



International Spectrum Management and Interference Mitigation



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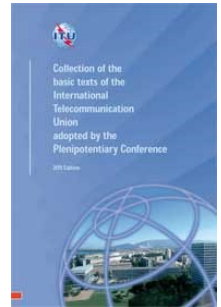
Outline of presentation

- **Related ITU documents**
- **Prevention of interference**
- **Resolving cases of interference**
- **Radiomonitoring as a complementary instrument of interference management**
- **ITU studies on interference mitigation techniques**

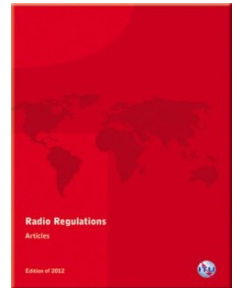
Related ITU documents

- ITU Constitution and Convention – basic instruments of the Union containing several related provisions, e.g.:

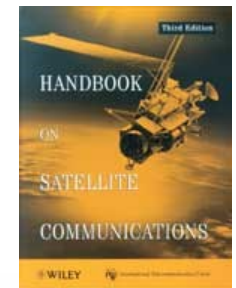
CS 197 - All stations must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Members which operate in accordance with the provisions of the Radio Regulations



- ITU Radio Regulations (RR) - the main regulatory document on international spectrum management
 - Main objective of RR is interference-free operation of stations
 - Provisions aimed at compatibility between radio services



- ITU-Regional agreements, e.g. GE85-R1 for MF aeronautical beacons
- ITU-R Recommendation, Reports and Handbooks – technical information, including mitigation techniques



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Possible reasons for interference

- Definitions related to interference in the RR: **Interference**(RR No.1.666), **Harmful interference**(RR No.1.169), **Permissible interference**(RR No.1.167) and **Accepted interference**(RR No.1.168)
- Operation in the bands **not** allocated by the Radio Regulations **or** with too wide bandwidth overlapping the adjacent frequency bands
- Operation of non-coordinated frequency assignments
- Operation with parameters different from the agreed ones, e.g. contained in a Plan, coordinated between administrations, recorded in the Master Register
- Non-compliance with frequency tolerances of transmitters
- Unwanted emissions i.e. out-of-band and spurious emissions of transmitters , e.g.FM radio system in 87-108MHz to GBAS in the 108-117.975MHz.
- Too high power producing intermodulation interference
- Unauthorized operations, i.e. the station works without license

Radio Regulations and preventing interference (1)

The main relevant Regulations on assigning frequencies are:

- Assignment and use of frequencies (Art.4)
 - General description, e.g. member states undertake to assign the frequencies to avoid harmful interferences to services using frequencies assigned in accordance with the Table of Frequency Allocations and the other provisions
- Allocation of frequency blocks to radio services (Art. 5)
 - Allocation to compatible services, e.g. fixed and land mobile
 - establishing priority in operation: primary and secondary allocations
 - Imposing regulatory/technical limitations on some allocations
- Set of coordination procedures (Art. 9) -> to ensure compatibility
 - Art. 9 lists cases of mandatory coordination of stations prior to bringing them in operation
- Recording in Master Register, that is worldwide database of existing stations (Art. 11) -> status of international recognition(Art.8)
 - Stations recorded in MIFR **shall** be taken into account by other countries
 - This status is important for resolving cases of harmful interference

Radio Regulations and preventing interference (2)

- **Example: To record earth stations of the MEVA III network in C-band in the Caribbean and Central American region in the ITU Master Register (MIFR) with ITU assistance**
- Mobile service in 3400 – 4200 MHz(S to E) may cause interference to VSAT receivers used for aeronautical communications
- The aim of registration of these VSAT receivers in MIFR is to obtain their international recognition and protection
- Registration also gives information about actual usage of C-band and provides visibility of earth stations for national telecom regulators
- WRC-15 will consider additional frequency bands for IMT, including C-band (Agenda item 1.1). In taking its decisions WRC-15 should consider the actual use. Only a few C-band earth stations are recorded in the MIFR so far
- To have full protection the uplink 5 925- 6425 MHz(E to S) used by transmitting VSATs should be also registered

Radio Regulations and preventing interference (2)(Cont.)

- VSAT coordination is effected under Article 9 of the RR
- ICAO provided ITU with a set parameters required to coordinate the earth stations.
- The Bureau carried an analysis based on the criteria and methodology of Appendix 7 to the RR and identified countries to coordinate with.
- Some examples of results of the study for the 17 earth stations to identify the Administrations with which coordination is required.

