Commission for
Communications Regulation

Report

2005 – 2006 Programme of Measurement of Non-Ionising Radiation emissions

Fourth Interim Report

Document No:	**07/05**
Date:	**30th January 2007**

An Coimisiún um Rialáil Cumarsáide
Commission for Communications Regulation
Abbey Court Irish Life Centre Lower Abbey Street Dublin 1 Ireland
Telephone +353 1 804 9600 *Fax* +353 1 804 9680 *Email* info@comreg.ie *Web* www.comreg.ie

Contents

1 Foreword

The use of radio technology has played and will continue to play a significant role in the development and growth of the Irish economy. Advances in mobile radio technology with the convenience it can bring to business and consumers alike are well documented. Today in Ireland over 3.17m people own a mobile phone. The use of SMS messages, once the domain of the young, is increasingly being adopted by all age groups and the latest technologies such as GPRS and 3G, with their range of new and interesting applications, indicate that further growth can be anticipated in the mobile communications sector.

This growth and development have raised the awareness of the public of the positive benefits mobile radio technology can bring to individuals, industry and commerce. This can be particularly important in an increasingly knowledge based economy like Ireland's where access to information and the tools to support and enhance competitiveness are key to our future progress and prosperity. To maintain this level of progress will however require continuing investment in the maintenance and upgrading of existing networks as well as the roll out of new infrastructure.

Recognising likely growth in radio infrastructure, ComReg has required in their respective licences that all operators are compliant with the international guidelines for general exposure to electromagnetic fields. The Commission has previously published three audit reports on compliance by operators with emission limits for non-ionising radiation. Each audit has focused on compliance with the general exposure limits specified in the guidelines published by the International Commission on Non Ionizing Radiation Protection (ICNIRP). On the basis of the work carried out in each of the audits it has been possible to confirm that all of the companies audited have procedures and processes in place to ensure compliance with these international general exposure limits.

In 2003 - 2004 an extensive programme was carried out by independent consultants engaged by ComReg to measure non-ionising radiation levels at up to 400 antenna sites around the country. That programme involved measuring the highest emission level associated with each site. The results of the measurements carried out indicated

that emissions from all of the sites tested were significantly below the internationally accepted limits. A further programme commenced in November 2005, the purpose of which is to survey emissions from a further 80 sites over a period of twelve months. This survey has been carried out on ComReg's behalf by Vilicom Ltd.

This data from the survey is published as part of a process to seek to better inform the public about the findings of the independent consultants in relation to compliance of radio installations with international guidelines for public exposure limits to non-ionising radiation.

This report on the final 20 sites concludes that, on the basis of the audit undertaken, all of the sites are significantly below the ICNIRP guideline levels. The final report, which will include readings from all 80 sites, is due in early 2007.

Commission for Communications Regulation

2 Executive Summary

This report is the fourth of four interim reports which outline the programme to measure Non-Ionising Radiation at 80 sites nationwide and covers the results of the final 20 sites measured under that programme. Each of the reports is available on the ComReg website[1]. The programme involves measurement of emission levels at the point of highest emission associated with antenna sites and is fully operated and funded by ComReg.

In late 2005, following a competitive tender process, Vilicom Ltd were contracted by ComReg to carry out Non-Ionising Radiation emission measurements at 80 sites throughout the country. On the basis of this work, Vilicom have concluded that the NIR emissions from all of the 20 sites measured in this report are significantly below the ICNIRP guideline limits[2].

[1] www.comreg.ie
[2] See Annex 1

3 Introduction

The Commission for Communications Regulation (ComReg) is the licensing authority for the use of the radio frequency spectrum in Ireland. The frequency spectrum is a valuable National resource which has been used for communications purposes for over 100 years. Applications of radio spectrum, today, include the transmission of a wide range of services, including radio and television broadcasting, mobile telephony and other telecommunications services such as internet connection.

