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Radio Frequency threats on meteorological radars operations

Philippe Tristant [1]

[1] Météo France, Toulouse (France)

EUMETNET frequency manager

WMO chairman of the Steering Group on Radio-Frequencies Coordination (SG-RFC)

1 Introduction

The ITU-R Radio Regulations (RR) designates the bands 2700-2900 MHz (S band), 5600-5650 MHz (C band) and 9300-9500 MHz (X band) for ground based meteorological radars. In the present world, radio-communications are developing fast and pressure on frequency bands used for meteorological purposes is increasing, acknowledging that more support is given nowadays by radiocommunication administrations to mass-market and added-value radio applications. This presents the potential risk of limiting meteorological applications in general and meteorological radars in particular.

2 Interference and threats on frequency bands

Following the outcomes of the World Radiocommunication Conference held in 2003 (WRC-03), the ECC, in particular, agreed on Decision ECC/DEC/(04)08 (9 July 2004) related to "*the harmonised use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)*" that describes the condition of use of RLAN in order to ensure protection of existing services, among of which, for meteorology, both active Earth Exploration Satellite Service (EESS) band 5250-5350 MHz and precipitation radars in the 5600-5650 MHz band (included in the generic radiolocation allocation band 5250-5850 MHz).

With regards to the protection of radars, the main tool that should allow compatibility between RLAN and radars including precipitation radars is the Dynamic Frequency Selection (DFS) feature by which the RLAN device, before transmitting needs to scan its different channels to see whether radars are transmitting. If the RLAN device is able to measure a "radar pulse" in a given channel, it is then not allowed to make use of this channel.

Recently, the Hungarian and Polish meteorological services experienced interference cases that occurred to operational meteorological radars due to RLANs. It appears that these RLAN were based on a former version of the ETSI Standard for which DFS was not adequately defined. It even appeared than for one RLAN device, the DFS was able to be switched-off !

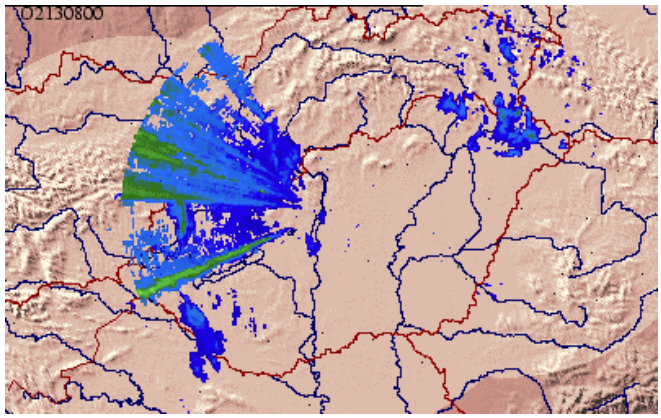

Fig. 1. Interference from RLAN 5 GHz to Budapest radar

This figure shows the impact of such interference on the Budapest radar and clearly shows the level of threat that could be envisaged for meteorological radar operations, hence **justifying that the whole community be involved in safeguarding the related frequency bands**.

Apart from the RLAN in the 5 GHz band for which, in any case, validation tests of the DFS will have to be performed in order to verify its adequacy to ensure safe operation of radars, a number of other radio-frequency issues are on-going that could present a threat for meteorological radars :

- the automotive industry is willing to use the 5470-5725 MHz RLAN band to implement "Intelligent Transport Systems" (ITS) on board cars for car-to-car and car-to-infrastructure communications. The main threat for radar is the serious doubt on the

efficiency of DFS with regards to such mobile communications (RLAN are so-called "nomadic" in that they are used at fixed points)