Earth Station Name	Country Name or Geographical Area / Notifying Administration	ITU Country Code / Notifying Administration	Coordination under 9.17 required with	
			Uplink	Downlink
MEVAIII-WILLEMSTAD	CURACAO / HOLLAND	CUW/HOL	ABW BES CLM VEN	ABW BES CLM DOM GRD HTI KNA MSR PTR TRD VCT VEN VIR VRG
MEVAIII-BOGOT@	COLOMBIA	CLM	mail	VEN
MEVAIII-SANTO DOMINGO	DOMINICAN REPUBLIC	DOM	PTR	ABW BES CLM CUW HTI KNA MSR PTR TCA VEN VIR VRG
MEVAIII-SAN JUAN	PUERTO RICO / USA	PTR/USA	VIR VRG	AIA ATG BAH BES BLM DOM GLP KNA MAF MSR SXM TCA VIR VRG

Note: details of country codes or geographical areas can be found in the Preface (<http://www.itu.int/ITU-R/go/space-preface/en>)

- Follow-up: to coordinate every ES with affected administrations (possibly through multilateral meetings) and notify the specific earth stations to the Bureau. Guidance and assistance from the Bureau may be requested any time.

Radio Regulations and preventing interference (3)

Technical characteristics of station(Art.3 & Apps to the RR.)

- Keeping the lowest values of the necessary bandwidths of emissions(App.1) to avoid overlapping the other bands
- Establishing limits of transmitter frequency tolerances between 9 kHz to 40 GHz (App. 2) -> reduction of out-of-band interference
- Establishing maximum power levels of unwanted emissions (App. 3) -> reduction of interference due to spurious emissions
- The adequate performance characteristics of receivers to ensure that they do not suffer from interference due to transmitters situated at a reasonable distance and which operate in accordance with these Regulations(Art.3)

Radio Regulations and preventing interference (4)

Installation of station

- Introduction of requirements for installation and parameters of stations (Art. 15) **to reduce interference**, e.g.:
 - **15.2** Transmitting stations shall radiate only as much power as is necessary to ensure a satisfactory service
 - **15.4** locations of transmitting stations ... shall be selected with particular care
 - **15.5** radiation in and reception from unnecessary directions shall be minimized by ... directional antennas
- > **reduction of unauthorized emissions and avoidance of infringement of the Radio Regulations**

ITU frequency plans

- Plan - distribution of frequencies between countries or stations aimed at compatible operation -> stations in conformity with a Plan are supposed to operate without interference
- Two types of plans: allotment (zones or countries) and assignment (stations)
- ITU maintains 12 terrestrial and 3 space Plans
- 3 plans for aeronautical mobile and ARNS services:



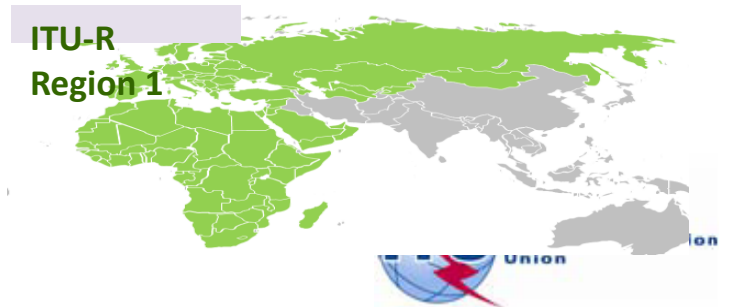
AP26 – Worldwide allotment Plan for aeronautical mobile (off-route) service, HF (3025 – 18030 kHz)



AP27 - Worldwide allotment Plan for aeronautical mobile(route) service, HF (2850 – 22000 kHz)



GE85-R1-AER: Region 1 assignment plan for aeronautical radionavigation service, MF bands



Protection of Distress and safety frequencies/services

- Special consideration for safety services: RNS, AM(R)S, AMS(R)S
 - **4.10** Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference...
 - **15.8** Special consideration shall be given to avoiding interference on distress and safety frequencies, those ...identified in Article **31** and those related to safety and regularity of flight identified in Appendix **27**
- Absolute protection of distress and safety frequencies in App.15

AP15-4

TABLE 15-2 (*end*) (WRC-12)

Frequency (MHz)	Description of usage	Notes
*406-406.1	406-EPIRB	This frequency band is used exclusively by satellite emergency position-indicating radio beacons in the Earth-to-space direction (see No. 5.266).
1 530-1 544	SAT-COM	In addition to its availability for routine non-safety purposes, the band 1 530-1 544 MHz is used for distress and safety purposes in the space-to-Earth direction in the maritime mobile-satellite service. GMDSS distress, urgency and safety communications have priority in this band (see No. 5.353A).

...Any emission causing harmful interference to distress and safety communications on any of the discrete frequencies identified in this Appendix is prohibited.

