



# International Spectrum Management and Interference Mitigation



**N. Vassiliev, Radiocommunication Bureau, ITU**

# Outline of presentation

- ITU activities related to spectrum management
- Prevention and resolving of interference
- Radiomonitoring as interference management tool

# Overview of the ITU

- ITU assists in connecting the world since 1865

1865

2013



Specialized agency of UN : **193** Member-States,  
**700** Sector Members,  
**40** Academies

# ITU is really international

- Based in Geneva, **12** regional and area offices, about **750** staff
- **6** official languages:
  - English, Arabic, Chinese, Spanish, French, Russian
  - meetings with interpretation, translation of documents
- Staff from the world: **80** countries
- 3 ITU Sector:
  - ITU-T - Standardization
  - ITU-D – Development
  - **ITU-R - Radiocommunications**
- Main documents: Constitution, Convention, **Radio Regulations**, International Telecommunication Regulations



*Elected officials*

# ITU-R and Radio Regulations

- RR is a single set of international regulations on spectrum/orbit use
- RR is intergovernmental treaty. Ratified by governments – mandatory for application
- RR - basis for national spectrum management
- Define the rights and obligations of Member States in respect of the use of spectrum/orbit resources. Explains how these rights may be obtained and kept
- Updated every 3-4 years by World Radiocommunication Conferences - WRCs
- Main goals of the RR:
  - interference free operation of stations
  - harmonization of spectrum usage



# Content and concepts of the RR

- RR is based on 3 main concepts:
  - Allocation of frequency blocks to radio services through Table of Frequency Allocations (Articles 1 and 5)
  - Mandatory technical parameters to be observed by stations
  - Regulatory procedures : coordination, recording frequencies in Master Register, **resolving cases of harmful interference**
- Allocation concept: Spectrum is divided in blocks. Blocks are allocated to specific services (e.g. 117.975-137 MHz to AM(R)S)
- Each radio service has several applications. Applications can use frequencies allocated to the service, examples:
  - GPS –
  - Weather radars –
  - ILS –
  - Aircraft ES -
  - RNSS
  - RLS
  - ARNS
  - AMSS and ?

# Types of allocations

Allocation to services		
Region 1	Region 2	Region 3
	75.4-76 FIXED MOBILE	75.4-87 FIXED MOBILE
	76-88 BROADCASTING Fixed Mobile	5.182 5.183 5.188
5.175 5.179 5.187	5.185	87-100 FIXED MOBILE BROADCASTING
87.5-100 BROADCASTING	88-100 BROADCASTING	
5.190		
100-108	BROADCASTING 5.192 5.194	
108-117.975	AERONAUTICAL RADIONAVIGATION 5.197 5.197A	

Primary and secondary

Worldwide and regional

By Table and by footnote

Exclusive and shared

**5.192** *Additional allocation:* in China and Korea (Rep. of), the band 100-108 MHz is also allocated to the fixed and mobile services on a primary basis. (WRC-97)

# Other key elements of RR

- RR establishes **mandatory technical parameters** to be observed by radio stations including **aeronautical stations**, e.g. Res. 417 (WRC-12) puts e.i.r.p. limits on AM(R)S to protect RNSS
- RR contains **procedures** :
  - Coordination procedures (Art. 9) -> **to ensure compatibility**
  - Procedure of notification and recording in Master Register (Art. 11) -> **to obtain rights to use spectrum & orbit**
    - Stations recorded in MIFR **shall** be taken into account by other countries
  - Procedure in case of interference (Art. 15) -> **to resolve them**
- RR contain **frequency plans** for AMS, MMS(e.g. AP27 for AM(R)S) -> **to obtain spectrum rights and ensure compatibility**



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# Radio Regulations and preventing interference

- RR establish specific technical limitations and coordination requirements on stations (Art. 5, 9, 21, WRC Resolutions) -> **reduction of interference between radio services**
- RR establish limits of transmitter frequency tolerances in 9 kHz to 40 GHz (AP 2) -> **reduction of out-of-band interference**
- RR establish maximum power levels of unwanted emissions (App. 3) -> **reduction of interference due to spurious emissions**
- RR introduce general requirements for installation and parameters of stations (Art. 15), e.g.:
  - **15.2** Transmitting stations shall radiate only as much power as is necessary to ensure a satisfactory service
  - **15.5** radiation in and reception from unnecessary directions shall be minimized by ... directional antennas

