as the competent international body to coordinate a worldwide policy for the operational use of ~~the~~ specified systems used by aviation. Furthermore, the ICAO Annexes contain procedures for regular and emergency communications that are specifically developed for aviation purposes, taking account of the operational conditions. These procedures supplement the basic requirements of the Radio Regulations for procedures in aeronautical communications. ~~[DOC9718, Vol 1,4.4.3]~~

2.1.4.3 The Radio Regulations and ICAO SARPs together thus form a complementary set of regulatory provisions without any overlap. The Radio Regulations must evolve within the general telecommunications environment with its many and diverse users of the radio frequency spectrum, while the ICAO SARPs respond to the operational safety aspects of air navigation and are developed and agreed by aviation within the ICAO organizational framework. ~~[DOC9718, Vol 1,4.4.4]~~

2.2 Spectrum coordination and management

2.2.1 General

2.2.1.1 In using frequency bands for radio services, ITU Members and ICAO Contracting States shall bear in mind that radio frequencies are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of Radio Regulations, Annex 10 to the ICAO Convention and national and regional planning. ~~[RR 0.3]~~

2.2.1.2 Any new assignment or any change of frequency or other basic characteristic of an existing assignment shall be made in such a way as to avoid causing harmful interference to services rendered by stations using frequencies assigned in accordance with this ~~guidance material~~manual. ~~[RR 4.3]~~

2.2.1.3 Frequency assignment planning should ensure the availability and protection from harmful interference of the frequencies provided for distress and safety purposes. ~~[RR 0.7]~~

2.2.2 Frequency coordination and registration ~~[DOC9718, Vol 1,4.5]~~

2.2.2.1 The coordination and registration of frequency assignments is the prerogative of the ITU and must be performed in accordance with procedures laid down in the Radio Regulations. Frequencies are registered in the Master International Frequency Register (MIFR) maintained at ITU Headquarters in Geneva. However, Incorporation of aeronautical frequencies in the MIFR is not subject to a technical analysis of the assignment for protecting other assignments in the COM lists from harmful interference

2.2.2.2 In exclusive aeronautical bands, actual (day-to-day) coordination of frequency assignments is being undertaken by ICAO, through the ICAO Regional Offices. ~~[DOC9718, Vol 1,4.5.2]~~. The Regional Office's frequency coordination role includes the coordination with the ICAO regional offices of regions that may be affected by the proposed frequency assignments, or, if bilateral coordination is required in the region(s), the State(s)/ Administration(s) that may be affected. Agreed frequency assignment are registered by ICAO in the ICAO global frequency database.

2.2.2.3 To support this coordination, the ICAO Regional Offices have developed the necessary procedures, including the relevant frequency assignment planning criteria. Coordination of frequency assignments is taking place in close (in most cases) ~~in coordination~~ co-operation with the national civil aviation authorities. ~~[DOC9718, Vol 1, 4.5.2]~~

2.2.2.4 Although in some cases aeronautical frequency assignments, notably those in HF and LF/MF bands, are registered with the ITU by the countries operating these services, other frequency assignments, particularly those in bands above 100 MHz, tend to be recorded only in national registers or in the ICAO Regional Air Navigation Plans. Because of this, de facto, the ICAO frequency register within ICAO forms the basis for international coordination of frequency assignment~~s.~~ and provide the most accurate statement of frequency assignment. ~~[DOC9718, Vol 1,4.5.3]~~

2.2.2.5 This does not dispense with the more general requirement for the coordination of a frequency assignment within the ITU and the registration of this frequency assignment in the MIFR, if international protection of that assignment is necessary.

2.2.2.6 Coordination and registration of frequency assignments in the HF bands (between 2850 kHz and 22000 kHz) is only taking place through the ITU. However, ICAO is considering developing, in parallel, a relevant ICAO list of HF frequency assignments. ~~[DOC9718, Vol 1, 4.5.4]~~

2.2.2.7 Coordination and registration of frequency assignments for radar stations and on-board autonomous radio navigation systems is ~~however~~ not~~NOT~~ being coordinated through ICAO. However, in the case of assigning SSR mode S II/SI codes ICAO Regional Office performs the coordination and listing of these codes. ~~[DOC9718, Vol 1, 4.5.5]~~

2.2.2.8 List of frequency bands coordinated by ICAO is given in Table 2.1.

Table 2.1 List of frequency bands

Symbols	Frequency range	Facility
LF/MF	190 – 495 kHz and 505 – 526.5 kHz	NDB and locator
VHF	108 – 117.975 MHz 117.975 – 137 MHz	ILS localizer (below 112 MHz), VOR and GBAS Air-ground communications (e.g., VDL Mode 4)
UHF	328.6 – 335.4 MHz 960 – 1215 MHz	ILS glide path DME/TACAN SSR

2.2.3 Procedure of Coordination for aeronautical frequency in APAC Region

2.2.3.1 The ICAO Third Asia/Pacific Regional Air Navigation (ASIA/PAC/3 RAN) Meeting in 1993 agreed that the ICAO APAC Regional Office would continue to maintain its frequency selection and coordination role, including the maintenance and promulgation of Frequency List Nos.1, 2 and 3 in a timely and periodic manner.

2.2.3.2 with the successful implementation of Frequency Finder, there is no more Frequency List No. 3 published by the ICAO APAC Regional Office after the 29th Edition in January 2016, and is replaced by the up-to-date database in Frequency Finder.

Note: Frequency Finder is the ICAO aeronautical radio frequency management tool for VHF COM and NAV frequency assignments (and SSR II/SI code).

2.2.3.3 The updated Frequency Lists of Nos. 1 and 2 are published on the APAC website under – CNS More Documents through secure portal of ICAO APAC website webpage, or can be downloaded from the ICAO database with Frequency Finder.

Note： ICAO APAC Office synchronized all registered assignments on Frequency List No.2 into Frequency Finder in 2022 and has been using Frequency Finder on frequency assignments for NAV systems.

2.2.3.4 Currently, States/Administrations can submit to the Regional Office their requests for new or modified frequency assignments in any format (e.g., letter, email). ~~[SRWG/4 WP2 2.3]~~

a) The administrative aspects of the frequency coordination can be improved by States/Administrations using Frequency Finder to generate electronic submissions for new or modified frequency assignments. This option permits States/Administrations to check a selected frequency to satisfy any operational need and to check the compatibility of this (proposed) frequency with other frequency assignments in the Frequency List No.2 or No.3. It greatly facilitates the final coordination that is performed by the ICAO Regional Office. The electronic submission(s) as generated with Frequency Finder, in the format of an Excel file, can be sent to the ICAO Regional Office through email.

b) The second option for States/Administrations to submit to the Regional Office requests for registering new or modified frequency assignments, also by electronic means, through a locally generated Excel or Word file that follows the template as in **Appendix A**.

c) The third option is for States/Administrations to submit to the Regional Office requests for new of modified frequency assignment by letter. The preferred format of the characteristics for these submissions is in **Appendix B**.

2.2.3.5 The basic aeronautical coordination procedure is depicted as Figure 2-1.

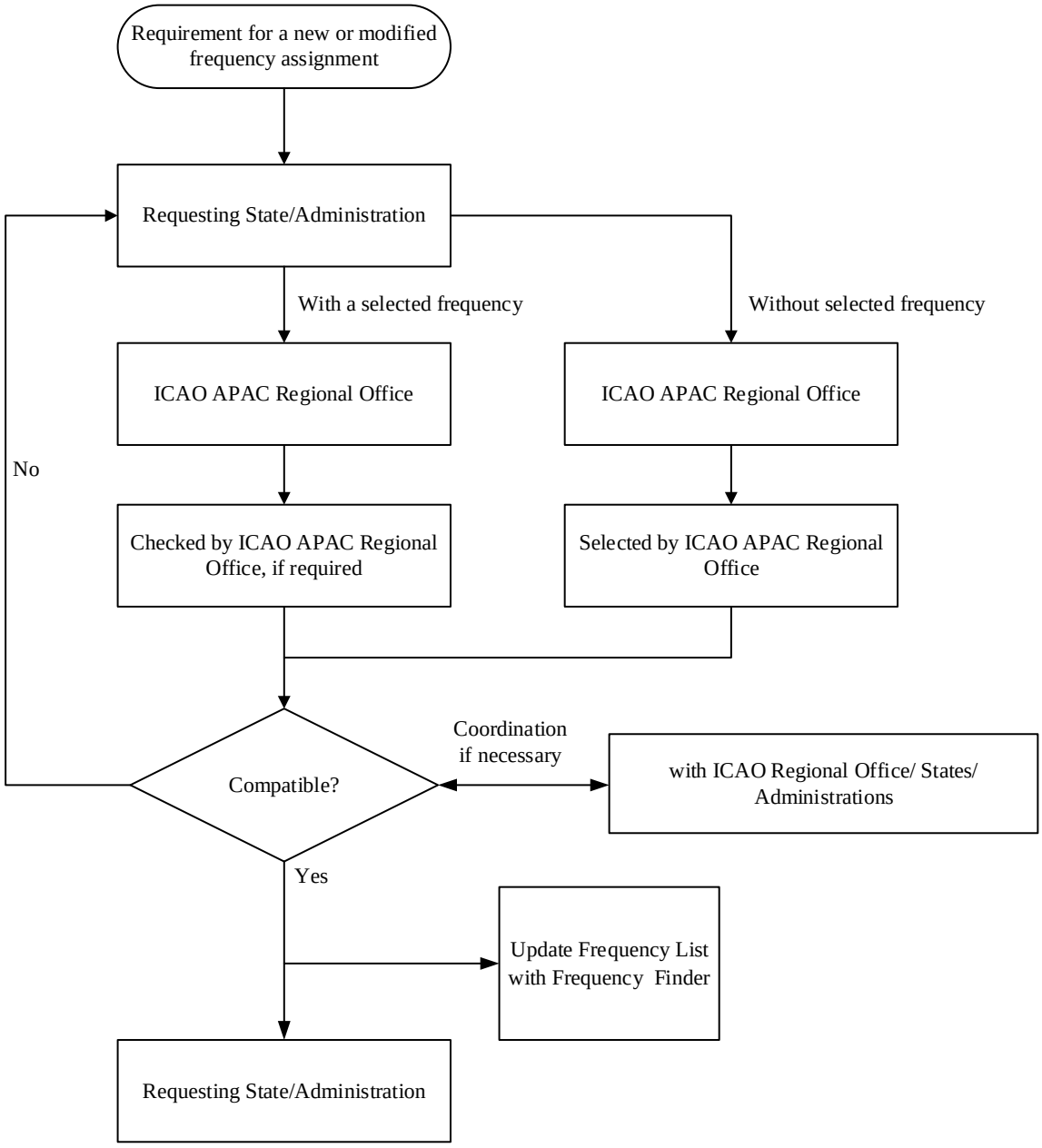


Figure 2-1 The basic aeronautical coordination procedure

Chapter 3

AIR-GROUND COMMUNICATION FREQUENCY MANAGEMENT

3.1 HF Air-ground Communication Frequency bands

3.1.1 HF bands (between 2850 kHz and 22 000 kHz) coordination is recommended to be carried out between States. Coordination and registration of HF frequencies is undertaken by the ITU, through the Radio Regulatory Authorities in each country. ICAO does not coordinate assignments for HF frequencies. ~~[SRWG/1, WP04, 2.3]~~ ICAO is considering developing, in parallel, a relevant ICAO list of HF frequency assignments. ~~[DOC9718, Vol 1,4.5.4]~~ Pre-coordination of HF frequencies could be arranged through the ICAO ASIA/PAC Office in Bangkok. However, the national radio regulator is required to develop a proposal for the registering required frequency assignments with the ITU. Such proposals should be based on the provisions of Appendix 27 to the ITU Radio Regulations, together with the information contained in the ITU International Frequency List (IFL) taking into consideration the protection requirements for HF as contained in Appendix 27. ~~[SRWG/1, WP04]~~

3.1.2 Appendix 27 to the Radio Regulations (RR) contains the frequency allotment plan for the AM(R)S in the HF bands. This appendix contains the plan for HF frequency allotments to major world air route areas and to regional and domestic air route areas as well as VOLMET areas. It also includes worldwide frequency allotments, which are for the use of aircraft operating agencies for AOC, to be assigned in accordance with RR 27/217. ~~[DOC9718, Vol 1, 4.2.6]~~

3.1.3 The technical characteristics for HF aviation equipment in Appendix 27 of the Radio Regulations, since they form part of the Radio Regulations, enjoy the same status as compulsory treaty obligations. ~~[DOC9718, Vol 1,4.6]~~

3.2 VHF Air-ground Communication Frequency bands

3.2.1 The general allotment of frequency band 117.975 – 137.000 MHz shall be as shown in Table 3.1. Specific allotments to services are to be determined regionally. ~~[ANN10, Vol 5, 4.1.1.1]~~

Table 3.1 Allotment table of frequency band 117.975 – 137.000 MHz

Block allotment frequencies (MHz)	Worldwide utilization	Remarks
118.000 –121.450 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
121.500	Emergency frequency	See Annex 10, Volume V, 4.1.3.1. Channels 121.475 and 121.525 are not assignable.
121.550 –121.9917inclusive	International and National Aerodrome Surface Communications	Reserved for ground movement, pre-flight checking, air traffic services clearances, and associated operations.
122.000 –123.050 inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.100	Auxiliary frequency SAR	See Annex 10, Volume V, 4.1.3.4. Channels 123.075 and 123.125 are not assignable.
123.150 –123.425inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered

		by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.450	Air-to-air communications	Reserved for air-to-air communication. Designated for use as provided for in Annex 10, Volume V, 4.1.3.2.
123.475-123.6917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.700 –129.6917 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
129.700 –130.8917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments but may be used in whole or in part, subject to regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
130.900 –136.875 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
136.900 –136.975 inclusive	International and National Aeronautical Mobile Services	Reserved for VHF air-ground data link communications.

3.2.2 In accordance with the provisions of Annex 10, the emergency channel (121.500 MHz) shall be used only for genuine emergency purposes, and where a requirement is established for the use of a frequency auxiliary to 121.500 MHz, the frequency 123.100 MHz shall be used.

~~3.2.2~~3.2.3 The Thirteenth Meeting of the APANPIRG agreed to adopted a regionally protected frequency of 128.950 MHz for Traffic Information Broadcasts by Aircraft (TIBA) to permit reports and relevant supplementary information of an advisory nature to be transmitted by pilots. States/Administrations could re-allot this frequency to other services accordingly their own needs. However, any assignment for 128.950 MHz to other services should not impact the airspace which have allotted or plan to allot 128.950 MHz to TIBA.

~~3.2.3~~3.2.4 Common signalling channels for VDL ~~[ANN10, Vol 5, 4.1.3.3]~~

~~3.2.3.1~~3.2.4.1 The frequency 136.975 MHz is reserved on a worldwide basis to provide a common signalling channel (CSC) to the VHF digital link Mode 2 (VDL Mode 2).

~~3.2.3.2~~3.2.4.2 In areas where VDL Mode 4 is implemented, the frequencies 136.925 MHz and 113.250 MHz shall be provided as common signalling channels (CSCs) to the VHF digital link Mode 4 (VDL Mode 4).

~~3.2.4~~3.2.5 Frequencies should be assigned to all VHF Aeronautical Mobile Service (AMS) facilities in accordance with the principles laid out in Annex 10, Volume V and ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718) Volumes I and II, and take into account:

(a) agreed geographical separation criteria based on 25 kHz or 8.33 kHz interleaving between channels;

(b) agreed geographical separation criteria for the implementation of VDL services;

(c) the need for maximum economy in frequency demands and in radio spectrum utilization; and

(d) a deployment of frequencies which ensures that international services are planned to be free of interference from other services using the same band. ~~[APAC ANP Vol II,2.41]~~

~~3.2.5~~3.2.6 The priority order to be followed in the assignment of frequencies to service is:

(a) ATS channels serving international services (ACC, APP, TWR, FIS);

(b) ATS channels serving national purposes;

(c) channels serving international VOLMET services;

(d) channels serving ATIS and PAR; and

(e) channels used for other than ATS purposes. ~~[APAC ANP Vol II, 2.42]~~

~~3.2.6~~3.2.7 The criteria used for frequency assignment planning for VHF AMS facilities serving international requirements should, to the extent practicable, also be used to satisfy the need for national VHF AMS facilities. ~~[APAC ANP Vol II, 2.43]~~

~~3.2.7~~3.2.8 Special provisions should be made, by agreement between the States concerned, for the sharing and the application of reduced protection of non-ATS frequencies in the national sub-bands, so as to obtain a more economical use of the available frequency spectrum consistent with operational requirements. ~~[APAC ANP Vol II, 2.44]~~

~~3.2.8~~3.2.9 States should ensure that no air/ground frequency is utilized outside its designated operational coverage and that the stated operational requirements for coverage of a given frequency can be met for the transmission sites concerned, taking into account terrain configuration.

~~3.2.9~~3.2.10 APAC region has agreed to base frequency assignment planning on 25 kHz frequency separation, according to the conclusions of ASIA/PAC/3 RAN (DOC9614), APANPIRG/26, etc. The complete regional 117.975MHz-137MHz frequency band utilization plan is shown in **Appendix C**,

Note1: the allocation of twelve (12) frequencies has not been included in the Asia-Pacific conference outcomes. the 12 frequencies are belonging to International and National Aeronautical Mobile Services band, and they are 132.050 MHz, 132.075 MHz, 134.525 MHz, 134.550 MHz, 134.575 MHz, 135.825 MHz, 135.850 MHz, 135.875 MHz, 135.900 MHz, 135.925 MHz, 135.950 MHz, 135.975 MHz. It is proposed to allocate these frequencies to ACC services as showed in Appendix C.

Note2: The note1 will be deleted if the new allotment plan as is approved.

~~3.2.10~~3.2.11 For co-frequency assignments, the minimum geographical separation between facilities shall be such that the DOC of each facility is separated by a distance not less than: ~~[DOC9718, Vol 2, 2.3.1.2]~~

(a) that required to provide a D/U ratio of 20 dB; or

(b) the sum of the distance to the radio horizon of the DOC area of each facility.

Alternatively, in areas where the frequency congestion is severe, a protection ratio of 14 dB can be used on the basis of a regional air navigation agreement.

~~3.2.11~~3.2.12 For adjacent frequency assignments, the minimum geographical separation between facilities shall be such that points at the edge of the designated operational coverage of each facility are separated by a distance sufficient to ensure operations free from harmful interference. ~~[DOC9718, Vol 2, 2.3.1.3]~~

Note : The edge of the DOC is at the maximum range and maximum height.

~~3.2.12~~3.2.13 Services and designated operational coverage (DOC) ~~[DOC9718, Vol 2, 2.6]~~

~~3.2.12.1~~3.2.13.1 Frequencies for aeronautical radio communication services are (normally) implemented to satisfy the operational need for specific services. These services, and their uniform DOC areas, are as in Table 3.2.

Table 3.2 Table of uniform designated operational coverage (DOC)

Service	SYMBOL	Designated Operational Coverage (DOC)		Comments	Mode
		Range (NM)	Height (ft)		
Aerodrome					
Aerodrome control tower	TWR	25	4000	Height above ground	A/G
Aerodrome flight information service	AFIS	25	4000	Height above ground	A/G
Aerodrome surface communications	AS	Limits of aerodrome	Surface		A/G

Service	SYMBOL	Designated Operational Coverage (DOC)		Comments	Mode
		Range (NM)	Height (ft)		
Approach					
Precision approach radar	PAR	25	4000	Height above ground	A/G
Approach control service (lower)	APP–L	50	12000		A/G
Approach control service (intermediate)	APP–I	75	25000		A/G
Approach control service (upper)	APP–U	150	45000		A/G
En-Route					
Area control centre (lower)	ACC–L	Area	25000	Within specified area; max range155 NM	A/G
Area control centre (intermediate)	ACC-I	Area	25000	Within specified area; max range 130 NM	A/G
Area control centre (upper)	ACC–U	Area	45000	Within specified area; max range 200 NM	A/G
Flight information service (lower)	FIS-L	Area	25000	Within specified area; max range 155 NM	A/G
Flight information service or Flight information service (upper)	FIS or FIS-U	Area	45000	Within specified area; max range 200 NM	A/G
Meteorological information for aircraft in flight	VOLMET	200	45000	Maximum range 200 NM	BC
Other functions					
Automatic terminal information service	ATIS	200	45000		BC
Air-to-air	A/A	200	45000	Maximum range 200 NM	A/G
Air-to-ground	A/G	200	45000	Maximum range 200 NM	A/G
Aeronautical operational control	AOC	100	25000	Not protected; max. range 100 NM	A/G
Emergency	EM	N/A	N/A	No frequency coordination required	A/G
Search and rescue	SAR	N/A	N/A	No frequency coordination required	A/G
VHF En-Route General Purpose	GP	200	45000	Maximum range 200 NM	A/G

Note 1: Different DOC areas may be specified by States.
Note 2: DOC for AOC-only provided to enable compatibility assessment when frequencies for AOC are shared with air traffic control (ATC) services; different DOC may be specified.
Note 3: For area services, no frequency protection is provided outside the specified area.
Note 4: Unless specified by States, the DOC for A/A and A/G is assumed at 45 000 ft/200 NM.
Note 5:Mode: A/G: air-ground communications; BC: (ground) broadcast communications.
Note 6:No coordination of frequency assignment planning is necessary for the emergency frequency 121.500 MHz and the SAR frequency 123.100 MHz as these services are available globally at each station where this service is required.

~~3.2.12.2~~3.2.13.2 Non-standard DOC (range and height) may be implemented as and when required. Reduced DOC, where operationally acceptable, may alleviate frequency congestion.

~~3.2.13~~3.2.14 The criteria of Geographical separation

~~3.2.13.1~~3.2.14.1 Applying the methodology as described in Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718), Volume II, paragraph 2.8, separation distances between the edges of the designated coverage areas are show in Table 3.3. ~~[DOC9718, Vol 2, 2.8.2.1]~~

Table 3.3 Minimum geographical co-frequency separation distances between the edges of the DOC

		VICTIM											
	Service	**TWR 25/4000**	**AFIS 25/4000**	**AS Surface**	**APP-U 150/450**	**APP- I 75/250**	**APP-L 50/120**	**ACC-U Area/450**	**ACC-L Area/250**	**FIS-U Area/450**	**FIS- L Area/250**	**VOLMET 260/450**	**ATIS 200/450**
INTERFERE	**TWR**	**156**	**156**		**338**	**273**	**212**	**338**	**273**	**338**	**273**	**338**	**338**
	AFIS	**156**	**156**		**338**	**273**	**212**	**338**	**273**	**338**	**273**	**338**	**338**
	AS (Note 2)			**25**									

		VICTIM											
	Service	TWR 25/4000	AFIS 25/4000	AS Surface	APP-U 150/450	APP- I 75/250	APP-L 50/120	ACC-U Area/450	ACC-L Area/250	FIS-U Area/450	FIS- L Area/250	VOLMET 260/450	ATIS 200/450
	APP-U	338	338		520	455	394	520	455	520	455	520	520
	APP-I	273	273		455	390	329	325	390	455	390	455	455
	APP-L	212	212		394	329	268	394	329	394	329	394	394
	ACC-U (Note 1)	338	338		520	455	394	520	455	520	455	520	520
	ACC-L (Note 1)	273	273		455	390	329	455	390	455	390	455	455
	FIS-U (Note 1)	338	338		520	455	394	520	455	520	455	520	520
	FIS-L (Note 1)	273	273		455	390	329	455	390	455	390	455	455
	VOLMET	338	338		520	455	394	520	455	520	455	15	15
	ATIS	338	338		520	455	394	520	455	520	455	15	15

Note 1: All distances are in NM.
Note 2: Frequencies for aerodrome surface communications should be selected from the band 121.600 – 121.975 MHz. This band is reserved exclusively for aerodrome surface communications. No separation distances with other services are provided. Should it be necessary to share frequencies for AS with air/ground communication services, the minimum geographical separation distance can be calculated as shown in paragraph 2.7.2.1.1 and assuming a designated operational coverage for aerodrome surface communications of 5 NM/100 ft.

3.2.14.2 For stations operating on the first adjacent frequency with the same characteristics, a separation distance of 10 NM is to be maintained between the ground transmitter and the ground receiver. This is considered to be not a frequency assignment planning constraint but rather an implementation issue for States to consider when implementing or modifying frequency assignments. A practical measure may be to avoid assigning a first adjacent frequency to the same location. ~~[DOC9718, Vol 2, 2.7.3.1.3]~~

~~3.2.13.2~~3.2.14.3 The designated coverage for VDL Mode 2 and VDL Mode 4 facilities need to be separated from the designated coverage of a co-frequency VHF-COM voice (DSB-AM) system with at least the distance to the radio horizon of each service. ~~[DOC9718, Vol 2, 2.9.1]~~

Note: This applies also to frequency assignments between VDL facilities.

~~3.2.13.3~~3.2.14.4 Table 3.4 present the guard band (channels) between VDL operating on adjacent frequencies with other VDL or VHF COM voice (DSB-AM) systems. ~~[DOC9718, Vol 2, 2.9.2]~~

Table 3.4 25 kHz guard band (channels) between DSB-AM, VDL mode 2 and VDL mode 4 (air-air)

		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM		1	2
	VDL 2	1	1	1
	VDL 4	2	1	1

Note: The numbers in Table are guard-bands (channels). The next frequency that can be used without frequency planning constrain is 1 channel higher (e.g., a desired DSB-AM station that is interfered by a VDL Mode 2 aircraft station requires one 25 kHz guard band. The next frequency, 50 kHz away, can be used in the same designated operational coverage without any frequency assignment planning constraint.

~~3.2.13.4~~3.2.14.5 Table 3.5 present the guard band (channels) for VDL Mode 2, VDL Mode 4 and VHF COM voice (DSB-AM) systems, when operating with aircraft on the surface of an airport. ~~[DOC9718, Vol 2, 2.9.3]~~

Table 3.5 25 kHz guard band (channels) between DSB-AM and VDL (modes 2 and 4) on the surface of an airport

	Interference source

		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM	-	4	4
	VDL 2	4	1	1
	VDL 4	4	1	1

3.2.14.6 VDL services can be deployed on channels separated by 25 kHz subject to sufficient distance separation between transmit and receive antennas of such services on the ground, which is estimated up to about 3 NM.

3.2.15 Guidance on the use of backup frequencies.

3.2.15.1 Backup frequencies may be operationally required to provide an alternative air-ground communication channel in cases where an operational radio frequency is not available. Examples include: intentional interference; unintentional interference (e.g., badly designed FM broadcasting stations); stuck microphone; and phony air traffic controllers.

3.2.15.2 Implementation of backup frequencies should be limited only to the following ATC services: AS, TWR, APP, ACC, COLMET, and FIS. Other air-ground communication services such as ATIS, AFIS, A/A, A/G, GP, and AOC do not require backup communication channels.

3.2.15.3 Backup frequencies should only be implemented at aerodromes with a clear operational requirement. The number of backup frequencies for the AS, TWR, and APP should not exceed two (with a maximum of one backup frequency for TWR and one backup frequency for APP services).

3.2.15.4 Backup frequencies should not be provided when communication channels are lost due to malfunctioning of the ground infrastructure.

3.2.15.5 The assessment of the required number of backup frequencies should be kept to the minimum needed. Where possible, it should be based on experience (e.g., number of days per year that a communication channel is not available).

3.2.15.6 Where operationally feasible, arrangements should be in place to share backup frequencies either between different services (at the same ATC centre) or between different facilities (e.g., different aerodromes or different ACC/FIS from different ATC centres).

3.2.15.7 Adjacent ATS units are encouraged to make suitable arrangements to share backup frequencies where possible, operationally feasible and spectrally efficient.

3.2.15.8 In the COM list in the global table of frequency assignments, backup frequencies are identified as such.

Chapter 4

RADIO NAVIGATION AID FREQUENCY MANAGEMENT

4.1 Non-Directional Radio Beacons (NDB)

4.1.1 Frequency band – The radio frequencies assigned to NDBs shall be selected from those available in that portion of the spectrum between 190 kHz and 1 750 kHz. The coordination and registration of bands 190–495 kHz and 505– 526.5kHz take place in ICAO Regional office.

4.1.2 NDB frequency management should take into account the following:

(a) the interference protection required at the edge of the rated coverage;

(b) the application of the figures shown for typical ADF equipment;

(c) the geographical spacings and the respective rated coverages;

(d) the possibility of interference from spurious radiation generated by non-aeronautical sources (e.g., electric power services, power line communication systems, industrial radiation, etc.). ~~[ANN10, Vol 5, 3.2.1]~~

4.1.3 The 1979 World Administrative Radio Conference adopted regulations concerning the assignment of frequencies for aeronautical radio beacons operating in the LF/MF frequency bands. A minimum protection ratio (wanted/ unwanted signal ratio) of 15 dB is to be used as the basis for frequency assignment planning (RR Appendix 12).

4.1.4 The minimum value of field strength in the rated coverage of an NDB should be 70°microvolts per metre. In order to obtain a satisfactory service within the rated coverage of an NDB located in latitudes between 40°N and 50°S, a minimum value of field strength of 120 microvolts per metre would be required, except where practical experience in the operation of NDBs over several years has revealed that a minimum field strength of 70 microvolts per metre would be adequate to meet all the operational needs. In some specific areas, field strength values considerably in excess of 120 microvolts per metre would be required. Such areas are: Indonesia and Papua New Guinea, Myanmar, Malay Peninsula, Thailand, Lao People's Democratic Republic, Democratic Kampuchea, Viet Nam and Northern Australia. ~~[ANN10, Vol 1, 3.4.2.1and Attachment C, 6.1.1/ RR Appendix 12/ DOC 9614,ASIA/PAC/3]~~

Note: Based on the latest propagation and noise data available to the ITU, studies of minimum field strengths required at the boundary of the rated coverage was shown in 6.3 of Attachment C, Annex 10. Attention is called particularly to the assumptions made.

4.1.5 NDB Frequency assignments should be based on the criteria contained in Annex 10, Volume I, Chapter 3 paragraph 3.4.3 and the guidance material contained in Attachment C paragraph 6 of Annex 10, Volume I.

4.1.6 Where locators associated with ILS facilities serving opposite ends of a single runway are assigned a common frequency, provision shall be made to ensure that the facility not in operational use cannot radiate. ~~[Annex 10 vol 1, Chapter3, paragraph 3.4.4.4]~~

4.1.7 To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of a single runway, the assignment of a common frequency to both of the outer locators should be permitted, and the assignment of a common frequency to both of the inner locators should be permitted, provided that:

(a) the operational circumstances permit;

(b) each locator is assigned a different identification signal; and

(c) arrangements are made whereby locators using the same frequency cannot radiate simultaneously. ~~[ANN10, Vol 5, 3.2.2]~~

4.2 Instrument Landing System (ILS)

4.2.1 Frequency band and channel spacing

4.2.1.1 Frequency band –The Localizer is operating in the frequency band 108 – 112MHz. This band is also used for VOR and GBAS/VDB systems. Localizers cannot be assigned a frequency allotted for a VOR and vice versa. The Glide Path is operating in the frequency band 328.6–335.4MHz. The Localizer and Glide Path frequencies are paired as shown in Appendix E. ~~[DOC9718, Vol 2, 3.3.1.1]~~

4.2.1.2 Channel spacing 100 kHz – The channel spacing for the Localizer is 100 kHz and for the Glide Path is 300 kHz. The Localizer operates on odd 100 kHz channels in the VHF band. ~~[DOC9718, Vol2, 3.3.1.2]~~

4.2.1.3 Channel spacing 50 kHz – The use of 50 kHz channels for the localizer (and 150 kHz for the glide path) is permitted as stipulated in Annex 10, Volume V, paragraph 4.2.2.1. ~~[DOC9718, Vol2, 3.3.1.3]~~

Note: Such use shall not cause harmful interference to ILS receivers not capable of tuning to these (50/150 kHz) channels and is subject to the condition that the operational service to international operators using airborne equipment designed for 100 kHz channel spacing (150 kHz for the Glide Path) is not derogated. ~~*[DOC9718 Vol2, 3.3.1.3]*~~

4.2.1.4 When the ILS is associated with a DME, the DME channels must be selected as **Appendix E**. Further guidance on DME frequency assignment planning, including the ILS/DME channel pairing, is in section 4.5.

