BELGIAN INSTITUTE FOR POSTAL SERVICES AND TELECOMMUNICATIONS

Reference:

DRAFT DECISION OF THE BIPT COUCIL OF 1 JULY 2011 ON THE COEXISTENCE BETWEEN 4G OPERATORS IN THE 2500-2690 MHz BAND AND RADARS IN THE 2700-2900 MHz BAND

To respond to this document

Deadline: until 5 August 2011
Contact person: Michaël Vandroogenbroek, senior engineer-advisor (02 226 88 11)
E-mail answering address: michael.vandroogenbroek@bipt.be

Answers can only be sent by e-mail.
The document must clearly indicate what should be considered as confidential.
This consultation takes place according to Article 140 of the Act of 13 June 2005.

CONTENTS

1. Introduction

1.1. Legal framework

Article 13 of the Act of 13 June 2005 on electronic communications lays down:

« Art. 13. The Institute is tasked with:

…

3° national and international coordination of radio frequencies;

… »

As the coexistence of 4G operators in the 2500-2690 MHz band and aeronautical radars poses a problem of national coordination, this decision is taken by virtue of Article 13 of the Act of 13 June 2005.

1.2. Purpose of the decision

The purpose of this decision is to ensure coexistence between aeronautical radars of Belgocontrol and of the Ministry of Defence in the 2700-2900 MHz frequency band on the one hand and the use of the 2500-2690 MHz band by 4G operators[1] on the other.

1.3. Public consultation

[To be completed]

1.4. Cooperation agreement

BIPT has sent a draft decision to the community regulatory bodies in accordance with the procedure described in sections 1 and 2 of Article 3 of the cooperation agreement of 17 November 2006:

"Art. 3. Draft decisions of a regulatory body relating to electronic communications networks are sent by this body to the other regulatory bodies listed in Article 2, 2°, of this cooperation agreement." (free translation)

The regulatory bodies consulted make their comments to the regulatory body that has sent the draft decision, within 14 calendar days.

[Results of the consultation]

2. Use of the 2500-2690 MHz band by 4G operators

2.1. Decision 2008/477/EC

Decision 2008/477/CE[2] aims at harmonising the conditions of provision and efficient use of the 2500-2690 MHz band for terrestrial systems capable of providing electronic communications services in the Community.

Decision 2008/477/EC obliges Member States to make the 2500-2690 MHz band available for terrestrial systems capable of providing electronic communications services in accordance with the technical parameters set in the annex to the decision.

Those parameters set in the annex to Decision 2008/477/EC, called "Block Edge Mask" (BEM) have to ensure coexistence between neighbouring networks. However, those parameters do not

[1] A 4G operator is an operator holding user rights for radio frequencies in the 2500-2690 MHz band.
[2] Commision Decision of 13 June 2008 on the harmonisation of the 2500-2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community

ensure coexistence between terrestrial systems capable of providing electronic communications services in the 2500-2690 MHz band and systems in adjacent bands.

Yet, Decision 2008/477/EC obliges[3] Member States to ensure that terrestrial systems capable of providing electronic communications services in the 2500-2690 MHz band give appropriate protection to systems in adjacent bands.

2.2. 4G Royal Decree

The 4G Royal Decree[4] lays down the terms for obtaining and exercising the user rights for radio frequencies in the 2500-2690 MHz band, used for electronic communications services.

The 4G Royal Decree stipulates that the user rights are granted by BIPT by means of an auction. On the website http://www.auction2011.be further information is available on the auctions held in 2011.

The 2500-2570 MHz (uplink) and 2620-2690 MHz (downlink) bands have to be used by FDD systems, while the 2575-2620 MHz band has to be used by TDD systems.

The 4G Royal Decree takes over the BEMs laid down in the annex to Decision 2008/477/EC in order to ensure coexistence between the various 4G operators.

3. Use of the 2700-2900 MHz band by radars

In the Radio Regulations of the International Telecommunication Union the 2700-2900 MHz frequency band is allocated to aeronautical radionavigation: the use of the 2700-2900 MHz band is restricted to ground radars and to associated airborne transponders (RR 5.337).

In Belgium, Belgocontrol and the Ministry of Defence use primary approach radars, in the 2700-2900 MHz frequency band, installed in airports.