As the licensing authority for radiocommunications in Ireland, ComReg is responsible for ensuring that communications operators comply with their licence condition relating to non-ionising radiation. The radiation emissions from communications sites must be within the levels set down in the latest international guidelines.

This report represents the results of Non-Ionising Radiation measurements at the final 20 sites chosen as part of the current Programme of Measurement of Non-Ionising Radiation emissions. The full programme consists of the measurement of Non-Ionising Radiation emissions at 80 sites throughout the country. The programme has been carried out by Vilicom Ltd on behalf of ComReg.

For each site, ComReg requires that the measured levels of non-ionising radiation emissions should not exceed the ICNIRP limits in any part of the site or surrounding area where the general public has access.

The remainder of this report is arranged as follows:

Section 4 outlines the role of the ComReg in the area of NIR. It outlines the appointment of Vilicom Ltd in the programme.

Section 5 contains summaries of the results for each antenna site from Vilicom Ltd's reports on the measurement programme. Each site report contains a conclusion by Vilicom on the extent of its compliance of each site with the general public exposure limits of the ICNIRP Guidelines 1998. Abbreviated versions of the individual site reports are to be found on the ComReg website[3]. Copies of the full site reports are available on request.

The final section contains the overall conclusions.

The Annex section contains two elements which are as follows:

1. An explanation of Non-Ionising Radiation and an explanation of the International Commission on Non-Ionizing Radiation Protection and the guideline limits associated with that body.
2. A guide to the methodology used in the site measurements.

[3] www.comreg.ie

4 Background

4.1 What is NIR?

Non-ionising radiation is that part of the electromagnetic spectrum below 2420 million MHz. Radio waves, infrared radiation and visible light are examples of NIR.

4.2 Role of the Commission for Communications Regulation

In 2005/2006 measurements of Non-Ionising Radiation emissions were taken at 80 sites throughout the country. The programme was carried out by Vilicom Ltd on behalf of ComReg.

The aim of the programme is to ensure that emissions from communications sites comply with the general public exposure limits set down by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). Some sites have been nominated by the public and the other sites are chosen by ComReg, based on population coverage. Currently, radiation emissions from communications sites must be within the levels set down in the ICNIRP guidelines.

4.3 The Role of Vilicom Ltd.

Following a competitive tender process held in late 2005, Vilicom Ltd were chosen to carry out the site measurements. Vilicom is an Irish based company which offers telecommunications related services such as the monitoring of NIR emissions and the quality testing of mobile networks.

5 Summary of Vilicom reports on the site measurement programme

5.1 Introduction

ComReg commissioned Vilicom Ltd, as an independent consultancy service to conduct a survey of 80 sites. Vilicom worked on the programme throughout 2005 and 2006.

Vilicom engineers measured the field strength (electric field voltage) of transmissions in the various radio bands to be surveyed[4] .The results are referenced and presented alongside the relevant International Commission on Non-Ionizing Radiation Protection (ICNIRP) recommended public maximum exposure levels.

Abbreviated versions of the reports for each site are available in the Non-Ionising Radiation section of the ComReg website. The full versions of the reports are available on request.

[4] See Annex 2 for the site measurement methodology

5.2 Summary of site report results[5]

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Bray Co. Wicklow *Christ Church, Church Road*	0.1 MHz – 1GHz	0.4245	42.21
	1GHz – 3GHz	0.2976	59.01
	GSM 900	0.4245	42.21
	GSM 1800	0.2976	59.01
	3G (2110 – 2200 MHz)	0.0997	61.00
Cahir Co. Tipperary	*The measurements of this site survey are not published in this report as the survey was conducted at a private residence*.		
Carlow Town Co. Carlow *Glendale just off the Green Lane Road*	0.1 MHz – 1GHz	0.7881	42.59
	1GHz – 3GHz	0.2486	58.93
	GSM 900	0.7881	42.59
	GSM 1800	0.2486	58.93
	3G (2110 – 2200 MHz)	0.0771	61.00