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Procedure in case of interference

- Procedure in a case of harmful interference is described in Article 15 of the Radio Regulations
- Administrations try to resolve the problem bilaterally, on the basis of goodwill and mutual assistance
- Interference may be treated by operators directly, e.g. coordination of cellular networks in border areas
- Administration may report interference to ITU/BR
 - for information
 - for assistance
- Request for assistance should contain technical and operational details and copies of the correspondence
- Interference cases should be reported in form of Appendix 10

Report of harmful interference

AP10-1

APPENDIX 10 (Rev.WRC-07)

Report of harmful interference

(See Article 15, Section VI)

Particulars concerning the station causing the interference:

- a Name, call sign or other means of identification
- b Frequency measured
- Date:
- Time (UTC):
- c Class of emission¹
- d Bandwidth (indicate whether measured or estimated)
- e Measured field strength or power flux-density²
- Date:
- Time (UTC):
- f Observed polarization
- g Class of station and nature of service
- h Location/position/area/bearing (QTE³) (WRC-07)
- i Location of the facility which made the above measurements

Particulars concerning the transmitting station interfered with:

- j Name, call sign or other means of identification
- k Frequency assigned

¹ The class of emission shall contain the basic characteristics listed in Appendix 1. If any characteristic cannot be determined, indicate the unknown symbol with a dash. However, if a station is not able to identify unambiguously whether the modulation is frequency or phase modulation, indicate frequency modulation (F).

² When measurements are not available, signal strengths according to the QSA scale should be provided.

³ See the most recent version of Recommendation ITU-R M.1172. (WRC-07)

AP10-2

- l Frequency measured
 - Date:
 - Time (UTC):
 - m Class of emission⁴
 - n Bandwidth (indicate whether measured or estimated, or indicate the necessary bandwidth notified to the Radiocommunication Bureau)
 - o Location/position/area
 - p Location of the facility which made the above measurements
- Particulars furnished by the receiving station experiencing the interference:*
- q Name of station
 - r Location/position/area
 - s Dates and times (UTC) of occurrence of harmful interference
 - t Bearings (QTE⁵) or other particulars (WRC-07)
 - u Nature of interference
 - v Field strength or power flux-density of the wanted emission at the receiving station experiencing the interference⁶
 - Date:
 - Time (UTC):
 - w Polarization of the receiving antenna or observed polarization
 - x Action requested

NOTE -- For convenience and brevity, telegraphic reports shall be in the format above, using the letters in the order listed in lieu of the explanatory titles, but only those letters for which information is provided should be used. However, sufficient information shall be provided to the administration receiving the report, so that an appropriate investigation can be conducted.

⁴ See footnote 1.

⁵ See footnote 3.

⁶ See footnote 2.

Actions in case of interference

- Identification of source of interference
 - using information in the Report of harmful interference
 - using information in the **Master Register**
 - requesting assistance of radiomonitoring stations of different countries
- Determination of the cause of interference
- Determination of regulatory status of the stations involved
 - primary or secondary services
 - conformity with the Frequency Allocation Table and allocation conditions, e.g. coordination requirements, power limits
 - recording in the Master Register
- Technical studies, if necessary
- Development of recommendations, contacting administrations
- **If interference persist**
 - Interference case may be reported to the Radio Regulations Board (12 elected members, 2 – 3 meetings per year)
 - Interference case can be brought to the attention of a world radiocommunication conference for consideration

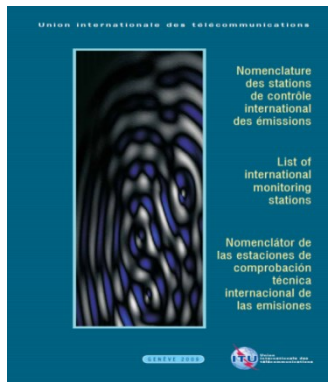
Cases of interference to distress and safety frequencies, to AM(S)S communications are treated by the BR within 24 hour period

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International Monitoring System

- International Monitoring System (IMS): monitoring stations and centralizing offices of administrations or group of administration.
- Objectives: assistance in cases of interference, in protection of safety services, evaluation of the actual spectrum use, verification compliance of transmitted signals, detecting illegal transmitters
- Monitoring station notified to ITU and published in List VIII
- *Uniform coverage* of the world by monitoring stations of ITU monitoring programs is basis for successful operation of IMS
- BR prepares and publishes summaries of monitoring data, supplied by IMS stations, according Article 16 of the RR