# 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.

# ITU-R documents on interference mitigation

- ITU-R Handbooks, Recommendations, Reports
- Examples of documents containing general information
  - Recommendation ITU-R **SM.1132-2** on general principles and methods for sharing between radio stations
  - Recommendation **SM.1541-4** “Unwanted emissions in the out-of-band domain”
- Examples of documents on sharing between specific services
  - Recommendation ITU-R M.1841 on compatibility between FM sound-broadcasting systems in 87-108 MHz and the aeronautical radionavigation in 108-117.975 MHz
  - Recommendation ITU-R M.1459 on sharing of aeronautical mobile service BSS/MSS in 1 452-1 525 MHz and 2 310-2 360 MHz

# Procedure in case of interference

- Procedure in a case of harmful interference described in Article 15 of the RR
- Administrations try to resolve the problem bilaterally
- Interference may be treated by operators, e.g. GSM in border areas
- Administration may report interference to ITU/BR
- Request for assistance should contain technical and operational details (in form of Appendix 10 of the Radio Regulations) and copies of correspondence

# 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 emission<sup>1</sup> .....
- d* Bandwidth (indicate whether measured or estimated) .....
- e* Measured field strength or power flux-density<sup>2</sup> .....
- Date: .....
- Time (UTC): .....
- f* Observed polarization .....
- g* Class of station and nature of service .....
- h* Location/position/area/bearing (QTE<sup>3</sup>) (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 .....

<sup>1</sup> 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).

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

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

AP10-2

- l* Frequency measured .....
- Date: .....
- Time (UTC): .....
- m* Class of emission<sup>4</sup> .....
- 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 (QTE<sup>5</sup>) 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 interference<sup>6</sup> .....
- 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.

<sup>4</sup> See footnote 1.

<sup>5</sup> See footnote 3.

<sup>6</sup> See footnote 2.

# BR actions in case of interference

- Identification of source of interference (information in interference Report, in the Master Register, radiomonitoring )
- Determination of the cause of interference
- Determination of regulatory status of the stations involved
  - primary or secondary services, conformity with technical restrictions
  - recording in the Master Register
- Technical studies, if necessary
- Development of recommendations, contacting administrations

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

- If interference persist:
  - Report to Radio Regulations Board (12 elected members, 3 meetings year)
  - Report to a world radiocommunication conference

# Examples of interference

- Interference to HF aeronautical station on 17908.4 kHz (AP27)
  - Source: a fishing vessel of country “B”
  - Reason: operation of maritime service in non-allocated band
  - BR actions: letter to “B” requesting to eliminate interference
- Interference to aircraft GPS receivers on 1227 MHz and 1575 MHz
  - Source: ground-based station of neighboring Administration “D”, operating in a non-allocated band
  - BR actions: request to “D” to eliminate interference
  - Development: MOC between ICAO and ITU on GNSS protection, 17.12.12



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# International Monitoring System

- International Monitoring System (IMS): monitoring stations and centralizing offices of administrations
- Objectives: assistance in cases of interference, in protection of safety services, evaluation the actual spectrum use, detecting illegal transmitters
- Monitoring station notified to ITU and published in List VIII
- BR prepares and publishes summaries of monitoring data, supplied by IMS stations, according Article 16 of the RR
- 2 monitoring programs:
  - Regular program in the HF bands
  - Special program in the band 406 – 406.1 MHz



# Example of monitoring station from List VIII

## PART II

### Particulars of monitoring stations carrying out measurements related to stations of terrestrial radiocommunications services

