

# Controlling the radio-frequency spectrum

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## **Abstract:**

Control, the last phase in the management of the radio-frequency spectrum, entails checking whether users comply with regulations and eliminating any interference that might occur despite all precautionary measures. Control is the “after-sales” service that guarantees authorized users that their assigned bandwidths are actually available. This necessary task is harder to perform as the spectrum is put to a more intensive use — we can barely mention a human activity that does not have recourse to radio waves. Various facets of this control are described, whether preventive (compliance with regulations) or remedial (elimination of interference), along with its technical means and methods.

The control of radio stations, equipment and networks pursues the following objectives:<sup>1</sup>

- check their conformity with regulations;
- investigate and settle reported cases of interference;
- verify whether the public exposure to electromagnetic fields stays within the limits set by regulations and even limit this exposure to values as low as possible.

This action of “policing the frequencies” guarantees access to the spectrum for all users and, thereby, the availability of services and the security of investments. It is also essential for the security of all citizens. In France, the National Frequency Agency (ANFR: Agence Nationale des Fréquences) conducts several actions for this purpose, among them: controlling the conformity of radio stations, networks and space stations; controlling safety systems on ships; overseeing the radio equipment market; handling reported cases of interference; protecting the reception of radio-frequency signals for television; and measuring the electromagnetic field on location.

## **Controlling the conformity of radio stations, networks, space stations and systems for rescue operations at sea**

Controlling radio installations means, in particular, checking whether regulatory conditions have been satisfied in relation to: on the one hand, the authorizations (licenses) to use frequency bands for the stations under ARCEP’s oversight; and, on the other hand, the conditions of use specified when a station is registered in the databases of the ANFR and of the International Telecommunication Union (ITU). These preventive controls of conformity are the basis for a harmonious “cohabitation” of radio-frequency users. They have three main objectives:

- limit interference by verifying the conformity of installations with the licenses granted by the ANFR.

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<sup>1</sup> This article has been translated from French by Noal Mellott (Omaha Beach, France). All websites were consulted in October 2020.

- ascertain that the frequencies used are registered in the national table of frequency allocations (TNRBF) or have been authorized. Registration in the table means the station enjoys legally protection against interference.
- verify whether all uses of a frequency band have been declared and ensure the reliability of the ANFR's data bases.

There are three types of controls: inspections on location; unannounced controls at stations; and controls of independent networks.

An inspection on location has several major phases:

- First of all, a summons is sent to each user on the same radio frequency band.
- Information is gathered (even by drone) about a station's geographical coordinates, its tower for transmitting/receiving signals, its installations and operators as well as the signals transmitted and received.
- This information is compiled; and, if need be, any discrepancies with the data figuring in the station's registration are reported.
- The operators are notified to undertake corrective actions and, as may be the case, to pay a tax in proportion to the seriousness of the discrepancies observed.

Unannounced controls do not follow all these steps. They are less rigorous on locations with a lower intensity of radio waves. The procedure is, otherwise, the same except for sending a summons.

For independent networks, there are controls to see whether they are operating in conformity with the authorizations granted by the Regulatory Authority of Electronic Communications & Post Office (ARCEP: Autorité de Régulation des Communications Électroniques et des Postes). These controls verify the zones of use and frequencies used.

The ANFR does not itself have the means for controlling the conformity of space radio stations (geostationary satellites, etc.). Thanks to an agreement signed by various administrations in Europe however, it has privileged access to the German station of Leeheim, near Frankfurt. It has thus been able to verify whether the uses of radio frequencies by constellations of nongeostationary satellites are compatible with the service allocated for radio astronomy. Take note that Leeheim has a system of geolocation of stations on the ground (which emit upwards toward space) that measures the differences in timing and frequency of the signals emitted by several repeaters on the satellite.

Finally, under an agreement with the Office of Maritime Affairs, the ANFR controls radio equipment on ships. The control is all the tighter, going so far as to verify the quality of the electricity supply, insofar as the equipment is GMDSS compatible (Global Maritime Distress and Safety System) and indispensable for saving human lives. The ANFR formulates, as needs be, recommendations and oversees their followup. In case of nonobservance, it informs the competent safety committee, and the ship's license to navigate might not be renewed. The ANFR has carried out more than 90,000 controls since 1 January 2000. Its recommendations have proven beneficial. The application of these recommendations has made it possible to rapidly rescue passengers during shipwrecks, since emergency services have been equipped to receive distress signals and localize the vessel with the operational radio equipment.

## Overseeing the radio equipment market

This control verifies whether the radio equipment sold in France complies with regulations. An EU directive imposes a strict procedure whereby the party placing radio equipment on the market has to declare that it is in conformity with EU regulations. These controls, which take place once the equipment is in stores, take two forms:

- controlling the administrative conformity (observing how it is marked and the documents accompanying it);
- controlling the equipment's technical conformity. In this case, the equipment is taken from the point of sale for testing in a certified laboratory chosen by the minister in charge of Electronic Communications. In effect, the laboratory has to be certified by COFRAC (Comité Français d'Accréditation) or the equivalent. For controls of any equipment worn close to the body (in particular telephones), the ANFR deems it very important to check the specific absorption rate (SAR).

In cases of nonconformity, the ANFR requires corrective measures or even the voluntary withdrawal of the equipment from the market. If these requirements are ignored, the agency may levy fines and file a report with the public prosecutor; and the minister in charge of Electronic Communications may issue a callback of the equipment (or even a service) from the market.