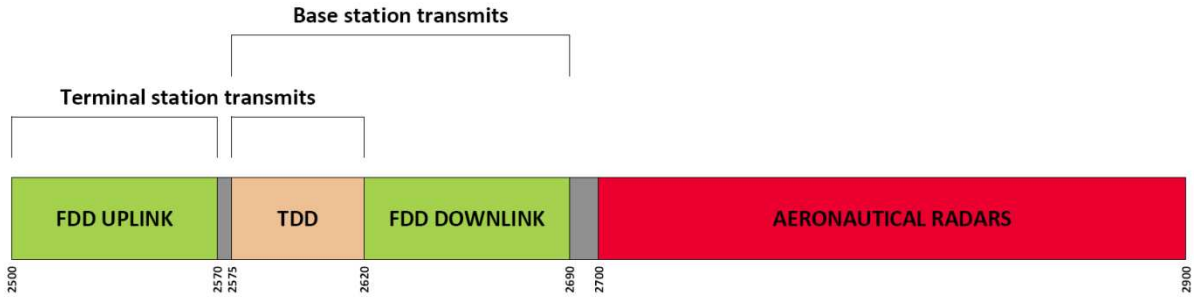
Belgocontrol uses the primary approach radars in Charleroi, Liège, Ostend and Zaventem.

The Ministry of Defence uses primary approach radars in Beauvechain, Florennes and Kleine-Brogel.

4. Coexistence between 4G networks and aeronautical radars

4.1. Overview of the situation

The figure below shows how the radio spectrum between 2500 and 2900 MHz is used in Belgium.



The 2570-2575 MHz guard band between the FDD systems (uplink) and the TDD systems, should remain unused.

[3] Article 2, 3
[4] Royal Decree of 22 December 2010 on radio access in the 2500-2690 MHz frequency band

The 2690-2700 MHz band is allocated to radio astronomy but it is currently not used in Belgium. This frequency band can be considered to be a guard band between the systems rolled out by the 4G operators and aeronautical radars. By contrast, the 2690-2700 MHz band is used for radio astronomy in the Netherlands.

4.2. Interference in radars caused by 4G networks

There are two types of interference in aeronautical radars caused by the 4G networks[5] to take account of:

4.2.1. Spurious emissions

This kind of interference results from radiation on frequencies situated outside the necessary bandwidth of 4G emissions, the level of which can be reduced without affecting the quality of the link. Spurious emissions produced in the receiving band of aeronautical radars could affect the operation of the radars.

A distinction can be made between:

- spurious emissions generated by a single station;
- spurious emissions resulting from intermodulation products, generated at the level of a station by various co-located stations.

In theory this type of interference can be produced by base stations as well as terminal equipment. In practice, however, this decision only concerns the base stations. BIPT cannot impose restrictions on terminal equipment considering free movement with the European Union. Moreover, the interference coming from terminal equipment is less important compared to the one coming from the base stations because of:

- the much bigger propagation loss;
- the bigger frequency separation;
- the much weaker radiated power level.

This type of interference can be solved by adding filters at the level of the basis stations which the interference originates from.

4.2.2. "Blocking" and intermodulation at the level of the radar receiver

This kind of interference results from radiation on frequencies situated within the necessary bandwidth of the 4G emissions, the level of which cannot be reduced without affecting the quality of the link. The lack of selectivity of the aeronautical radars' receivers is the main cause of this type of interference.

Two distinct phenomena may affect the operation of the radars:

- an overload of the LNA[6];
- a third order intermodulation product in the radar band.

In theory this type of interference can be produced by base stations as well as terminal equipment. In practice, however, for the same reasons as those mentioned in section 0, this decision only concerns the base stations.

This type of interference can be solved:

- by adding filters at the level of the radars in order to improve selectivity;

[5] A 4G network is a radio communications network rolled out by a 4G operator.
[6] Low Noise Amplifier

- by changing the radar's frequency in order to enhance the frequency separation.

4.2.3. Study made by Intersoft Electronics

BIPT has commissioned Intersoft Electronics to make a study in order to evaluate the degradation of Belgian aeronautical radar performance in the 2700-2900 MHz band due to interference from 4G communication technologies and to make recommendations on the measures to take. The public version of the report about this study is available at http://www.auction2011.be.

4.3. Interference in 4G networks caused by radars

In theory both types of interference, spurious emissions and "blocking", in 4G networks caused by radars may occur: the radars may interfere both with base stations and terminal equipment.