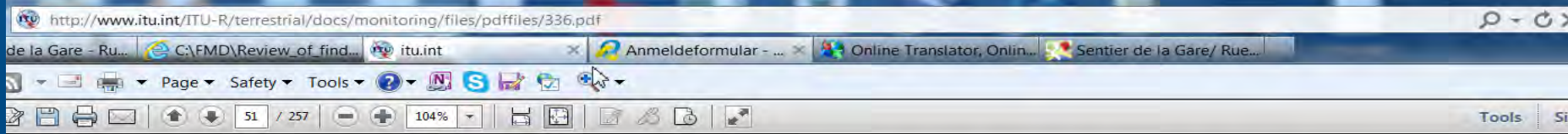
Name of station	Geographical coordinates	Types of measurements	Ranges of frequencies for each measurement	Hours of service	Remarks
<b>AFS South Africa (Republic of)</b>					
<b>Panorama (Johannesburg)</b>	(IMS) 27°54'45" E 26°06'25" S	Frequency	10 kHz – 30 MHz	0430-2015	
		Field strength or power flux-density	9 kHz – 30 MHz	0430-2015	
		Bandwidth	100 kHz – 100 MHz	0430-2015	Spectrum analyser with oscilloscope display.
		Automatic spectrum occupancy surveys	9 kHz – 30 MHz	0430-2015	Automatic chart recorder connected to receiver with electronic scanning.
<b>ALS Alaska</b>					
<b>Anchorage, Alaska</b>	150°00' W 61°10' N	Frequency	10 kHz – 30 MHz	H24	
		Direction-finding	400 kHz – 30 MHz	H24	11-channel interferometer (wide aperture). Remotely controlled from Columbia, Maryland.
		Bandwidth	540 kHz – 30 MHz	H24	Manual observation with DSP data reduction.
<b>ARG Argentine Republic</b>					
<b>Altamira</b>	(IMS) 64°07'54" W 31°25'26" S	Frequency	9 kHz – 3 GHz	0900-1800	Available H24. The station has a GPS-referenced frequency standard. The station is incorporated in the national monitoring system by means of a satellite link. It has a computing system which enables all the technical measurements recommended by ITU to be performed automatically, while keeping the results that are obtained through the following functions: systematic monitoring of transmitters, search for unauthorized transmitters, observation of specific frequencies, channel analysis, trans-mitter occupancy, frequency occupancy, noise measurement, TV signal measurement and interference analysis. Remotely controlled in real time from an operative centre using a satellite link.

# ITU regular monitoring program

- Regular monitoring program in the HF bands 2850 - 28000 kHz
- From 1947, monitoring summaries published since 1953
- Objectives: information on spectrum utilization, identification of non-conforming stations, sharing data with administrations not having HF monitoring facilities
- Measurements: frequency, field strength, bearing, occupancy
- Submission of reports to the BR on a monthly basis
- Publication at <http://www.itu.int/ITU-R/go/terrestrial-monitoring>

# Summaries of regular monitoring program

Extract from summary of monitoring data



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
KOR	CRMO	6400,000	06	11	0913	0913	84,7	PYONGYANG BS	KRE	BC	1K01E	A3E										11	
KOR	CRMO	6400,000	07	11	0450	0450	70,2	PYONGYANG BS	KRE	BC	10H0E	A3E											11
KOR	CRMO	6400,000	08	11	1038	1038	76,2	PYONGYANG BS	KRE	BC	2K99E	A3E											11
KOR	CRMO	6400,000	08	11	2148	2148	75,3	PYONGYANG BS	KRE	BC	2K99E	A3E											11
KOR	CRMO	6400,000	09	11	0633	0633	79,1	PYONGYANG BS	KRE	BC	2K99E	A3E											11
KOR	CRMO	6400,000	12	11	2226	2226	74,0	PYONGYANG BS	KRE	BC	2K99E	A3E											11
KOR	CRMO	6400,000	14	11	0434	0434	58,5	PYONGYANG BS	KRE	BC	2K99E	A3E											11
KOR	CRMO	6400,000	14	11	1449	1449	56,4	PYONGYANG BS	KRE	BC	700HE	A3E											11