4.2.2 Designated Operational Coverage (DOC)

4.2.2.1 The horizontal Designated Operational Coverage of the Localizer and Glide Path is shown in Figure 4-1. The DOC can be extended (optional) with a range of 10 NM outside the clearance sector of the Localizer as promulgated by States/Administrations. ~~[DOC9718, Vol 2, 3.2.1, 3.2.2.1]~~

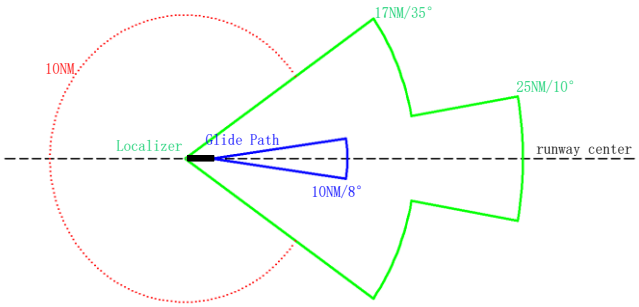


Figure 4-1. DOC of the ILS Localizer and Glide Path

4.2.2.2 The maximum protection height for the localizer DOC is 6250 ft and for the Glide Path 2500 ft. This height is relative to the elevation of the Localizer transmitter. ~~[DOC9718, Vol 2, 3.2.2]~~

4.2.2.3 States/Administrations may modify the coverage to meet specific operational requirements. Unless a (modified) DOC is provided, the standard DOC as in paragraph 4.2.2.1 is used in the frequency assignment planning process. ~~[DOC9718, Vol 2, 3.2.3]~~

4.2.2.4 When the ILS is associated with a DME, the DOC of the DME is typically the same as for the Localizer. However, States/Administrations may require the associated DME to provide coverage in a larger area. ~~[DOC9718, Vol 2, 3.2.4]~~

Note: In practice, many frequency assignments for a DME, associated with an ILS, have a DOC of 10.000 ft/100 NM. Frequency assignment planning criteria for DME are in section 4.5.

4.2.3 ~~[PFD limit]~~ The minimum field strength for a Localizer is 40 µV/m (or 32 dBµV/m or - 116 dBW) throughout the DOC. For a Glide Path the minimum field strength is 400 µV/m (or 52 dBµV/m or - 106 dBW). ~~[DOC 9718 Vol2, 3.2.4.1]~~

4.2.4 ILS serving both ends of the same runway. ~~[DOC9718, Vol 2, 3.2.7]~~

To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of the same runway or different runways at the same airport, the assignment of identical ILS localizer and glide path paired frequencies should be permitted provided that:

a) the operational circumstances permit;

b) each localizer is assigned a different identification signal; and

c) arrangements are made whereby the localizer and glide path not in operational use cannot radiate.

4.2.5 ~~[Facility Code]~~ Information on the planning of identifications can be found in section 4.6.

4.2.6 A compatibility assessment for potential interference that can be caused by FM broadcasting stations operating in the frequency band 87 – 108 MHz is necessary before a Localizer frequency can be put into operational use. The FM immunity performance requirements for Localizer receivers are contained in Annex 10, Volume I, paragraph 3.1.4. Additional information on the process to assess compatibility with FM broadcast stations is in Recommendation ITU-R SM.1009. ~~[DOC9718, Vol 2, 3.6]~~

4.2.7 Frequency Assignment Planning Principles

4.2.7.1 When the main direction of radiation of the ILS system is not known, for frequency assignment planning purposes, the coverage is assumed to be omnidirectional. The localizer coverage is originated from the location of the Localizer; the Glide Path coverage is originated from the location of the Glide Path. ~~[DOC9718, Vol 2, 3.2.5]~~

4.2.7.2 The criteria must be applied in respect of each localizer installation, in the sense that while of two localizers, the first may not cause interference to the use of the second, nevertheless the second may cause interference to the use of the first. ~~[ANN 10, ATT C, 2.6.1]~~

4.2.7.3 The DOC for the Localizer is much larger than that for the Glide Path. When a localizer frequency has been assigned, the associated Glide Path frequency is automatically protected from harmful interference from other co-channel ILS facilities. However, when non-co-channel Localizer frequency has been assigned, a separate adjacent channel compatibility assessment is necessary for the Glide Path frequency with regard to other nearby ILS facilities operating on adjacent Glide Path frequencies. Therefore, the frequency assignment planning for Localizer and Glide Path has to be performed separately. ~~[DOC9718, Vol 2, 3.3.1.5]~~

4.2.7.4 In so far as the wanted and unwanted carriers may produce a heterodyne note, the protection ratio ensures that the instrumentation is not affected. However, in cases where a voice facility is used, the heterodyne note may interfere with this facility. ~~[DOC9718, Vol 2, 3.2.6]~~

4.2.8 Required Distance Separations of ILS/ILS Facilities

4.2.8.1 The minimum required separation distances between the desired ILS system and potentially interfering ILS systems are based on the assumption that protection against interference is afforded to the desired signal from the undesired signal is 20 dB. This corresponds to a disturbance of not more than 15 microamperes at the limit of the service distance of the ILS. ~~[DOC9718, Vol 2, 3.4.1]~~

4.2.8.2 The minimum D/U ratios requirements within the DOC and different frequency separation to protect different receivers of Localizer / Glide Path can be referred to Annex 10, Volume I, Attachment C 2.6.2.1, 2.6.2.2.

4.2.8.3 Table 4.1 provides the minimum geographical separation distances between the edge of coverage of a desired ILS facility and the location of an undesired ILS facility, established using the method in **Appendix D.**

Table 4.1 Separation distances between the edge of coverage of a desired ILS and an undesired ILS

Undesired Facility:					
Localizer (e.i.r.p.~~EIRP~~= 30 dBW)	Δf:	Distance for 100 kHz receiver (desired facility)	D/U	Distance for 50 kHz receiver (desired facility)	D/U
	0 kHz	268 NM	36 dB	268 NM	36 dB
	0 kHz	135 NM	20 dB	135 NM	20 dB
	50 kHz	94 NM	-7 dB	36 NM	-34 dB
	100 kHz	n/a	n/a	n/a	n/a
	150 kHz	9 NM	-50 dB	9 NM	-50 dB
Glide Path	Δf:	300 kHz receiver	D/U	150 kHz receiver	D/U

(e.i.r.p. = 20 dBW)	0 kHz	88 NM	36 dB	74 NM	36 dB
	0 kHz	71 NM	20 dB	58 NM	20 dB
	150 kHz	36 NM	-0 dB	11 NM	-20 dB
	300 kHz	11 NM	-20 dB	1 NM	-40 dB
	450 kHz	1 NM	-40	-	-
Localizer (e.i.r.p. = 17 dBW)	Δf:	100 kHz receiver	D/U	50 kHz receiver	D/U
	0 kHz	135 NM	36 dB	135 NM	36 dB
	0 kHz	112 NM	20 dB	112 NM	20 dB
	50 kHz	44 NM	-7 dB	10 NM	-34 dB
	100 kHz	n/a	n/a	n/a	n/a
	150 kHz	1 NM	-50 dB	1 NM	-50 dB
Glide Path (e.i.r.p. = 14 dBW)	Δf:	300 kHz receiver	D/U	150 kHz receiver	D/U
	0 kHz	88 NM	36 dB	74 NM	36 dB
	0 kHz	71 NM	20 dB	58 NM	20 dB
	150 kHz	36 NM	-0 dB	11 NM	-20 dB
	300 kHz	11 NM	-20 dB	1 NM	-40 dB
	450 kHz	1	-40	- - -	- - -

4.2.8.4 In Regions where both 100 kHz and 50 kHz Localizer channels are being used (300 kHz and 150 kHz channels for the Glide Path), the protection of the Localizer is based on the protection of receivers designed for 100 kHz channel spacing.

4.2.9 Geographical separation distances between (desired) Localizer and (undesired) adjacent frequency VOR facilities is as Table 4.2.

Table 4.2 Geographical separation distances between (desired) Localizer and (undesired) VOR

VOR Tx (dBW)	ΔF (kHz)	D/U(dB)	D (NM)	Remarks
17	50	-7	72	Undesired VOR; 100 kHz receiver;
17	50	-34	15	Undesired VOR; 50 kHz receiver;
17	100	-46	5	Undesired VOR; 50/100 kHz receiver;
17	150	-50	3	Undesired VOR; 50/100 kHz receiver;
20	50	-7	80	Undesired VOR; 100 kHz receiver;
20	50	-34	19	Undesired VOR; 50 kHz receiver;
20	100	-46	7	Undesired VOR; 50/100 kHz receiver;
20	150	-50	4	Undesired VOR; 50/100 kHz receiver;
30	50	-7	107	Undesired VOR; 100 kHz receiver;
30	50	-34	36	Undesired VOR; 50 kHz receiver;
30	100	-46	16	Undesired VOR; 50/100 kHz receiver;
30	150	-50	13	Undesired VOR; 50/100 kHz receiver;

Note: ITU-R aeronautical propagation curve for the Localizer: 108 MHz, h1 = 20 ft, h2 = 6250 ft; 5% of the time. The minimum required separation distance is measured from the location of the (undesired) VOR to the closest point of the DOC of the Localizer

4.2.10 Geographical separation distance between (desired) Localizer and the location of an (undesired) GBAS/VDB as Table 4.3.

Table 4.3 Geographical separation distances between a desired Localizer and an undesired GBAS/VDB

GBAS/VDB Tx (dBW)	ΔF (kHz)	D/U(dB)	D (NM)	Remarks
17	0	26	187	
17	25	0	108	
17	50	-34	20	
17	75	-46	5	
17	100	-65	0	Planning freedom

Note: ITU-R aeronautical propagation curve for the Localizer: 108 MHz, h1 = 45 ft, h2 = 6250 ft; 5% of the time. The minimum required separation distance is measured from the location of the (undesired) GBAS/VDB to the closest point of the DOC of the Localizer

4.2.11 Practical experience in the operation of ILSs over several years has revealed that the minimum required separation distances of Annex 10, Volume I, Table C-3 can protect against interference to the desired signal. Required Localizer and Glide Path separation distances is shown in Table 4.4. These separation distances can be used in areas where the frequency congestion is severe.

Table 4.4 Required distance separations

	Frequency separation	**Minimum separation between second facility and the protection point of the first facility km (NM)**	
		List A	**List B**
Localizer	Co-channel	148(80)	148(80)
	50kHz	37(20)	9(5)
	100kHz	9(5)	0
	150kHz	0	0
	200kHz	0	0
Glide path	Co-channel	93(50)	93(50)
	150kHz	20(11)	2(1)
	300kHz	2(1)	0
	450kHz	0	0
	600kHz	0	0

List A refers to the use of localizer receivers designed for 100 kHz channel spacing coupled with glide path receivers designed for 300 kHz channel spacing.

List B refers to the use of localizer receivers designed for 50 kHz channel spacing coupled with glide path receivers designed for 150 kHz channel spacing.

Note 1. The above figures are based on the assumption of protection points for the localizer at 46 km (25 NM) distance and 1900 m (6250 ft) height and for the ILS glide path at 18.5 km (10 NM) distance and 760 m (2500 ft) height.

Note 2. States, in applying the separations shown in the table, have to recognize the necessity to site the ILS and VOR facilities in a manner which will preclude the possibility of airborne receiver error due to overloading by high unwanted signal levels when the aircraft is in the initial and final approach phases.

Note 3. States, in applying the separations shown in the table, have to recognize the necessity to site the ILS glide path facilities in a manner which will preclude the possibility of erroneous glide path indications due to reception of adjacent channel signals when the desired signal ceases to radiate for any reason while the aircraft is in the final approach phase.

Note: The application of the figures given in Table 4.4 *will only be correct within the limitations set by the assumptions. If more precise determination of separation distances is required in areas of frequency congestion, this may be determined for each facility from appropriate propagation curves, taking into account the particular directivity factors, radiated power characteristics and the operational requirements as to coverage. Where reduced separation distances are determined by taking into account directivity, etc., flight measurements at the ILS protection point and at all points on the approach path should be made wherever possible to ensure that a protection ratio of at least 20 dB is achieved in practice. ~~[Annex 10, ATT C 2.6.7]~~*

4.3 VHF Omnidirectional Range (VOR)

4.3.1 Frequency band and channel spacing

4.3.1.1 VOR is operating in the frequency band 108–117.975MHz. Within band 108–111.975MHz, frequencies ending in either even tenths or even tenths plus a twentieth of a megahertz are used only by VOR and therefore cannot cause co-channel interference to the ILS Localizer. In areas where 50 kHz channel spacing is introduced measures are in place to avoid that no harmful adjacent channel interference is caused to the ILS Localizer.~~frequencies ending in either even tenths or even tenths plus a twentieth of a megahertz are used only by VOR that should no harmful adjacent channel interference to ILS. [DOC9718, Vol 2, 4.3.1.1 /ANN10, Vol 5, 4.2.1]~~

4.3.1.2 The channel spacing is 100 kHz. The use of 50 kHz VOR channels is permitted as stipulated in Annex 10, Volume V, paragraph 4.2.3.1.

Note: The use of 50 kHz VOR channels shall not cause harmful interference to VOR receivers not capable of tuning to these channels and the operational service to international operators using airborne 100 kHz equipment is not derogated. ~~[DOC9718, Vol 2, 4.3.1.2]~~

4.3.1.3 In aera where VDL Mode 4 is implemented, the frequency 113.250 is reserved as common signalling channel for VDL Mode 4 ~~(ANN10, Vol 5, 4.1.3.3.2)~~.

4.3.1.4 VOR facilities are often associated with DME facilities. The associated DME channels shall be selected in Appendix E. Further guidance on DME frequency assignment planning, including the VOR/DME channel pairing, is in section 4.5.

Note: A separate compatibility assessment for the DME facilities associated with a VOR facility is required in all cases.

4.3.2 ~~[DOC]~~ The designated operational coverage (DOC) of the VOR is determined through the operational requirement as promulgated by States/Administrations. In many cases the DOC is circular and can typically vary from 25 NM to approximately 200 NM and with the protected altitude up to between 10 000 feet and ~~60~~ 45 000 feet normally, may be extended up to 60 000 feet. Protection from harmful interference is only provided within the DOC. ~~[DOC9718,Vol2, 4.2.1]~~

Note: When the VOR is associated with a DME, the DOC of the DME is typically the same as for the VOR.

4.3.3 ~~[PFD limit]~~ The field strength or power density in space of VOR signals required should be 90 µV/m (39 dBµV/m) or 107 dBW/m^2 (or - 110 dBW at 118 MHz) throughout the DOC. ~~[ANN10, Vol 1, 3.3.4.2 / DOC9718 Vol 2, 4.2.2.1]~~

4.3.4 ~~[With FM]~~ A compatibility assessment for potential interference that can be caused by FM broadcasting stations operating in the frequency band 87 – 108 MHz is necessary. The FM immunity performance requirements for VOR receivers are contained in Annex 10, Volume I, paragraph 3.3.8. Additional information on the process to assess compatibility with FM broadcast stations is in Recommendation ITU-R SM.1009.

4.3.5 ~~[Facility Code]~~ Information on the planning of identifications can be found in section 4.6.

4.3.6 Protection criteria for a desired VOR and an undesired VOR or Localizer or GBAS/VDB.

4.3.6.1 Localizer and VOR facilities cannot operate on the same frequency. Adjacent channel compatibility with an (undesired) Localizer is assessed in the same way as adjacent channel interference from a VOR assessed. ~~[DOC9718, Vol 2, 4.3.4.2]~~

4.3.6.2 The protection of VOR facilities operating on the same frequency is based on a desired to undesired (D/U) signal ratio of 20dB. This corresponds to a bearing error of less than 1 degree due to unwanted signals. ~~[DOC9718, Vol 2, 4.4.1]~~

4.3.6.3 Protection requirement for a desired VOR from interference by an~~d~~ undesired localizer or VOR facility is contained in ~~Annex 10, Volume I, Attachment C, paragraph 3.6.4. and~~ DOC 9718, Volume II, paragraph 3.4.

4.3.6.4 Protection criteria for a desired VOR from interference by ~~and~~ an undesired GBAS/VDB is contained in ~~Annex 10, Volume I, Attachment D, paragraph 7.2.1.1, and~~ DOC 9718, Volume II, paragraph 3.5.

4.3.6.5 Where both 100 kHz and 50 kHz VOR channels are being used, the protection of the VOR is based on the protection of receivers designed for 100 kHz channel spacing. ~~receivers designed for 100 kHz channel spacing.~~

4.3.7 Sectorized coverage

4.3.7.1 Application of the calculation methods described above may produce incorrect results if sectorization (key-holing) is used. Figure 4-2 can be used to explain the problem:

4.3.7.2 Consider A to be the desired VOR facility and B the undesired one. The “Critical Point” is most exposed to interference from facility B because it is the point of the DOC of facility A which is nearest to transmitter B.

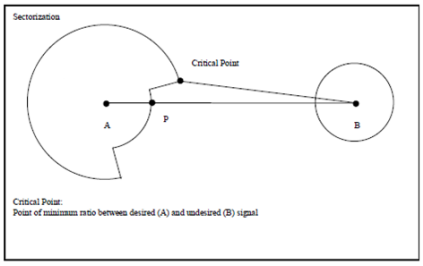


Figure 4-2 Geometry for determining the test points

4.3.8 Table 4.5 to Table 4.7 present the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) VOR and the location of the (undesired) VOR or ILS-Localizer.

Table 4.5 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	**D/U (dB)**	**Tx = 17 dBW**		**Tx = 20 dBW**		**Tx=30 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired VOR at 45000 ft**
0	20	147	268	150	271	160	284	50/100 kHz receiver
50	-7	120	134	123	174	133	231	100 kHz receiver
50	-34	93	5	96	11	106	43	50 kHz receiver
100	-46	81	<0.5	84	<0.5	94	7	50/100 kHz receiver
150	-50	77	<0.5	80	<0.5	90	<0.5	50/100 kHz receiver

Table 4.6 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	**D/U (dB)**	**Tx = 17 dBW**		**Tx = 20 dBW**		**Tx=30 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired VOR at 25000 ft**
0	20	147	208	150	212	160	225	50/100 kHz receiver
50	-7	120	115	123	131	133	175	100 kHz receiver
50	-34	93	9	96	13	106	42	50 kHz receiver
100	-46	81	<0.5	84	<0.5	94	10	50/100 kHz receiver
150	-50	77	<0.5	80	<0.5	90	5	50/100 kHz receiver

Table 4.7 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	**D/U (dB)**	**Tx = 17 dBW**		**Tx = 20 dBW**		**Tx=30 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired VOR at 10000 ft**
0	20	147	143	150	147	160	161	50/100 kHz receiver
50	-7	120	71	123	82	133	115	100 kHz receiver
50	-34	93	10	96	14	106	29	50 kHz receiver
100	-46	81	1	84	3	94	11	50/100 kHz receiver
150	-50	77	<0.5	80	1	90	7	50/100 kHz receiver

Note1: The separation distances are between the edge of coverage for a desired VOR and the location of an undesired VOR (or Localizer) facility. The EIRP of the undesired VOR (or Localizer) is as specified in column "Tx".

Note2: ITU-R aeronautical propagation curve for 108 MHz and 5% of the time. The antenna height of the desired aircraft receiver is indicated in the "Remarks" column, and the antenna height of undesired Localizer is 6 ft, undesired VOR is 20 ft.

4.3.9 Table 4.8 presents the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) VOR and the location of the (undesired) GBAS/VDB station.

Table 4.8 Distance between the edge of the DOC of the desired VOR (50 kHz receiver) from GBAS/VDB

VOR - Height (ft)	**Co-frequency** **D/U = 26 dB** **L = 153 dB**	**1st adj freq. (+/-25 kHz)** **D/U = 0 dB** **L = 126 dB**	**2nd adj freq. (+/- 50 kHz)** **D/U = - 34 dB** **L = 92 dB**	**3rd adj freq. (+/-75 kHz)** **D/U = -46 dB** **L = 87 dB**	**4th adj freq. (+/- 100 kHz)** **D/U = -65 dB** **L = 61 dB**
5 000	127 NM	80 NM	9 NM	5 NM	Frequency assignment planning freedom
10 000	161 NM	111 NM	8 NM	5 NM	
15 000	186 NM	135 NM	8 NM	4 NM	
20 000	206 NM	155 NM	8 NM	3 NM	
25 000	225 NM	172 NM	8 NM	2 NM	
30 000	242 NM	189 NM	7 NM	Frequency assignment planning freedom	
35 000	237 NM	203 NM	6 NM		
40 000	271 NM	217 NM	5 NM		
45 000	284 NM	228 NM	3 NM		
50 000	297 NM	242 NM	Planning freedom		
60 000	320 NM	264 NM			

Note 1: With minimum separation distances less than 0.5 NM frequency assignment planning freedom is assumed.

Note 2: Separation distances ≤ 5 NM may be considered as operational insignificant.

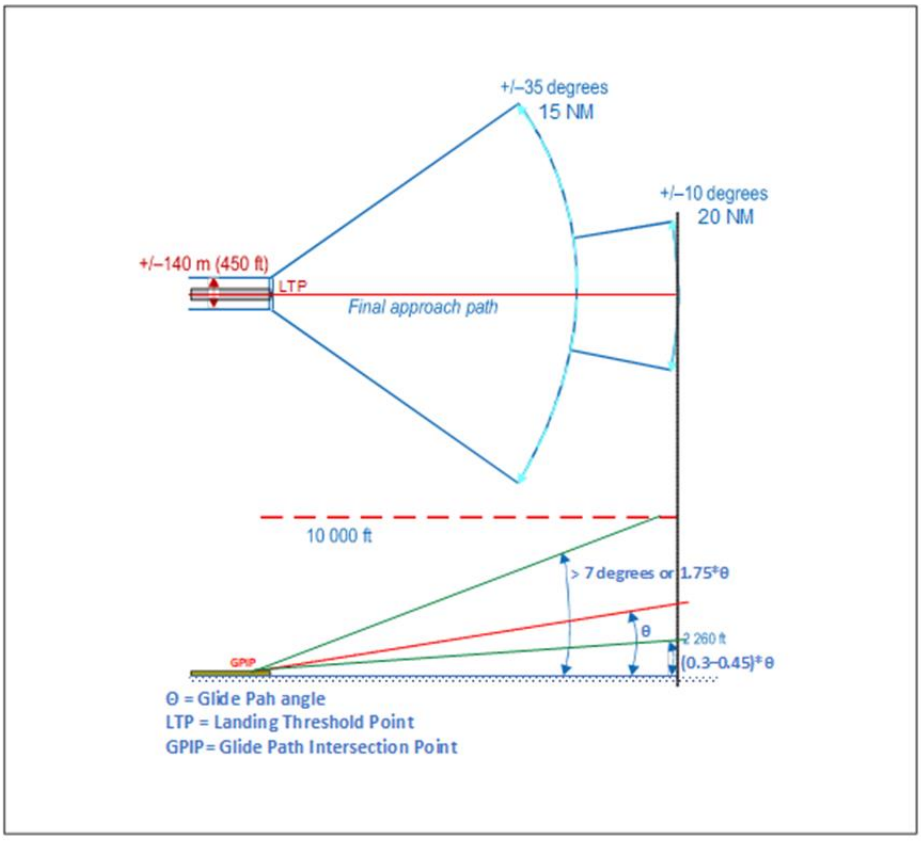
Note3: ITU-R aeronautical propagation curve for 108 MHz and 5% of the time. The antenna height of undesired GBAS/VDB is 45 ft.

4.4 Ground Based Augmentation System (GBAS)

4.4.1 ~~[Frequency band and channel spacing]~~ The GNSS ground-based augmentation system (GBAS) VHF data broadcast (VDB) frequency band is 108 to 117.975MHz. The lowest assignable frequency is 108.025 MHz and the highest assignable frequency is 117.950 MHz, the channel spacing is 25 kHz.

4.4.2 Designated Operational Coverage (DOC)

4.4.2.1 The minimum DOC required for a GBAS VDB to provide approach services ~~The DOC of the GBAS/VDB to provide the approach service~~ is as shown in Figure 4-3~~Figure 4-3~~.



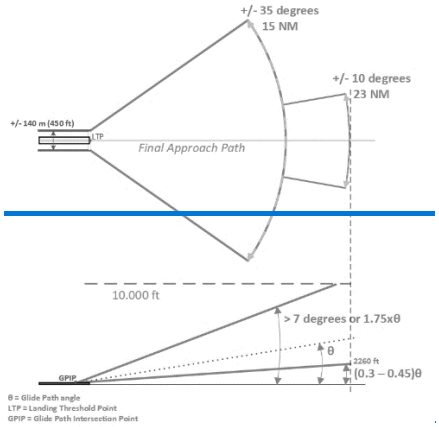


Figure 4-3 Minimum required DOC of GBAS

4.4.2.2 For GBAS approaches supported by the minimum DOC, the vertical coverage is limited by a plane that extends from the glide path interception point (GPIP) with an angle of 0.3 times the glide path angle. For a glide path of 3 degrees, this angle is 0.9 degrees. At 20 NM, this plane is 2 260 ft above the earth. The upper limit of the coverage to be used for frequency assignment planning for this case is 10.000 ft above the runway threshold.

4.4.2.3 Typically, the DOC for GBAS VDB facilities is referenced to the location and the elevation of the threshold of the runway. However, in cases where such information is not available, the coverage may be referenced to the location of the VDB transmitter. In this case, considering the offset of the VDB transmitter from the runway threshold, for frequency assignment planning purposes, the DOC of the GBAS should be extended by 3 NM from the location of the VDB transmitter or the aerodrome reference point (ARP), in which case a circular coverage may need to be considered or assumed.

4.4.2.4 Figure 4-3~~Figure 4-3~~ presents the minimum approach DOC, States/Administrations may specify an extended DOC based on the operational requirements. More information on establishing the DOC is in Annex 10, Volume I, Attachment D, paragraph 7.3.

4.4.2.5 It is recommended to assume a single omnidirectional coverage that encompasses all GBAS DOCs at an airport, if feasible. At a particular airport the set of GBAS DOC that are supported may include one or multiple GBAS DOC at all runways or a subset of runways. Furthermore, each GBAS DOC may be described either by the minimum DOC according to

Figure 4 3 or by an extended DOC as specified by the GBAS service provider. When frequency coordination is not feasible assuming single omnidirectional coverage, it may be feasible to protect coverage only in the GBAS DOC's.

~~4.4.2.2 Typically, the DOC for GBAS/VDB facilities is referenced to the location and the elevation of the threshold of the runway. It is recommended to use an omnidirectional coverage that extends to 23 NM from the runway threshold and up to a level of 10, 000 ft above runway threshold. [DOC9718, Vol 2, 6.2]~~

~~4.4.2.3 The vertical coverage is limited by a plane that extends from the glide path interception point with an angle of 0.3 times the Glide Path angle. The upper limit of coverage is 10000 ft that follows the Earth curvature. [DOC9718, Vol 2, 6.2]~~

~~4.4.2.4~~

~~4.4.2.5 When GBAS supports multiple approaches, use of a single omnidirectional VDB may be considered, if geographically feasible. In this case, frequency coordination should include all GBAS coverage areas. [DOC9718, Vol 2, 6.2]~~

~~4.4.2.6 Figure 4-3 presents the minimum approach DOC, States/Administrations may specify different (larger) DOC areas. More information on establishing the DOC is in Annex 10, Volume I, Attachment D, paragraph 7.3. [DOC9718, Vol 2, 6.2]~~

4.4.3 GBAS/VDB positioning service EIRP

4.4.3.1 The EIRP for the GBAS/VDB when providing the approach service is typically 17dBW (50 W) to provide service down to about 2 000 ft at the lower edge of the DOC.

4.4.3.2 The EIRP for the GBAS/VDB when providing the positioning service is in Table 4.9.

Table 4.9 Typical EIRP for GBAS/VDB positioning service

Range (NM)	EIRP (dBW)	EIRP (W)
50	14	25
100	20	100
150	23	200
200	26	400

Note: The EIRP of a GBAS/VDB system shall be provided as Peak Envelope Power. Since MOPS specify the output power to be measured as mean power over a bit-sequence in the preamble, care must be taken that the PEP is used for calculation. ~~[EUR 011, 4.1.10]~~

4.4.4 ~~[PFD limit]~~ For frequency assignment planning purposes, it is assumed the field strength of the desired corresponds to the minimum field strength, as defined in Annex10, Volume I, throughout the designated operational coverage. The minimum field strength is 215 µV/m (-99 dBW/m2) which is equivalent to a power level at the aircraft antenna output of -102 dBW with an ideal isotropic antenna (for the horizontal component of the GBAS/VDB signal). The maximum field strength is (SIS max) 0.879 V/m (− 27 dBW/m^2 when converted to power flux density or –29 dBW when converted to power at the output of an isotropic antenna ~~-27dBW/m2 or -29dBW~~). ~~[DOC9718, Vol 2, 6.3.4]~~

4.4.5 For use in civil aviation, the GBAS signal is horizontally polarized. The value for cross polarization isolation between horizontal and vertical polarization assumed to be 10 dB ~~[ANN10, Vol 1, Attachment D, 7.2.4)~~.

4.4.6 ~~[With FM]~~ The risk of interference from FM broadcasting stations in the band 87 – 108 MHz caused by unwanted emissions into the aeronautical band or generated in the airborne receiver should be taken into account. The relevant Recommendation for GBAS is ITU-R SM.1841. ~~[EUR 011, 4.1.4]~~

4.4.7 ~~[Facility code]~~ Information on the planning of identifications can be found in section 4.6.

4.4.8 Besides the frequency, co-ordination must also take into account reference path data selectors (RPDS) and reference station data selectors (RSDS) and time slots. More information on the use and coordination of RPDSs and RSDSs is in Annex 10, Volume I, Appendix B. However as these are currently not planned to be used in the APAC Region, no relevant planning criteria have been developed yet. ~~[EUR 011, 4.1.6 / DOC9718,Vol 2, 6.5]~~

4.4.9 Protection requirements

4.4.9.1 Protection requirements for GBAS/VDB receivers.

The GBAS/VDB receiver shall be capable to achieve a message failure rate of not more than one failed message per 1000 data messages. The D/U ratios in Table 4.10 will meet this requirement.

Table 4.10 Co- and adjacent channel protection requirements for GBAS/VDB receivers

Frequency offset	**VDB/VDB**	**VDB/VOR**	**VDB/ILS**	**VDB/VHF-COM**
Co-frequency	26 dB	26 dB	26 dB	n/a
+/- 25 kHz	-18 dB	0 dB	0 dB	n/a
+/- 50 kHz	-43 dB	-34 dB	-34 dB	-32 dB
+/- 58.33 kHz	n/a	n/a	n/a	-~~37~~ 38 dB
+/- 66.66 kHz	n/a	n/a	n/a	-41 dB
+/- 75 kHz~~ – +/- 975 kHz~~	-46 dB	-46 dB	-46 dB	-~~44~~ 45 dB
+/- 83.33 kHz	n/a	n/a	n/a	-47 dB
+/- 91.66 kHz	n/a	n/a	n/a	-49 dB
+/- 100 kHz	-46 dB	-46 dB	-46 dB	-51 dB
+/–975 kHz	-46 dB	-46 dB	-46 dB	-51 dB
≥ 1000 kHz	-46 dB	-60 dB	-60 dB	-77 dB

4.4.9.2 For the calculation of the minimum geographical separation distance between a desired GBAS VDB facility and an undesired GBAS VDB (or localizer, VOR or VDL Mode 4) facility, the generic model described in Appendix D, need to be applied.