[5] See each individual site report for the full set of measurement results

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Castlerea Co. Roscommon *New Estate, Knockroe*	0.1 MHz – 1GHz	0.5535	42.14
	1GHz – 3GHz	0.0566	61.00
	GSM 900	0.5535	42.14
	GSM 1800	0.0231	59.90
	3G (2110 – 2200 MHz)	0.0566	61.00
Clontarf Dublin 3 *Vernon Avenue*	0.1 MHz – 1GHz	1.7846	42.11
	1GHz – 3GHz	0.2454	61.00
	GSM 900	1.7846	42.11
	GSM 1800	0.1751	59.56
	3G (2110 – 2200 MHz)	0.2454	61.00
Crosshaven Co. Cork *Ballinaluska, Near Atlantic Villas*	0.1 MHz – 1GHz	0.8834	28.00
	1GHz – 3GHz	0.0356	61.00
	GSM 900	0.5113	42.14
	GSM 1800	0.0161	59.60
	3G (2110 – 2200 MHz)	0.0023	61.00

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Donnycarney Dublin 9 *off Collins Avenue West, Belton Park Avenue*	0.1 MHz – 1GHz	0.0020	42.28
	1GHz – 3GHz	0.1439	61.00
	GSM 900	0.0020	42.28
	GSM 1800	0.0187	59.79
	3G (2110 – 2200 MHz)	0.1439	61.00
Greenlake Co. Wexford	0.1 MHz – 1GHz	0.1205	42.18
	1GHz – 3GHz	0.0350	58.96
	GSM 900	0.1205	42.18
	GSM 1800	0.0350	58.96
	3G (2110 – 2200 MHz)	0.0184	61.00
Kilworth Co. Cork	0.1 MHz – 1GHz	0.2526	42.59
	1GHz – 3GHz	0.0029	59.89
	GSM 900	0.2526	42.59
	GSM 1800	0.0029	59.89
	3G (2110 – 2200 MHz)	0.0016	61.00

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Kinnegad Co. Westmeath *Hilmar Hotel*	0.1 MHz – 1GHz	0.8891	42.26
	1GHz – 3GHz	0.0675	59.66
	GSM 900	0.8891	42.26
	GSM 1800	0.0675	59.66
	3G (2110 – 2200 MHz)	0.0101	61.00
Lahinch Co. Clare *Doonbeg Road*	0.1 MHz – 1GHz	0.5619	42.32
	1GHz – 3GHz	0.0296	59.92
	GSM 900	0.5619	42.32
	GSM 1800	0.0296	59.92
	3G (2110 – 2200 MHz)	0.0057	61.00
Longford Town Co.Longford *Tesco Shopping Centre off Great Water Street*	0.1 MHz – 1GHz	0.7821	42.11
	1GHz – 3GHz	0.0955	59.16
	GSM 900	0.7821	42.11
	GSM 1800	0.0955	59.16
	3G (2110 – 2200 MHz)	0.0220	61.00

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Mayglass Co. Wexford *Water Tower*	0.1 MHz – 1GHz	0.0710	42.16
	1GHz – 3GHz	0.0025	58.94
	GSM 900	0.0710	42.16
	GSM 1800	0.0025	58.94
	3G (2110 – 2200 MHz)	0.0016	61.00
Mullingar Co. Westmeath *car park on Blackhall Street*	0.1 MHz – 1GHz	0.1510	42.37
	1GHz – 3GHz	0.2858	58.95
	GSM 900	0.1510	42.37
	GSM 1800	0.2858	58.95
	3G (2110 – 2200 MHz)	0.0241	61.00
Nenagh Co. Tipperary *Ashe Road, entrance to Saint Mary's Secondary School*	0.1 MHz – 1GHz	0.3168	42.58
	1GHz – 3GHz	0.1381	61.00
	GSM 900	0.3168	42.58
	GSM 1800	0.0177	58.86
	3G (2110 – 2200 MHz)	0.1381	61.00
Rathnew Co. Wicklow *Between Rathnew and Ballymerrigan*	0.1 MHz – 1GHz	0.2541	42.54
	1GHz – 3GHz	0.1316	61.00
	GSM 900	0.2541	42.54
	GSM 1800	0.0072	59.06
	3G (2110 – 2200 MHz)	0.1316	61.00