**RM station  
(CCRM)**

**Frequency  
(6550.0 kHz)**

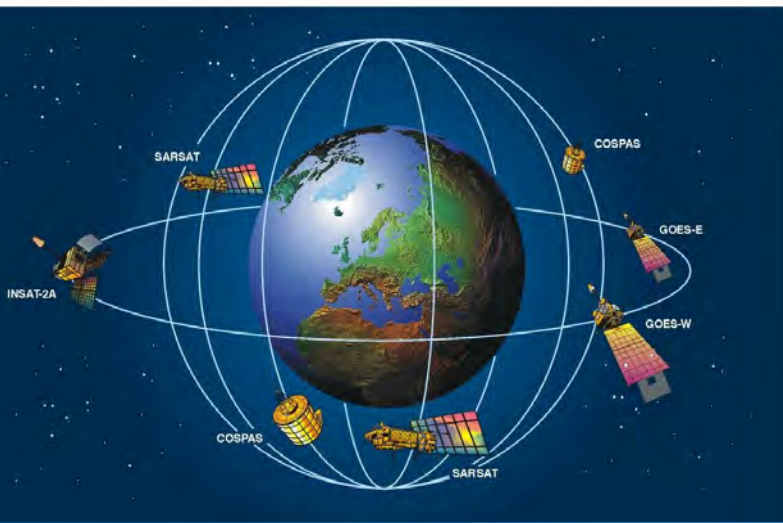
**Administration  
(F)**

**Station class  
(MS - ship)**

**Remarks  
(fisher)**

BEL	C.C.R.M.	6413,000	05	10	0858						3K00	J2D											9	Stanag-428 2400bps		
E	EL CASAR	6413,000	20	10	1900	2200	34,0	OSN4ti	BEL	FC	1K10E	F1B											22	B		
E	EL CASAR	6414,500	15	10	1000	1200	12,0		G		3K00E	G7D											4	B		
BEL	C.C.R.M.	6429,500	05	10	0900						3K00	J2D												9		
E	EL CASAR	6431,000	20	10	1900	2200	20,0				3K00E	G7D											14	B		
E	EL CASAR	6441,000	20	10			39,0		HOL		3K00E	G7D											22	A		
BEL	C.C.R.M.	6456,500	05	10	0912						3K00	J2D												9		
BEL	C.C.R.M.	6467,000	05	10	0916			LFI Rogaland Radio	NOR	FC	450HE	F1B													GW 200H 100Bd	
E	EL CASAR	6467,000	20	10	1920	2200	23,0	ROGALAND RADIO	NOR	FC	340HE	F1B											16	B		
E	EL CASAR	6476,500	20	10	1920	2200	31,0		GRC		3K00E	G7D											84	B		
BEL	C.C.R.M.	6478,000	05	10	0921			SAB Goetsborg Radio	S	FC	360H	F1B													GW-FSK 100Bd	
E	EL CASAR	6478,000	20	10	1920	2200	30,0	GOETEBORG RADIO	S	FC	340HE	F1B											26	C		
KOR	CRMO	6480,000	18	10	1031	1031	42,1	R.ALATURA	PRU	BC	2K99E	A3E												11		
J	TOKYO	6480,000	22	10	1021				KRE	BC		A3E	125	E	49	40	N	00	296	C						
BEL	C.C.R.M.	6487,500	05	10	0955						3K00E	J2D												9		
BEL	C.C.R.M.	6493,500	05	10	0958			Globewireless (HEC)	SUI	FC	400HE	F1B													GlobeWireless	
BEL	C.C.R.M.	6501,500	05	10	1127						3K00	J2D												9		
J	TOKYO	6514,500	22	10	1023				KRE	BC		A3E	125	E	30	39	N	05	291	B						
J	TOKYO	6517,500	22	10	0811				KRE	BC		A3E	125	F	27	39	N	17	291	B						
EL	C.C.R.M.	6552,000	19	11	0839			H07 Shannon HFDL ch 5	IRL	FD	2K20E	J2D														
EL	C.C.R.M.	6550,000	19	11	0842				F	MS	2K70E	J3E												11	fishers	
EL	C.C.R.M.	6555,000	19	11	0845				F	MS	2K70E	J3E													11	fishers
BEL	C.C.R.M.	6570,000	19	11	0843				E	MS	2K70E	J3E													11	fishers

# Special monitoring program



- Monitoring 406 – 406.1 MHz band
- Performed in accordance with Res. 205 (Rev. WRC-12)

- Objective: to identify and locate unauthorized emissions in the band 406-406.1 MHz that cause harmful interference to the reception of satellite EPIRB signals of the COSPAS-SARSAT
- BR immediately contacts the Administrations responsible for the area where the unauthorized transmitters are located, requesting them to take immediate action to stop emissions.

# Conclusions

- The entire ITU regulatory framework (RR, ITU-R Recommendations) is aimed at interference-free operation of radio stations
- RR contain regulatory, operational and technical measures to prevent and resolve interference
- Cases of harmful interference are dealt by administrations concerned with possible assistance of the BR, RRB and WRC
- Special attention is paid to interference to safety services, distress and safety frequencies
- 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!***