~~4.4.9.2 Airborne Contribution Factor~~

~~a) With the view to protect the desired VDB signals in space, an airborne contribution factor has been added. This airborne contribution factor compensates for antenna gain variations in the horizontal plane (between the directions of the desired versus the undesired transmitter) and on-board transmission line loss variation (between the frequency of the desired and the undesired signal. The airborne contribution factor can be calculated with 15 + Min (6, 6 x Frequency Offset (in kHz) /1000) with a maximum frequency offset of 1000 kHz.~~

~~b) Table 4.11 contains the protection ratios that are to be observed in frequency assignment planning to protect a desired GBAS/VDB from interference that can be caused by an undesired GBAS/VDB, VOR or ILS or VHF COM facility.~~

~~Table 4.11 Co- and adjacent channel protection requirements for GBAS/VDB; signal in space~~

~~**Frequency offset**~~	~~**VDB/VDB**~~	~~**VDB/VOR**~~	~~**VDB/ILS**~~	~~**VDB/VHF-COM**~~
~~Co-frequency~~	~~41 dB~~	~~41 dB~~	~~41 dB~~	~~n/a~~
~~+/- 25 kHz~~	~~-3 dB~~	~~15 dB~~	~~15 dB~~	~~n/a~~
~~+/- 50 kHz~~	~~-27 dB~~	~~-18 dB~~	~~-18 dB~~	
~~+/- 58.33 kHz~~	~~n/a~~	~~n/a~~	~~n/a~~	
~~+/- 66.66 kHz~~	~~n/a~~	~~n/a~~	~~n/a~~	
~~+/- 75 kHz~~	~~-30 dB~~	~~-30 dB~~	~~-30 dB~~	
~~+/- 83.33 kHz~~	~~n/a~~	~~n/a~~	~~n/a~~	
~~+/- 91.66 kHz~~	~~n/a~~	~~n/a~~	~~n/a~~	
~~+/- 100 kHz~~				
~~+/- 975 kHz~~	~~-25 dB~~	~~-25 dB~~	~~-25 dB~~	
~~≥ 1000 kHz~~	~~-25 dB~~	~~-39 dB~~	~~-39 dB~~	

4.4.10 The separation distances between desired and undesired GBAS stations in Table 4.11~~Table 4.12~~ were calculated for desired GBAS facilities providing approach services.

Table 4.11~~12~~ Minimum separation distances between desired and undesired GBAS stations

Frequency offset	**D/U (dB)**	**L (dB)**	**Distance from DOC of desired station to undesired station**	**Distance between the GBAS stations**
0 (Co- channel)	26	145	149 NM	172 NM
25 kHz	-18	101	24 NM	47 NM
50 kHz	-43	76	0 NM	0 NM
Δf ≥ 75 kHz~~75 kHz – 975 kHz~~	-46	73	0 NM	0 NM
~~≥ 1000 kHz~~	~~-46~~	~~73~~	~~0~~	

Note: It's assumed that the GBAS VDB is within 3 miles of all runway ends supported by the GBAS and that all runway ends are supported by the minimum approach DOC illustrated in Figure 4-3.

4.4.11 The calculation of the minimum separation distances between the edge of coverage (DOC) of a desired GBAS VDB facility and the location of an undesired VOR or Localizer in Table 4.12~~Table 4.13~~ and ~~Table 4.14~~.

Table 4.12~~13~~ Minimum separation distances between the DOC of the desired GBAS and the location of the undesired VOR or localizer

D/U (dB)	VOR or localizer (17dBW)			VOR (27dBW)		VOR (30dBW)	
	L(dB) 5%	VOR ~~(17dBW)~~ Distance (NM)	Localizer ~~(17dBW)~~ Distance (NM)	L(dB) 5%	VOR ~~(27dBW)~~ Distance (NM)	L(dB) 5%	VOR ~~(30 dBW)~~ Distance (NM)
26 (Δf = 0 kHz)	145	14~~90~~	14~~925~~	155	163~~54~~	156~~8~~	201~~158~~
0 (Δf = 25 kHz)	119	68	38	129	101	132	111
-34 (Δf = 50 kHz)	85	4	4	95	1~~3~~2	98	17
-46 (Δf = 75 kHz)	73	0	0	83	3	86	4
-46 (Δf = 100 kHz)	73	0	0	83	3	86	4
-46 (Δf = 975 kHz)	73	0	0	83	3	86	4
-60 (Δf ≥ 1000 kHz)	59	0	0	69	0	72	0

~~Table 4.14 Minimum separation distances between the DOC of the desired GBAS and the location of the undesired VOR or localizer, consider Airborne Contribution Factor~~

~~D/U (dB)~~	~~L(dB) 5%~~	~~VOR (17dBW) Distance (NM)~~	~~Localizer (17dBW) Distance (NM)~~	~~L(dB) 5%~~	~~VOR (27dBW) Distance (NM)~~	~~L(dB) 5%~~	~~VOR (30 dBW) Distance (NM)~~
~~41 (Δf = 0)~~	~~160~~	~~160~~	~~146~~	~~170~~	~~243~~	~~173~~	~~260~~
~~15 (Δf = 25)~~	~~134~~	~~118~~	~~85~~	~~144~~	~~138~~	~~147~~	~~143~~
~~-18 (Δf = 50)~~	~~101~~	~~21~~	~~14~~	~~111~~	~~43~~	~~114~~	~~51~~
~~-30 (Δf = 75)~~	~~89~~	~~6~~	~~6~~	~~99~~	~~18~~	~~102~~	~~23~~
~~-30 (Δf = 100)~~	~~89~~	~~6~~	~~6~~	~~99~~	~~18~~	~~102~~	~~23~~
~~-25 (Δf = 975)~~	~~94~~	~~11~~	~~8~~	~~104~~	~~26~~	~~107~~	~~31~~
~~-39 (Δf ≥ 1000)~~	~~80~~	~~1~~	~~1~~	~~90~~	~~7~~	~~93~~	~~10~~

Note：The parameters used in the calculations below are:

Height of the antenna of the (undesired) VOR is 20 ft above local terrain.
Height of the antenna of the (undesired) Localizer) is 6 ft above local terrain.
Height of the (desired) VDB aircraft is 10.000 ft.
ITU-R aeronautical propagation curves (Recommendation P.528-4) for 112 MHz, 5% of the time

4.4.12 Interference from VHF-COM signals

4.4.12.1 On-board compatibility

No frequency assignment planning constraints have been identified to secure the compatibility between the on-board transmission of VHF-COM signals and the reception of GBAS/VDB signals on the same aircraft.

4.4.12.2 Air-to-air interference can be expected as in Table 4.13~~Table 4.15~~.

Table 4.13~~15~~ Minimum separation distances between aircraft

ΔF (kHz)	D/U	10dBW		14 dBW		17dBW		20 dBW	
		L (dB)	D(NM)	L (dB)	D(NM)	L (dB)	D(NM)	L (dB)	D(NM)
50~~50~~	–32 dB~~-34 dB~~	80~~78~~	1.5~~< 1~~	84~~82~~	2~~1.5~~	87~~85~~	3~~3~~	91~~88~~	4.5~~4.5~~
58.3	–38 dB	74	0.6	78	1	81	1	84	2
66.6	–41 dB	71	0.4	75	0.7	78	1	81	3
75~~75~~	–45 dB~~-39 dB~~	67~~73~~	0.3~~< 1~~	71~~77~~	0.4~~< 1~~	74~~80~~	0.6~~< 1~~	77~~83~~	0.9~~2~~
83.3	–47 dB	65	0.2	69	0.3	72	0.5	75	0.7
91.6	–49 dB	63	0.1	67	0.3	70	0.4	73	0.5

100~~100~~	–51 dB~~-42 dB~~	61~~70~~	0.1~~< 1~~	65~~76~~	0.2~~< 1~~	68~~77~~	0.3~~< 1~~	71~~80~~	0.4~~1~~
125	-46 dB	47~~66~~	~~< 1~~0	61~~70~~	~~< 1~~0.1	~~79~~64	0.2~~< 1~~	~~76~~67	~~< 1~~0.2

The minimum separation distances as in Table 4.13~~Table 4.15~~ were calculated assuming isotropic antennas on board the desired and the undesired aircraft. Taking into account that the effect of the actual antenna diagram of the VHF-COM and the GBAS/VDB antenna as well as the transient effect of air-to-air interference, at a frequency separation greater than 100 kHz no air-to-air interference is expected.

Note: An aircraft EIRP. of 20 dBW (100 W) is not normally used. For aircraft EIRP. of 17dBW (50 W) or less, a minimum frequency separation between the aircraft VHF-COM and the GBAS/VDB receiver of 50~~ [58.3]~~ kHz may be recommended.

~~4.4.12.2~~4.4.12.3 Ground-to-air interference

At short distances, as shown in Table 4.13~~Table 4.15~~, interference from a VHF-Ground facility can be expected when the EIRP of the ground station is between 14 dBW (25W) to 20 dBW (100W). Maintaining a minimum frequency separation of 100 kHz between the assigned GBAS/VDB and VHF-COM frequency would avoid such interference. One option is to ensure in the frequency assignment planning process that a guard band of 100 kHz is introduced which would exclude the frequencies between 117.900 – 117.975 MHz to be used for GBAS/VDB.

Note: This condition seems to be extremely conservative. Taking into account the actual antenna diagram and the geography of short distances to the (interfering) VHF COM station, is may be sufficient to only exclude the frequency 117.950 MHz from being assigned to a GBAS/VDB station.

4.4.13 Airborne Contribution Factor

4.4.13.1 In extreme cases where the assumptions as in paragraph 4.4.9 cannot be applied or are not offering the GBAS/VDB compatibility calculations for GBAS versus GBAS, Localizer and VOR facilities may include the use of the Airborne Contribution Factor (ACF). This will require larger protection distances between the desired GBAS/VDB and the undesired GBAS/VDB, Localizer and VOR and, in the case of adjacent channel interference, over a range of plus/minus 1 MHz. In this case it may be difficult if not impossible to find a proper GBAS/VDB frequency that can be assigned and, in return, such a frequency assignment will prohibit in a large area the addition of new VOR or Localizer facilities.

4.4.13.2 The airborne contribution factor compensates for antenna gain variations in the horizontal plane (between the direction of the desired versus the undesired transmitter) and on-board transmission line loss variation (between the frequency of the desired and undesired signal). The airborne contribution factor can be calculated with 15 + Min (6, 6 x frequency offset (in kHz) /1 000) with a maximum frequency offset of 1 000 kHz.

4.4.13.3 ~~Table 4.11~~ contains requirements for GBAS VDB receivers accounting for ACF.

Table 4.14~~11~~ Co- and adjacent channel protection requirements for GBAS/VDB; signal-in-space

Frequency offset	**VDB/VDB**	**VDB/VOR**	**VDB/ILS**	**VDB/VHF-COM**
Co-frequency	41 dB	41 dB	41 dB	n/a
+/- 25 kHz	-3 dB	15 dB	15 dB	n/a
+/- 50 kHz	-27 dB	-18 dB	-18 dB	
+/- 58.33 kHz	n/a	n/a	n/a	
+/- 66.66 kHz	n/a	n/a	n/a	
+/- 75 kHz	-30 dB	-30 dB	-30 dB	
+/- 83.33 kHz	n/a	n/a	n/a	
+/- 91.66 kHz	n/a	n/a	n/a	
+/- 100 kHz				
+/- 975 kHz	-25 dB	-25 dB	--25 dB	
≥ 1000 kHz	-25 dB	-39 dB	-39 dB	

4.5 Distance Measuring Equipment (DME)

4.5.1 Frequency band and channel spacing

4.5.1.1 The DME operates on paired interrogation and reply frequencies (each combination of these frequencies is a "channel") in the frequency band 960 – 1215 MHz. A number of these channels are in turn paired with ILS or VOR frequencies. The DME channelling arrangement is shown in Appendix D. ~~[DOC9718, Vol 2, 5.3.1]~~

Note: The frequency band 960 – 1215 MHz is also used for TACAN. TACAN operates with the same channeling scheme as the DME and can be paired with a VOR (VOR/TAC). From the frequency assignment planning point of view TACAN is equivalent to DME.

4.5.1.2 The spacing between DME channels is 1MHz. DME X and Y channels with the same channel number use the same interrogator frequency but with different pulse coding. The reply frequency for the X and Y channel is different as well as the pulse coding. The Y channels reuse the reply frequencies within the interrogation frequency block (1025 – 1150 MHz).

4.5.2 ~~[DOC]~~ The Designated Operational Coverage (DOC) of the DME is normally as promulgated by States/Administrations. When the DME is associated with an ILS or a VOR, the DOC of the DME is normally not less than the DOC of the ILS or VOR. ~~[DOC9718, Vol, 5.2.1]~~

4.5.3 ~~[PFD limit]~~ The peak equivalent isotopically radiated power shall not be less than that required to ensure a peak pulse power density of ~~minus~~ -89 dBW/m^2 under all operational weather conditions at any point within coverage. Minus 111 dBW at the antenna corresponds to a power flux density of ~~minus~~ -89 dBW/m^2 at the mid-band frequency.

4.5.4 ~~[Facility code]~~ Information on the planning of identifications can be found in section 4.6.

4.5.5 Protection requirements

Notes: For frequency planning purposes,
1) There is no difference between DME/N and DME/P.
2) TACAN facilities are treated in the same way as DME stations.
3) No criteria are defined for DME/W and DME/Z.

4.5.5.1 The necessary desired to undesired (D/U) signal ratios needed to protect the desired transponder reply signal at an airborne receiver from the various co-frequency/adjacent frequency, same code/different code, undesired transponder reply signal combinations that may exist. ~~[ANN10, Vol 1, Attachment C, 7.1.8.1]~~

4.5.5.2 The prerequisite for any D/U calculation to be valid is that the minimum signal of the (desired) DME (-111 dBW) at the aircraft antenna is achieved at all points throughout the coverage.

4.5.5.3 In making an assignment, each DME facility must be treated as the desired source with the other acting as the undesired. If both satisfy their unique D/U requirement, then the channel assignment may be made. This "reverse" check is necessary if the DME facilities being considered radiate with different EIRP or have a different DOC. ~~[DOC9718, Vol 2, 5.7.7.1]~~

4.5.5.4 To each X or Y DME channel corresponds a specific reply frequency within the band 960 - 1215 MHz. X and Y DME channels do not have reply frequencies in common. Hence, for the protection of the desired transponder replies from other co-channel transponder replies, it is sufficient to consider only DME facilities with the same channel designation (including the pulse code). However, for DME facilities operating on Y channels, the reply frequency may be the same as the interrogator frequency of another DME X facility. ~~[DOC9718, Vol 2, 5.7.1.3]~~

4.5.5.5 For co-channel assignments, the D/U signal ratio should be at least 8 dB throughout the service volume. ~~[ANN10, Vol 1, Attachment D, 7.1.8.2]~~

4.5.5.6 For Adjacent frequency assignments, the minimum required D/U ratio within the operational service volume shall be in accordance with the values given in Table 4.15~~Table 4.16~~. ~~[ANN10, Vol 1, Attachment D, 7.1.8.2]~~

The following values are assumed for the adjacent-channel emissions of the transponder (P_u):
200 mW (-7 dBW) on the first adjacent frequency;
2 mW (-27 dBW) on the second adjacent frequency.

Table 4.15~~16~~ Protection criteria for the DME Ground Station (Interrogator)~~Minimum separation distances between the DME Ground Station~~

Type of assignment	A	B
Co-frequency:		
Same pulse code	8	8
Different pulse code	8	-43
First adjacent frequency:		
Same pulse code	- (P_u - 1)	-42

Different pulse code	- (P_u + 7)	-75
Second adjacent frequency: Same pulse code Different pulse code	 - (P_u + 19) - (P_u + 27)	 -75 -75

Note 1: The D/U ratios in column A protect those DME/N interrogators operating on X or Y channels. Column A applies to decoder rejection of 6 microseconds.

Note 2: The D/U ratios in column B protect those DME/N or DME/P interrogators utilizing discrimination in conformance with 3.5.5.3.4.2 and 3.5.5.3.4.3 of Chapter 3, Annex 10, Volume I and providing a decoder rejection conforming to 3.5.5.3.5 of Chapter 3. Annex 10, Volume I

Note 3: Pu is the peak effective radiated power of the undesired signal in dBW.

Note 4: The frequency protection requirement is dependent upon the antenna patterns of the desired and undesired facility and the EIRP of the undesired facility.

Note 5: In assessing adjacent channel protection, the magnitude of D/U ratio in column A should not exceed the magnitude of the value in column B.

4.5.5.7 Separation requirement for DME reply frequencies which are separated by 63MHz. The channel assignment plan for DME is such that the transponder reply frequency for each Y channel is the same as the interrogation frequency of another DME channel. When the reply frequency of one DME matches the interrogation frequency of a second DME, a minimum separation distance of 15 NM (28km) between these (ground) facilities would be required, in general.

4.5.5.8 Table 4.16~~Table 4.17~~ to Table 4.18~~Table 4.19~~ present the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) DME and the location of the (undesired) DME.

Table 4.16~~17~~ Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DEM at 45000 ft**
0	8	146	256	149	260	156	265	co-channel
1	8	112	3	112	3	112	3	first adjacent channel
63			15		15		15	

Table 4.17~~18~~ Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DME at 25000 ft**
0	8	146	197	149	200	156	204	co-channel
1	8	112	6	112	6	112	6	first adjacent channel
63			15		15		15	

Table 4.18~~19~~ Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DME at 10000 ft**
0	8	146	131	149	133	156	137	co-channel
1	8	112	5	112	5	112	5	first adjacent channel
63			15		15		15	

Note1: The separation distances are between the edge of coverage for a desired DME and the location of an undesired DME. The EIRP of the undesired DME is as specified in column "Tx".

Note2: ITU-R aeronautical propagation curve for 1080 MHz and 5% of the time. The antenna height of the desired aircraft receiver is indicated in the "Remarks" column, and the antenna height of undesired DME is20 ft.

4.5.6 Sectorized DOC of the DME. ~~[DOC9718, Vol 2, 5.11]~~

4.5.6.1 Similar to VOR (as described in section 4.3), the DME DOC may be sectorized (instead of circular). In this case, compatibility of the DME with other DME assignments needs to be assured at the critical point which is the closest point of the DOC of the desired DME (with sectorized DOC) and any potential interfering DME transponder.

4.5.7 Use of directional antenna. ~~[DOC9718, Vol 2, 5.12]~~

4.5.7.1 When omnidirectional DOC is not required, the use of a DME with directional antenna is encouraged, subject to the proviso that the operational requirements for the service to be provided by this facility are met. In Particular, they are useful for the replacement of ILS marker beacons. The directional DME could provide a means to mitigate frequency congestion.

4.5.7.2 The compatibility of DMEs with directional antennas can be examined basically along the same lines as those developed for omnidirectional DME. However, because of the variable antenna gain of a DME with directional antenna, the value of the quantity K (EIRP of the desired minus the EIRP of the undesired facility) in the above formulas depends in general on the position of the airborne receiver. It is noted in particular that because of the orientation of a DME with directional antenna, the minimum D/U value is not necessarily attained along the direct line connecting desired and undesired facilities, as opposed to the case of compatibility between omnidirectional DME.

4.5.7.3 In the presence of at least one DME with directional antenna, the following method should be applied. At first an appropriate number of points is selected along the edge of the DOC of the desired DME, regardless of the type of its antenna. Subsequently at all such points the required D/U criteria are checked. Compatibility is ensured if at all such points the required D/U criteria are met.

4.6 Identifications of Radio Navigation Aids

4.6.1 Identifications of navigation aids shall be so composed, if possible, as to facilitate association with the name of the point in plain language. The Table 4.19~~Table 4.20~~ provides an overview of the requirements which have to be taken into account for identifications.

Table 4.19~~20~~ The requirements have to be taken into account for identifications

Facility	Identification	Remarks
NDB and Locator	2 or 3 letters of the International Morse Code.	
ILS	2 or 3 letters of the International Morse Code which may be preceded by the letter I.	Transmitted by the localizer.
ILS/DME	ILS: 2 or 3 letters of the International Morse Code which may be preceded by the letter I. DME: Identical to associated ILS.	Associated DME identification signal.
VOR	2 or 3 letters of the International Morse Code.	
VOR/DME (VOR/TACAN also called VORTAC)	VOR: 2 or 3 letters of the International Morse Code. DME: Identical to associated VOR.	Associated DME identification signal.
DME (TACAN)	Letters and numerals of the International Morse Code.	Independent DME identification signal for stand-alone DME facility.
GBAS	4 characters (Only upper-case letters, numeric digits and IA-5 “space” are used. The rightmost character is transmitted first. For a three-character GBAS ID, the rightmost (first transmitted) character shall be IA-5 “space”.)	The GBAS ID is normally identical to the location indicator at the nearest aerodrome

4.6.2 The identification TST is reserved for radio navigation facilities on test and should not be used for other purposes.

4.6.3 Coded identification shall not be duplicated within 1 100 km (600 NM) of the location of the radio navigation aid concerned, except as noted hereunder. ~~[ANN11, Appendix 2, 2.2.2]~~

Note: When two radio navigation aids operating in different bands of the frequency spectrum are situated at the same location, their radio identifications are normally the same.

4.6.4 States/Administrations’ requirements for identifications shall be notified to the Regional Offices for coordination.

Appendix A

TEMPLATE FOR AN EXCEL OR WORD FILE THAT CAN BE USED FOR ELECTRONIC SUBMISSION OF ONE (OR MORE) NEW OR MODIFIED FREQUENCY ASSIGNMENTS FOR NAV SYSTEMS TO THE REGIONAL OFFICE

Essential characteristics should to be included in the submission to the Regional Office:

Country	
Location	
Latitude	
Longitude	
Frequency	
Channel	
VHFDOC	
VHFPwr	
DMEDOC	
DMEPwr	
Cat	
Remarks	
TRD	

In the table, the following format should be used:

Country — Country name as per ICAO directory

Location — Name of the location of the NAV facility

Latitude — Latitude in the format xxDyy'zz'' (e.g. 32D44'55'')

Longitude — Longitude in the format xxxDyy'zz'' (e.g.054D55'56'')

Facility — Select one of the following facilities

- ILS
- ILS/DME
- VOR
- VOR/DME
- DME
- TACAN
- GBAS

Frequency — xxx.yyy (e.g. 109.200 or 113.450) [MHz]

A frequency can be proposed by a State or selected by the Regional Office and is subject to a compatibility assessment with or frequency assignments in the COM list 2

Channel — DME channel (e.g. 36X or 45Y)

VHFDOC — xxx/yyy e.g. 200/250 — xxx is the range of the coverage (e.g. 200 is 200 NM); yyy is the height (FL) of the coverage (e.g. 250 is FL 250 or 25000ft)

DMEDOC — xxx/yyy e.g. 200/250 — xxx is the range of the DME coverage (e.g. 200 is 200 NM); yyy is the height (FL) of the DME coverage (e.g. 250 is FL 250 or 25000ft)

Remarks — Optional, as provided by the State

Cat — Category; either ICAO or NAT

VHFPwr — As provided by the State

DMEPwr — As provided by the State

Note: The values for VHFPwr and DMEPwr are for the effective isotopically radiated power (e.i.r.p) of the relevant facility. In the absence of such information, the following values are assumed in the frequency assignment planning process:

ILS/Localizer	30 dBW	
ILS/DME	27 dBW (e.i.r.p for the associated DME)	
VOR	Range <50 NM	e.i.r.p 17 dBW
	Range 50 – 100 NM	e.i.r.p 20 dBW
	Range 100 – 150 NM	e.i.r.p 23 dBW
	Range > 150 NM	e.i.r.p 30 dBW
VOR/DME	Range <50 NM	e.i.r.p 27 dBW (landing DME)
	Range 150 -150 NM	e.i.r.p 30 dBW (terminal DME
	Rnage >150 NM	e.i.r.p 37 dBW (en route DME)
DME only	as for DME associated with VOR.	

Note: The e.i.r.p values for DME apply also for TACAN facilities

TRD Runway azimuth

Note: If no TRD, circler coverage assumed.

Appendix B

PREFERRED FORMAT OF THE CHARACTERISTICS OF SUBMISSIONS

Reference of submission:

Date:

Subject: Application for xx, at xx (location name)

Contact information of the civil aviation authority of States

Suggested basic information of a submission:

Function of the proposed assignments,

Details of the facility: VHF-COM, ILS, VOR, GBAS~~Manufacturer & Model (if possible)~~, DME,

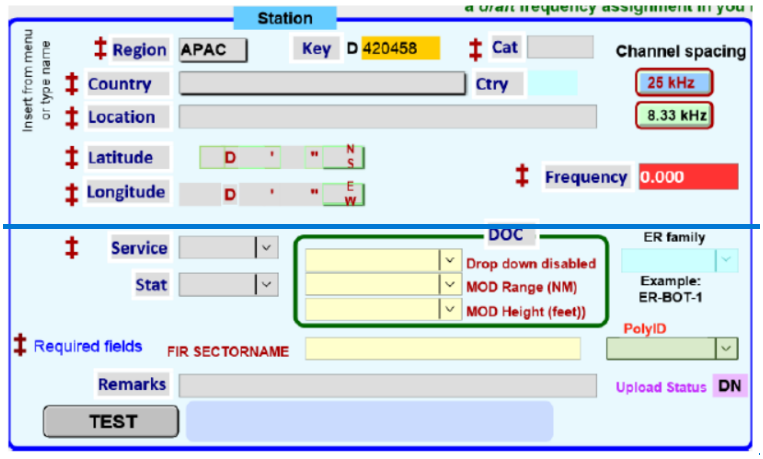
Frequency Range (if request RO for proposal) or proposed frequency,

~~Transmit Power or DOC~~Transmit Power (EIRP) and DOC,

Latitude/Longitude:

Minimum information required with reference to the following screenshot:

Country, Location, Latitude/Longitudes, Service.



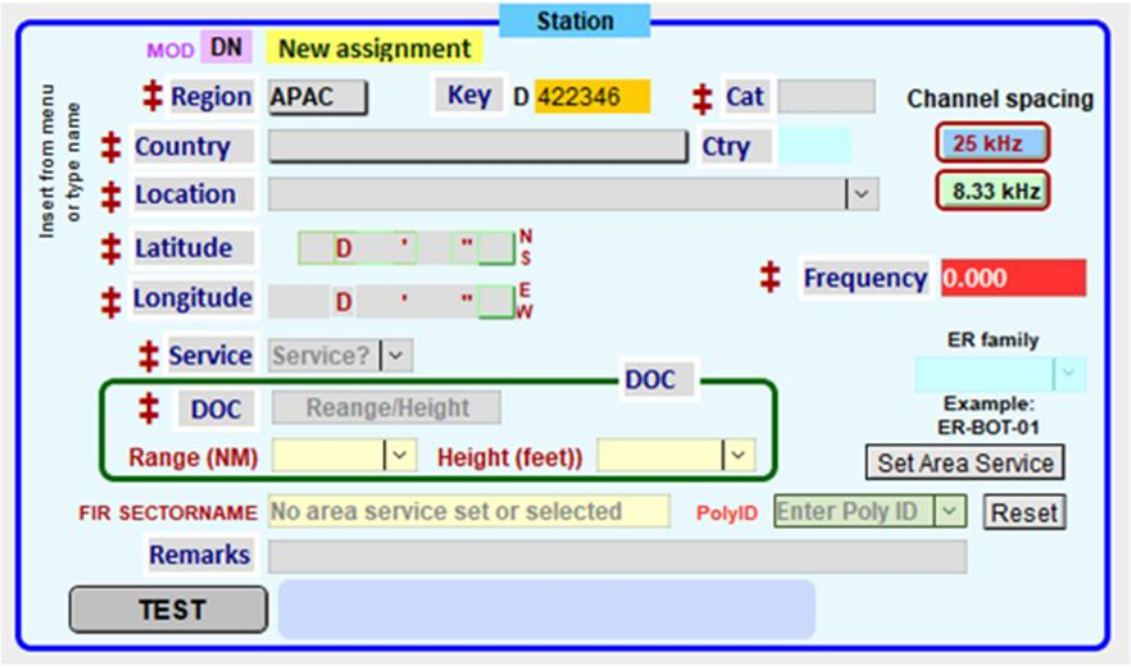


Fig. 1 VHF COM

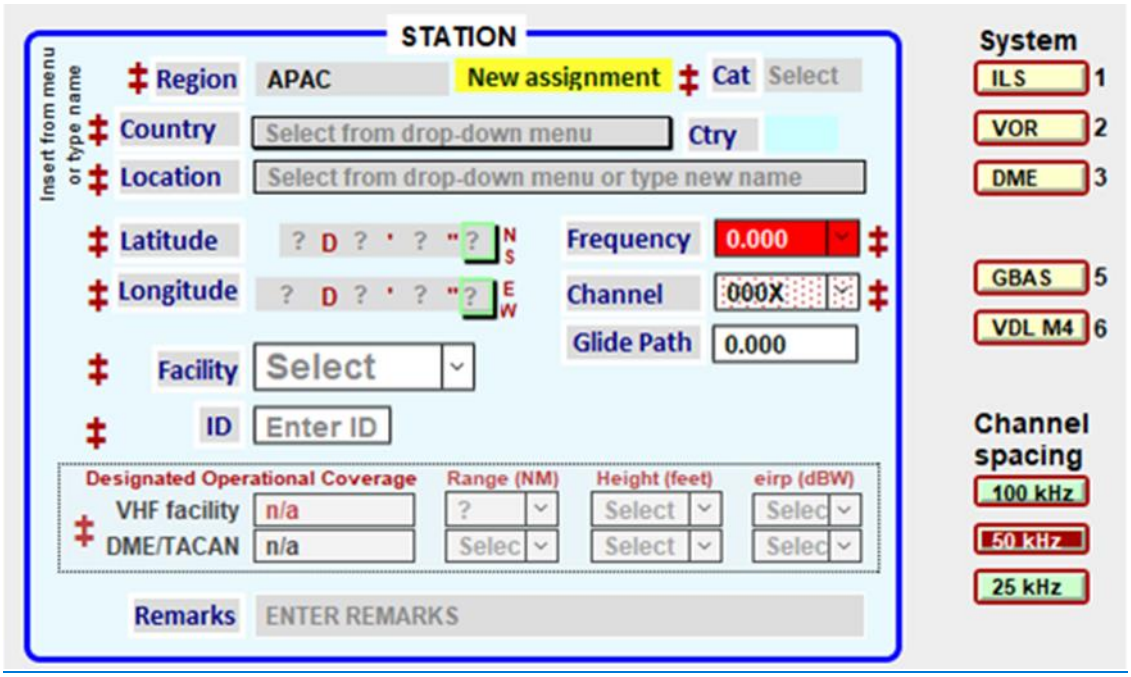


Fig. 2 VHF NAV

Appendix C

REGIONAL 117.975-137MHz FREQUENCY ALLOTMENT PLAN

Function	Frequencies (MHz)
TWR	118.000 118.025 118.050 118.075 118.100 118.125 118.150 118.175 118.200 118.225 118.250 118.275 118.300 118.325 118.350 118.375 118.400 118.425 118.450 118.475 118.500 118.525 118.550 118.575 118.600 118.625 118.650 118.675 118.700 118.725 118.750 118.775 118.800 118.825 118.850 118.875 124.300 124.325 124.350 124.375
AS	**121.550 121.575** 121.600 121.625 121.650 121.675 121.700 121.725 121.750 121.775 121.800 121.825 121.850 121.875 121.900 121.925 121.950 121.975
APP	119.500 119.525 119.550 119.575 119.600 119.625 119.650 119.675 119.800 119.825 119.850 119.875 119.900 119.925 119.950 119.975
APP-L, APP-I, Also used for APP Direction finding or APP Surveillance radar	119.000 119.025 119.050 119.075 119.100 119.125 119.150 119.175 119.200 119.225 119.250 119.275 119.400 119.425 119.450 119.475 119.700 119.725 119.750 119.775 120.000 120.025 120.050 120.075 120.200 120.225 120.250 120.275 120.400 120.425 120.450 120.475 120.600 120.625 120.650 120.675 120.800 120.825 120.850 120.875 121.000 121.025 121.050 121.075 121.100 121.125 121.150 121.175 121.200 121.225 121.250 121.275 121.400 **121.425 121.450** 123.800 123.825 123.850 123.875 124.000 124.025 124.050 124.075 124.700 124.725 124.750 124.775 125.100 125.125 125.150 125.175 125.500 125.525 125.550 125.575 126.500 126.525 126.550 126.575 127.700 127.725 127.750 127.775 127.900 127.925 127.950 127.975
APP-U	120.300 120.325 120.350 120.375 121.300 121.325 121.350 121.375 124.200 124.225 124.250 124.275 124.400 124.425 124.450 124.475

