

Radio frequencies are scarce key resources for the meteorological community to either collect the observation data upon which its predictions are based or to process and disseminate weather information and warnings to the public.

Managing Radio Spectrum for Meteorology

Radio-frequency applications range from a few kHz to several hundred GHz, and make use of a variety of radio technologies, such as telecommunication (e.g. for ra-

diosondes or satellites), radars (precipitation and windprofilers) and teledetection (e.g. passive satellite remote sensing or lightning detection).

In 2002, the International

Telecommunication Union (ITU) and the World Meteorological Organization (WMO) issued a Handbook on the "Use of radio spectrum for meteorology". It describes in detail all the related applications, including:

- Radiosondes operating mainly in the 400 and 1700 MHz bands
- Weather radars operating mainly at 2.8, 5.6 and 9.4 GHz
- Windprofilers operating mainly in the 400 and 1300 MHz bands
- Earth exploration by satellite (passive), performing measures on natural radiation in frequency bands that depend on physical laws (e.g. 1.4 GHz, 24 GHz, and up to 200 GHz nowadays)
- Earth exploration by satellite (active) for physical measures (altimeters, cloud profiling and precipitation detection), e.g. in the 1.3, 5, 9.5, and 35 GHz bands
- Lightning detection in bands around 100 kHz

Apart from certain purely passive bands used for the passive sensing of the atmosphere, the frequency bands allocated to meteorological uses are in general shared with other radiocommunication services under regulatory or technical conditions that in theory should allow all applications to operate on a nominal basis.

Radio regulations

The provisions mentioned above are given in the "Radio Regulations", an international treaty elaborated during the ITU World Radiocommunication Conferences (WRC) held every 3 or 4 years.

Each WRC agenda consists

of specific issues that can request, for example, a new frequency allocation for a given type of service or elaborate new regulatory regimes for certain applications.

The preparation for WRC is a careful process, allowing for all the necessary technical studies and the preparation of arguments both for and against by all administrations and representative organizations.

The preparation takes place in a number of Working Parties (WP) within ITU. WP 7B, 7C, and 8B for radars are specialized in meteorological issues. These groups are attended by a number of meteorological administrations, radiocommunication regulators and WMO representatives. The Study Group for Radio Frequency Coordination (SG-RFC) of the WMO is normally held prior to WP 7B and 7C to coordinate positions among meteorological administrations.

Meteorological issues at WRCs

As an example, the possible introduction of Mobile Satellite applications (so-called little LEOs) in the 400.15-406 MHz frequency bands has been on the agenda of the Conferences since 1995. These applications have the potential to drastically constrain radiosonde operations by producing interference levels that would reduce data availability. Facing this threat, the meteorological community became convinced that the protection of the part of the spectrum used for meteorological operations was essential. After considerable

Summary of WRC-03 Outcomes

WRC-03 held in Geneva had a long agenda presenting more than 40 different items. Apart from the protection of radiosondes in the 400 MHz band from Mobile Satellite applications, the main items included:

- The Conference allocated the 5 GHz band for Radio LANs systems (i.e. high data rate WIFI). However, the Conference imposed limitations to RLANS, such as power limits and indoor use to protect Earth exploration (active) in the 5250-5350 MHz band, as well as power and EIRP limits and mitigation techniques, such as power control or Dynamic Frequency Selection (DFS), to protect radars, including weather radars in the 5600-5650 MHz band.

- The protection of passive services (EESS and Radioastronomy) from unwanted emissions, in particular from those produced by space services transmissions. No specific regulation has been drawn but the Conference decided that the problem of unwanted emissions into passive bands will have to be further studied and technical regula-

tions put in place.

- Radionavigation services issues, with primary interest in Europe with regard to the GALILEO system. Meteorological interest concerned the protection of the radiolocation service in the 1270-1295 MHz band used by wind profiler radars. Radionavigation-satellite service in the band 1215-1300 MHz was requested not to cause harmful interference to the radiolocation service, including windprofilers.