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Ronanstown Dublin 22 *Garda Station*	0.1 MHz – 1GHz	0.2602	28.00
	1GHz – 3GHz	0.2501	59.23
	GSM 900	0.2034	42.54
	GSM 1800	0.2501	59.23
	3G (2110 – 2200 MHz)	0.0226	61.00
Skerries Co. Dublin *Railway Station*	0.1 MHz – 1GHz	0.5203	42.51
	1GHz – 3GHz	0.2517	61.00
	GSM 900	0.5203	42.51
	GSM 1800	0.0738	59.25
	3G (2110 – 2200 MHz)	0.2517	61.00
Tullamore Co. Offaly *Western Relief Road*	0.1 MHz – 1GHz	0.1149	42.58
	1GHz – 3GHz	0.4355	61.00
	GSM 900	0.1149	42.58
	GSM 1800	0.3054	58.91
	3G (2110 – 2200 MHz)	0.4355	61.00

Site	Frequency Range	Highest reading V/m	ICNIRP guideline Limit V/m
Wexford Town Co.Wexford *Garda Station*	0.1 MHz – 1GHz	0.1559	28.00
	1GHz – 3GHz	0.2781	59.05
	GSM 900	0.1063	42.57
	GSM 1800	0.2781	59.05
	3G (2110 – 2200 MHz)	0.1686	61.00

Conclusion

The conclusion of the site measurements undertaken is that emission levels at all the sites measured fall significantly below the international ICNIRP general exposure levels. In some cases the levels are in fact less than one thousandth of the ICNIRP limits.

Annex 1

Non-Ionising Radiation (NIR) and the International Commission on Non-Ionizing Radiation Protection (ICNIRP)

Definition

Non-ionising radiation is that part of the electromagnetic spectrum below 2420 million MHz. Radio waves, infrared radiation and visible light are examples of NIR. Electromagnetic waves at frequencies above 2420 million MHz are known as ionising radiation and this includes X-rays and Gamma rays.

Standards for emissions limits for non-ionising radiation

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is an independent, scientific organisation established in 1992. The ICNIRP was established for the purpose of advancing Non-Ionising Radiation Protection for the benefit of people and the environment and in particular to provide guidance and recommendations on protection from NIR exposure. ICNIRP operates in co-operation with the Environmental Health Division of the World Health Organisation and the United Nations Environment Programme. In 1998 ICNIRP issued a position paper on the health and safety aspects of NIR. This reviewed both thermal and athermal effects and its conclusion endorsed the 1988 guidelines produced by the International Radiation Protection Association (IRPA).

ComReg's current programme of NIR measurements requires sites to be in compliance with the ICNIRP (1998) guidelines. A summary of the maximum public exposure levels in the ICNIRP Guidelines for the radio systems in this audit are shown in Table 1[6]. It should be noted that in 1999 the Council of the European Union issued a recommendation[7] to limit exposure of the general public to electromagnetic fields 0Hz - 300GHz based on a set of basic restrictions and reference levels developed internationally under the advice of the International Commission on Non-Ionizing Radiation Protection. In relation to emissions within the radio spectrum, these limits are equivalent to the ICNIRP guideline limits used by ComReg.

[6] See page 21
[7] Recommendation of the European Council 1999/519/EC of July 12, 1999

ICNIRP limits

In 1998 ICNIRP published "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz)". ComReg and a large number of international regulators have adopted the 1998 ICNIRP document as the reference for ensuring that NIR levels do not cause an adverse health effect.