Up to now, no studies have been finalised to evaluate the degradation of 4G networks due to aeronautical radars.

4.4. Solutions recommended by BIPT

4.4.1. Protection of radars

4G operators should ensure that spurious emissions from their base stations do not generate a power level that is too high at the level of the various radars that need to be protected. The maximum power level and the way to calculate it are defined in this decision. The maximum level of spurious emissions corresponds with a power level of -122 dBm/MHz at the LNA input: the Intersoft Electronics study shows that those levels are sufficient for all types of radars installed in Belgium.

In addition, BIPT intends to propose at the international level, modifications to the harmonised standards in order to limit spurious emissions of base stations and terminal equipment.

As mentioned in section 0, the problems of "blocking" and'intermodulation at the level of the radar receiver can be solved:

- by adding filters at the level of the radars in order to improve selectivity;
- by changing the radar's frequency in order to enhance the frequency separation.

Modifications should be made at the level of aeronautical radars in order for the radiation in the 2575-2690 MHz band coming from 4G base stations situated at one km at least from the radar, not to affect the radar's operation. The distance of one km corresponds with a base station with a line of sight to the radar and emitting at the maximum power authorised in the direction of that radar. Base stations situated at less than a km are not authorised, unless it has been ascertained that they would not affect the radar's operation; therefore for these base stations an individual coordination will have to be made

A period of adaptation is necessary however in order for Belgocontrol and the Ministry of Defence to make the necessary modifications to their aeronautical radars.

Until 1 July 2013 the 4G operators have to ensure that radiation from their base stations on frequencies within the 2575-2690 MHz band do not generate a power level that is too high at the level of the various radars that need to be protected. The maximum power level and the way to calculate it are defined in this decision. The maximum power levels have been calculated based on the Intersoft Electronics study.

The following hypotheses are taken into account:

- Maximum antenna gain of the radars: 34 dBi

- Loss at radar level: 1dB
- The signals coming from the 4G base stations are seen from the radar antenna with a horizontal elevation and a discrimination of the corresponding radar antenna of 6 db
- 6 dB margin in order to take account of the multi-operator/site effects, for radiation within the 2575-2690 MHz band

4.4.2. Protection of the 4G operators

The aeronautical radars should at least observe the international standards concerning spurious emissions generated in the 2500-2690 MHz band.

There are two international reference recommendations regarding the limits of spurious emissions:

- CEPT recommendation REC 74/01;
- ITU recommendation ITU-R SM.329.

Both recommendations mention the same maximum levels tolerated for spurious emissions for the radars: -30 dBm/MHz or 100 dB attenuation below the peak envelope power supplied to the antenna's transmission line, depending on the least binding value.

A period of adaptation is necessary however in order for Belgocontrol and the Ministry of Defence to make the necessary modifications to their aeronautical radars.

As from July 2013 the radars' spurious emissions generated in the 2500-2690 MHz band will have to be below the maximum tolerance levels mentioned in the recommendations.

5. Decision

1. Until 1 July 2013 total radiation from a 4G operator's base stations situated at the same antenna site[7] generated in the 2575-2690 MHz band has to be such that:

   a) $W + 30 - L < PL$

   b) $W_{SD}(f) + 30 - L < IML(f)$

   for each radar, where:

   – N: number of transmitters used by the 4G operator at the site

   – $W = 10 \times \log \sum_{C=1}^{N} 10^{\frac{P_C(\varphi)}{10}}$

   – $W_{SD} = 10 \times \log \sum_{C=1}^{N} 10^{\frac{S_C(\varphi)}{10}}$

   – φ: the radar's azimuth seen from the base station

   – $P_C(\varphi)$: maximum EIRP of transmitter C in azimuth φ in dBW

   – $S_C(\varphi)$: spectral density of maximum EIRP of transmitter C in azimuth φ in dBW/MHz

   – L: propagation loss in dB, between the base station and the radar, calculated on the basis of recommendation ITU-R P.452 with the following parameters:

   - ΔN = 45 N-units/km
   - N0 = 325 N-units
   - P = 1013 hPa

[7] Article 2, 52°, of the Act of 13 June 2005 on electronic communications

- T = 15°C
- p = 20%

If a 4G operator thinks that in a specific case, the real loss exceeds the loss calculated, he can ask BIPT to examine that case.