	124.600 124.625 124.650 124.675 124.800 124.825 124.850 124.875 125.000 125.025 125.050 125.075 125.200 125.225 125.250 125.275 125.400 125.425 125.450 125.475 125.600 125.625 125.650 125.675 125.800 125.825 125.850 125.875 126.000 126.025 126.050 126.075 126.300 126.325 126.350 126.375
ACC L Also used for ACC L Surveillance Radar	126.100 126.125 126.150 126.175 127.500 127.525 127.550 127.575 128.300 128.325 128.350 128.375 128.700 128.725 128.750 128.775
ACC U ACC L	118.900 118.925 118.950 118.975 119.300 119.325 119.350 119.375 120.500 120.525 120.550 120.575 120.700 120.725 120.750 120.775 120.900 120.925 120.950 120.975 123.700 123.725 123.750 123.775 124.500 124.525 124.550 124.575 125.300 125.325 125.350 125.375 125.700 125.725 125.750 125.775 125.900 125.925 125.950 125.975 128.100 128.125 128.150 128.175 132.050 132.075 132.100 132.125 132.150 132.175 132.200 132.225 132.250 132.275 132.300 132.325 132.350 132.375 132.400 132.425 132.450 132.475 132.500 132.525 132.550 132.575 132.600 132.625 132.650 132.675 132.700 132.725 132.750 132.775 132.800 132.825 132.850 132.875 132.900 132.925 132.950 132.975 133.000 133.025 133.050 133.075 133.100 133.125 133.150 133.175 133.200 133.225 133.250 133.275 133.300 133.325 133.350 133.375 133.400 133.425 133.450 133.475 133.500 133.525 133.550 133.575 133.600 133.625 133.650 133.675 133.700 133.725 133.750 133.775 133.800 133.825 133.850 133.875 133.900 133.925 133.950 133.975 134.000 134.025 134.050 134.075 134.100 134.125 134.150 134.175 134.200 134.225 134.250 134.275 134.300 134.325 134.350 134.375 134.400 134.425 134.450 134.475 134.500 134.525 134.550 134.575 135.825 135.850 135.875 135.900 135.925 135.950 135.975
FIS L FIS U	120.100 120.125 120.150 120.175 123.900 123.925 123.950 123.975

	~~124.100 124.125 124.150 124.175~~ ~~124.900 124.925 124.950 124.975~~ ~~126.700 126.725 126.750 126.775~~ ~~126.900 126.925 126.950 126.975~~ ~~127.100 127.125 127.150 127.175~~ ~~127.300 127.325 127.350 127.375~~ ~~128.500 128.525 128.550 128.575~~
~~FIS-U~~ ~~Also used for General purpose communications~~	~~134.600 134.625 134.650 134.675~~ ~~134.700 134.725 134.750 134.775~~ ~~134.800 134.825 134.850 134.875~~ ~~134.900 134.925 134.950 134.975~~ ~~135.000 135.025 135.050 135.075~~ ~~135.100 135.125 135.150 135.175~~ ~~135.200 135.225 135.250 135.275~~ ~~135.300 135.325 135.350 135.375~~ ~~135.400 135.425 135.450 135.475~~ ~~135.500 135.525 135.550 135.575~~ ~~135.600 135.625 135.650 135.675~~ ~~135.700 135.725 135.750 135.775~~ ~~135.800~~
~~VOLMET/ATIS~~	~~126.200 126.225 126.250 126.275~~ ~~126.400 126.425 126.450 126.475~~ ~~126.600 126.625 126.650 126.675~~ ~~126.800 126.825 126.850 126.875~~ ~~127.000 127.025 127.050 127.075~~ ~~127.200 127.225 127.250 127.275~~ ~~127.400 127.425 127.450 127.475~~ ~~127.600 127.625 127.650 127.675~~ ~~127.800 127.825 127.850 127.875~~ ~~128.000 128.025 128.050 128.075~~ ~~128.200 128.225 128.250 128.275~~ ~~128.400 128.425 128.450 128.475~~ ~~128.600 128.625 128.650 128.675~~ ~~128.800 128.825 128.850 128.875~~
~~AOC~~	~~128.900 132.025~~
~~DATA LINK~~	~~136.000 136.975~~
~~AIR-TO-AIR~~	~~123.450 128.950 (TIBA)~~
~~NOT ALLOTED~~	~~122.000 123.675~~

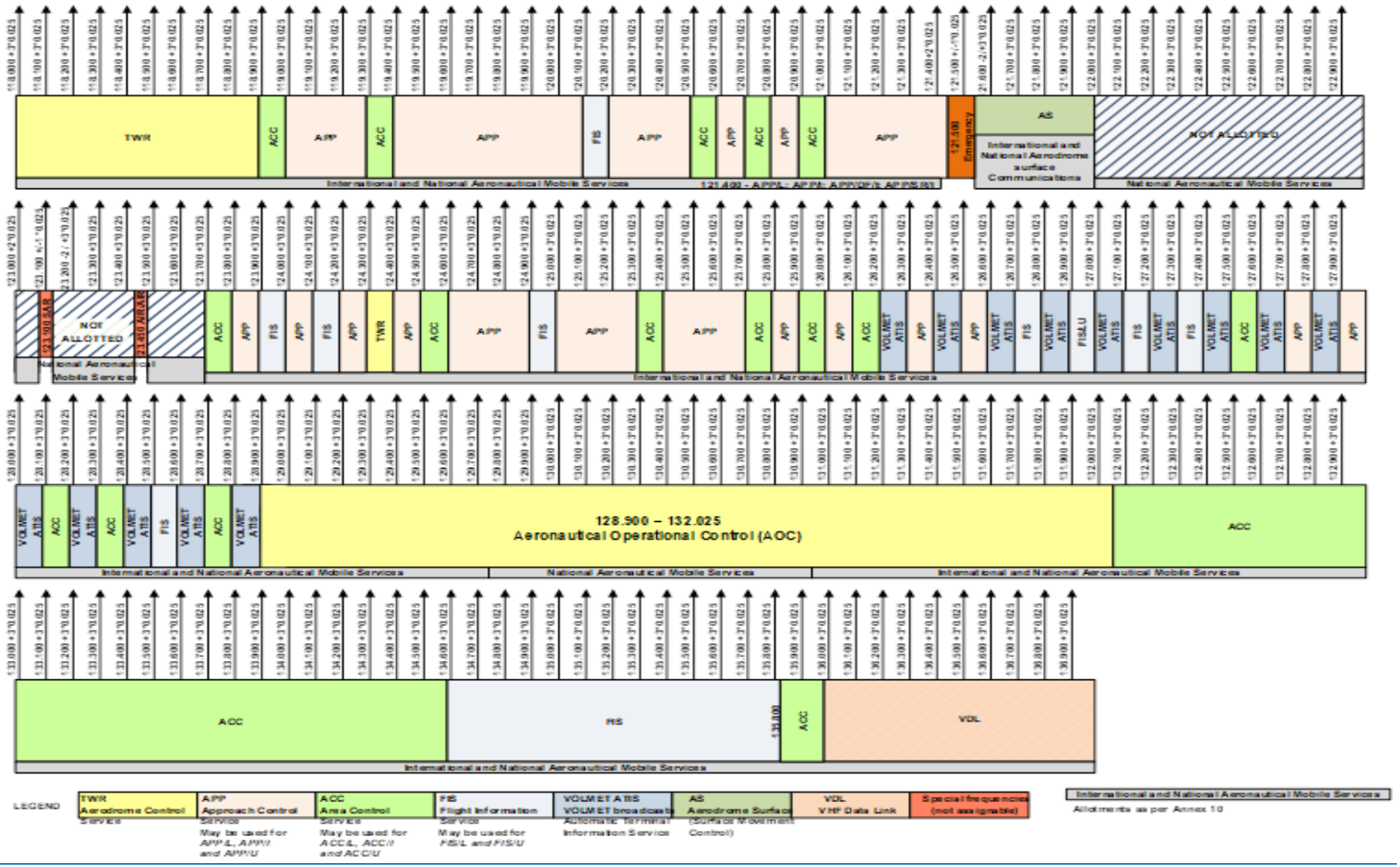
Function	**Frequencies (MHz)**
TWR 118.000-118.875MHz 124.300-124.375MHz	118.000 118.025 118.050 118.075 118.100 118.125 118.150 118.175 118.200 118.225 118.250 118.275 118.300 118.325 118.350 118.375 118.400 118.425 118.450 118.475 118.500 118.525 118.550 118.575 118.600 118.625 118.650 118.675 118.700 118.725 118.750 118.775 118.800 118.825 118.850 118.875 124.300 124.325 124.350 124.375
AS 121.550-121.975MHz	**121.550 121.575** 121.600 121.625 121.650 121.675 121.700 121.725 121.750 121.775 121.800 121.825 121.850 121.875 121.900 121.925 121.950 121.975

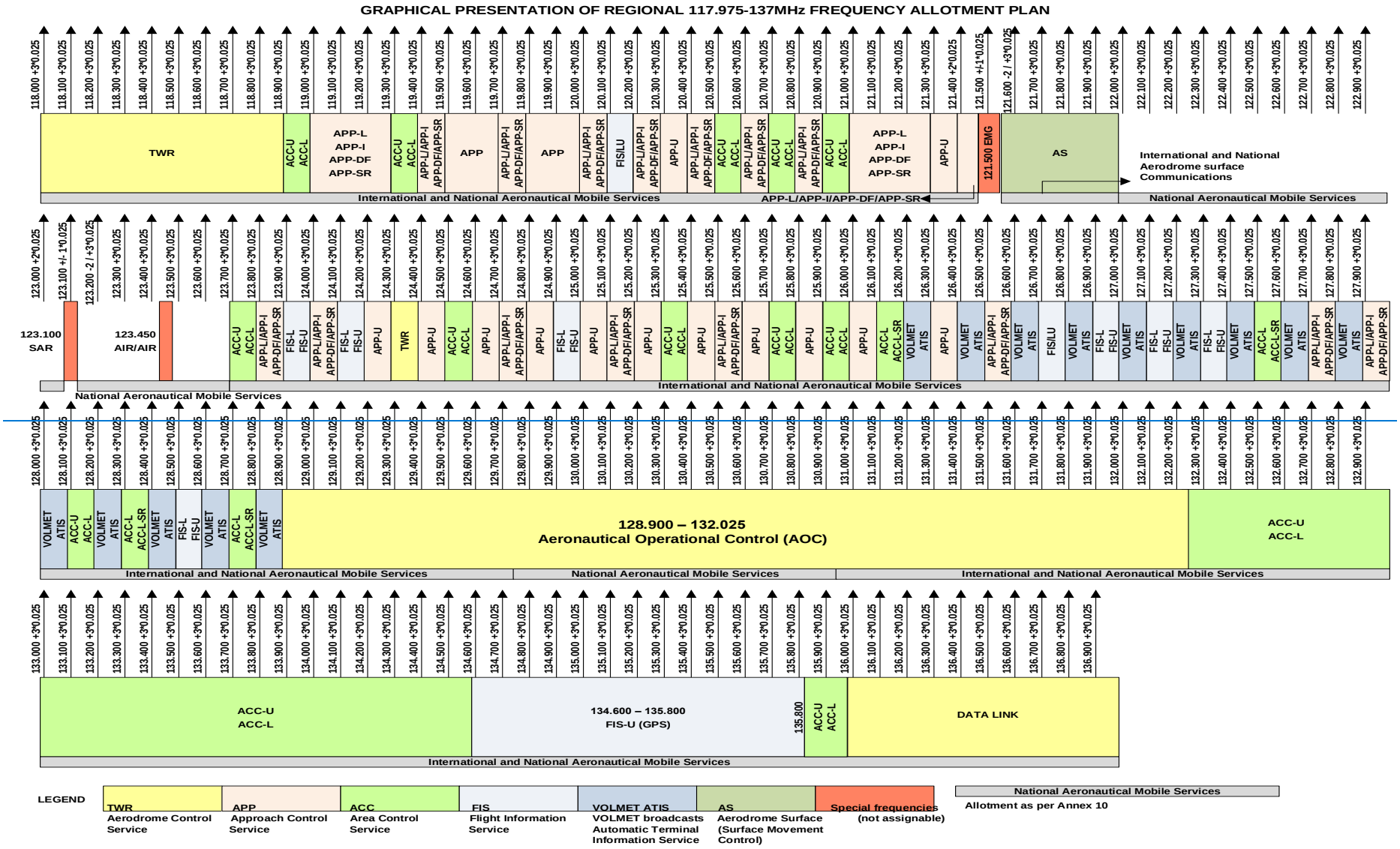
APP 119.000-119.275MHz 119.400-120.075MHz 120.200-120.475MHz	119.500 119.525 119.550 119.575 119.600 119.625 119.650 119.675 119.800 119.825 119.850 119.875 119.900 119.925 119.950 119.975
120.600-120.675MHz 120.800-120.875MHz 121.000-121.450MHz 123.800-123.875MHz 124.000-124.075MHz 124.200-124.275MHz 124.400-124.475MHz 124.600-124.875MHz 125.000-125.275MHz 125.400-125.675MHz 125.800-125.875MHz 126.000-126.075MHz 126.300-126.375MHz 126.500-126.575MHz 127.700-127.775MHz 127.900-127.975MHz	119.100 119.125 119.150 119.175 119.200 119.225 119.250 119.275 119.400 119.425 119.450 119.475 119.700 119.725 119.750 119.775 120.000 120.025 120.050 120.075 120.200 120.225 120.250 120.275 120.400 120.425 120.450 120.475 120.600 120.625 120.650 120.675 120.800 120.825 120.850 120.875 121.000 121.025 121.050 121.075 121.100 121.125 121.150 121.175 121.200 121.225 121.250 121.275 121.400 **121.425 121.450** 123.800 123.825 123.850 123.875 124.000 124.025 124.050 124.075 124.700 124.725 124.750 124.775 125.100 125.125 125.150 125.175 125.500 125.525 125.550 125.575 126.500 126.525 126.550 126.575 127.700 127.725 127.750 127.775 127.900 127.925 127.950 127.975
	120.300 120.325 120.350 120.375 121.300 121.325 121.350 121.375 124.200 124.225 124.250 124.275 124.400 124.425 124.450 124.475 124.600 124.625 124.650 124.675 124.800 124.825 124.850 124.875 125.000 125.025 125.050 125.075 125.200 125.225 125.250 125.275 125.400 125.425 125.450 125.475 125.600 125.625 125.650 125.675 125.800 125.825 125.850 125.875 126.000 126.025 126.050 126.075 126.300 126.325 126.350 126.375
ACC 118.900-118.975MHz 119.300-119.375MHz 120.500-120.575MHz	126.100 126.125 126.150 126.175 127.500 127.525 127.550 127.575 128.300 128.325 128.350 128.375 128.700 128.725 128.750 128.775
120.700-120.775MHz 120.900-120.975MHz 123.700-123.775MHz 124.500-124.575MHz 125.300-125.375MHz 125.700-125.775MHz 125.900-125.975MHz 126.100-126.175MHz 127.500-127.575MHz 128.100-128.175MHz 128.300-128.375MHz 128.700-128.775MHz	118.900 118.925 118.950 118.975 119.300 119.325 119.350 119.375 120.500 120.525 120.550 120.575 120.700 120.725 120.750 120.775 120.900 120.925 120.950 120.975 123.700 123.725 123.750 123.775 124.500 124.525 124.550 124.575 125.300 125.325 125.350 125.375 125.700 125.725 125.750 125.775 125.900 125.925 125.950 125.975 128.100 128.125 128.150 128.175 132.050 132.075

132.050-134.575MHz 135.825-135.975MHz	132.100 132.125 132.150 132.175 132.200 132.225 132.250 132.275 132.300 132.325 132.350 132.375 132.400 132.425 132.450 132.475 132.500 132.525 132.550 132.575 132.600 132.625 132.650 132.675 132.700 132.725 132.750 132.775 132.800 132.825 132.850 132.875 132.900 132.925 132.950 132.975 133.000 133.025 133.050 133.075 133.100 133.125 133.150 133.175 133.200 133.225 133.250 133.275 133.300 133.325 133.350 133.375 133.400 133.425 133.450 133.475 133.500 133.525 133.550 133.575 133.600 133.625 133.650 133.675 133.700 133.725 133.750 133.775 133.800 133.825 133.850 133.875 133.900 133.925 133.950 133.975 134.000 134.025 134.050 134.075 134.100 134.125 134.150 134.175 134.200 134.225 134.250 134.275 134.300 134.325 134.350 134.375 134.400 134.425 134.450 134.475 134.500 134.525 134.550 134.575 135.825 135.850 135.875 135.900 135.925 135.950 135.975
FIS 120.100-120.175MHz 123.900-123.975MHz 124.100-124.175MHz 124.900-124.975MHz 126.700-126.775MHz 126.900-126.975MHz 127.100-127.175MHz 127.300-127.375MHz 128.500-128.575MHz 134.600-135.800MHz	120.100 120.125 120.150 120.175 123.900 123.925 123.950 123.975 124.100 124.125 124.150 124.175 124.900 124.925 124.950 124.975 126.700 126.725 126.750 126.775 126.900 126.925 126.950 126.975 127.100 127.125 127.150 127.175 127.300 127.325 127.350 127.375 128.500 128.525 128.550 128.575
	134.600 134.625 134.650 134.675 134.700 134.725 134.750 134.775 134.800 134.825 134.850 134.875 134.900 134.925 134.950 134.975 135.000 135.025 135.050 135.075 135.100 135.125 135.150 135.175 135.200 135.225 135.250 135.275 135.300 135.325 135.350 135.375 135.400 135.425 135.450 135.475 135.500 135.525 135.550 135.575 135.600 135.625 135.650 135.675 135.700 135.725 135.750 135.775 135.800
VOLMET/ATIS 126.200-126.275MHz 126.400-126.475MHz 126.600-126.675MHz 126.800-126.875MHz	126.200 126.225 126.250 126.275 126.400 126.425 126.450 126.475 126.600 126.625 126.650 126.675 126.800 126.825 126.850 126.875 127.000 127.025 127.050 127.075

127.000-127.075MHz 127.200-127.275MHz 127.400-127.475MHz 127.600-127.675MHz 127.800-127.875MHz 128.000-128.075MHz 128.200-128.275MHz 128.400-128.475MHz 128.600-128.675MHz 128.800-128.875MHz	127.200 127.225 127.250 127.275 127.400 127.425 127.450 127.475 127.600 127.625 127.650 127.675 127.800 127.825 127.850 127.875 128.000 128.025 128.050 128.075 128.200 128.225 128.250 128.275 128.400 128.425 128.450 128.475 128.600 128.625 128.650 128.675 128.800 128.825 128.850 128.875
AOC	128.900-132.025(Except 128.950MHz)
DATA LINK	136.000-136.975
AIR-TO-AIR	123.450 128.950 (TIBA)
NOT ALLOTED	122.000-123.675(Except 123.100MHz, 123.450MHz)

Note: In Australia, Myanmar, New Zealand, Thailand the frequency of 128.950 MHz has been allotted to TIBA.


TWR
ACC
APP
FIS
121.500 Emergency
AS
International and National Aerodrome surface Communications
NOT ALLOTTED
International and National Aeronautical Mobile Services
121.400 - APP/A - APP/I - APP/D/S APP/S/I
NOT ALLOTTED
121.900 AAR
121.400 AIR/AS
National Aeronautical Mobile Service
TWR
VOLMET ATIS
FIS/LU
128.900 – 132.025
Aeronautical Operational Control (AOC)
RIS
VDL
LEGEND
TWR Aerodrome Control Service
APP Approach Control Service May be used for APP/L, APP/I and APP/U
ACC Area Control Service May be used for ACC/L, ACC/I and ACC/U
FIS Flight Information Service May be used for FIS/L and FIS/U
VOLMET ATIS VOLMET broadcasts Automatic Terminal Information Service
AS Aerodrome Surface (Surface Movement Control)
VDL VHF Data Link
Special frequencies (not assignable)
International and National Aeronautical Mobile Services
Allotments as per Annex 10


GRAPHICAL PRESENTATION OF REGIONAL 117.975-137MHz FREQUENCY ALLOTMENT PLAN
TWR
APP-L APP-I APP-DF APP-SR
APP
FIS/LU
APP-U
121.500 EMG
AS
International and National Aerodrome surface Communications
International and National Aeronautical Mobile Services
APP-L/APP-I/APP-DF/APP-SR
National Aeronautical Mobile Services
123.100 SAR
123.450 AIR/AIR
National Aeronautical Mobile Services
International and National Aeronautical Mobile Services
128.900 – 132.025
Aeronautical Operational Control (AOC)
ACC-U ACC-L
International and National Aeronautical Mobile Services
National Aeronautical Mobile Services
International and National Aeronautical Mobile Services
ACC-U ACC-L
134.600 – 135.800
FIS-U (GPS)
135.800
DATA LINK
International and National Aeronautical Mobile Services
LEGEND
TWR
Aerodrome Control Service
APP
Approach Control Service
ACC
Area Control Service
FIS
Flight Information Service
VOLMET ATIS
VOLMET broadcasts Automatic Terminal Information Service
AS
Aerodrome Surface (Surface Movement Control)
Special frequencies (not assignable)
National Aeronautical Mobile Services
Allotment as per Annex 10

Appendix D

GENERIC CALCULATION METHOD FOR GEOGRAPHICAL SEPARATION DISTANCES

a. For the calculation of minimum separation distances with a (desired) facility and an (undesired) facility the generic model as described in Chapter 1 of DOC 9718 has been established.

b. To establish minimum geographical separation distances between a desired facility and an undesired facility, the following parameters are used:

a) The minimum received desired power Pd of the desired facility (dBW).
b) D/U ratio. The prerequisite for any D/U calculation to be valid is that the minimal receive power is achieved at all points throughout the coverage.
c) EIRP of the undesired facility Tx (dBW).
d) Designated operational range of the desired facility.
e) ITU-R aeronautical propagation curve for 5% of the time.

c. The generic method establishes the minimum geographical separation distance between the edge of the DOC of the desired facility and undesired facility. This distance provides for the transmission loss (attenuation) of the undesired signal to a level that meets the D/U requirement for the desired signal, L = Tx -Pd + D/U. This distance is obtained with using the relevant (frequency) ITU propagation curve applicable for the maximum height of the DOC of the desired facility and the site elevation of the undesired facility.

d. When the minimum distance from the edge of coverage from the desired facility to the undesired facility has been established, the station-to-station separation distance can be obtained by adding the DOR to the minimum distance from the edge of coverage to the undesired facility.

e. These steps need to be undertaken in the reverse direction whereby the desired facility becomes the undesired facility and the undesired facility becomes the desired facility. The maximum distance between the two processes determine the minimum separation between the two facilities.

Appendix E

PAIRING OF ILS/VOR/DME CHANNELS

Source: Annex 10, Volume 1, Table A			DME parameters					
			Interrogation				Reply	
				Pulse codes				
Channel pairing					DME/P mode			
DME channel number	VHF frequency MHz	GS frequency MHz	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
* 1X	–	–	1 025	12	–	–	962	12
** 1Y	–	–	1 025	36	–	–	1 088	30
* 2X	–	–	1 026	12	–	–	963	12
** 2Y	–	–	1 026	36	–	–	1 089	30
* 3X	–	–	1 027	12	–	–	964	12
** 3Y	–	–	1 027	36	–	–	1 090	30
* 4X	–	–	1 028	12	–	–	965	12
** 4Y	–	–	1 028	36	–	–	1 091	30
* 5X	–	–	1 029	12	–	–	966	12
** 5Y	–	–	1 029	36	–	–	1 092	30
* 6X	–	–	1 030	12	–	–	967	12
** 6Y	–	–	1 030	36	–	–	1 093	30
* 7X	–	–	1 031	12	–	–	968	12
** 7Y	–	–	1 031	36	–	–	1 094	30
* 8X	–	–	1 032	12	–	–	969	12
** 8Y	–	–	1 032	36	–	–	1 095	30
* 9X	–	–	1 033	12	–	–	970	12
** 9Y	–	–	1 033	36	–	–	1 096	30
* 10X	–	–	1 034	12	–	–	971	12
** 10Y	–	–	1 034	36	–	–	1 097	30
* 11X	–	–	1 035	12	–	–	972	12
** 11Y	–	–	1 035	36	–	–	1 098	30
* 12X	–	–	1 036	12	–	–	973	12
** 12Y	–	–	1 036	36	–	–	1 099	30
* 13X	–	–	1 037	12	–	–	974	12
** 13Y	–	–	1 037	36	–	–	1 100	30
* 14X	–	–	1 038	12	–	–	975	12
** 14Y	–	–	1 038	36	–	–	1 101	30

*	15X	–	–	1 039	12	–	–	976	12
**	15Y	–	–	1 039	36	–	–	1 102	30
*	16X	–	–	1 040	12	–	–	977	12
**	16Y	–	–	1 040	36	–	–	1 103	30
?	17X	108		1 041	12	–	–	978	12
	17Y	108.05		1 041	36	36	42	1 104	30
	18X	108.1	334.7	1 042	12	12	18	979	12
	18Y	108.15	334.55	1 042	36	36	42	1 105	30
	19X	108.2		1 043	12	–	–	980	12
	19Y	108.25		1 043	36	36	42	1 106	30
	20X	108.3	334.1	1 044	12	12	18	981	12
	20Y	108.35	333.95	1 044	36	36	42	1 107	30
	21X	108.4		1 045	12	–	–	982	12
	21Y	108.45		1 045	36	36	42	1 108	30
	22X	108.5	329.9	1 046	12	12	18	983	12
	22Y	108.55	329.75	1 046	36	36	42	1 109	30
	23X	108.6		1 047	12	–	–	984	12
	23Y	108.65		1 047	36	36	42	1 110	30
	24X	108.7	330.5	1 048	12	12	18	985	12
	24Y	108.75	330.35	1 048	36	36	42	1 111	30
	25X	108.8		1 049	12	–	–	986	12
	25Y	108.85		1 049	36	36	42	1 112	30
	26X	108.9	329.3	1 050	12	12	18	987	12
	26Y	108.95	329.15	1 050	36	36	42	1 113	30
	27X	109		1 051	12	–	–	988	12
	27Y	109.05		1 051	36	36	42	1 114	30
	28X	109.1	331.4	1 052	12	12	18	989	12
	28Y	109.15	331.25	1 052	36	36	42	1 115	30
	29X	109.2		1 053	12	–	–	990	12
	29Y	109.25		1 053	36	36	42	1 116	30
	30X	109.3	332.0	1 054	12	12	18	991	12
	30Y	109.35	331.85	1 054	36	36	42	1 117	30
	31X	109.4		1 055	12	–	–	992	12
	31Y	109.45		1 055	36	36	42	1 118	30

32X	109.5	332.6	1 056	12	12	18	993	12
32Y	109.55	332.45	1 056	36	36	42	1 119	30
33X	109.6		1 057	12	–	–	994	12
33Y	109.65		1 057	36	36	42	1 120	30
34X	109.7	333.2	1 058	12	12	18	995	12
34Y	109.75	333.05	1 058	36	36	42	1 121	30
35X	109.8		1 059	12	–	–	996	12
35Y	109.85		1 059	36	36	42	1 122	30
36X	109.9	333.8	1 060	12	12	18	997	12
36Y	109.95	333.65	1 060	36	36	42	1 123	30
37X	110		1 061	12	–	–	998	12
37Y	110.05		1 061	36	36	42	1 124	30
38X	110.1	334.4	1 062	12	12	18	999	12
38Y	110.15	334.25	1 062	36	36	42	1 125	30
39X	110.2		1 063	12	–	–	1 000	12
39Y	110.25		1 063	36	36	42	1 126	30
40X	110.3	335.0	1 064	12	12	18	1 001	12
40Y	110.35	334.85	1 064	36	36	42	1 127	30
41X	110.4		1 065	12	–	–	1 002	12
41Y	110.45		1 065	36	36	42	1 128	30
42X	110.5	329.6	1 066	12	12	18	1 003	12
42Y	110.55	329.45	1 066	36	36	42	1 129	30
43X	110.6		1 067	12	–	–	1 004	12
43Y	110.65		1 067	36	36	42	1 130	30
44X	110.7	330.2	1 068	12	12	18	1 005	12
44Y	110.75	330.05	1 068	36	36	42	1 131	30
45X	110.8		1 069	12	–	–	1 006	12
45Y	110.85		1 069	36	36	42	1 132	30
46X	110.9	330.8	1 070	12	12	18	1 007	12
46Y	110.95	330.65	1 070	36	36	42	1 133	30
47X	111		1 071	12	–	–	1 008	12
47Y	111.05		1 071	36	36	42	1 134	30
48X	111.1	331.7	1 072	12	12	18	1 009	12

	48Y	111.15	331.55	1 072	36	36	42	1 135	30
	49X	111.2		1 073	12	–	–	1 010	12
	49Y	111.25		1 073	36	36	42	1 136	30
	50X	111.3	332.3	1 074	12	12	18	1 011	12
	50Y	111.35	332.15	1 074	36	36	42	1 137	30
	51X	111.4		1 075	12	–	–	1 012	12
	51Y	111.45		1 075	36	36	42	1 138	30
	52X	111.5	332.9	1 076	12	12	18	1 013	12
	52Y	111.55	332.75	1 076	36	36	42	1 139	30
	53X	111.6		1 077	12	–	–	1 014	12
	53Y	111.65		1 077	36	36	42	1 140	30
	54X	111.7	333.5	1 078	12	12	18	1 015	12
	54Y	111.75	333.35	1 078	36	36	42	1 141	30
	55X	111.8		1 079	12	–	–	1 016	12
	55Y	111.85		1 079	36	36	42	1 142	30
	56X	111.9	331.1	1 080	12	12	18	1 017	12
	56Y	111.95	330.95	1 080	36	36	42	1 143	30
	57X	112		1 081	12	–	–	1 018	12
	57Y	112.05		1 081	36	–	–	1 144	30
	58X	112.1		1 082	12	–	–	1 019	12
	58Y	112.15		1 082	36	–	–	1 145	30
	59X	112.2		1 083	12	–	–	1 020	12
	59Y	112.25		1 083	36	–	–	1 146	30
**	60X	–		1 084	12	–	–	1 021	12
**	60Y	–		1 084	36	–	–	1 147	30
**	61X	–		1 085	12	–	–	1 022	12
**	61Y	–		1 085	36	–	–	1 148	30
**	62X	–		1 086	12	–	–	1 023	12
**	62Y	–		1 086	36	–	–	1 149	30
**	63X	–		1 087	12	–	–	1 024	12
**	63Y	–		1 087	36	–	–	1 150	30
**	64X	–		1 088	12	–	–	1 151	12
**	64Y	–		1 088	36	–	–	1 025	30

**	65X	–	1 089	12	–	–	1 152	12
**	65Y	–	1 089	36	–	–	1 026	30
**	66X	–	1 090	12	–	–	1 153	12
**	66Y	–	1 090	36	–	–	1 027	30
**	67X	–	1 091	12	–	–	1 154	12
**	67Y	–	1 091	36	–	–	1 028	30
**	68X	–	1 092	12	–	–	1 155	12
**	68Y	–	1 092	36	–	–	1 029	30
**	69X	–	1 093	12	–	–	1 156	12
**	69Y	–	1 093	36	–	–	1 030	30
	70X	112.3	1 094	12	–	–	1 157	12
**	70Y	112.35	1 094	36	–	–	1 031	30
	71X	112.4	1 095	12	–	–	1 158	12
**	71Y	112.45	1 095	36	–	–	1 032	30
	72X	112.5	1 096	12	–	–	1 159	12
**	72Y	112.55	1 096	36	–	–	1 033	30
	73X	112.6	1 097	12	–	–	1 160	12
**	73Y	112.65	1 097	36	–	–	1 034	30
	74X	112.7	1 098	12	–	–	1 161	12
**	74Y	112.75	1 098	36	–	–	1 035	30
	75X	112.8	1 099	12	–	–	1 162	12
**	75Y	112.85	1 099	36	–	–	1 036	30
	76X	112.9	1 100	12	–	–	1 163	12
**	76Y	112.95	1 100	36	–	–	1 037	30
	77X	113	1 101	12	–	–	1 164	12
**	77Y	113.05	1 101	36	–	–	1 038	30
	78X	113.1	1 102	12	–	–	1 165	12
**	78Y	113.15	1 102	36	–	–	1 039	30
	79X	113.2	1 103	12	–	–	1 166	12
**	79Y	113.25	1 103	36	–	–	1 040	30
	80X	113.3	1 104	12	–	–	1 167	12
	80Y	113.35	1 104	36	36	42	1 041	30
	81X	113.4	1 105	12	–	–	1 168	12
	81Y	113.45	1 105	36	36	42	1 042	30