Part 1A - Centralizing Offices						Part 1B - Alphabetical Index of Stations					
Administration	Centralizing Office	Postal address	Telephone	Telefax	Electronic-mail	Remarks	Station	Administration	Postal address	Telephone	Remarks
AFS South Africa (Republic of)	Department of Arts and Communications Telecommunications Commission	Private Bag 104 Pretoria 001	012 294 1				Abidjan	CI	Agence des Télécommunications de Côte d'Ivoire B.P. 233 Abidjan 18 Côte d'Ivoire	+25 20 34 50 70	42
ARG Argentine Republic	Secretaría de Comunicaciones y Transportes Comisión Nacional de Comunicaciones Instituto de Ingenieros	Paseo 101 Paseo 101 2000 Rosario (Ros)	+54 341 444 1000 +54 341 444 1000				Acapulco	MEX	Carretera 90 B Car. Juan N. Álvarez Acapulco, Gro. México	+52 747 4723225	
AUS Australia	Postal and Communications Authority	Communications Operations and Service Centre P.O. Box 970 Belconnen ACT 2616	+61 2 6206 1000				Aden	YEM	P.O. Box 1256 Yemen Aden	2352	
AUT Austria	Upper Austria for Transport, Innovation and Technology Communications Monitoring	Organisations 1 2300 Wien	+43 1 5350 1000				Agua Calientes	MEX	Carretera Federal 150 Ciudad Industrial Agua Calientes, Ag. México	+52 449 9723400	
B Brazil	Agência Nacional de Telecomunicações (ANATEL)	Sede Operativa E-1000 Brasília, DF 7º andar, Bloco A Brasília DF	+55 61 3212 1000 +55 61 3212 1000 +55 61 3212 1000				Ahtisfel	TUR	Ulaştırma Bakanlığı Siviliz. Bld. 8/A Ereğli Antalya	+90 332 2323808	43
BEL Belgium	Inter-Regional Services Institute of the Information Society (IRIS)	Floris Building Avenue de la Liberté 45 1050 Brussels	+32 2 2909 1000				Alj Abad	IRN	P.O. Box 34825-2438 Tehran Iran Islamic Republic of	+98 21 2219779	13
BFA Burkina Faso	Direction Générale de l'Office National des Télécommunications (DONT)	Section des Radios Boulevard de la République	020 44 01 00 020 44 01 00				Allegan	USA	United States		14
BS Bosnia and Herzegovina	Agencija Republičke uprave za regulisanje u oblasti komunikacija	Ulica Matije Gupca 1 71000 Sarajevo	+387 33 620 1000								
BLR Belarus (Republic of)	State Agency for Information Communications and Interconnection	22 Republic Street 220030 Minsk	+375 10 220 1000								



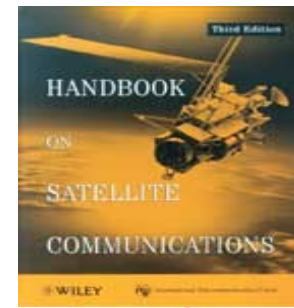
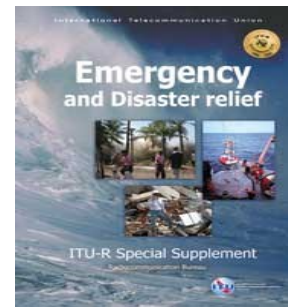
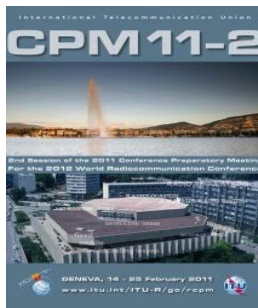
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Overview of ITU-R studies

- Organization of studies: Radiocommunication Assembly -> Study Groups -> Working Parties (e.g. **WP5B** for maritime, **aeronautical and radiodetermination services**)
- Areas of studies: spectrum management, radiomonitoring, spectrum requirements, system parameters, propagation, sharing, protection criteria, interference mitigation, etc.
- Study Groups products:
 - Technical bases for Radiocommunication Conferences
 - ITU-R Recommendations
 - ITU-R reports and Handbooks

e.g. Recommendation ITU-R M.1841 “Compatibility between FM sound-broadcasting systems in 87-108 MHz and the aeronautical ground-based augmentation system in 108-117.975 MHz”



Conclusions

- The entire ITU regulatory framework (Constitution, Convention, RR) is aimed at interference-free operation of radio stations
- RR contain a set of regulatory, operational and technical measures to prevent interference
- Cases of harmful interference are dealt by administrations concerned with possible assistance of the BR, RRB and WRC
- Special attention is paid to prevention and elimination of interference to safety services, distress and safety frequencies
- Recording of the frequency assignments could obtain international recognition and protection and facilitate to prevent and to solve the harmful interferences.
- ITU established International Monitoring System and conducts monitoring programs that assist in interference management
- ITU-R studies sharing and mitigation to create a technical basis, for compatible operation of stations

***Thank you for your
attention!***

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