



International Committee on
Global Navigation Satellite Systems

What is Spectrum "Protection"

How do you protect a ghost?

- you can't touch it
- you can't feel it
- you can't build a fence around it...
- So, how do you protect spectrum?



Clean spectrum

- "Protection" is about keeping the spectrum 'clean'
- Clean spectrum means keeping the frequencies near to GNSS free from licenced, unlicensed and illegal transmissions that interfere with GNSS reception, eg
 - GNSS jammers
 - uncontrolled GNSS repeater installations
 - spurious emissions from radio equipment, eg motors
 - other radio services, eg TV broadcasts
 - malfunctioning electronic equipment



Why keep it clean?

- Clean spectrum for GNSS minimizes signal errors and maximizes the performance for GNSS receivers
 - better and more reliable positioning and timing
 - faster time to first fix
 - better tracking performance in challenging environments



Keeping it clean

- Keeping spectrum clean requires technical means to detect when such interference occurs
- National regulators usually have the capacity to detect **strong** interferers
 - direction finding equipment or geolocation techniques
 - the ITU can also help coordinate such activities when cross border interference occurs



Interference to GNSS

- Strong interferers are relatively easy to detect
- However, if weak interferers are far away from the detectors, they will not be seen
- The weak interfering signals are still stronger than GNSS and will have widespread impact on GNSS reception



Finding GNSS interference

- to find weak interferers (eg 'personal' GNSS jammers) requires more specialised local equipment or a dense detector network
- the ICG has been considering this challenge
- example techniques will be discussed in a later session



Effective spectrum management

- Finding interference is only half the story, more important is preventing it in the first place
- GNSS jammers are illegal in most countries
 - national regulators need to make sure they are not manufactured or sold in their countries
 - a key role for national market surveillance authorities
- GNSS repeaters can be useful, but only if used where regular GNSS signals cannot reach
 - specific authorisation and licensing should be done on a case by case basis



Effective spectrum management

- National regulators should not authorise other radio services in GNSS bands
- Before considering new radio services in adjacent bands, national regulators should also thoroughly check that the new services are compatible with GNSS
 - eg mobile broadband adjacent to GNSS is a bad idea
- This requires expertise and effort.
 - ITU processes / recommendations can help
- It's better to engineer effective spectrum management than to deal with the effects of bad management



ITU Constitution (CS)

“The Union shall effect **allocation of bands** of the radio-frequency spectrum, the **allotment of radio frequencies** and the **registration of radio frequency assignments** and, for space services, of any associated orbital position in the geostationary-satellite orbit or any associated characteristics of satellite in other orbits, in order **to avoid harmful interference** between radio stations of different countries.”

(Article 1, par.11)



Infringement of the ITU CS, CV or RR

CS - ARTICLE 45 - Harmful Interference

1. CS 197- *All stations, whatever their purpose, **must be established and operated in such a manner as not to cause harmful interference to the radio services or communications of other Member States** or of recognized operating agencies, or of other duly authorized operating agencies which carry on a radio service, and which operate in accordance with the provisions of the Radio Regulations*
2. CS 199 - *Further, the Member States recognize the necessity of taking all practicable steps to prevent the operation of electrical apparatus and installations of all kinds from causing harmful interference to the radio services or communications mentioned in No. 197 above*



Harmful Interference in the Radio Regulations

1. No 1.166 *interference*: The effect of unwanted energy due to one or a combination of *emissions, radiations*, or inductions upon reception in a *radiocommunication* system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy
2. No 1.167 *permissible interference*: Observed or predicted *interference* which complies with quantitative *interference* and sharing criteria contained in the ITU RR or in ITU-R Recommendations or in special agreements as provided for in the ITU RR
3. No 1.168 *accepted interference*: *Interference* at a higher level than that defined as *permissible interference* and which has been agreed upon between two or more administrations without prejudice to other administrations.



Harmful Interference in the Radio Regulations

No. 1.169 Harmful Interference:

“Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations (CS1003).”

- **No Distinction** between **Deliberate/Intentional** and **Unintended** Interference
- **No specific level** to define from **Permissible Interference** (No.1.167) to **Accepted Interference** (No.1.168) and then **Harmful Interference** (No.1.169)
- **No real Enforcement Mechanism** apart from **ART.56 CS** (*Settlement of Disputes*) and **Optional Protocol**



RR Mechanisms to control HI

Control of Interference

ALLOCATION

Frequency separation
of stations
of different services

POWER LIMITS

PFD to protect TERR services
EIRP to protect SPACE services
EPFD to protect GSO from N-GSO
(EPFD = aggregate equivalent power flux-density)

REGULATORY PROTECTION

e.g. No. 22.2: Non-GSO to
protect GSO (FSS and BSS)

COORDINATION

between Administrations to
ensure **interference-free**
operations conditions



Measures against HI (1/3)

1. No. 4.3 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 assignments recorded in the MIFR* in accordance with the Table of Frequency Allocations (ART 5) and the other provisions of the RR;
2. No. 4.4 Administrations *shall not assign to a station any frequency in derogation of either the Table of Frequency Allocations (ART 5) or the other provisions of the RR, except on the express condition that such a station shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provisions of the Constitution, the Convention and the Radio Regulations*



Measures against HI (2/3)

PRIMARY and secondary services (Nos. 5.23 – 5.31)

1. PRIMARY service

2. *Secondary service*

- shall cause no harmful interference to, nor claim protection from, the PRIMARY service;
- can claim protection from harmful interference from stations of the same or other secondary services.



Measures against HI (3/3)

➤ Right to international recognition (No. 8.3)

1. *Any frequency assignment recorded in the Master Register (MIFR) with a favourable finding* with respect to the Table of Frequency Allocations and other provisions of the RR shall have the right to *international recognition and protection*
2. This right means that other administrations *shall take it into account when making their own assignments, in order to avoid harmful interference*



Summary and Key Messages

1. Spectrum protection starts with effective spectrum management
2. Effective spectrum management is established based upon the ITU Radio Regulations
3. National regulations should avoid conflicts with the ITU Radio Regulations
4. Good spectrum management will help maximize the benefits of GNSS and other radio services