82X	113.5	1 106	12	–	–	1 169	12
82Y	113.55	1 106	36	36	42	1 043	30
83X	113.6	1 107	12	–	–	1 170	12
83Y	113.65	1 107	36	36	42	1 044	30
84X	113.7	1 108	12	–	–	1 171	12
84Y	113.75	1 108	36	36	42	1 045	30
85X	113.8	1 109	12	–	–	1 172	12
85Y	113.85	1 109	36	36	42	1 046	30
86X	113.9	1 110	12	–	–	1 173	12
86Y	113.95	1 110	36	36	42	1 047	30
87X	114	1 111	12	–	–	1 174	12
87Y	114.05	1 111	36	36	42	1 048	30
88X	114.1	1 112	12	–	–	1 175	12
88Y	114.15	1 112	36	36	42	1 049	30
89X	114.2	1 113	12	–	–	1 176	12
89Y	114.25	1 113	36	36	42	1 050	30
90X	114.3	1 114	12	–	–	1 177	12
90Y	114.35	1 114	36	36	42	1 051	30
91X	114.4	1 115	12	–	–	1 178	12
91Y	114.45	1 115	36	36	42	1 052	30
92X	114.5	1 116	12	–	–	1 179	12
92Y	114.55	1 116	36	36	42	1 053	30
93X	114.6	1 117	12	–	–	1 180	12
93Y	114.65	1 117	36	36	42	1 054	30
94X	114.7	1 118	12	–	–	1 181	12
94Y	114.75	1 118	36	36	42	1 055	30
95X	114.8	1 119	12	–	–	1 182	12
95Y	114.85	1 119	36	36	42	1 056	30
96X	114.9	1 120	12	–	–	1 183	12
96Y	114.95	1 120	36	36	42	1 057	30
97X	115	1 121	12	–	–	1 184	12
97Y	115.05	1 121	36	36	42	1 058	30
98X	115.1	1 122	12	–	–	1 185	12

98Y	115.15	1 122	36	36	42	1 059	30
99X	115.2	1 123	12	–	–	1 186	12
99Y	115.25	1 123	36	36	42	1 060	30
100X	115.3	1 124	12	–	–	1 187	12
100Y	115.35	1 124	36	36	42	1 061	30
101X	115.4	1 125	12	–	–	1 188	12
101Y	115.45	1 125	36	36	42	1 062	30
102X	115.5	1 126	12	–	–	1 189	12
102Y	115.55	1 126	36	36	42	1 063	30
103X	115.6	1 127	12	–	–	1 190	12
103Y	115.65	1 127	36	36	42	1 064	30
104X	115.7	1 128	12	–	–	1 191	12
104Y	115.75	1 128	36	36	42	1 065	30
105X	115.8	1 129	12	–	–	1 192	12
105Y	115.85	1 129	36	36	42	1 066	30
106X	115.9	1 130	12	–	–	1 193	12
106Y	115.95	1 130	36	36	42	1 067	30
107X	116	1 131	12	–	–	1 194	12
107Y	116.05	1 131	36	36	42	1 068	30
108X	116.1	1 132	12	–	–	1 195	12
108Y	116.15	1 132	36	36	42	1 069	30
109X	116.2	1 133	12	–	–	1 196	12
109Y	116.25	1 133	36	36	42	1 070	30
110X	116.3	1 134	12	–	–	1 197	12
110Y	116.35	1 134	36	36	42	1 071	30
111X	116.4	1 135	12	–	–	1 198	12
111Y	116.45	1 135	36	36	42	1 072	30
112X	116.5	1 136	12	–	–	1 199	12
112Y	116.55	1 136	36	36	42	1 073	30
113X	116.6	1 137	12	–	–	1 200	12
113Y	116.65	1 137	36	36	42	1 074	30
114X	116.7	1 138	12	–	–	1 201	12
114Y	116.75	1 138	36	36	42	1 075	30

	115X	116.8	1 139	12	–	–	1 202	12
	115Y	116.85	1 139	36	36	42	1 076	30
	116X	116.9	1 140	12	–	–	1 203	12
	116Y	116.95	1 140	36	36	42	1 077	30
	117X	117	1 141	12	–	–	1 204	12
	117Y	117.05	1 141	36	36	42	1 078	30
	118X	117.1	1 142	12	–	–	1 205	12
	118Y	117.15	1 142	36	36	42	1 079	30
	119X	117.2	1 143	12	–	–	1 206	12
	119Y	117.25	1 143	36	36	42	1 080	30
	120X	117.3	1 144	12	–	–	1 207	12
	120Y	117.35	1 144	36	–	–	1 081	30
	121X	117.4	1 145	12	–	–	1 208	12
	121Y	117.45	1 145	36	–	–	1 082	30
	122X	117.5	1 146	12	–	–	1 209	12
	122Y	117.55	1 146	36	–	–	1 083	30
	123X	117.6	1 147	12	–	–	1 210	12
	123Y	117.65	1 147	36	–	–	1 084	30
	124X	117.7	1 148	12	–	–	1 211	12
**	124Y	117.75	1 148	36	–	–	1 085	30
	125X	117.8	1 149	12	–	–	1 212	12
**	125Y	117.85	1 149	36	–	–	1 086	30
	126X	117.9	1 150	12	–	–	1 213	12
**	126Y	117.95	1 150	36	–	–	1 087	30

* These channels are reserved exclusively for national allotments.

** These channels may be used for national allotment on a secondary basis.

The primary reason for reserving these channels is to provide protection for the secondary surveillance radar (SSR) system.

108.0 MHz is not scheduled for assignment to ILS service. The associated DME operating channel No. 17X may be assigned for emergency use. The reply frequency of channel No. 17X (i.e. 978 MHz) is also utilized for the operation of the universal access transceiver (UAT). Standards and Recommended Practices for UAT are found in Annex 10, Volume III, Part I, Chapter 12.

Asia/Pacific Regional Frequency Management Manual

Edition 1.1

International Civil Aviation Organization

AMENDMENTS

Amendments are announced in the supplements to the *Publications Catalogue*; the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS, CORRIGENDA AND ADDENDA

AMENDMENTS		
No.	Date	Entered by
1.1	**TBD**	**ICAO APAC Regional office**

CORRIGENDA / ADDENDA		
No.	Date	Entered by

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ABBREVIATIONS

AAC	Aeronautical Administrative Communications
ACC	Area Control Centre
ADF	Automatic Direction Finder
AFIS	Aerodrome Flight Information Service
AM(R)S	Aeronautical Mobile (Route) Service
ANP	Air Navigation Plan (for APAC)
ANSP	Air Navigation Service Provider
AOC	Aeronautical Operational Control
APAC	Asia and Pacific
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APP	Approach Control Service
ARNS	Aeronautical Radionavigation Service
AS	Aerodrome Surface Communications
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Service
CAA	Civil Aviation Authority/Administration
CNS	Communications, Navigation and Surveillance
COM	Communications
CPM	Conference Preparatory Meetings (ITU)
CSC	Common Signaling Channel
D/U	Wanted/ Unwanted Signal Ratio
DME	Distance Measuring Equipment
DOC	Designated Operational Coverage
DOH	Designated Operational Height
DOR	Designated Operational Range
DVOR	Doppler VHF Omni-Directional Range
EIRP or e.i.r.p	Equivalent Isotopically Radiated Power or Effective Isotropic Radiated Power
FIS	Flight Information Service
FSMP	Frequency Spectrum Management Panel (successor of ACP WG/F (frequency))
GBAS	Ground-Based Augmentation System
GPIP	Glide Path Intersection Point
HF	High Frequency
ICAO	International Civil Aviation Organization
ICT	Information and Communication Technology
ILS	Instrument Landing System
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication Sector
LTP	Landing Threshold Point
MIFR	Master International Frequency Register (ITU)
MOPS	Minimum Operational Performance Standards
NDB	Non-directional Radio Beacon
NSP	Navigation Systems Panel (ICAO)
PAR	Precision Approach Radar
PIRGs	Planning and Implementation Groups
RR	Radio Regulations (ITU)

SARPs	Standards and Recommended Practices
SRWG	the Spectrum Review Working Group of APANPIRG
SST	The Supersonic Transport
TIBA	Traffic Information Broadcasts by Aircraft
TRD	True Radiation Direction
TWR	Aerodrome Control Tower
VDB	VHF Data Broadcast (used with GBAS)
VDL	VHF Digital Link
VHF	Very High Frequency
VOLMET	Meteorological Information for Aircraft in Flight
VOR	VHF Omnidirectional Radio Range
WRC	World Radiocommunication Conference (ITU)

Chapter 1

INTRODUCTION

This manual has been developed under a recommendation from the fourth meeting of the Spectrum Review Working Group (SRWG/4) of APANPIRG which was held via video conferencing from 09 to 10 June 2020. It is for States/Administrations in the APAC region to implement the frequency assignments in a coordinated manner with ANSP, CAA and national frequency Authorities to satisfy future operational needs or the introduction of new technologies, with emphasis on communication and navigation systems.

1.1 OBJECTIVE and SCOPE

1.1.1 Aeronautical services are recognized internationally to be prime users of radio frequencies. The civil aviation community must accordingly develop and present, as necessary, its agreed policies and its quantified and qualified statements of requirement for radio frequency spectrum to ensure the continuing availability of adequate radio spectrum and, ultimately, the ongoing viability of air navigation services throughout the world.

1.1.2 For the APAC Region, the Secretariat is developing, with the support of ICAO contracting states, materials to support frequency assignment planning in the region.

1.1.3 In accordance with above, the prime objectives of this document are:

a) to provide background information on the international spectrum management institutional framework.

b) to provide a convenient record for important frequency planning principles and coordination procedure.

c) to provide frequency assignment planning criteria to secure that aeronautical radio communication and navigation systems are protected from harmful interference on a uniform basis.

1.1.4 This manual describes general references in aeronautical frequency management of APAC region, including the introduction and relationships between the main participants, overview of the framework and process of aeronautical spectrum management, etc.

1.1.5 This manual is suitable for national authorities, telecommunication authorities (or telecommunication administrations), ATCs, aerodromes, and airlines which will manage or use aeronautical frequencies.

1.1.6 This manual is not intended to and shall not replace the relevant requirements stipulated in Annex 10 and Doc 9718. In the event of any inconsistency or conflict between this document and Annex 10 and Doc 9718, Annex 10 and Doc 9718 shall take precedence.

1.1.6.1 Regions and States may supplement the material in Doc 9718 or use different frequency assignment planning criteria to meet regional requirements.

Chapter 2

BACKGROUND

2.1 Institutional framework

2.1.1 ITU

2.1.1.1 The International Telecommunication Union (ITU) is the United Nations specialized agency for information and communication technologies (ICTs). To facilitate international connectivity in communications networks, ITU allocate global radio spectrum and satellite orbits to specific users, develop the technical standards that ensure networks and technologies seamlessly interconnect.

Note: Other specialized agencies, such as ICAO, would not be barred from any kind of work touching upon aeronautical telecommunications including standardization activities.

2.1.1.2 The legal framework of ITU comprises the basic instruments of the Union, which have treaty status and are binding on ITU Member States. These instruments are the Constitution and Convention of the International Telecommunication Union and the Administrative Regulations, which complement the Constitution and the Convention. The Radio Regulations (RR) form an integral part of the Administrative Regulations.

2.1.1.3 The RR include allocations, provisions on licensing, interference resolution, safety and distress procedures and other aspects. Within the RR, the finite useable radio spectrum, from approximately 8.3 kHz to 275 GHz, is allocated to user services in response to their recognized demands, and among three ITU world Regions in accordance with the major regional spectrum requirements for these services in the relevant region. To enable new technologies and changes in spectrum usage, an ITU World Radiocommunication Conference (WRC) is held every 4 years where parts of the Radio Regulations are revised and updated.

2.1.1.4 Aviation services are recognized important users of radio spectrum to create safe and expeditious conditions to support air operations. The AM(R)S, the ARNS and their satellite service counterparts are important components in the mobile and radiodetermination families of users with (normally) exclusive allocations made on a worldwide basis to ensure global harmonization. The RR are used as the framework for the relevant ICAO Annexes and the Standards and Recommended Practices (SARPs) contained therein.

2.1.2 ICAO

2.1.2.1 Pursuant to the provisions in Art 37 of the Convention on International Civil Aviation, ICAO develops Standards and Recommended Practices (SARPs) for Communication, (radio) Navigation and Surveillance (CNS) systems. These standards include technical characteristics and protection requirements to secure interference free operation of these systems and are incorporated in Annex 10.

2.1.2.2 In order to provide for more detailed guidance material on the provisions in Annex 10 for CNS systems, ICAO has developed Doc 9718. Doc 9718 is (currently) published in two parts:

- Volume I which contains material relevant to the allocation and use of aeronautical frequency bands by the ITU.
- Volume II which contains material relevant to the frequency assignment planning for CNS systems.

2.1.2.3 ICAO is accorded observer status at relevant ITU WRCs and also participates at meetings of the ITU-R study groups, including the Conference Preparatory Meetings (CPMs) which prepare the technical and regulatory basis for WRCs. Within ICAO, the necessary activity to support these ITU-generated functions exists at two levels:

a) At the worldwide level, through the work of the Air Navigation Commission, with the assistance of the FSMP (and communication divisional meetings or air navigation conferences, as required), to prepare the coordinated ICAO policies, spectrum estimates and technical inputs for ITU conferences and ITU-R study groups. The ICAO spectrum strategy, policy statements and the ICAO Position for WRCs are approved by the Council; and

b) At the regional level, by the ICAO Regional Offices, through coordination of frequency assignment plans with states/administrations, using agreed ICAO planning criteria. This activity is supported by the Regional Planning and Implementation Groups (PIRGs).

2.1.2.4 At a Regional level, Air Navigation Plans have been developed. These ANPs contain, based on Regional Air Navigation Agreements, provisions that States have agreed to apply on the use of aeronautical radio communication, navigation and surveillance systems, including material relevant to frequency assignment planning.

2.1.3 National and regional authorities

2.1.3.1 Within ITU Member States, the telecommunication authorities / administrations normally control and operate the mechanism which develops the national proposals for amending the Radio Regulations for submission to the ITU WRCs. The outcome of these discussions in the WRCs normally results in material being incorporated in the ITU Radio Regulations or in ITU-R Recommendations and subsequently being applied through national regulation by national telecommunication authorities.

2.1.3.2 To develop and maintain the ICAO Spectrum Strategy and Policy on Radio Frequency Spectrum, a coordinated aeronautical position (the ICAO Position) and other materials must be established for every ITU WRC to support the update of the ITU Radio Regulations (RR). All ICAO Member States and relevant international organizations are encouraged to present proposals to develop the ICAO Position.

2.1.3.3 National and international (regional) preparatory committees function as the coordination medium to which the aeronautical requirements and proposals, either from ICAO coordinated or nationally derived, are presented by the national aviation authorities for consideration.

2.1.3.4 It is essential that aeronautical participation in these national and regional activities be ensured in order to support and defend aviation requirements.

2.1.4 Relationship between ITU RR and ICAO SARPS

2.1.4.1 The Radio Regulations have treaty status, and there is an inherent obligation on States to comply, unless an exception is stated and embodied in the Final Acts of the Conference which created the regulation. Aeronautical services are obliged to operate within the framework established by the Radio Regulations.

2.1.4.2 ICAO is recognized internationally as the competent international body to coordinate a worldwide policy for the operational use of specified systems used by aviation. Furthermore, the ICAO Annexes contain procedures for regular and emergency communications that are specifically developed for aviation purposes, taking account of the operational conditions. These procedures supplement the basic requirements of the Radio Regulations for procedures in aeronautical communications.

2.1.4.3 The Radio Regulations and ICAO SARPs together thus form a complementary set of regulatory provisions without any overlap. The Radio Regulations must evolve within the general telecommunications environment with its many and diverse users of the radio frequency spectrum, while the ICAO SARPs respond to the operational safety aspects of air navigation and are developed and agreed by aviation within the ICAO organizational framework.

2.2 Spectrum coordination and management

2.2.1 General

2.2.1.1 In using frequency bands for radio services, ITU Members and ICAO Contracting States shall bear in mind that radio frequencies are limited natural resources and that they must be used rationally, efficiently and economically, in conformity with the provisions of Radio Regulations, Annex 10 to the ICAO Convention and national and regional planning.

2.2.1.2 Any new assignment or any change of frequency or other basic characteristic of an existing assignment shall be made in such a way as to avoid causing harmful interference to services rendered by stations using frequencies assigned in accordance with this manual.

2.2.1.3 Frequency assignment planning should ensure the availability and protection from harmful interference of the frequencies provided for distress and safety purposes.

2.2.2 Frequency coordination and registration

2.2.2.1 The coordination and registration of frequency assignments is the prerogative of the ITU and must be performed in accordance with procedures laid down in the Radio Regulations. Frequencies are registered in the Master International Frequency Register (MIFR) maintained at ITU Headquarters in Geneva. However, Incorporation of aeronautical frequencies in the MIFR is not subject to a technical analysis of the assignment for protecting other assignments in the COM lists from harmful interference

2.2.2.2 In exclusive aeronautical bands, actual (day-to-day) coordination of frequency assignments is being undertaken by ICAO, through the ICAO Regional Offices. The Regional Office’s frequency coordination role includes the coordination

with the ICAO regional offices of regions that may be affected by the proposed frequency assignments, or, if bilateral coordination is required in the region(s), the State(s)/ Administration(s) that may be affected. Agreed frequency assignment are registered by ICAO in the ICAO global frequency database.

2.2.2.3 To support this coordination, the ICAO Regional Offices have developed the necessary procedures, including the relevant frequency assignment planning criteria. Coordination of frequency assignments is taking place in close (in most cases) co-operation with the national civil aviation authorities.

2.2.2.4 Although in some cases aeronautical frequency assignments, notably those in HF and LF/MF bands, are registered with the ITU by the countries operating these services, other frequency assignments, particularly those in bands above 100 MHz, tend to be recorded only in national registers or in the ICAO Regional Air Navigation Plans. Because of this, de facto, the ICAO frequency register within ICAO forms the basis for international coordination of frequency assignment and provide the most accurate statement of frequency assignment.

2.2.2.5 This does not dispense with the more general requirement for the coordination of a frequency assignment within the ITU and the registration of this frequency assignment in the MIFR, if international protection of that assignment is necessary.

2.2.2.6 Coordination and registration of frequency assignments in the HF bands (between 2850 kHz and 22000 kHz) is only taking place through the ITU. However, ICAO is considering developing, in parallel, a relevant ICAO list of HF frequency assignments.

2.2.2.7 Coordination and registration of frequency assignments for radar stations and on-board autonomous radio navigation systems is not being coordinated through ICAO. However, in the case of assigning SSR mode S II/SI codes ICAO Regional Office performs the coordination and listing of these codes.

2.2.2.8 List of frequency bands coordinated by ICAO is given in Table 2.1.

Table 2.1 List of frequency bands

Symbols	Frequency range	Facility
LF/MF	190 – 495 kHz and 505 – 526.5 kHz	NDB and locator
VHF	108 – 117.975 MHz 117.975 – 137 MHz	ILS localizer (below 112 MHz), VOR and GBAS Air-ground communications (e.g., VDL Mode 4)
UHF	328.6 – 335.4 MHz 960 – 1215 MHz	ILS glide path DME/TACAN SSR

2.2.3 Procedure of Coordination for aeronautical frequency in APAC Region

2.2.3.1 The ICAO Third Asia/Pacific Regional Air Navigation (ASIA/PAC/3 RAN) Meeting in 1993 agreed that the ICAO APAC Regional Office would continue to maintain its frequency selection and coordination role, including the maintenance and promulgation of Frequency List Nos.1, 2 and 3 in a timely and periodic manner.

2.2.3.2 with the successful implementation of Frequency Finder, there is no more Frequency List No. 3 published by the ICAO APAC Regional Office after the 29th Edition in January 2016, and is replaced by the up-to-date database in Frequency Finder.

Note: Frequency Finder is the ICAO aeronautical radio frequency management tool for VHF COM and NAV frequency assignments (and SSR II/SI code).

2.2.3.3 The updated Frequency Lists of Nos. 1 and 2 are published on the APAC website under – CNS More Documents through secure portal of ICAO APAC website webpage, or can be downloaded from the ICAO database with Frequency Finder.

Note： ICAO APAC Office synchronized all registered assignments on Frequency List No.2 into Frequency Finder in 2022 and has been using Frequency Finder on frequency assignments for NAV systems.

2.2.3.4 Currently, States/Administrations can submit to the Regional Office their requests for new or modified frequency assignments in any format (e.g., letter, email).

a) The administrative aspects of the frequency coordination can be improved by States/Administrations using Frequency Finder to generate electronic submissions for new or modified frequency assignments. This option permits States/Administrations to check a selected frequency to satisfy any operational need and to check the

compatibility of this (proposed) frequency with other frequency assignments in the Frequency List No.2 or No.3. It greatly facilitates the final coordination that is performed by the ICAO Regional Office. The electronic submission(s) as generated with Frequency Finder, in the format of an Excel file, can be sent to the ICAO Regional Office through email.

b) The second option for States/Administrations to submit to the Regional Office requests for registering new or modified frequency assignments, also by electronic means, through a locally generated Excel or Word file that follows the template as in **Appendix A**.

c) The third option is for States/Administrations to submit to the Regional Office requests for new of modified frequency assignment by letter. The preferred format of the characteristics for these submissions is in **Appendix B**.

2.2.3.5 The basic aeronautical coordination procedure is depicted as Figure 2-1.

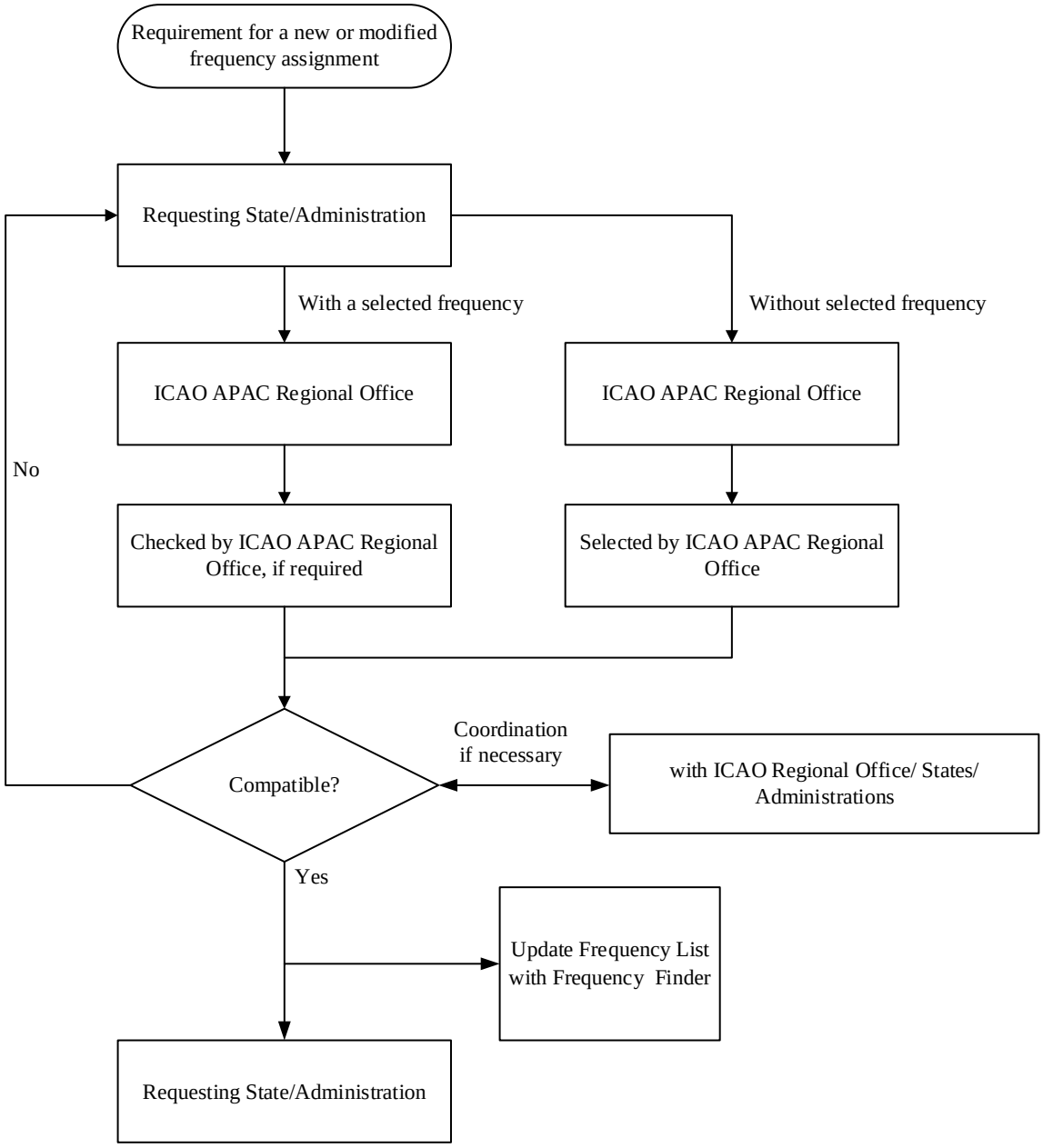


Figure 2-1 The basic aeronautical coordination procedure

Chapter 3

AIR-GROUND COMMUNICATION FREQUENCY MANAGEMENT

3.1 HF Air-ground Communication Frequency bands

3.1.1 HF bands (between 2850 kHz and 22 000 kHz) coordination is recommended to be carried out between States. Coordination and registration of HF frequencies is undertaken by the ITU, through the Radio Regulatory Authorities in each country. ICAO does not coordinate assignments for HF frequencies. ICAO is considering developing, in parallel, a relevant ICAO list of HF frequency assignments. Pre-coordination of HF frequencies could be arranged through the ICAO ASIA/PAC Office in Bangkok. However, the national radio regulator is required to develop a proposal for the registering required frequency assignments with the ITU. Such proposals should be based on the provisions of Appendix 27 to the ITU Radio Regulations, together with the information contained in the ITU International Frequency List (IFL) taking into consideration the protection requirements for HF as contained in Appendix 27.

3.1.2 Appendix 27 to the Radio Regulations (RR) contains the frequency allotment plan for the AM(R)S in the HF bands. This appendix contains the plan for HF frequency allotments to major world air route areas and to regional and domestic air route areas as well as VOLMET areas. It also includes worldwide frequency allotments, which are for the use of aircraft operating agencies for AOC, to be assigned in accordance with RR 27/217.

3.1.3 The technical characteristics for HF aviation equipment in Appendix 27 of the Radio Regulations, since they form part of the Radio Regulations, enjoy the same status as compulsory treaty obligations.

3.2 VHF Air-ground Communication Frequency bands

3.2.1 The general allotment of frequency band 117.975 – 137.000 MHz shall be as shown in Table 3.1. Specific allotments to services are to be determined regionally.

Table 3.1 Allotment table of frequency band 117.975 – 137.000 MHz

Block allotment frequencies (MHz)	Worldwide utilization	Remarks
118.000 –121.450 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
121.500	Emergency frequency	See Annex 10, Volume V, 4.1.3.1. Channels 121.475 and 121.525 are not assignable.
121.550 –121.9917inclusive	International and National Aerodrome Surface Communications	Reserved for ground movement, pre-flight checking, air traffic services clearances, and associated operations.
122.000 –123.050 inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.100	Auxiliary frequency SAR	See Annex 10, Volume V, 4.1.3.4. Channels 123.075 and 123.125 are not assignable.
123.150 –123.425inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered

		by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.450	Air-to-air communications	Reserved for air-to-air communication. Designated for use as provided for in Annex 10, Volume V, 4.1.3.2.
123.475-123.6917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
123.700 –129.6917 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in the light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
129.700 –130.8917 inclusive	National Aeronautical Mobile Services	Reserved for national allotments but may be used in whole or in part, subject to regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
130.900 –136.875 inclusive	International and National Aeronautical Mobile Services	Specific international allotments will be determined in light of regional agreement. National assignments are covered by the provisions in Annex 10, Volume V, 4.1.4.8 and 4.1.4.9.
136.900 –136.975 inclusive	International and National Aeronautical Mobile Services	Reserved for VHF air-ground data link communications.

3.2.2 In accordance with the provisions of Annex 10, the emergency channel (121.500 MHz) shall be used only for genuine emergency purposes, and where a requirement is established for the use of a frequency auxiliary to 121.500 MHz, the frequency 123.100 MHz shall be used.

3.2.3 The Thirteenth Meeting of the APANPIRG agreed to adopted a regionally protected frequency of 128.950 MHz for Traffic Information Broadcasts by Aircraft (TIBA) to permit reports and relevant supplementary information of an advisory nature to be transmitted by pilots. States/Administrations could re-allot this frequency to other services accordingly their own needs. However, any assignment for 128.950 MHz to other services should not impact the airspace which have allotted or plan to allot 128.950 MHz to TIBA.

3.2.4 Common signalling channels for VDL

3.2.4.1 The frequency 136.975 MHz is reserved on a worldwide basis to provide a common signalling channel (CSC) to the VHF digital link Mode 2 (VDL Mode 2).

3.2.4.2 In areas where VDL Mode 4 is implemented, the frequencies 136.925 MHz and 113.250 MHz shall be provided as common signalling channels (CSCs) to the VHF digital link Mode 4 (VDL Mode 4).

3.2.5 Frequencies should be assigned to all VHF Aeronautical Mobile Service (AMS) facilities in accordance with the principles laid out in Annex 10, Volume V and ICAO Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718) Volumes I and II, and take into account:

(a) agreed geographical separation criteria based on 25 kHz or 8.33 kHz interleaving between channels;

(b) agreed geographical separation criteria for the implementation of VDL services;

(c) the need for maximum economy in frequency demands and in radio spectrum utilization; and

(d) a deployment of frequencies which ensures that international services are planned to be free of interference from other services using the same band.

3.2.6 The priority order to be followed in the assignment of frequencies to service is:

(a) ATS channels serving international services (ACC, APP, TWR, FIS);

(b) ATS channels serving national purposes;

(c) channels serving international VOLMET services;

(d) channels serving ATIS and PAR; and

(e) channels used for other than ATS purposes.

3.2.7 The criteria used for frequency assignment planning for VHF AMS facilities serving international requirements should, to the extent practicable, also be used to satisfy the need for national VHF AMS facilities.

3.2.8 Special provisions should be made, by agreement between the States concerned, for the sharing and the application of reduced protection of non-ATS frequencies in the national sub-bands, so as to obtain a more economical use of the available frequency spectrum consistent with operational requirements.

3.2.9 States should ensure that no air/ground frequency is utilized outside its designated operational coverage and that the stated operational requirements for coverage of a given frequency can be met for the transmission sites concerned, taking into account terrain configuration.