- The Conference allocated the band 1668-1675 MHz to mobile satellite applications. It also urged administrations not to implement new radiosonde systems in the band 1668.4-1675 MHz and encouraged them to migrate existing radiosonde operations to other bands as soon as practicable. The interests of the Meteorological Satellite Service in the same frequency range have been safeguarded, since the Conference agreed that in the band 1670-1675 MHz, stations in the mobile-satellite service will not cause harmful interference to, nor constrain the development of, existing meteorological earth stations. ●

technical and operational debate spanning 8 years, as well as political discussions during the related WRCs, the consistent involvement of the meteorological community has been successful. WRC-2003 decided to close the debate and not allow Mobile Satellite applications in the 400.15-406 MHz band.

This involvement also gave successful results during WRC-2000, in preparation for which some administrations were proposing the 2.7-2.9 GHz frequency band, used by a number of weather radars worldwide, as a possible extension band for the IMT-2000 mobile phone (best known as 3G). Thanks to the actions taken, the IMT-2000 applications were finally allocated to the 2.5-2.7 GHz band.

The protection of passive bands used for satellites is also worth mentioning, since it represents a very specific issue that is repeatedly on the WRC agenda. These applications, essential for meteorological forecasts, involve the measurement of naturally occurring radiations at very low power levels. The appropriate bands are uniquely determined by the physical properties (e.g. molecular resonance), which cannot be moved and are therefore important natural resources. Low levels of interference (from in-band or out-of-band interferers) received at the input of the passive sensors may have a degrading impact on the use of passive frequency bands, especially since they are not able to discriminate between natural radiations and manmade emissions or radiations. Compati-

bility with passive applications needs to be very carefully studied to avoid any risk of harmful interference that would render the corresponding bands unusable and lost for meteorological forecasts.

Other frequency issues

Even though WRC issues represent a large part of frequency management, there are also other regular topics that are considered either at ITU or regional levels.

For example, within ITU, WP7C is currently reviewing the Recommendations dealing with radiosonde characteristics, performance and interference criteria. WP 8B has initiated work towards a better understanding of radar protection criteria. The meteorological community needs to be involved with both issues. It can lead a review of the conditions under which meteorological applications could share their bands with other services.

On a European level, the harmonization of spectrum use and possible introduction of new applications produce continuous work aiming at the adoption of European Decisions. A few years ago, this work led to the adoption of a regula-

tion allowing Active Medical Implants (AMI) in the 402-405 MHz band with adequate power limitations to protect radiosonde operations.

More recently, the introduction of automotive short-range radars (SRR) in the 24 GHz band has led to active debate. These SRR systems, supported by a powerful automotive lobby, were intended to use a 5 GHz bandwidth centered at 24.15 GHz and hence transmitting in the passive band 23.4-26 GHz, a

band of crucial importance to the water vapor absorption line. The final decision is not totally satisfactory since these applications have been allowed to operate in this frequency band but, thanks to the participation of the scientific and meteorological communities, only on a limited basis in number (max 7% of cars equipped) and until 2013, after which these devices will have to operate in the 79 GHz band.

Currently, two particular issues of interest to the mete- ➤

Weather radar in Toulouse.



Meteorological exploration by satellite can be either passive (measures on natural radiation in frequency bands that depend on physical laws) or active for physical measures (altimeters, cloud profiling and precipitation detection).

orological community are ongoing at a European level:

- The compatibility between wind profiler radars (WPR) operating in the 1270-1295 MHz band and the future European Radio-navigation system, GALILEO. Initial technical studies performed by Vaisala pointed out potential interference to WPR that could result in a substantial degradation of the availability of wind data. Despite the outcome of WRC-03, and acknowledging the European priority given to GALILEO, the meteorological community is requested to study, within the ECC/SE39 project team, the feasibility of possible mitigation techniques to apply to WPR that could improve the compatibility between the two applications.