– PL: level of protection required for the power flux density at the level of the radar in dBW/m^2

– $PL = 10 \times \log(pl)$

– $pl = \sum_{C=1}^{N} \left\{ 10^{\frac{P_C(\varphi)-W}{10}} \frac{1}{B_C} \int_{f_C-B_C/2}^{f_C+B_C/2} plc(f)df \right\}$

– f_C: centre frequency of the signal generated by transmitter C

– B_C: bandwidth of the signal generated by transmitter C

– $PLC = 10 \times \log(plc)$

– PLC(f): protection level curve for the power flux density at the level of the radar based on the frequency in dBW/m^2

– IML(f): the spectral density limit of power flux density at the level of the radar in $dBW/m^2/MHz$

2. As from 1 July 2013:

   – the constraints imposed in point 1 no longer apply;

   – all 4G base stations situated at less than a km from a radar have to be coordinated on an individual basis.

3. Total spurious emissions from a 4G operator's base stations situated at the same antenna site generated in the 2700-2900 MHz band has to be such that:

   $U + 30 - L < SEL$

   for each radar, where:

   – $U = 10 \times \log \sum_{C=1}^{N} 10^{\frac{S_C(\varphi)}{10}}$

   – $S_C(\varphi)$: spectral density of maximum EIRP of transmitter C radiated in the 2700-2900 MHz band, in azimuth φ, in dBW/MHz

   – SEL: spurious emissions limit (spectral density of power flux density) at the level of the radar. This limit is set at -149 $dBW/m^2/MHz$.

4. The technical characteristics indicated in points 1 to 3 are given for each radar to be protected, in annex 1 to this decision.

5. All 4G base stations have to be notified to BIPT at least two months before the station is put into operation. The format to be used to coordinate or notify a station to BIPT is indicated in annex 2 of this decision. If BIPT should find a problem of compatibility with the radars, it will inform the operator concerned before the date planned for putting it into operation, and impose appropriate measures.

6. If despite the observance of the constraints imposed in points 1 and 3, a radar was experiencing interference, the 4G operator involved must take immediately all necessary measures to put an end to it.

7. As from 1 July 2013, in accordance with ITU recommendation ITU-R SM.329 spurious emissions from the radars generated in the 2500-2690 MHz band have to be lower than -30

dBm/MHz or 100 dB attenuation below the peak envelope power supplied to the antenna's transmission line, depending on the least binding value.

Axel Desmedt Membre du Conseil	Charles Cuvelliez Membre du Conseil
Catherine Rutten Membre du Conseil	Luc Hindryckx Président du Conseil

Appeal procedures

In accordance with the Act of 17 January 2003 on the appeals and the settling of lawsuits arising from the Act of 17 January 2003 on the status of the regulator of the Belgian postal and telecommunications sectors you have the possibility to lodge an appeal against this decision before the Brussels Court of Appeal, Place Poelaert 1, B-1000 Brussels. The higher appeal shall be lodged, on penalty of nullity pronounced automatically, by filing a signed request with the court registry of the Brussels Court of Appeal within a period of sixty days starting from the notification of the decision, or in the absence of such notification, from the publication of the decision, or in the absence of such publication, from the inspection of the decision.

The request shall be filed with the court registry of the Court of Appeal in as many copies as there are parties involved. On penalty of nullity the request shall contain all indications referred to in Article, 2, § 2 of the Act of 17 January 2003 on the appeals and the settling of lawsuits following the Act of 17 January 2003 on the status of the regulator of the Belgian postal and telecommunications sectors.

ANNEX 1
TECHNICAL CHARACTERISTICS OF THE RADARS TO BE PROTECTED

Upon request annex 1 is available at BIPT.

ANNEX 2

FORMAT TO BE USED FOR COORDINATION OR NOTIFICATION OF A BASE STATION

- One line per base station
- Use a decimal point [.] as separator
- List of fields used
    1. Name of the site
    2. Longitude in decimal degrees (WGS84)
    3. Latitude in decimal degrees (WGS84)
    4. Height of the transmitting antenna
    5. Centre frequency of the signal (MHz)
    6. Channel bandwidth (MHz)
    7. Maximum EIRP in 36 azimuths[8] (0°, 10°, 20°, …, 340°, 350°)
    8. Planned date of putting into operation (DD/MM/YYYY)

[8] 0° = NORTH ; 90° = EAST ; 180° = SOUTH ; 270° = WEST