3.2.10 APAC region has agreed to base frequency assignment planning on 25 kHz frequency separation, according to the conclusions of ASIA/PAC/3 RAN (DOC9614), APANPIRG/26, etc. The complete regional 117.975MHz-137MHz frequency band utilization plan is shown in **Appendix C**,

Note1: the allocation of twelve (12) frequencies has not been included in the Asia-Pacific conference outcomes. the 12 frequencies are belonging to International and National Aeronautical Mobile Services band, and they are 132.050 MHz, 132.075 MHz, 134.525 MHz, 134.550 MHz, 134.575 MHz, 135.825 MHz, 135.850 MHz, 135.875 MHz, 135.900 MHz, 135.925 MHz, 135.950 MHz, 135.975 MHz. It is proposed to allocate these frequencies to ACC services as showed in Appendix C.

Note2: The note1 will be deleted if the new allotment plan as is approved.

3.2.11 For co-frequency assignments, the minimum geographical separation between facilities shall be such that the DOC of each facility is separated by a distance not less than:

(a) that required to provide a D/U ratio of 20 dB; or

(b) the sum of the distance to the radio horizon of the DOC area of each facility.

Alternatively, in areas where the frequency congestion is severe, a protection ratio of 14 dB can be used on the basis of a regional air navigation agreement.

3.2.12 For adjacent frequency assignments, the minimum geographical separation between facilities shall be such that points at the edge of the designated operational coverage of each facility are separated by a distance sufficient to ensure operations free from harmful interference.

Note : The edge of the DOC is at the maximum range and maximum height.

3.2.13 Services and designated operational coverage (DOC)

3.2.13.1 Frequencies for aeronautical radio communication services are (normally) implemented to satisfy the operational need for specific services. These services, and their uniform DOC areas, are as in Table 3.2.

Table 3.2 Table of uniform designated operational coverage (DOC)

Service	SYMBOL	Designated Operational Coverage (DOC)		Comments	Mode
		Range (NM)	Height (ft)		
Aerodrome					
Aerodrome control tower	TWR	25	4000	Height above ground	A/G
Aerodrome flight information service	AFIS	25	4000	Height above ground	A/G
Aerodrome surface communications	AS	Limits of aerodrome	Surface		A/G

Service	SYMBOL	Designated Operational Coverage (DOC)		Comments	Mode
		Range (NM)	Height (ft)		
Approach					
Precision approach radar	PAR	25	4000	Height above ground	A/G
Approach control service (lower)	APP–L	50	12000		A/G
Approach control service (intermediate)	APP–I	75	25000		A/G
Approach control service (upper)	APP–U	150	45000		A/G
En-Route					
Area control centre (lower)	ACC–L	Area	25000	Within specified area; max range155 NM	A/G
Area control centre (intermediate)	ACC-I	Area	25000	Within specified area; max range 130 NM	A/G
Area control centre (upper)	ACC–U	Area	45000	Within specified area; max range 200 NM	A/G
Flight information service (lower)	FIS-L	Area	25000	Within specified area; max range 155 NM	A/G
Flight information service or Flight information service (upper)	FIS or FIS-U	Area	45000	Within specified area; max range 200 NM	A/G
Meteorological information for aircraft in flight	VOLMET	200	45000	Maximum range 200 NM	BC
Other functions					
Automatic terminal information service	ATIS	200	45000		BC
Air-to-air	A/A	200	45000	Maximum range 200 NM	A/G
Air-to-ground	A/G	200	45000	Maximum range 200 NM	A/G
Aeronautical operational control	AOC	100	25000	Not protected; max. range 100 NM	A/G
Emergency	EM	N/A	N/A	No frequency coordination required	A/G
Search and rescue	SAR	N/A	N/A	No frequency coordination required	A/G
VHF En-Route General Purpose	GP	200	45000	Maximum range 200 NM	A/G

Note 1: Different DOC areas may be specified by States.
Note 2: DOC for AOC-only provided to enable compatibility assessment when frequencies for AOC are shared with air traffic control (ATC) services; different DOC may be specified.
Note 3: For area services, no frequency protection is provided outside the specified area.
Note 4: Unless specified by States, the DOC for A/A and A/G is assumed at 45 000 ft/200 NM.
Note 5:Mode: A/G: air-ground communications; BC: (ground) broadcast communications.
Note 6:No coordination of frequency assignment planning is necessary for the emergency frequency 121.500 MHz and the SAR frequency 123.100 MHz as these services are available globally at each station where this service is required.

3.2.13.2 Non-standard DOC (range and height) may be implemented as and when required. Reduced DOC, where operationally acceptable, may alleviate frequency congestion.

3.2.14 The criteria of Geographical separation

3.2.14.1 Applying the methodology as described in Handbook on Radio Frequency Spectrum Requirements for Civil Aviation (Doc 9718), Volume II, paragraph 2.8, separation distances between the edges of the designated coverage areas are show in Table 3.3.

Table 3.3 Minimum geographical co-frequency separation distances between the edges of the DOC

		VICTIM											
	Service	**TWR 25/4000**	**AFIS 25/4000**	**AS Surface**	**APP-U 150/450**	**APP- I 75/250**	**APP-L 50/120**	**ACC-U Area/450**	**ACC-L Area/250**	**FIS-U Area/450**	**FIS- L Area/250**	**VOLMET 260/450**	**ATIS 200/450**
INTERFERE	**TWR**	**156**	**156**		**338**	**273**	**212**	**338**	**273**	**338**	**273**	**338**	**338**
	AFIS	**156**	**156**		**338**	**273**	**212**	**338**	**273**	**338**	**273**	**338**	**338**
	AS (Note 2)			**25**									

		VICTIM											
	Service	**TWR 25/4000**	**AFIS 25/4000**	**AS Surface**	**APP-U 150/450**	**APP- I 75/250**	**APP-L 50/120**	**ACC-U Area/450**	**ACC-L Area/250**	**FIS-U Area/450**	**FIS- L Area/250**	**VOLMET 260/450**	**ATIS 200/450**
	APP-U	**338**	**338**		**520**	**455**	**394**	**520**	**455**	**520**	**455**	**520**	**520**
	APP-I	**273**	**273**		**455**	**390**	**329**	**325**	**390**	**455**	**390**	**455**	**455**
	APP-L	**212**	**212**		**394**	**329**	**268**	**394**	**329**	**394**	**329**	**394**	**394**
	ACC-U (Note 1)	**338**	**338**		**520**	**455**	**394**	**520**	**455**	**520**	**455**	**520**	**520**
	ACC-L (Note 1)	**273**	**273**		**455**	**390**	**329**	**455**	**390**	**455**	**390**	**455**	**455**
	FIS-U (Note 1)	**338**	**338**		**520**	**455**	**394**	**520**	**455**	**520**	**455**	**520**	**520**
	FIS-L (Note 1)	**273**	**273**		**455**	**390**	**329**	**455**	**390**	**455**	**390**	**455**	**455**
	VOLMET	**338**	**338**		**520**	**455**	**394**	**520**	**455**	**520**	**455**	**15**	**15**
	ATIS	**338**	**338**		**520**	**455**	**394**	**520**	**455**	**520**	**455**	**15**	**15**

Note 1: All distances are in NM.
Note 2: Frequencies for aerodrome surface communications should be selected from the band 121.600 – 121.975 MHz. This band is reserved exclusively for aerodrome surface communications. No separation distances with other services are provided. Should it be necessary to share frequencies for AS with air/ground communication services, the minimum geographical separation distance can be calculated as shown in paragraph 2.7.2.1.1 and assuming a designated operational coverage for aerodrome surface communications of 5 NM/100 ft.

3.2.14.2 For stations operating on the first adjacent frequency with the same characteristics, a separation distance of 10 NM is to be maintained between the ground transmitter and the ground receiver. This is considered to be not a frequency assignment planning constraint but rather an implementation issue for States to consider when implementing or modifying frequency assignments. A practical measure may be to avoid assigning a first adjacent frequency to the same location.

3.2.14.3 The designated coverage for VDL Mode 2 and VDL Mode 4 facilities need to be separated from the designated coverage of a co-frequency VHF-COM voice (DSB-AM) system with at least the distance to the radio horizon of each service.

Note: This applies also to frequency assignments between VDL facilities.

3.2.14.4 Table 3.4 present the guard band (channels) between VDL operating on adjacent frequencies with other VDL or VHF COM voice (DSB-AM) systems.

Table 3.4 25 kHz guard band (channels) between DSB-AM, VDL mode 2 and VDL mode 4 (air-air)

		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM		1	2
	VDL 2	1	1	1
	VDL 4	2	1	1

Note: The numbers in Table are guard-bands (channels). The next frequency that can be used without frequency planning constrain is 1 channel higher (e.g., a desired DSB-AM station that is interfered by a VDL Mode 2 aircraft station requires one 25 kHz guard band. The next frequency, 50 kHz away, can be used in the same designated operational coverage without any frequency assignment planning constraint.

3.2.14.5 Table 3.5 present the guard band (channels) for VDL Mode 2, VDL Mode 4 and VHF COM voice (DSB-AM) systems, when operating with aircraft on the surface of an airport.

Table 3.5 25 kHz guard band (channels) between DSB-AM and VDL (modes 2 and 4) on the surface of an airport

		Interference source		
		DSB-AM	VDL 2	VDL 4
Victim	DSB-AM	-	4	4

	VDL 2	4	1	1
	VDL 4	4	1	1

3.2.14.6 VDL services can be deployed on channels separated by 25 kHz subject to sufficient distance separation between transmit and receive antennas of such services on the ground, which is estimated up to about 3 NM

3.2.15 Guidance on the use of backup frequencies.

3.2.15.1 Backup frequencies may be operationally required to provide an alternative air-ground communication channel in cases where an operational radio frequency is not available. Examples include: intentional interference; unintentional interference (e.g., badly designed FM broadcasting stations); stuck microphone; and phony air traffic controllers.

3.2.15.2 Implementation of backup frequencies should be limited only to the following ATC services: AS, TWR, APP, ACC, COLMET, and FIS. Other air-ground communication services such as ATIS, AFIS, A/A, A/G, GP, and AOC do not require backup communication channels.

3.2.15.3 Backup frequencies should only be implemented at aerodromes with a clear operational requirement. The number of backup frequencies for the AS, TWR, and APP should not exceed two (with a maximum of one backup frequency for TWR and one backup frequency for APP services).

3.2.15.4 Backup frequencies should not be provided when communication channels are lost due to malfunctioning of the ground infrastructure.

3.2.15.5 The assessment of the required number of backup frequencies should be kept to the minimum needed. Where possible, it should be based on experience (e.g., number of days per year that a communication channel is not available).

3.2.15.6 Where operationally feasible, arrangements should be in place to share backup frequencies either between different services (at the same ATC centre) or between different facilities (e.g., different aerodromes or different ACC/FIS from different ATC centres).

3.2.15.7 Adjacent ATS units are encouraged to make suitable arrangements to share backup frequencies where possible, operationally feasible and spectrally efficient.

3.2.15.8 In the COM list in the global table of frequency assignments, backup frequencies are identified as such.

Chapter 4

RADIO NAVIGATION AID FREQUENCY MANAGEMENT

4.1 Non-Directional Radio Beacons (NDB)

4.1.1 Frequency band – The radio frequencies assigned to NDBs shall be selected from those available in that portion of the spectrum between 190 kHz and 1 750 kHz. The coordination and registration of bands 190–495 kHz and 505– 526.5kHz take place in ICAO Regional office.

4.1.2 NDB frequency management should take into account the following:

(a) the interference protection required at the edge of the rated coverage;

(b) the application of the figures shown for typical ADF equipment;

(c) the geographical spacings and the respective rated coverages;

(d) the possibility of interference from spurious radiation generated by non-aeronautical sources (e.g., electric power services, power line communication systems, industrial radiation, etc.).

4.1.3 The 1979 World Administrative Radio Conference adopted regulations concerning the assignment of frequencies for aeronautical radio beacons operating in the LF/MF frequency bands. A minimum protection ratio (wanted/ unwanted signal ratio) of 15 dB is to be used as the basis for frequency assignment planning (RR Appendix 12).

4.1.4 The minimum value of field strength in the rated coverage of an NDB should be 70°microvolts per metre. In order to obtain a satisfactory service within the rated coverage of an NDB located in latitudes between 40°N and 50°S, a minimum value of field strength of 120 microvolts per metre would be required, except where practical experience in the operation of NDBs over several years has revealed that a minimum field strength of 70 microvolts per metre would be adequate to meet all the operational needs. In some specific areas, field strength values considerably in excess of 120 microvolts per metre would be required. Such areas are: Indonesia and Papua New Guinea, Myanmar, Malay Peninsula, Thailand, Lao People's Democratic Republic, Democratic Kampuchea, Viet Nam and Northern Australia.

Note: Based on the latest propagation and noise data available to the ITU, studies of minimum field strengths required at the boundary of the rated coverage was shown in 6.3 of Attachment C, Annex 10. Attention is called particularly to the assumptions made.

4.1.5 NDB Frequency assignments should be based on the criteria contained in Annex 10, Volume I, Chapter 3 paragraph 3.4.3 and the guidance material contained in Attachment C paragraph 6 of Annex 10, Volume I.

4.1.6 Where locators associated with ILS facilities serving opposite ends of a single runway are assigned a common frequency, provision shall be made to ensure that the facility not in operational use cannot radiate.

4.1.7 To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of a single runway, the assignment of a common frequency to both of the outer locators should be permitted, and the assignment of a common frequency to both of the inner locators should be permitted, provided that:

(a) the operational circumstances permit;

(b) each locator is assigned a different identification signal; and

(c) arrangements are made whereby locators using the same frequency cannot radiate simultaneously.

4.2 Instrument Landing System (ILS)

4.2.1 Frequency band and channel spacing

4.2.1.1 Frequency band –The Localizer is operating in the frequency band 108 – 112MHz. This band is also used for VOR and GBAS/VDB systems. Localizers cannot be assigned a frequency allotted for a VOR and vice versa. The Glide Path is operating in the frequency band 328.6–335.4MHz. The Localizer and Glide Path frequencies are paired as shown in Appendix E.

4.2.1.2 Channel spacing 100 kHz – The channel spacing for the Localizer is 100 kHz and for the Glide Path is 300 kHz. The Localizer operates on odd 100 kHz channels in the VHF band.

4.2.1.3 Channel spacing 50 kHz – The use of 50 kHz channels for the localizer (and 150 kHz for the glide path) is permitted as stipulated in Annex 10, Volume V, paragraph 4.2.2.1.

Note: Such use shall not cause harmful interference to ILS receivers not capable of tuning to these (50/150 kHz) channels and is subject to the condition that the operational service to international operators using airborne equipment designed for 100 kHz channel spacing (150 kHz for the Glide Path) is not derogated.

4.2.1.4 When the ILS is associated with a DME, the DME channels must be selected as **Appendix E**. Further guidance on DME frequency assignment planning, including the ILS/DME channel pairing, is in section 4.5.

4.2.2 Designated Operational Coverage (DOC)

4.2.2.1 The horizontal Designated Operational Coverage of the Localizer and Glide Path is shown in Figure 4-1. The DOC can be extended (optional) with a range of 10 NM outside the clearance sector of the Localizer as promulgated by States/Administrations.

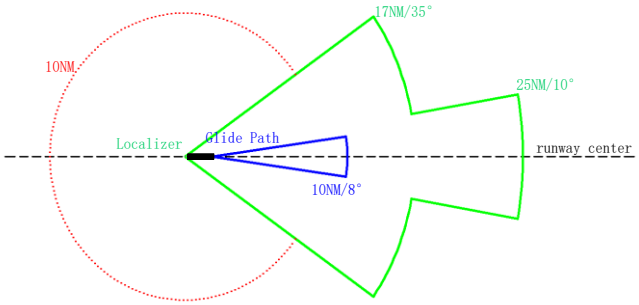


Figure 4-1. DOC of the ILS Localizer and Glide Path

4.2.2.2 The maximum protection height for the localizer DOC is 6250 ft and for the Glide Path 2500 ft. This height is relative to the elevation of the Localizer transmitter.

4.2.2.3 States/Administrations may modify the coverage to meet specific operational requirements. Unless a (modified) DOC is provided, the standard DOC as in paragraph 4.2.2.1 is used in the frequency assignment planning process.

4.2.2.4 When the ILS is associated with a DME, the DOC of the DME is typically the same as for the Localizer. However, States/Administrations may require the associated DME to provide coverage in a larger area.

Note: In practice, many frequency assignments for a DME, associated with an ILS, have a DOC of 10.000 ft/100 NM. Frequency assignment planning criteria for DME are in section 4.5.

4.2.3 The minimum field strength for a Localizer is 40 µV/m (or 32 dBµV/m or - 116 dBW) throughout the DOC. For a Glide Path the minimum field strength is 400 µV/m (or 52 dBµV/m or - 106 dBW).

4.2.4 ILS serving both ends of the same runway.

To alleviate frequency congestion problems at locations where two separate ILS facilities serve opposite ends of the same runway or different runways at the same airport, the assignment of identical ILS localizer and glide path paired frequencies should be permitted provided that:

a) the operational circumstances permit;

b) each localizer is assigned a different identification signal; and

c) arrangements are made whereby the localizer and glide path not in operational use cannot radiate.

4.2.5 Information on the planning of identifications can be found in section 4.6.

4.2.6 A compatibility assessment for potential interference that can be caused by FM broadcasting stations operating in the frequency band 87 – 108 MHz is necessary before a Localizer frequency can be put into operational use. The FM immunity performance requirements for Localizer receivers are contained in Annex 10, Volume I, paragraph 3.1.4. Additional information on the process to assess compatibility with FM broadcast stations is in Recommendation ITU-R SM.1009.

4.2.7 Frequency Assignment Planning Principles

4.2.7.1 When the main direction of radiation of the ILS system is not known, for frequency assignment planning purposes, the coverage is assumed to be omnidirectional. The localizer coverage is originated from the location of the Localizer; the Glide Path coverage is originated from the location of the Glide Path.

4.2.7.2 The criteria must be applied in respect of each localizer installation, in the sense that while of two localizers, the first may not cause interference to the use of the second, nevertheless the second may cause interference to the use of the first.

4.2.7.3 The DOC for the Localizer is much larger than that for the Glide Path. When a localizer frequency has been assigned, the associated Glide Path frequency is automatically protected from harmful interference from other co-channel ILS facilities. However, when non-co-channel Localizer frequency has been assigned, a separate adjacent channel compatibility assessment is necessary for the Glide Path frequency with regard to other nearby ILS facilities operating on adjacent Glide Path frequencies. Therefore, the frequency assignment planning for Localizer and Glide Path has to be performed separately.

4.2.7.4 In so far as the wanted and unwanted carriers may produce a heterodyne note, the protection ratio ensures that the instrumentation is not affected. However, in cases where a voice facility is used, the heterodyne note may interfere with this facility.

4.2.8 Required Distance Separations of ILS/ILS Facilities

4.2.8.1 The minimum required separation distances between the desired ILS system and potentially interfering ILS systems are based on the assumption that protection against interference is afforded to the desired signal from the undesired signal is 20 dB. This corresponds to a disturbance of not more than 15 microamperes at the limit of the service distance of the ILS.

4.2.8.2 The minimum D/U ratios requirements within the DOC and different frequency separation to protect different receivers of Localizer / Glide Path can be referred to Annex 10, Volume I, Attachment C 2.6.2.1, 2.6.2.2.

4.2.8.3 Table 4.1 provides the minimum geographical separation distances between the edge of coverage of a desired ILS facility and the location of an undesired ILS facility, established using the method in **Appendix D.**

Table 4.1 Separation distances between the edge of coverage of a desired ILS and an undesired ILS

Undesired Facility:					
Localizer (e.i.r.p.= 30 dBW)	Δf:	Distance for 100 kHz receiver (desired facility)	D/U	Distance for 50 kHz receiver (desired facility)	D/U
	0 kHz	268 NM	36 dB	268 NM	36 dB
	0 kHz	135 NM	20 dB	135 NM	20 dB
	50 kHz	94 NM	-7 dB	36 NM	-34 dB
	100 kHz	n/a	n/a	n/a	n/a
	150 kHz	9 NM	-50 dB	9 NM	-50 dB
Glide Path (e.i.r.p. = 20 dBW)	Δf:	300 kHz receiver	D/U	150 kHz receiver	D/U
	0 kHz	88 NM	36 dB	74 NM	36 dB
	0 kHz	71 NM	20 dB	58 NM	20 dB
	150 kHz	36 NM	-0 dB	11 NM	-20 dB
	300 kHz	11 NM	-20 dB	1 NM	-40 dB
	450 kHz	1 NM	-40	-	-
Localizer (e.i.r.p. = 17 dBW)	Δf:	100 kHz receiver	D/U	50 kHz receiver	D/U
	0 kHz	135 NM	36 dB	135 NM	36 dB
	0 kHz	112 NM	20 dB	112 NM	20 dB

	50 kHz	44 NM	-7 dB	10 NM	-34 dB
	100 kHz	n/a	n/a	n/a	n/a
	150 kHz	1 NM	-50 dB	1 NM	-50 dB
Glide Path (e.i.r.p. = 14 dBW)	Δf:	300 kHz receiver	D/U	150 kHz receiver	D/U
	0 kHz	88 NM	36 dB	74 NM	36 dB
	0 kHz	71 NM	20 dB	58 NM	20 dB
	150 kHz	36 NM	-0 dB	11 NM	-20 dB
	300 kHz	11 NM	-20 dB	1 NM	-40 dB
	450 kHz	1	-40	- - -	- - -

4.2.8.4 In Regions where both 100 kHz and 50 kHz Localizer channels are being used (300 kHz and 150 kHz channels for the Glide Path), the protection of the Localizer is based on the protection of receivers designed for 100 kHz channel spacing.

4.2.9 Geographical separation distances between (desired) Localizer and (undesired) adjacent frequency VOR facilities is as Table 4.2.

Table 4.2 Geographical separation distances between (desired) Localizer and (undesired) VOR

VOR Tx (dBW)	ΔF (kHz)	D/U(dB)	D (NM)	Remarks
17	50	-7	72	Undesired VOR; 100 kHz receiver;
17	50	-34	15	Undesired VOR; 50 kHz receiver;
17	100	-46	5	Undesired VOR; 50/100 kHz receiver;
17	150	-50	3	Undesired VOR; 50/100 kHz receiver;
20	50	-7	80	Undesired VOR; 100 kHz receiver;
20	50	-34	19	Undesired VOR; 50 kHz receiver;
20	100	-46	7	Undesired VOR; 50/100 kHz receiver;
20	150	-50	4	Undesired VOR; 50/100 kHz receiver;
30	50	-7	107	Undesired VOR; 100 kHz receiver;
30	50	-34	36	Undesired VOR; 50 kHz receiver;
30	100	-46	16	Undesired VOR; 50/100 kHz receiver;
30	150	-50	13	Undesired VOR; 50/100 kHz receiver;

Note: ITU-R aeronautical propagation curve for the Localizer: 108 MHz, h1 = 20 ft, h2 = 6250 ft; 5% of the time. The minimum required separation distance is measured from the location of the (undesired) VOR to the closest point of the DOC of the Localizer

4.2.10 Geographical separation distance between (desired) Localizer and the location of an (undesired) GBAS/VDB as Table 4.3.

Table 4.3 Geographical separation distances between a desired Localizer and an undesired GBAS/VDB

GBAS/VDB Tx (dBW)	ΔF (kHz)	D/U(dB)	D (NM)	Remarks
17	0	26	187	
17	25	0	108	
17	50	-34	20	
17	75	-46	5	
17	100	-65	0	Planning freedom

Note: ITU-R aeronautical propagation curve for the Localizer: 108 MHz, h1 = 45 ft, h2 = 6250 ft; 5% of the time. The minimum required separation distance is measured from the location of the (undesired) GBAS/VDB to the closest point of the DOC of the Localizer

4.2.11 Practical experience in the operation of ILSs over several years has revealed that the minimum required separation distances of Annex 10, Volume I, Table C-3 can protect against interference to the desired signal. Required Localizer and Glide Path separation distances is shown in Table 4.4. These separation distances can be used in areas where the frequency congestion is severe.

Table 4.4 Required distance separations

	Frequency separation	Minimum separation between second facility and the protection point of the first facility km (NM)	
		List A	List B
Localizer	Co-channel	148(80)	148(80)
	50kHz	37(20)	9(5)
	100kHz	9(5)	0
	150kHz	0	0
	200kHz	0	0
Glide path	Co-channel	93(50)	93(50)
	150kHz	20(11)	2(1)
	300kHz	2(1)	0
	450kHz	0	0
	600kHz	0	0

List A refers to the use of localizer receivers designed for 100 kHz channel spacing coupled with glide path receivers designed for 300 kHz channel spacing.

List B refers to the use of localizer receivers designed for 50 kHz channel spacing coupled with glide path receivers designed for 150 kHz channel spacing.

Note 1. The above figures are based on the assumption of protection points for the localizer at 46 km (25 NM) distance and 1900 m (6250 ft) height and for the ILS glide path at 18.5 km (10 NM) distance and 760 m (2500 ft) height.

Note 2. States, in applying the separations shown in the table, have to recognize the necessity to site the ILS and VOR facilities in a manner which will preclude the possibility of airborne receiver error due to overloading by high unwanted signal levels when the aircraft is in the initial and final approach phases.

Note 3. States, in applying the separations shown in the table, have to recognize the necessity to site the ILS glide path facilities in a manner which will preclude the possibility of erroneous glide path indications due to reception of adjacent channel signals when the desired signal ceases to radiate for any reason while the aircraft is in the final approach phase.

Note: The application of the figures given in Table 4.4 *will only be correct within the limitations set by the assumptions. If more precise determination of separation distances is required in areas of frequency congestion, this may be determined for each facility from appropriate propagation curves, taking into account the particular directivity factors, radiated power characteristics and the operational requirements as to coverage. Where reduced separation distances are determined by taking into account directivity, etc., flight measurements at the ILS protection point and at all points on the approach path should be made wherever possible to ensure that a protection ratio of at least 20 dB is achieved in practice.*

4.3 VHF Omnidirectional Range (VOR)

4.3.1 Frequency band and channel spacing

4.3.1.1 VOR is operating in the frequency band 108–117.975MHz. Within band 108–111.975MHz, frequencies ending in either even tenths or even tenths plus a twentieth of a megahertz are used only by VOR and therefore cannot cause co-channel interference to the ILS Localizer. In areas where 50 kHz channel spacing is introduced measures are in place to avoid that no harmful adjacent channel interference is caused to the ILS Localizer.

4.3.1.2 The channel spacing is 100 kHz. The use of 50 kHz VOR channels is permitted as stipulated in Annex 10, Volume V, paragraph 4.2.3.1.

Note: The use of 50 kHz VOR channels shall not cause harmful interference to VOR receivers not capable of tuning to these channels and the operational service to international operators using airborne 100 kHz equipment is not derogated.

4.3.1.3 In aera where VDL Mode 4 is implemented, the frequency 113.250 is reserved as common signalling channel for VDL Mode 4.

4.3.1.4 VOR facilities are often associated with DME facilities. The associated DME channels shall be selected in Appendix E. Further guidance on DME frequency assignment planning, including the VOR/DME channel pairing, is in section 4.5.

Note: A separate compatibility assessment for the DME facilities associated with a VOR facility is required in all cases.

4.3.2 The designated operational coverage (DOC) of the VOR is determined through the operational requirement as promulgated by States/Administrations. In many cases the DOC is circular and can typically vary from 25 NM to approximately 200 NM and with the protected altitude up to between 10 000 feet and 45 000 feet normally, may be extended up to 60 000 feet. Protection from harmful interference is only provided within the DOC.

Note: When the VOR is associated with a DME, the DOC of the DME is typically the same as for the VOR.

4.3.3 The field strength or power density in space of VOR signals required should be 90 μV/m (39 dBμV/m) or 107 dBW/m^2 (or - 110 dBW at 118 MHz) throughout the DOC.

4.3.4 A compatibility assessment for potential interference that can be caused by FM broadcasting stations operating in the frequency band 87 – 108 MHz is necessary. The FM immunity performance requirements for VOR receivers are contained in Annex 10, Volume I, paragraph 3.3.8. Additional information on the process to assess compatibility with FM broadcast stations is in Recommendation ITU-R SM.1009.

4.3.5 Information on the planning of identifications can be found in section 4.6.

4.3.6 Protection criteria for a desired VOR and an undesired VOR or Localizer or GBAS/VDB.

4.3.6.1 Localizer and VOR facilities cannot operate on the same frequency. Adjacent channel compatibility with an (undesired) Localizer is assessed in the same way as adjacent channel interference from a VOR assessed.

4.3.6.2 The protection of VOR facilities operating on the same frequency is based on a desired to undesired (D/U) signal ratio of 20dB. This corresponds to a bearing error of less than 1 degree due to unwanted signals.

4.3.6.3 Protection requirement for a desired VOR from interference by an undesired localizer or VOR facility is contained in DOC 9718, Volume II, paragraph 3.4.

4.3.6.4 Protection criteria for a desired VOR from interference by an undesired GBAS/VDB is contained in DOC 9718, Volume II, paragraph 3.5.

4.3.6.5 Where both 100 kHz and 50 kHz VOR channels are being used, the protection of the VOR is based on the protection of receivers designed for 100 kHz channel spacing.

4.3.7 Sectorized coverage

4.3.7.1 Application of the calculation methods described above may produce incorrect results if sectorization (key-holing) is used. Figure 4-2 can be used to explain the problem:

4.3.7.2 Consider A to be the desired VOR facility and B the undesired one. The “Critical Point” is most exposed to interference from facility B because it is the point of the DOC of facility A which is nearest to transmitter B.

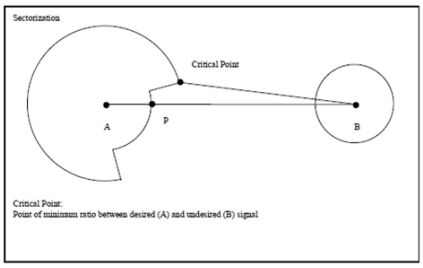


Figure 4-2 Geometry for determining the test points

4.3.8 Table 4.5 to Table 4.7 present the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) VOR and the location of the (undesired) VOR or ILS-Localizer.

Table 4.5 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	**D/U (dB)**	**Tx = 17 dBW**		**Tx = 20 dBW**		**Tx=30 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired VOR at 45000 ft**
0	20	147	268	150	271	160	284	50/100 kHz receiver
50	-7	120	134	123	174	133	231	100 kHz receiver

ΔF (kHz)	D/U (dB)	Tx = 17 dBW		Tx = 20 dBW		Tx=30 dBW		Remarks
		L (dB)	D (NM)	L (dB)	D (NM)	L (dB)	D (NM)	Desired VOR at 45000 ft
50	-34	93	5	96	11	106	43	50 kHz receiver
100	-46	81	<0.5	84	<0.5	94	7	50/100 kHz receiver
150	-50	77	<0.5	80	<0.5	90	<0.5	50/100 kHz receiver

Table 4.6 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	D/U (dB)	Tx = 17 dBW		Tx = 20 dBW		Tx=30 dBW		Remarks
		L (dB)	D (NM)	L (dB)	D (NM)	L (dB)	D (NM)	Desired VOR at 25000 ft
0	20	147	208	150	212	160	225	50/100 kHz receiver
50	-7	120	115	123	131	133	175	100 kHz receiver
50	-34	93	9	96	13	106	42	50 kHz receiver
100	-46	81	<0.5	84	<0.5	94	10	50/100 kHz receiver
150	-50	77	<0.5	80	<0.5	90	5	50/100 kHz receiver

Table 4.7 Minimum separation distances between desired VOR and undesired VOR or LOC

ΔF (kHz)	D/U (dB)	Tx = 17 dBW		Tx = 20 dBW		Tx=30 dBW		Remarks
		L (dB)	D (NM)	L (dB)	D (NM)	L (dB)	D (NM)	Desired VOR at 10000 ft
0	20	147	143	150	147	160	161	50/100 kHz receiver
50	-7	120	71	123	82	133	115	100 kHz receiver
50	-34	93	10	96	14	106	29	50 kHz receiver
100	-46	81	1	84	3	94	11	50/100 kHz receiver
150	-50	77	<0.5	80	1	90	7	50/100 kHz receiver

Note1: The separation distances are between the edge of coverage for a desired VOR and the location of an undesired VOR (or Localizer) facility. The EIRP of the undesired VOR (or Localizer) is as specified in column "Tx".