- The compatibility of "generic" Ultra-Wide Band (UWB) applications, i.e. new technologies that use several GHz bandwidth and may cover multiple frequency ranges and potentially impact a large number of radio services in all frequency bands, currently between 1 and 10 GHz. The general concept of designated frequency bands in the Radio Regulations is not relevant for regulating these types of applications. The situation in Europe is complicated by the fact that the United States has already authorized these applications, with the maximum power density limit (-41.3 dBm/MHz). However, all studies presented in Europe, related in particular to Earth exploration (passive and active) and all weather radar bands, show that this power limit is not sufficiently low to ensure the protection of the corresponding services from the aggregate interference produced by the thousands of such UWB devices that are expected to be implemented in telecommunications, broadcasting and computer equipment. This issue is handled within a specific task group in ECC (TG3) as well as in its counterpart in ITU (TG 1/8) and the situation is likely to transfer

onto the political playground, in view of the economical potential of the UWB applications. Here, again, the participation of the meteorological community is necessary to make sure our interests are safeguarded.

Future trends and necessary actions

People around the world are hoping for communications facilities that are easy to handle, without constraints and allow for wireless connections at home, in the office or from any remote area. To satisfy this demand, the inventiveness of new technology and skillfulness of radio engineers have almost no limits.

The new applications, such as mobile phones, WIFI, UWB or satellite, demand more and more bandwidth and improved flexibility in the use of spectrum. They are also supported by powerful economical lobbies.

Even though we all take advantage of these facilities, the trend presents a growing threat to the frequency bands used for meteorological purposes and could tremendously impact meteorological forecasts and warning capability with related financial consequences.

The meteorological community is convinced that the protection of the part of the spectrum used for meteorological operations is essential. Thus it has mobilized to actively participate in the different related forums. Collaboration between meteorological services, researchers and industry is essential and must continue in order to safeguard the current and future use of frequency bands for meteorological purposes.

The international decision-making process is in general influenced by national radiocommunications authorities that have to satisfy telecommunications needs. This sets limitations on our involvement.

The meteorological community should be aware that action

through international bodies would be significantly facilitated by consistent action on a national basis by meteorological services, researchers and manufacturers. We need to voice the essential need for accurate meteo-

rological forecast and the necessity to maintain the availability of the frequency bands used for meteorological purposes. ●

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WRC-07 Agenda

WRC-03 agreed on the agenda for the next WRC, scheduled for 2007. The agenda contains 20 items, including:

- The extension of the current 18.1-18.3 GHz geostationary meteorological satellites' allocation and the protection of passive bands 10.6-10.68 GHz and 36-37 GHz.

- The possible upgrading of the status of the radiolocation service 9000-9200 MHz and 9300-9500 MHz, the latter being allocated to weather radars, and extending the existing allocations to the Earth exploration-satellite service (active) in the band 9500-9800 MHz by up to 200 MHz.

- The compatibility between the fixed-satellite service and other services around 1.4 GHz, and in particular the protection of the passive 1400-1427 MHz from unwanted emissions.

- The results of studies and proposals for regulatory measures regarding the protection of the Earth exploration-satellite service (passive) from unwanted emissions.

These four items represent important issues for the meteorological community either to ensure the protection of existing bands or to get new allocations to prepare for future use.

In addition, several agenda items for WRC-07 do not directly concern meteorological interests but, due to their wide scope in terms of frequency ranges, may have an impact on frequency bands used for meteorological purposes and will therefore also need to be cautiously considered.

The preparation for WRC-07 has already started. It is first taking place in the ITU but also at national and regional levels where initial positions are elaborated. For example, 46 European countries have a common preparation within the Conference Preparatory Group (CPG) of the Electronic Communication Committee, which is assumed to prepare the European Common Proposals (ECP). Meteorological administrations are able to participate within their national delegation. EUMETNET, currently representing 19 European meteorological administrations, is a recognized observer of the CPG process and fully entitled to contribute to the debate and voice the positions of the meteorological community. ●