- The "Mobile" community, promoting 3rd and 4th generation mobile telephony (IMT-2000) is willing to identify, within the preparation of the World Radiocommunication Conference 2007 (WRC-07), the 5470-5725 MHz RLAN band for "nomadic" IMT-2000 and, more recently, is proposing the 2700-2900 MHz band for generic IMT-2000. It has to be noted that this latter band was not agreed for such applications at the (WRC-2000), in the light of technical studies obviously showing non-compatibility and demonstrates that frequency issues are never closed.
- Still in the preparation of the WRC-07, a possible allocation for satellite Synthetic Aperture Radars (SAR) in the 9300-9500 MHz is under study. The technical studies shows a potential for very high but very short interference which impact on meteorological radars is not trivial to assess.
- Ultra Wide Band (UWB) applications that represent a new radio technology intending to make use of several GHz of spectrum in the 1 to 10 GHz frequency range, putting at risk all corresponding radio applications, including meteorological radars. Studies undertaken within ITU-R have shown that such devices have to be operated at very low levels to ensure protection of radars. The regulatory work in Europe has allowed to safeguard the 3 meteorological radars bands but there are still countries that are within their regulatory process for which involvement of their national meteorological communities will be necessary to reach a similar satisfactory conclusion than in Europe.
- General work on radar protection criteria : both ITU-R and ECC have started the work toward a possible revision of radars protection criteria that are needed to perform studies under which regulatory Decisions are drawn. Indeed, current protection criteria are expressed as constant I/N figures that do not allow to adequately take into account either time varying interference or other pulse type interference, this latter being representative of interference that could be produced by other types of radars. It is necessary that the whole meteorological community (developers, manufacturers and users) take part of this work in order to be able to propose and justify adequate figures that would ensure protection of meteorological radars.

3 Potential impact of wind farms

Another threat to meteorological radars that has recently been highlighted but does not relates to specific frequency bands concerns the impact of **wind farms**.

Indeed, technical studies recently performed by Météo France in 2005 have shown that wind farms deployment in distances of several km (up to 30 km) around meteorological radars could have a tremendous impact on the corresponding data. Three impact scenarios have been studied (Blocking of the beam, Clutters and Doppler), but it appears that the worst situation pertain to the Doppler mode for which data can be totally corrupted in all azimuths.

These theoretical studies, that led to a Report of the French radiocommunication agency (ANFR), have been confirmed by measurements on a French radar (Abbeville) in the vicinity of which wind farms are already deployed. The following figure shows measurements performed in clear sky conditions on pixels corresponding to the wind farm location and that presents reflectivity levels up to 64 dBz, corresponding, at this distance (19 km), to an equivalent RCS of 23 dBsm.

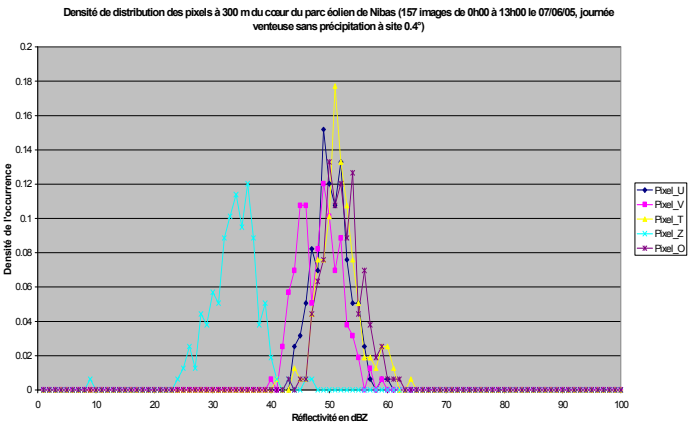

Fig. 2. Measured impacts of wind farms on meteorological radars

Looking at the large foreseen deployment of wind farms in a medium-term future, the meteorological radar community should consider this possible threat quite seriously that could jeopardise all recent and future development made in meteorological radars.

4 Conclusions

On a more general basis, the meteorological community should be aware that the world is going fast and that meteorological radars are operated in a moving environment (other radio applications, wind farms,….) that has to be kept under constant scrutiny to safeguard the corresponding activities. On this basis, close contacts with the national authorities in charge of these domains are necessary if not mandatory.