Note2: ITU-R aeronautical propagation curve for 108 MHz and 5% of the time. The antenna height of the desired aircraft receiver is indicated in the "Remarks" column, and the antenna height of undesired Localizer is 6 ft, undesired VOR is 20 ft.

4.3.9 Table 4.8 presents the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) VOR and the location of the (undesired) GBAS/VDB station.

Table 4.8 Distance between the edge of the DOC of the desired VOR (50 kHz receiver) from GBAS/VDB

VOR - Height (ft)	**Co-frequency** **D/U = 26 dB** **L = 153 dB**	**1st adj freq. (+/-25 kHz)** **D/U = 0 dB** **L = 126 dB**	**2nd adj freq. (+/- 50 kHz)** **D/U = - 34 dB** **L = 92 dB**	**3rd adj freq. (+/-75 kHz)** **D/U = -46 dB** **L = 87 dB**	**4th adj freq. (+/- 100 kHz)** **D/U = -65 dB** **L = 61 dB**
5 000	127 NM	80 NM	9 NM	5 NM	Frequency assignment planning freedom
10 000	161 NM	111 NM	8 NM	5 NM	
15 000	186 NM	135 NM	8 NM	4 NM	
20 000	206 NM	155 NM	8 NM	3 NM	
25 000	225 NM	172 NM	8 NM	2 NM	
30 000	242 NM	189 NM	7 NM	Frequency assignment planning freedom	
35 000	237 NM	203 NM	6 NM		
40 000	271 NM	217 NM	5 NM		
45 000	284 NM	228 NM	3 NM		
50 000	297 NM	242 NM	Planning freedom		
60 000	320 NM	264 NM			

Note 1: With minimum separation distances less than 0.5 NM frequency assignment planning freedom is assumed.

Note 2: Separation distances ≤ 5 NM may be considered as operational insignificant.

Note3: ITU-R aeronautical propagation curve for 108 MHz and 5% of the time. The antenna height of undesired GBAS/VDB is 45 ft.

4.4 Ground Based Augmentation System (GBAS)

4.4.1 The GNSS ground-based augmentation system (GBAS) VHF data broadcast (VDB) frequency band is 108 to 117.975MHz. The lowest assignable frequency is 108.025 MHz and the highest assignable frequency is 117.950 MHz, the channel spacing is 25 kHz.

4.4.2 Designated Operational Coverage (DOC)

4.4.2.1 The minimum DOC required for a GBAS VDB to provide approach services is as shown in Figure 4-3.

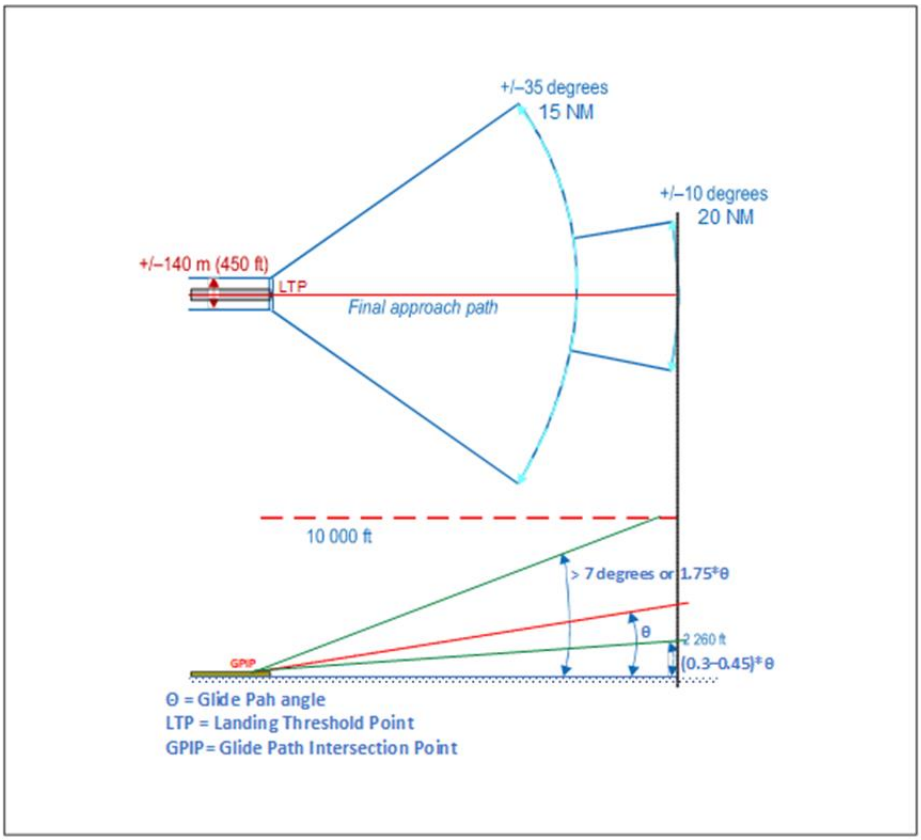


Figure 4-3 Minimum required DOC of GBAS

4.4.2.2 For GBAS approaches supported by the minimum DOC, the vertical coverage is limited by a plane that extends from the glide path interception point (GPIP) with an angle of 0.3 times the glide path angle. For a glide path of 3 degrees, this angle is 0.9 degrees. At 20 NM, this plane is 2 260 ft above the earth. The upper limit of the coverage to be used for frequency assignment planning for this case is 10.000 ft above the runway threshold.

4.4.2.3 Typically, the DOC for GBAS VDB facilities is referenced to the location and the elevation of the threshold of the runway. However, in cases where such information is not available, the coverage may be referenced to the location of the VDB transmitter. In this case, considering the offset of the VDB transmitter from the runway threshold, for frequency assignment planning purposes, the DOC of the GBAS should be extended by 3 NM from the location of the VDB transmitter or the aerodrome reference point (ARP), in which case a circular coverage may need to be considered or assumed.

4.4.2.4 Figure 4-3 presents the minimum approach DOC, States/Administrations may specify an extended DOC based on the operational requirements. More information on establishing the DOC is in Annex 10, Volume I, Attachment D, paragraph 7.3.

4.4.2.5 It is recommended to assume a single omnidirectional coverage that encompasses all GBAS DOCs at an airport, if feasible. At a particular airport the set of GBAS DOC that are supported may include one or multiple GBAS DOC at all runways or a subset of runways. Furthermore, each GBAS DOC may be described either by the minimum DOC according to Figure 4 3 or by an extended DOC as specified by the GBAS service provider. When frequency coordination is not feasible assuming single omnidirectional coverage, it may be feasible to protect coverage only in the GBAS DOC's.

4.4.3 GBAS/VDB positioning service EIRP

4.4.3.1 The EIRP for the GBAS/VDB when providing the approach service is typically 17dBW (50 W) to provide service down to about 2 000 ft at the lower edge of the DOC.

4.4.3.2 The EIRP for the GBAS/VDB when providing the positioning service is in Table 4.9.

Table 4.9 Typical EIRP for GBAS/VDB positioning service

Range (NM)	EIRP (dBW)	EIRP (W)
50	14	25
100	20	100
150	23	200
200	26	400

Note: The EIRP of a GBAS/VDB system shall be provided as Peak Envelope Power. Since MOPS specify the output power to be measured as mean power over a bit-sequence in the preamble, care must be taken that the PEP is used for calculation.

4.4.4 For frequency assignment planning purposes, it is assumed the field strength of the desired corresponds to the minimum field strength, as defined in Annex10, Volume I, throughout the designated operational coverage. The minimum field strength is 215 μV/m (-99 dBW/m2) which is equivalent to a power level at the aircraft antenna output of -102 dBW with an ideal isotropic antenna (for the horizontal component of the GBAS/VDB signal). The maximum field strength is (SIS max) 0.879 V/m (– 27 dBW/m^2 when converted to power flux density or –29 dBW when converted to power at the output of an isotropic antenna).

4.4.5 For use in civil aviation, the GBAS signal is horizontally polarized. The value for cross polarization isolation between horizontal and vertical polarization assumed to be 10 dB.

4.4.6 The risk of interference from FM broadcasting stations in the band 87 – 108 MHz caused by unwanted emissions into the aeronautical band or generated in the airborne receiver should be taken into account. The relevant Recommendation for GBAS is ITU-R SM.1841.

4.4.7 Information on the planning of identifications can be found in section 4.6.

4.4.8 Besides the frequency, co-ordination must also take into account reference path data selectors (RPDS) and reference station data selectors (RSDS) and time slots. More information on the use and coordination of RPDSs and RSDSs is in Annex 10, Volume I, Appendix B. However as these are currently not planned to be used in the APAC Region, no relevant planning criteria have been developed yet.

4.4.9 Protection requirements

4.4.9.1 Protection requirements for GBAS/VDB receivers.

The GBAS/VDB receiver shall be capable to achieve a message failure rate of not more than one failed message per 1000 data messages. The D/U ratios in Table 4.10 will meet this requirement.

Table 4.10 Co- and adjacent channel protection requirements for GBAS/VDB receivers

Frequency offset	**VDB/VDB**	**VDB/VOR**	**VDB/ILS**	**VDB/VHF-COM**
Co-frequency	26 dB	26 dB	26 dB	n/a
+/- 25 kHz	-18 dB	0 dB	0 dB	n/a
+/- 50 kHz	-43 dB	-34 dB	-34 dB	-32 dB
+/- 58.33 kHz	n/a	n/a	n/a	-38 dB
+/- 66.66 kHz	n/a	n/a	n/a	-41 dB
+/- 75 kHz	-46 dB	-46 dB	-46 dB	-45 dB
+/- 83.33 kHz	n/a	n/a	n/a	-47 dB
+/- 91.66 kHz	n/a	n/a	n/a	-49 dB
+/- 100 kHz	-46 dB	-46 dB	-46 dB	-51 dB
+/–975 kHz	-46 dB	-46 dB	-46 dB	-51 dB
≥ 1000 kHz	-46 dB	-60 dB	-60 dB	-77 dB

4.4.9.2 For the calculation of the minimum geographical separation distance between a desired GBAS VDB facility and an undesired GBAS VDB (or localizer, VOR or VDL Mode 4) facility, the generic model described in Appendix D, need to be applied.

4.4.10 The separation distances between desired and undesired GBAS stations in Table 4.11 were calculated for desired GBAS facilities providing approach services.

Table 4.11 Minimum separation distances between desired and undesired GBAS stations

Frequency offset	D/U (dB)	L (dB)	Distance from DOC of desired station to undesired station	Distance between the GBAS stations
0 (Co- channel)	26	145	149 NM	172 NM
25 kHz	-18	101	24 NM	47 NM
50 kHz	-43	76	0 NM	0 NM
Δf ≥ 75 kHz	-46	73	0 NM	0 NM

Note: It's assumed that the GBAS VDB is within 3 miles of all runway ends supported by the GBAS and that all runway ends are supported by the minimum approach DOC illustrated in Figure 4-3.

4.4.11 The calculation of the minimum separation distances between the edge of coverage (DOC) of a desired GBAS VDB facility and the location of an undesired VOR or Localizer in Table 4.12.

Table 4.12 Minimum separation distances between the DOC of the desired GBAS and the location of the undesired VOR or localizer

D/U (dB)	VOR or localizer (17dBW)			VOR (27dBW)		VOR (30dBW)	
	L(dB) 5%	VOR Distance (NM)	Localizer Distance (NM)	L(dB) 5%	VOR Distance (NM)	L(dB) 5%	VOR Distance (NM)
26 (Δf = 0 kHz)	145	149	149	155	163	156	201
0 (Δf = 25 kHz)	119	68	38	129	101	132	111
-34 (Δf = 50 kHz)	85	4	4	95	13	98	17
-46 (Δf = 75 kHz)	73	0	0	83	3	86	4
-46 (Δf = 100 kHz)	73	0	0	83	3	86	4
-46 (Δf = 975 kHz)	73	0	0	83	3	86	4
-60 (Δf ≥ 1000 kHz)	59	0	0	69	0	72	0

Note：The parameters used in the calculations below are:
Height of the antenna of the (undesired) VOR is 20 ft above local terrain.
Height of the antenna of the (undesired) Localizer) is 6 ft above local terrain.
Height of the (desired) VDB aircraft is 10.000 ft.
ITU-R aeronautical propagation curves (Recommendation P.528-4) for 112 MHz, 5% of the time

4.4.12 Interference from VHF-COM signals

4.4.12.1 On-board compatibility

No frequency assignment planning constraints have been identified to secure the compatibility between the on-board transmission of VHF-COM signals and the reception of GBAS/VDB signals on the same aircraft.

4.4.12.2 Air-to-air interference can be expected as in Table 4.13.

Table 4.13 Minimum separation distances between aircraft

ΔF (kHz)	D/U	10dBW		14 dBW		17dBW		20 dBW	
		L (dB)	D(NM)	L (dB)	D(NM)	L (dB)	D(NM)	L (dB)	D(NM)
50	–32 dB	80	1.5	84	2	87	3	91	4.5
58.3	–38 dB	74	0.6	78	1	81	1	84	2
66.6	–41 dB	71	0.4	75	0.7	78	1	81	3
75	–45 dB	67	0.3	71	0.4	74	0.6	77	0.9
83.3	–47 dB	65	0.2	69	0.3	72	0.5	75	0.7
91.6	–49 dB	63	0.1	67	0.3	70	0.4	73	0.5
100	–51 dB	61	0.1	65	0.2	68	0.3	71	0.4
125	-46 dB	47	0	61	0.1	64	0.2	67	0.2

The minimum separation distances as in Table 4.13 were calculated assuming isotropic antennas on board the desired and the undesired aircraft. Taking into account that the effect of the actual antenna diagram of the VHF-COM and the GBAS/VDB antenna as well as the transient effect of air-to-air interference, at a frequency separation greater than 100 kHz no air-to-air interference is expected.

Note: An aircraft EIRP. of 20 dBW (100 W) is not normally used. For aircraft EIRP. of 17dBW (50 W) or less, a minimum frequency separation between the aircraft VHF-COM and the GBAS/VDB receiver of 50 kHz may be recommended.

4.4.12.3 Ground-to-air interference

At short distances, as shown in Table 4.13, interference from a VHF-Ground facility can be expected when the EIRP of the ground station is between 14 dBW (25W) to 20 dBW (100W). Maintaining a minimum frequency separation of 100 kHz between the assigned GBAS/VDB and VHF-COM frequency would avoid such interference. One option is to ensure in the frequency assignment planning process that a guard band of 100 kHz is introduced which would exclude the frequencies between 117.900 – 117.975 MHz to be used for GBAS/VDB.

Note: This condition seems to be extremely conservative. Taking into account the actual antenna diagram and the geography of short distances to the (interfering) VHF COM station, is may be sufficient to only exclude the frequency 117.950 MHz from being assigned to a GBAS/VDB station.

4.4.13 Airborne Contribution Factor

4.4.13.1 In extreme cases where the assumptions as in paragraph 4.4.9 cannot be applied or are not offering the GBAS/VDB compatibility calculations for GBAS versus GBAS, Localizer and VOR facilities may include the use of the Airborne Contribution Factor (ACF). This will require larger protection distances between the desired GBAS/VDB and the undesired GBAS/VDB, Localizer and VOR and, in the case of adjacent channel interference, over a range of plus/minus 1 MHz. In this case it may be difficult if not impossible to find a proper GBAS/VDB frequency that can be assigned and, in return, such a frequency assignment will prohibit in a large area the addition of new VOR or Localizer facilities.

4.4.13.2 The airborne contribution factor compensates for antenna gain variations in the horizontal plane (between the direction of the desired versus the undesired transmitter) and on-board transmission line loss variation (between the frequency of the desired and undesired signal). The airborne contribution factor can be calculated with 15 + Min (6, 6 x frequency offset (in kHz) /1 000) with a maximum frequency offset of 1 000 kHz.

4.4.13.3 Table 4.14 contains requirements for GBAS VDB receivers accounting for ACF.

Table 4.14 Co- and adjacent channel protection requirements for GBAS/VDB; signal-in-space

Frequency offset	**VDB/VDB**	**VDB/VOR**	**VDB/ILS**	**VDB/VHF-COM**
Co-frequency	41 dB	41 dB	41 dB	n/a
+/- 25 kHz	-3 dB	15 dB	15 dB	n/a
+/- 50 kHz	-27 dB	-18 dB	-18 dB	
+/- 58.33 kHz	n/a	n/a	n/a	
+/- 66.66 kHz	n/a	n/a	n/a	
+/- 75 kHz	-30 dB	-30 dB	-30 dB	
+/- 83.33 kHz	n/a	n/a	n/a	
+/- 91.66 kHz	n/a	n/a	n/a	
+/- 100 kHz				
+/- 975 kHz	-25 dB	-25 dB	--25 dB	
≥ 1000 kHz	-25 dB	-39 dB	-39 dB	

4.5 Distance Measuring Equipment (DME)

4.5.1 Frequency band and channel spacing

4.5.1.1 The DME operates on paired interrogation and reply frequencies (each combination of these frequencies is a "channel") in the frequency band 960 – 1215 MHz. A number of these channels are in turn paired with ILS or VOR frequencies. The DME channelling arrangement is shown in Appendix D.

Note: The frequency band 960 – 1215 MHz is also used for TACAN. TACAN operates with the same channeling scheme as the DME and can be paired with a VOR (VOR/TAC). From the frequency assignment planning point of view TACAN is equivalent to DME.

4.5.1.2 The spacing between DME channels is 1MHz. DME X and Y channels with the same channel number use the same interrogator frequency but with different pulse coding. The reply frequency for the X and Y channel is different as well as the pulse coding. The Y channels reuse the reply frequencies within the interrogation frequency block (1025 – 1150 MHz).

4.5.2 The Designated Operational Coverage (DOC) of the DME is normally as promulgated by States/Administrations. When the DME is associated with an ILS or a VOR, the DOC of the DME is normally not less than the DOC of the ILS or VOR.

4.5.3 The peak equivalent isotopically radiated power shall not be less than that required to ensure a peak pulse power density of -89 dBW/m^2 under all operational weather conditions at any point within coverage. Minus 111 dBW at the antenna corresponds to a power flux density of -89 dBW/m^2 at the mid-band frequency.

4.5.4 Information on the planning of identifications can be found in section 4.6.

4.5.5 Protection requirements

Notes: For frequency planning purposes,

1) There is no difference between DME/N and DME/P.

2) TACAN facilities are treated in the same way as DME stations.

3) No criteria are defined for DME/W and DME/Z.

4.5.5.1 The necessary desired to undesired (D/U) signal ratios needed to protect the desired transponder reply signal at an airborne receiver from the various co-frequency/adjacent frequency, same code/different code, undesired transponder reply signal combinations that may exist.

4.5.5.2 The prerequisite for any D/U calculation to be valid is that the minimum signal of the (desired) DME (-111 dBW) at the aircraft antenna is achieved at all points throughout the coverage.

4.5.5.3 In making an assignment, each DME facility must be treated as the desired source with the other acting as the undesired. If both satisfy their unique D/U requirement, then the channel assignment may be made. This "reverse" check is necessary if the DME facilities being considered radiate with different EIRP or have a different DOC.

4.5.5.4 To each X or Y DME channel corresponds a specific reply frequency within the band 960 - 1215 MHz. X and Y DME channels do not have reply frequencies in common. Hence, for the protection of the desired transponder replies from other co-channel transponder replies, it is sufficient to consider only DME facilities with the same channel designation (including the pulse code). However, for DME facilities operating on Y channels, the reply frequency may be the same as the interrogator frequency of another DME X facility.

4.5.5.5 For co-channel assignments, the D/U signal ratio should be at least 8 dB throughout the service volume.

4.5.5.6 For Adjacent frequency assignments, the minimum required D/U ratio within the operational service volume shall be in accordance with the values given in Table 4.15.

The following values are assumed for the adjacent-channel emissions of the transponder (P_u):

200 mW (-7 dBW) on the first adjacent frequency;

2 mW (-27 dBW) on the second adjacent frequency.

Table 4.15 Protection criteria for the DME Ground Station (Interrogator)

Type of assignment	A	B
Co-frequency:		
Same pulse code	8	8
Different pulse code	8	-43
First adjacent frequency:		
Same pulse code	- (P_u - 1)	-42
Different pulse code	- (P_u + 7)	-75
Second adjacent frequency:		
Same pulse code	- (P_u + 19)	-75
Different pulse code	- (P_u + 27)	-75

Note 1: The D/U ratios in column A protect those DME/N interrogators operating on X or Y channels. Column A applies to decoder rejection of 6 microseconds.

Note 2: The D/U ratios in column B protect those DME/N or DME/P interrogators utilizing discrimination in conformance with 3.5.5.3.4.2 and 3.5.5.3.4.3 of Chapter 3, Annex 10, Volume I and providing a decoder rejection conforming to 3.5.5.3.5 of Chapter 3. Annex 10, Volume I

Note 3: Pu is the peak effective radiated power of the undesired signal in dBW.

Note 4: The frequency protection requirement is dependent upon the antenna patterns of the desired and undesired facility and the EIRP of the undesired facility.

Note 5: In assessing adjacent channel protection, the magnitude of D/U ratio in column A should not exceed the magnitude of the value in column B.

4.5.5.7 Separation requirement for DME reply frequencies which are separated by 63MHz. The channel assignment plan for DME is such that the transponder reply frequency for each Y channel is the same as the interrogation frequency of another DME channel. When the reply frequency of one DME matches the interrogation frequency of a second DME, a minimum separation distance of 15 NM (28km) between these (ground) facilities would be required, in general.

4.5.5.8 Table 4.16 to Table 4.18 present the co- and adjacent frequency separation distance between the edge of the DOC of the (desired) DME and the location of the (undesired) DME.

Table 4.16 Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DEM at 45000 ft**
0	8	146	256	149	260	156	265	co-channel
1	8	112	3	112	3	112	3	first adjacent channel
63			15		15		15	

Table 4.17 Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DME at 25000 ft**
0	8	146	197	149	200	156	204	co-channel
1	8	112	6	112	6	112	6	first adjacent channel
63			15		15		15	

Table 4.18 Minimum separation distances between desired DME and undesired DME

ΔF (MHz)	**D/U (dB)**	**Tx = 27 dBW**		**Tx = 30 dBW**		**Tx=37 dBW**		**Remarks**
		L (dB)	**D (NM)**	**L (dB)**	**D (NM)**	**L (dB)**	**D (NM)**	**Desired DME at 10000 ft**
0	8	146	131	149	133	156	137	co-channel
1	8	112	5	112	5	112	5	first adjacent channel
63			15		15		15	

Note1: The separation distances are between the edge of coverage for a desired DME and the location of an undesired DME. The EIRP of the undesired DME is as specified in column "Tx".

Note2: ITU-R aeronautical propagation curve for 1080 MHz and 5% of the time. The antenna height of the desired aircraft receiver is indicated in the "Remarks" column, and the antenna height of undesired DME is20 ft.

4.5.6 Sectorized DOC of the DME.

4.5.6.1 Similar to VOR (as described in section 4.3), the DME DOC may be sectorized (instead of circular). In this case, compatibility of the DME with other DME assignments needs to be assured at the critical point which is the closest point of the DOC of the desired DME (with sectorized DOC) and any potential interfering DME transponder.

4.5.7 Use of directional antenna.

4.5.7.1 When omnidirectional DOC is not required, the use of a DME with directional antenna is encouraged, subject to the proviso that the operational requirements for the service to be provided by this facility are met. In Particular, they are useful for the replacement of ILS marker beacons. The directional DME could provide a means to mitigate frequency congestion.

4.5.7.2 The compatibility of DMEs with directional antennas can be examined basically along the same lines as those developed for omnidirectional DME. However, because of the variable antenna gain of a DME with directional antenna, the value of the quantity K (EIRP of the desired minus the EIRP of the undesired facility) in the above formulas depends in general on the position of the airborne receiver. It is noted in particular that because of the orientation of a DME with directional antenna, the minimum D/U value is not necessarily attained along the direct line connecting desired and undesired facilities, as opposed to the case of compatibility between omnidirectional DME.

4.5.7.3 In the presence of at least one DME with directional antenna, the following method should be applied. At first an appropriate number of points is selected along the edge of the DOC of the desired DME, regardless of the type of its antenna. Subsequently at all such points the required D/U criteria are checked. Compatibility is ensured if at all such points the required D/U criteria are met.

4.6 Identifications of Radio Navigation Aids

4.6.1 Identifications of navigation aids shall be so composed, if possible, as to facilitate association with the name of the point in plain language. The Table 4.19 provides an overview of the requirements which have to be taken into account for identifications.

Table 4.19 The requirements have to be taken into account for identifications

Facility	Identification	Remarks
NDB and Locator	2 or 3 letters of the International Morse Code.	
ILS	2 or 3 letters of the International Morse Code which may be preceded by the letter I.	Transmitted by the localizer.
ILS/DME	ILS: 2 or 3 letters of the International Morse Code which may be preceded by the letter I. DME: Identical to associated ILS.	Associated DME identification signal.
VOR	2 or 3 letters of the International Morse Code.	
VOR/DME (VOR/TACAN also called VORTAC)	VOR: 2 or 3 letters of the International Morse Code. DME: Identical to associated VOR.	Associated DME identification signal.
DME (TACAN)	Letters and numerals of the International Morse Code.	Independent DME identification signal for stand-alone DME facility.
GBAS	4 characters (Only upper-case letters, numeric digits and IA-5 “space” are used. The rightmost character is transmitted first. For a three-character GBAS ID, the rightmost (first transmitted) character shall be IA-5 “space”.)	The GBAS ID is normally identical to the location indicator at the nearest aerodrome

4.6.2 The identification TST is reserved for radio navigation facilities on test and should not be used for other purposes.

4.6.3 Coded identification shall not be duplicated within 1 100 km (600 NM) of the location of the radio navigation aid concerned, except as noted hereunder.

Note: When two radio navigation aids operating in different bands of the frequency spectrum are situated at the same location, their radio identifications are normally the same.

4.6.4 States/Administrations’ requirements for identifications shall be notified to the Regional Offices for coordination.

Appendix A

TEMPLATE FOR AN EXCEL OR WORD FILE THAT CAN BE USED FOR ELECTRONIC SUBMISSION OF ONE (OR MORE) NEW OR MODIFIED FREQUENCY ASSIGNMENTS FOR NAV SYSTEMS TO THE REGIONAL OFFICE

Essential characteristics should to be included in the submission to the Regional Office:

Country	
Location	
Latitude	
Longitude	
Frequency	
Channel	
VHFDOC	
VHFPwr	
DMEDOC	
DMEPwr	
Cat	
Remarks	
TRD	

In the table, the following format should be used:

Country — Country name as per ICAO directory

Location — Name of the location of the NAV facility

Latitude — Latitude in the format xxDyy'zz'' (e.g. 32D44'55'')

Longitude — Longitude in the format xxxDyy'zz'' (e.g.054D55'56'')

Facility — Select one of the following facilities

- ILS
- ILS/DME
- VOR
- VOR/DME
- DME
- TACAN
- GBAS

Frequency — xxx.yyy (e.g. 109.200 or 113.450) [MHz]

A frequency can be proposed by a State or selected by the Regional Office and is subject to a compatibility assessment with or frequency assignments in the COM list 2

Channel — DME channel (e.g. 36X or 45Y)

VHFDOC — xxx/yyy e.g. 200/250 — xxx is the range of the coverage (e.g. 200 is 200 NM); yyy is the height (FL) of the coverage (e.g. 250 is FL 250 or 25000ft)

DMEDOC — xxx/yyy e.g. 200/250 — xxx is the range of the DME coverage (e.g. 200 is 200 NM); yyy is the height (FL) of the DME coverage (e.g. 250 is FL 250 or 25000ft)

Remarks — Optional, as provided by the State

Cat — Category; either ICAO or NAT

VHFPwr — As provided by the State

DMEPwr — As provided by the State

Note: The values for VHFPwr and DMEPwr are for the effective isotopically radiated power (e.i.r.p) of the relevant facility. In the absence of such information, the following values are assumed in the frequency assignment planning process:

ILS/Localizer	30 dBW	
ILS/DME	27 dBW (e.i.r.p for the associated DME)	
VOR	Range <50 NM	e.i.r.p 17 dBW
	Range 50 – 100 NM	e.i.r.p 20 dBW
	Range 100 – 150 NM	e.i.r.p 23 dBW
	Range > 150 NM	e.i.r.p 30 dBW
VOR/DME	Range <50 NM	e.i.r.p 27 dBW (landing DME)
	Range 150 -150 NM	e.i.r.p 30 dBW (terminal DME
	Rnage >150 NM	e.i.r.p 37 dBW (en route DME)

DME only as for DME associated with VOR.
Note: The e.i.r.p values for DME apply also for TACAN facilities

TRD Runway azimuth
Note: If no TRD, circler coverage assumed.

Appendix B

PREFERRED FORMAT OF THE CHARACTERISTICS OF SUBMISSIONS

Reference of submission:

Date:

Subject: Application for xx, at xx (location name)

Contact information of the civil aviation authority of States

Suggested basic information of a submission:

Function of the proposed assignments,

Details of the facility: VHF-COM, ILS, VOR, GBAS, DME,

Frequency Range (if request RO for proposal) or proposed frequency,

Transmit Power (EIRP) and DOC,

Latitude/Longitude:

Minimum information required with reference to the following screenshot:

Country, Location, Latitude/Longitudes, Service.