## Handling reported cases of interference

Even though the ANFR takes all possible preventive measures so that authorized installations and equipment can coexist on frequency bands, interference might still occur. The ANFR will have to intervene to clear up the disturbances reported to it under the following conditions:

- The disturbance is affecting a radio navigation service or any other security or safety service; or is repetitive, even persistent.
- The disturbance is affecting a radio system that has received the ANFR's authorization and figures in the national table of frequencies.

The ANFR will also intervene when systems are affected that have never been registered in this table but that are highly critical (*e.g.*, stations for the physical safety and security of persons). It might also intervene in the case of radio systems without any guarantee of protection from interference (*e.g.*, the remote controls used by the public), but this is not an obligation. The identification of the equipment causing a radio-frequency disturbance often leads to observing that regulations have not been upheld.

To identify and locate the origin of interference or jamming, the ANFR uses fixed, transportable or mobile devices. In many cases, the causes are quite variable and are not intentional, as in the following cases:

- a radio source that is defective or is not in conformity with regulations: engineering defects, unauthorized mobile telephone repeaters, jammers, wireless telephones that comply with American standards, WiFi devices not in conformity with regulatory standards, faulty preamplifiers on TV antennas, systems for alarms or closed-circuit television (CCTV) that do not operate properly, etc.;
- electromagnetic parasites created by electronic equipment or electricity installations: electric fences or billboards, screens, computers or lighting systems, the absence of earth connections for electrical circuits, etc.;
- the nonlinear effects of unwanted radio signals from installations in a shoddy state: rust on transmission towers, too many unused antennas, etc.

After identifying and locating the signal's origin, the ANFR makes a notice of its technical recommendation and will then monitor whether the requested repair work has been done. The procedure is usually engaged on a friendly basis with the parties at the origin of the interference. When necessary however, legal means are brought to bear; and a report may be filed with the public prosecutor. A disturbance of radio signals due to nonconformity with regulations is liable to penal sanctions (up to six months in prison) and a fine of €30,000.

## **Protecting the reception of television signals**

Under a 1986 act on the freedom of communications, the ANFR and CSA are jointly responsible for protecting the television air waves. The ANFR collects complaints from plaintiffs, opens an investigation and identifies the origin of disturbances.

This special case of electromagnetic interference can affect many people, in fact, anyone watching television in France. A concrete example: a viewer whose TV is subject to interference reports the problem on a platform, website or call center, which informs him of any preidentified malfunctions (often by crossing information about the geographical location, radio frequencies and timing of disturbances). If the installation of a mobile telephone station is causing the disturbance, the ANFR will ask its operator to set up a filter for the viewer. This usually puts an end to the interference. If the disturbance persists however, the ANFR will ask the viewer to file a request for an intervention that has been countersigned by a specialist who installs antennas and attests to the absence of defects in the receiving equipment and its installation. The ANFR then completes its investigation through contacts with the viewer, specialist, multiplex and broadcaster. This investigation usually leads to a solution. If a solution is still not found, the ANFR will send a team on location, as previously described, who is technically equipped to investigate the interference.

## **Measuring the electromagnetic field on location**

Anyone can become a controller! In effect, anyone who wants to do so may request a measurement for free of the exposure to electromagnetic waves from fixed communicating devices (apart from high-voltage power lines), such as the smart meters installed in homes or public places. The person simply fills in a form that has to be signed by an authorized organization (local authority, association certified for the protection of the environment, etc.), and then addressed to the ANFR, which will send a team from a certified independent laboratory to measure the waves. The results will be posted publicly on a website ([www.cartoradio.fr](http://www.cartoradio.fr)), which now contains nearly 50,000 results. The ANFR itself may proceed to measure an electromagnetic field in pursuance, for example, of a control of conformity.

Furthermore, lawmakers have assigned the ANFR the job of conducting an annual census of "atypical points", *i.e.*, places where the exposure to electromagnetic waves substantially exceeds what is generally observed on the national scale. This global level of exposure equal to or more than 6 V/m corresponds to the level for which the ANFR's measurement protocol requires details about the sources of the exposure. Approximately thirty atypical points have been identified. For them, the ANFR asks operators to undertake actions, if technically feasible, for reducing this exposure while maintaining the coverage and quality of radio services.

## **Big events**

These events, mainly political or sports, attract media coverage and lead to many demands for access to the radio-frequency spectrum in a single place, at a single time and for a limited period. The ANFR offers a “premium service” that coordinates frequencies and provides for preventive controls of the conformity of equipment and for remedial controls to immediately handle reported cases of interference. This intervention by the ANFR occurs following a demand from state authorities or under an agreement with an event’s organizer. These interventions occur on a regular basis for events such as: Enduropale (in Touquet), the French Open Roland-Garros, the 24 Hours of Le Mans, the French Grand Prix, the Tour de France bicycle race, the parade on Bastille Day (14 July), the Paris Air Show, and summit meetings.

## **The means for controls**

The ANFR has seven services of control in eight locations spread through the country plus four overseas in French Polynesia, New Caledonia, French Antilles-Guiana and Réunion-Mayotte). These services use major means (material, fixed, transportable and mobile, *e.g.*, vehicles equipped with laboratories) that cover all frequency bands (HF-EHF) and are constantly being adapted to rapid changes in radio technology and to the task of performing controls (spectrum analyzers and scanners adapted to intercept and measure radio waves and the 5G field, goniometers, hyperbolic receivers, drones...).