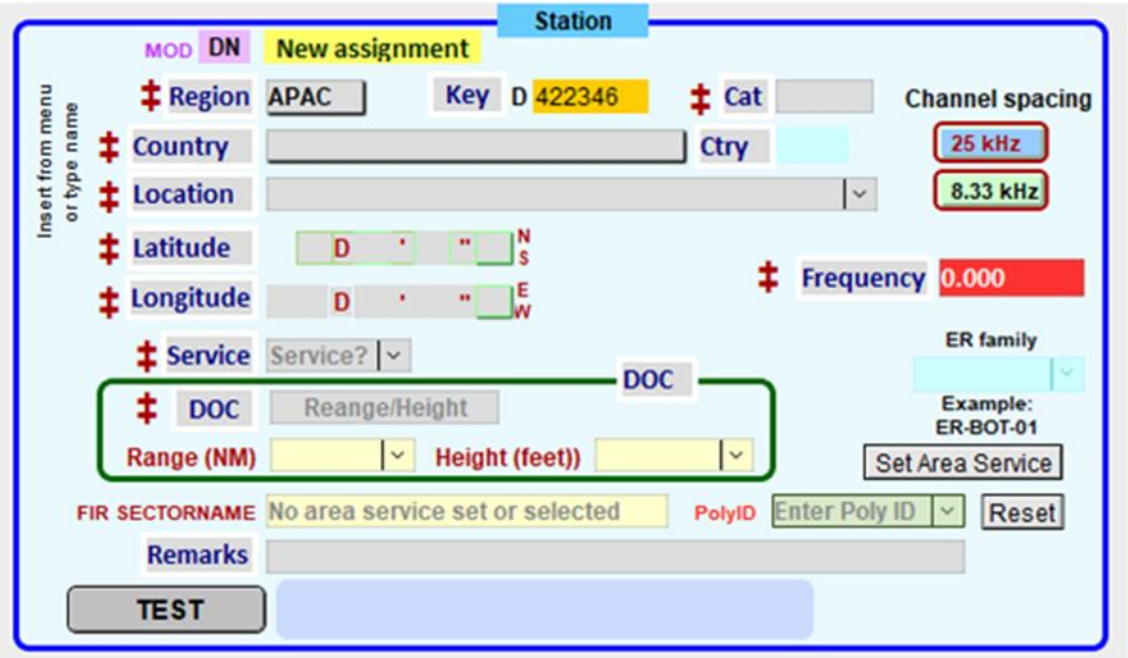


Fig. 1 VHF COM

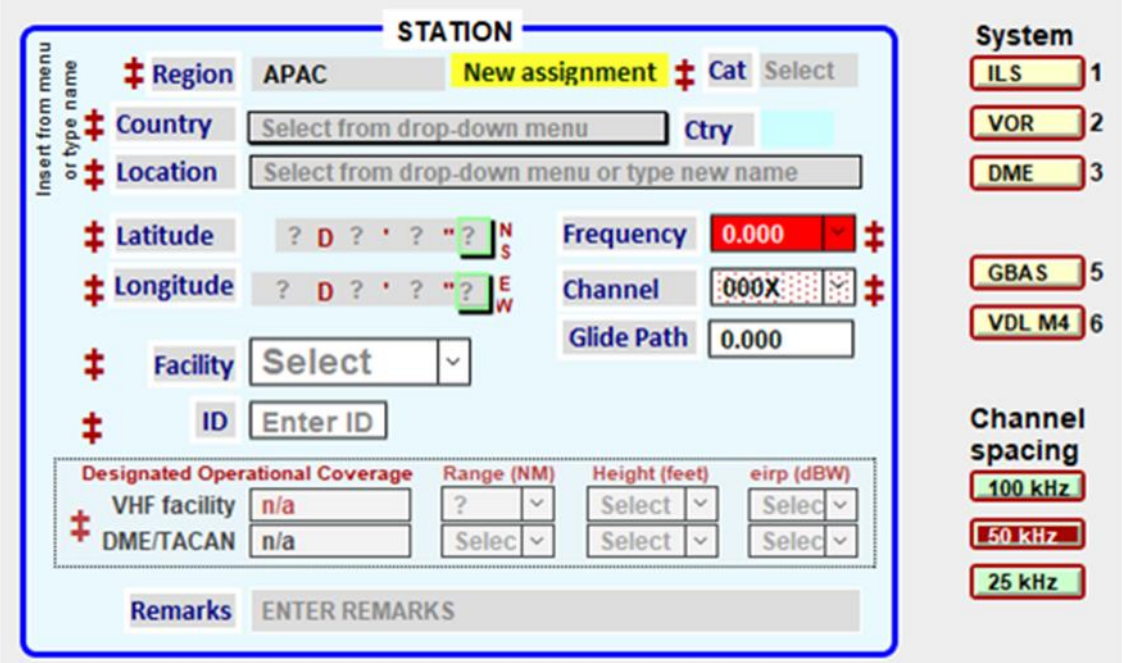

STATION
Insert from menu or type name
Region
APAC
New assignment
Cat
Select
Country
Select from drop-down menu
Ctry
Location
Select from drop-down menu or type new name
Latitude
? D ? ' ? " ?
N S
Longitude
? D ? ' ? " ?
E W
Frequency
0.000
Channel
000X
Glide Path
0.000
Facility
Select
ID
Enter ID
Designated Operational Coverage
Range (NM)
Height (feet)
eirp (dBW)
VHF facility
n/a
DME/TACAN
n/a
Remarks
ENTER REMARKS
System
ILS 1
VOR 2
DME 3
GBAS 5
VDL M4 6
Channel spacing
100 kHz
50 kHz
25 kHz

Fig. 2 VHF NAV

Appendix C

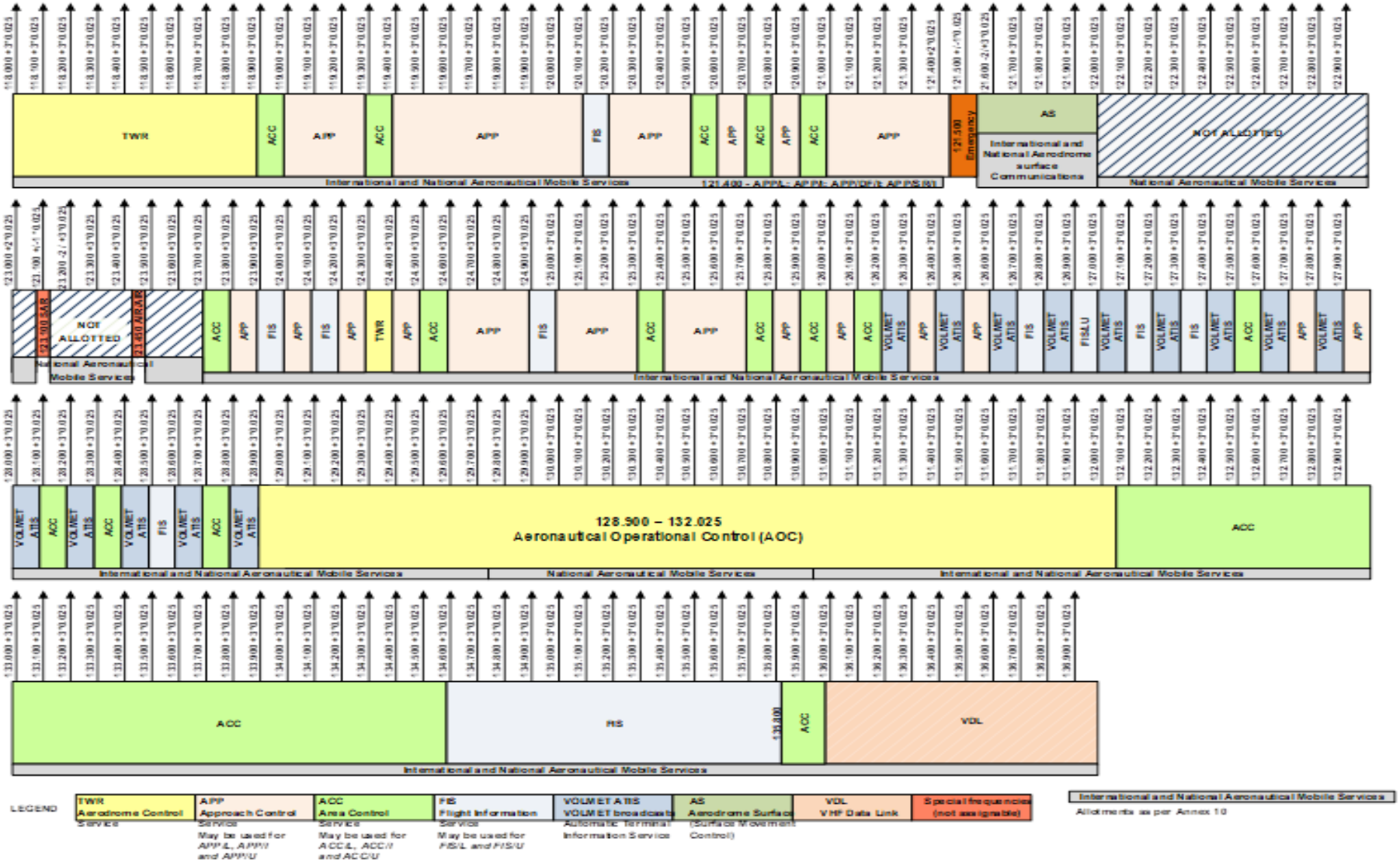
REGIONAL 117.975-137MHz FREQUENCY ALLOTMENT PLAN

Function	Frequencies (MHz)
TWR 118.000-118.875MHz 124.300-124.375MHz	118.000 118.025 118.050 118.075 118.100 118.125 118.150 118.175 118.200 118.225 118.250 118.275 118.300 118.325 118.350 118.375 118.400 118.425 118.450 118.475 118.500 118.525 118.550 118.575 118.600 118.625 118.650 118.675 118.700 118.725 118.750 118.775 118.800 118.825 118.850 118.875 124.300 124.325 124.350 124.375
AS 121.550-121.975MHz	**121.550 121.575** 121.600 121.625 121.650 121.675 121.700 121.725 121.750 121.775 121.800 121.825 121.850 121.875 121.900 121.925 121.950 121.975
APP 119.000-119.275MHz 119.400-120.075MHz 120.200-120.475MHz	119.500 119.525 119.550 119.575 119.600 119.625 119.650 119.675 119.800 119.825 119.850 119.875 119.900 119.925 119.950 119.975
120.600-120.675MHz 120.800-120.875MHz 121.000-121.450MHz 123.800-123.875MHz 124.000-124.075MHz 124.200-124.275MHz 124.400-124.475MHz 124.600-124.875MHz 125.000-125.275MHz 125.400-125.675MHz 125.800-125.875MHz 126.000-126.075MHz 126.300-126.375MHz 126.500-126.575MHz 127.700-127.775MHz 127.900-127.975MHz	119.100 119.125 119.150 119.175 119.200 119.225 119.250 119.275 119.400 119.425 119.450 119.475 119.700 119.725 119.750 119.775 120.000 120.025 120.050 120.075 120.200 120.225 120.250 120.275 120.400 120.425 120.450 120.475 120.600 120.625 120.650 120.675 120.800 120.825 120.850 120.875 121.000 121.025 121.050 121.075 121.100 121.125 121.150 121.175 121.200 121.225 121.250 121.275 121.400 **121.425 121.450** 123.800 123.825 123.850 123.875 124.000 124.025 124.050 124.075 124.700 124.725 124.750 124.775 125.100 125.125 125.150 125.175 125.500 125.525 125.550 125.575 126.500 126.525 126.550 126.575 127.700 127.725 127.750 127.775 127.900 127.925 127.950 127.975
	120.300 120.325 120.350 120.375 121.300 121.325 121.350 121.375 124.200 124.225 124.250 124.275 124.400 124.425 124.450 124.475 124.600 124.625 124.650 124.675

	124.800 124.825 124.850 124.875 125.000 125.025 125.050 125.075 125.200 125.225 125.250 125.275 125.400 125.425 125.450 125.475 125.600 125.625 125.650 125.675 125.800 125.825 125.850 125.875 126.000 126.025 126.050 126.075 126.300 126.325 126.350 126.375
ACC 118.900-118.975MHz 119.300-119.375MHz 120.500-120.575MHz	126.100 126.125 126.150 126.175 127.500 127.525 127.550 127.575 128.300 128.325 128.350 128.375 128.700 128.725 128.750 128.775
120.700-120.775MHz 120.900-120.975MHz 123.700-123.775MHz 124.500-124.575MHz 125.300-125.375MHz 125.700-125.775MHz 125.900-125.975MHz 126.100-126.175MHz 127.500-127.575MHz 128.100-128.175MHz 128.300-128.375MHz 128.700-128.775MHz 132.050-134.575MHz 135.825-135.975MHz	118.900 118.925 118.950 118.975 119.300 119.325 119.350 119.375 120.500 120.525 120.550 120.575 120.700 120.725 120.750 120.775 120.900 120.925 120.950 120.975 123.700 123.725 123.750 123.775 124.500 124.525 124.550 124.575 125.300 125.325 125.350 125.375 125.700 125.725 125.750 125.775 125.900 125.925 125.950 125.975 128.100 128.125 128.150 128.175 132.050 132.075 132.100 132.125 132.150 132.175 132.200 132.225 132.250 132.275 132.300 132.325 132.350 132.375 132.400 132.425 132.450 132.475 132.500 132.525 132.550 132.575 132.600 132.625 132.650 132.675 132.700 132.725 132.750 132.775 132.800 132.825 132.850 132.875 132.900 132.925 132.950 132.975 133.000 133.025 133.050 133.075 133.100 133.125 133.150 133.175 133.200 133.225 133.250 133.275 133.300 133.325 133.350 133.375 133.400 133.425 133.450 133.475 133.500 133.525 133.550 133.575 133.600 133.625 133.650 133.675 133.700 133.725 133.750 133.775 133.800 133.825 133.850 133.875 133.900 133.925 133.950 133.975 134.000 134.025 134.050 134.075 134.100 134.125 134.150 134.175 134.200 134.225 134.250 134.275 134.300 134.325 134.350 134.375 134.400 134.425 134.450 134.475 134.500 134.525 134.550 134.575 135.825 135.850 135.875 135.900 135.925 135.950 135.975
FIS 120.100-120.175MHz 123.900-123.975MHz	120.100 120.125 120.150 120.175 123.900 123.925 123.950 123.975 124.100 124.125 124.150 124.175

124.100-124.175MHz 124.900-124.975MHz 126.700-126.775MHz 126.900-126.975MHz 127.100-127.175MHz 127.300-127.375MHz 128.500-128.575MHz 134.600-135.800MHz	124.900 124.925 124.950 124.975 126.700 126.725 126.750 126.775 126.900 126.925 126.950 126.975 127.100 127.125 127.150 127.175 127.300 127.325 127.350 127.375 128.500 128.525 128.550 128.575 134.600 134.625 134.650 134.675 134.700 134.725 134.750 134.775 134.800 134.825 134.850 134.875 134.900 134.925 134.950 134.975 135.000 135.025 135.050 135.075 135.100 135.125 135.150 135.175 135.200 135.225 135.250 135.275 135.300 135.325 135.350 135.375 135.400 135.425 135.450 135.475 135.500 135.525 135.550 135.575 135.600 135.625 135.650 135.675 135.700 135.725 135.750 135.775 135.800
VOLMET/ATIS 126.200-126.275MHz 126.400-126.475MHz 126.600-126.675MHz 126.800-126.875MHz 127.000-127.075MHz 127.200-127.275MHz 127.400-127.475MHz 127.600-127.675MHz 127.800-127.875MHz 128.000-128.075MHz 128.200-128.275MHz 128.400-128.475MHz 128.600-128.675MHz 128.800-128.875MHz	126.200 126.225 126.250 126.275 126.400 126.425 126.450 126.475 126.600 126.625 126.650 126.675 126.800 126.825 126.850 126.875 127.000 127.025 127.050 127.075 127.200 127.225 127.250 127.275 127.400 127.425 127.450 127.475 127.600 127.625 127.650 127.675 127.800 127.825 127.850 127.875 128.000 128.025 128.050 128.075 128.200 128.225 128.250 128.275 128.400 128.425 128.450 128.475 128.600 128.625 128.650 128.675 128.800 128.825 128.850 128.875
AOC	128.900-132.025(Except 128.950MHz)
DATA LINK	136.000-136.975
AIR-TO-AIR	123.450 128.950 (TIBA)
NOT ALLOTED	122.000-123.675(Except 123.100MHz, 123.450MHz)

Note: In Australia, Myanmar, New Zealand, Thailand the frequency of 128.950 MHz has been allotted to TIBA.


TWR
ACC
APP
FIS
AS
International and National Aeronautical Mobile Services
121.400 - APP/A - APP/I - APP/D/S APP/S/I
121.500 Emergency
International and National Aerodrome surface Communications
NOT ALLOTTED
National Aeronautical Mobile Services
121.900 AAR
121.400 ARAS
VOLMET ATIS
128.900 – 132.025
Aeronautical Operational Control (AOC)
VDL
LEGEND
Aerodrome Control Service
Approach Control Service
May be used for APP/L, APP/I and APP/U
Area Control Service
May be used for ACC/L, ACC/I and ACC/U
Flight Information Service
May be used for FIS/L and FIS/U
VOLMET broadcasts
Automatic Terminal Information Service
Aerodrome Surface (Surface Movement Control)
VHF Data Link
Special frequencies (not assignable)
Allotments as per Annex 10

Appendix D

GENERIC CALCULATION METHOD FOR GEOGRAPHICAL SEPARATION DISTANCES

a. For the calculation of minimum separation distances with a (desired) facility and an (undesired) facility the generic model as described in Chapter 1 of DOC 9718 has been established.

b. To establish minimum geographical separation distances between a desired facility and an undesired facility, the following parameters are used:

a) The minimum received desired power Pd of the desired facility (dBW).
b) D/U ratio. The prerequisite for any D/U calculation to be valid is that the minimal receive power is achieved at all points throughout the coverage.
c) EIRP of the undesired facility Tx (dBW).
d) Designated operational range of the desired facility.
e) ITU-R aeronautical propagation curve for 5% of the time.

c. The generic method establishes the minimum geographical separation distance between the edge of the DOC of the desired facility and undesired facility. This distance provides for the transmission loss (attenuation) of the undesired signal to a level that meets the D/U requirement for the desired signal, L = Tx -Pd + D/U. This distance is obtained with using the relevant (frequency) ITU propagation curve applicable for the maximum height of the DOC of the desired facility and the site elevation of the undesired facility.

d. When the minimum distance from the edge of coverage from the desired facility to the undesired facility has been established, the station-to-station separation distance can be obtained by adding the DOR to the minimum distance from the edge of coverage to the undesired facility.

e. These steps need to be undertaken in the reverse direction whereby the desired facility becomes the undesired facility and the undesired facility becomes the desired facility. The maximum distance between the two processes determine the minimum separation between the two facilities.

Appendix E

PAIRING OF ILS/VOR/DME CHANNELS

Source: Annex 10, Volume 1, Table A			DME parameters					
			Interrogation				Reply	
				Pulse codes				
Channel pairing					DME/P mode			
DME channel number	VHF frequency MHz	GS frequency MHz	Frequency MHz	DME/N µs	Initial approach µs	Final approach µs	Frequency MHz	Pulse codes µs
* 1X	–	–	1 025	12	–	–	962	12
** 1Y	–	–	1 025	36	–	–	1 088	30
* 2X	–	–	1 026	12	–	–	963	12
** 2Y	–	–	1 026	36	–	–	1 089	30
* 3X	–	–	1 027	12	–	–	964	12
** 3Y	–	–	1 027	36	–	–	1 090	30
* 4X	–	–	1 028	12	–	–	965	12
** 4Y	–	–	1 028	36	–	–	1 091	30
* 5X	–	–	1 029	12	–	–	966	12
** 5Y	–	–	1 029	36	–	–	1 092	30
* 6X	–	–	1 030	12	–	–	967	12
** 6Y	–	–	1 030	36	–	–	1 093	30
* 7X	–	–	1 031	12	–	–	968	12
** 7Y	–	–	1 031	36	–	–	1 094	30
* 8X	–	–	1 032	12	–	–	969	12
** 8Y	–	–	1 032	36	–	–	1 095	30
* 9X	–	–	1 033	12	–	–	970	12
** 9Y	–	–	1 033	36	–	–	1 096	30
* 10X	–	–	1 034	12	–	–	971	12
** 10Y	–	–	1 034	36	–	–	1 097	30
* 11X	–	–	1 035	12	–	–	972	12
** 11Y	–	–	1 035	36	–	–	1 098	30
* 12X	–	–	1 036	12	–	–	973	12
** 12Y	–	–	1 036	36	–	–	1 099	30
* 13X	–	–	1 037	12	–	–	974	12
** 13Y	–	–	1 037	36	–	–	1 100	30
* 14X	–	–	1 038	12	–	–	975	12
** 14Y	–	–	1 038	36	–	–	1 101	30

*	15X	–	–	1 039	12	–	–	976	12
**	15Y	–	–	1 039	36	–	–	1 102	30
*	16X	–	–	1 040	12	–	–	977	12
**	16Y	–	–	1 040	36	–	–	1 103	30
?	17X	108		1 041	12	–	–	978	12
	17Y	108.05		1 041	36	36	42	1 104	30
	18X	108.1	334.7	1 042	12	12	18	979	12
	18Y	108.15	334.55	1 042	36	36	42	1 105	30
	19X	108.2		1 043	12	–	–	980	12
	19Y	108.25		1 043	36	36	42	1 106	30
	20X	108.3	334.1	1 044	12	12	18	981	12
	20Y	108.35	333.95	1 044	36	36	42	1 107	30
	21X	108.4		1 045	12	–	–	982	12
	21Y	108.45		1 045	36	36	42	1 108	30
	22X	108.5	329.9	1 046	12	12	18	983	12
	22Y	108.55	329.75	1 046	36	36	42	1 109	30
	23X	108.6		1 047	12	–	–	984	12
	23Y	108.65		1 047	36	36	42	1 110	30
	24X	108.7	330.5	1 048	12	12	18	985	12
	24Y	108.75	330.35	1 048	36	36	42	1 111	30
	25X	108.8		1 049	12	–	–	986	12
	25Y	108.85		1 049	36	36	42	1 112	30
	26X	108.9	329.3	1 050	12	12	18	987	12
	26Y	108.95	329.15	1 050	36	36	42	1 113	30
	27X	109		1 051	12	–	–	988	12
	27Y	109.05		1 051	36	36	42	1 114	30
	28X	109.1	331.4	1 052	12	12	18	989	12
	28Y	109.15	331.25	1 052	36	36	42	1 115	30
	29X	109.2		1 053	12	–	–	990	12
	29Y	109.25		1 053	36	36	42	1 116	30
	30X	109.3	332.0	1 054	12	12	18	991	12
	30Y	109.35	331.85	1 054	36	36	42	1 117	30
	31X	109.4		1 055	12	–	–	992	12
	31Y	109.45		1 055	36	36	42	1 118	30

32X	109.5	332.6	1 056	12	12	18	993	12
32Y	109.55	332.45	1 056	36	36	42	1 119	30
33X	109.6		1 057	12	–	–	994	12
33Y	109.65		1 057	36	36	42	1 120	30
34X	109.7	333.2	1 058	12	12	18	995	12
34Y	109.75	333.05	1 058	36	36	42	1 121	30
35X	109.8		1 059	12	–	–	996	12
35Y	109.85		1 059	36	36	42	1 122	30
36X	109.9	333.8	1 060	12	12	18	997	12
36Y	109.95	333.65	1 060	36	36	42	1 123	30
37X	110		1 061	12	–	–	998	12
37Y	110.05		1 061	36	36	42	1 124	30
38X	110.1	334.4	1 062	12	12	18	999	12
38Y	110.15	334.25	1 062	36	36	42	1 125	30
39X	110.2		1 063	12	–	–	1 000	12
39Y	110.25		1 063	36	36	42	1 126	30
40X	110.3	335.0	1 064	12	12	18	1 001	12
40Y	110.35	334.85	1 064	36	36	42	1 127	30
41X	110.4		1 065	12	–	–	1 002	12
41Y	110.45		1 065	36	36	42	1 128	30
42X	110.5	329.6	1 066	12	12	18	1 003	12
42Y	110.55	329.45	1 066	36	36	42	1 129	30
43X	110.6		1 067	12	–	–	1 004	12
43Y	110.65		1 067	36	36	42	1 130	30
44X	110.7	330.2	1 068	12	12	18	1 005	12
44Y	110.75	330.05	1 068	36	36	42	1 131	30
45X	110.8		1 069	12	–	–	1 006	12
45Y	110.85		1 069	36	36	42	1 132	30
46X	110.9	330.8	1 070	12	12	18	1 007	12
46Y	110.95	330.65	1 070	36	36	42	1 133	30
47X	111		1 071	12	–	–	1 008	12
47Y	111.05		1 071	36	36	42	1 134	30
48X	111.1	331.7	1 072	12	12	18	1 009	12

	48Y	111.15	331.55	1 072	36	36	42	1 135	30
	49X	111.2		1 073	12	–	–	1 010	12
	49Y	111.25		1 073	36	36	42	1 136	30
	50X	111.3	332.3	1 074	12	12	18	1 011	12
	50Y	111.35	332.15	1 074	36	36	42	1 137	30
	51X	111.4		1 075	12	–	–	1 012	12
	51Y	111.45		1 075	36	36	42	1 138	30
	52X	111.5	332.9	1 076	12	12	18	1 013	12
	52Y	111.55	332.75	1 076	36	36	42	1 139	30
	53X	111.6		1 077	12	–	–	1 014	12
	53Y	111.65		1 077	36	36	42	1 140	30
	54X	111.7	333.5	1 078	12	12	18	1 015	12
	54Y	111.75	333.35	1 078	36	36	42	1 141	30
	55X	111.8		1 079	12	–	–	1 016	12
	55Y	111.85		1 079	36	36	42	1 142	30
	56X	111.9	331.1	1 080	12	12	18	1 017	12
	56Y	111.95	330.95	1 080	36	36	42	1 143	30
	57X	112		1 081	12	–	–	1 018	12
	57Y	112.05		1 081	36	–	–	1 144	30
	58X	112.1		1 082	12	–	–	1 019	12
	58Y	112.15		1 082	36	–	–	1 145	30
	59X	112.2		1 083	12	–	–	1 020	12
	59Y	112.25		1 083	36	–	–	1 146	30
**	60X	–		1 084	12	–	–	1 021	12
**	60Y	–		1 084	36	–	–	1 147	30
**	61X	–		1 085	12	–	–	1 022	12
**	61Y	–		1 085	36	–	–	1 148	30
**	62X	–		1 086	12	–	–	1 023	12
**	62Y	–		1 086	36	–	–	1 149	30
**	63X	–		1 087	12	–	–	1 024	12
**	63Y	–		1 087	36	–	–	1 150	30
**	64X	–		1 088	12	–	–	1 151	12
**	64Y	–		1 088	36	–	–	1 025	30

**	65X	–	1 089	12	–	–	1 152	12
**	65Y	–	1 089	36	–	–	1 026	30
**	66X	–	1 090	12	–	–	1 153	12
**	66Y	–	1 090	36	–	–	1 027	30
**	67X	–	1 091	12	–	–	1 154	12
**	67Y	–	1 091	36	–	–	1 028	30
**	68X	–	1 092	12	–	–	1 155	12
**	68Y	–	1 092	36	–	–	1 029	30
**	69X	–	1 093	12	–	–	1 156	12
**	69Y	–	1 093	36	–	–	1 030	30
	70X	112.3	1 094	12	–	–	1 157	12
**	70Y	112.35	1 094	36	–	–	1 031	30
	71X	112.4	1 095	12	–	–	1 158	12
**	71Y	112.45	1 095	36	–	–	1 032	30
	72X	112.5	1 096	12	–	–	1 159	12
**	72Y	112.55	1 096	36	–	–	1 033	30
	73X	112.6	1 097	12	–	–	1 160	12
**	73Y	112.65	1 097	36	–	–	1 034	30
	74X	112.7	1 098	12	–	–	1 161	12
**	74Y	112.75	1 098	36	–	–	1 035	30
	75X	112.8	1 099	12	–	–	1 162	12
**	75Y	112.85	1 099	36	–	–	1 036	30
	76X	112.9	1 100	12	–	–	1 163	12
**	76Y	112.95	1 100	36	–	–	1 037	30
	77X	113	1 101	12	–	–	1 164	12
**	77Y	113.05	1 101	36	–	–	1 038	30
	78X	113.1	1 102	12	–	–	1 165	12
**	78Y	113.15	1 102	36	–	–	1 039	30
	79X	113.2	1 103	12	–	–	1 166	12
**	79Y	113.25	1 103	36	–	–	1 040	30
	80X	113.3	1 104	12	–	–	1 167	12
	80Y	113.35	1 104	36	36	42	1 041	30
	81X	113.4	1 105	12	–	–	1 168	12
	81Y	113.45	1 105	36	36	42	1 042	30

82X	113.5	1 106	12	–	–	1 169	12
82Y	113.55	1 106	36	36	42	1 043	30
83X	113.6	1 107	12	–	–	1 170	12
83Y	113.65	1 107	36	36	42	1 044	30
84X	113.7	1 108	12	–	–	1 171	12
84Y	113.75	1 108	36	36	42	1 045	30
85X	113.8	1 109	12	–	–	1 172	12
85Y	113.85	1 109	36	36	42	1 046	30
86X	113.9	1 110	12	–	–	1 173	12
86Y	113.95	1 110	36	36	42	1 047	30
87X	114	1 111	12	–	–	1 174	12
87Y	114.05	1 111	36	36	42	1 048	30
88X	114.1	1 112	12	–	–	1 175	12
88Y	114.15	1 112	36	36	42	1 049	30
89X	114.2	1 113	12	–	–	1 176	12
89Y	114.25	1 113	36	36	42	1 050	30
90X	114.3	1 114	12	–	–	1 177	12
90Y	114.35	1 114	36	36	42	1 051	30
91X	114.4	1 115	12	–	–	1 178	12
91Y	114.45	1 115	36	36	42	1 052	30
92X	114.5	1 116	12	–	–	1 179	12
92Y	114.55	1 116	36	36	42	1 053	30
93X	114.6	1 117	12	–	–	1 180	12
93Y	114.65	1 117	36	36	42	1 054	30
94X	114.7	1 118	12	–	–	1 181	12
94Y	114.75	1 118	36	36	42	1 055	30
95X	114.8	1 119	12	–	–	1 182	12
95Y	114.85	1 119	36	36	42	1 056	30
96X	114.9	1 120	12	–	–	1 183	12
96Y	114.95	1 120	36	36	42	1 057	30
97X	115	1 121	12	–	–	1 184	12
97Y	115.05	1 121	36	36	42	1 058	30
98X	115.1	1 122	12	–	–	1 185	12

98Y	115.15	1 122	36	36	42	1 059	30
99X	115.2	1 123	12	–	–	1 186	12
99Y	115.25	1 123	36	36	42	1 060	30
100X	115.3	1 124	12	–	–	1 187	12
100Y	115.35	1 124	36	36	42	1 061	30
101X	115.4	1 125	12	–	–	1 188	12
101Y	115.45	1 125	36	36	42	1 062	30
102X	115.5	1 126	12	–	–	1 189	12
102Y	115.55	1 126	36	36	42	1 063	30
103X	115.6	1 127	12	–	–	1 190	12
103Y	115.65	1 127	36	36	42	1 064	30
104X	115.7	1 128	12	–	–	1 191	12
104Y	115.75	1 128	36	36	42	1 065	30
105X	115.8	1 129	12	–	–	1 192	12
105Y	115.85	1 129	36	36	42	1 066	30
106X	115.9	1 130	12	–	–	1 193	12
106Y	115.95	1 130	36	36	42	1 067	30
107X	116	1 131	12	–	–	1 194	12
107Y	116.05	1 131	36	36	42	1 068	30
108X	116.1	1 132	12	–	–	1 195	12
108Y	116.15	1 132	36	36	42	1 069	30
109X	116.2	1 133	12	–	–	1 196	12
109Y	116.25	1 133	36	36	42	1 070	30
110X	116.3	1 134	12	–	–	1 197	12
110Y	116.35	1 134	36	36	42	1 071	30
111X	116.4	1 135	12	–	–	1 198	12
111Y	116.45	1 135	36	36	42	1 072	30
112X	116.5	1 136	12	–	–	1 199	12
112Y	116.55	1 136	36	36	42	1 073	30
113X	116.6	1 137	12	–	–	1 200	12
113Y	116.65	1 137	36	36	42	1 074	30
114X	116.7	1 138	12	–	–	1 201	12
114Y	116.75	1 138	36	36	42	1 075	30

	115X	116.8	1 139	12	–	–	1 202	12
	115Y	116.85	1 139	36	36	42	1 076	30
	116X	116.9	1 140	12	–	–	1 203	12
	116Y	116.95	1 140	36	36	42	1 077	30
	117X	117	1 141	12	–	–	1 204	12
	117Y	117.05	1 141	36	36	42	1 078	30
	118X	117.1	1 142	12	–	–	1 205	12
	118Y	117.15	1 142	36	36	42	1 079	30
	119X	117.2	1 143	12	–	–	1 206	12
	119Y	117.25	1 143	36	36	42	1 080	30
	120X	117.3	1 144	12	–	–	1 207	12
	120Y	117.35	1 144	36	–	–	1 081	30
	121X	117.4	1 145	12	–	–	1 208	12
	121Y	117.45	1 145	36	–	–	1 082	30
	122X	117.5	1 146	12	–	–	1 209	12
	122Y	117.55	1 146	36	–	–	1 083	30
	123X	117.6	1 147	12	–	–	1 210	12
	123Y	117.65	1 147	36	–	–	1 084	30
	124X	117.7	1 148	12	–	–	1 211	12
**	124Y	117.75	1 148	36	–	–	1 085	30
	125X	117.8	1 149	12	–	–	1 212	12
**	125Y	117.85	1 149	36	–	–	1 086	30
	126X	117.9	1 150	12	–	–	1 213	12
**	126Y	117.95	1 150	36	–	–	1 087	30

* These channels are reserved exclusively for national allotments.

** These channels may be used for national allotment on a secondary basis.

The primary reason for reserving these channels is to provide protection for the secondary surveillance radar (SSR) system.

108.0 MHz is not scheduled for assignment to ILS service. The associated DME operating channel No. 17X may be assigned for emergency use. The reply frequency of channel No. 17X (i.e. 978 MHz) is also utilized for the operation of the universal access transceiver (UAT). Standards and Recommended Practices for UAT are found in Annex 10, Volume III, Part I, Chapter 12.