The main purpose of the "Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz)" is to provide guidelines for limiting Electromagnetic Field (EMF) exposure that will provide protection against known adverse health effects. An adverse health effect causes detectable impairment of the health of the exposed individual or his or her offspring.

Two classes of guidance are presented:

- Basic Restrictions
- Reference Levels

Basic Restrictions

Restrictions on exposure to time-varying electric, magnetic and electromagnetic fields that are based on health effects are termed "basic restrictions". Depending upon the frequency of the field, the physical quantities used to specify these restrictions are current density (J), Specific Absorption Rate (SAR), and power density (S). Of these, only power density can be readily measured. Measurement of power density is performed in air, outside the human body, rather than within the living tissue of exposed individuals.

Reference Levels

These levels are provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Some reference levels are derived from basic restrictions using measurement and/or computational techniques, and some address perception and adverse indirect effects of exposure to EMF.

Compliance with the reference levels will ensure compliance with the relevant basic restriction. If the measured or calculated value exceeds the reference level, it does not necessarily follow that the basic restriction will be exceeded. However, when a reference level is exceeded, it is necessary to test compliance with the relevant basic restriction and to determine whether additional protective measures are necessary.

The reference levels, taken from the ICNIRP Guidelines[8], appropriate to the frequency range 100 kHz to 40GHz, covered by this report are given in *Table 1* on the following page.

[8] International Commission on Non-Ionizing Radiation Protection, *"Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)"*, Health Physics, vol 74, no. 4, April 1998
Available on the Web at www.icnirp.de

Table 1: GUIDELINE LIMITS OF NIR FOR MEMBERS OF THE GENERAL PUBLIC

Frequency f (MHz)	Unperturbed RMS Electric Field Strength E (V/m)	Unperturbed RMS Magnetic Field Strength H (A/m)	Equivalent Plane Wave Power Density (mW/cm^2)	Radio Service
0.003 - 0.15	87	5	-	
0.15 - 1	87	0.73/f	-	LW and MW Radio Broadcasting
1 - 10	$87/f^{1/2}$	0.73/f	-	
10 - 400	28	0.073	0.2	VHF Radio and Television Broadcasting
400 - 2000	$1.375f^{1/2}$	$0.0037f^{1/2}$	f/2000	UHF Television Broadcasting and Mobile Telephony Systems
2000 - 300000	61	0.16	1	Microwave Links, and MMDS

Note: f denotes frequency in MHz

The guideline levels are lowest in the 10 MHz to 400 MHz frequency range as at these wavelengths resonance in parts or all of the body may occur resulting in optimum coupling of the radio frequency energy.

The ICNIRP guidelines require that in instances of simultaneous exposure to multiple sources, the sum of the exposure levels should be considered. In the case of the frequency range 30 MHz to 40 GHz, covered by the narrowband equipment used to generate this report, both the electric field strength and the magnetic field strength at each frequency should be expressed as a fraction of the limit at that frequency and both the sum of the

electric field strength fractions squared and the sum of the magnetic field strength fractions squared should not exceed unity.

Annex 2

Methodology and measurements

Introduction

Measurements of the non-ionising radiation emissions from each site were conducted in accordance with ECC Recommendation (02) 04. For the purposes of this programme, measurements were carried out at Cellular (Third Generation and GSM Mobile Telephony sites), as well as at Mixed Use sites.

Cellular sites

Cellular sites are sites and locations in Ireland at which electronic communications network transmission facilities and/or infrastructure are located, the primary purpose or sole use of such facilities/infrastructure being to facilitate the provision of mobile telephony services in Ireland. Measurements at these sites were conducted in both the GSM900 and GSM1800 bands as well as the 2110-2200 MHz band currently in use for Third Generation Mobile Telephony.

Mixed use sites

Mixed use sites are sites and locations in Ireland at which electronic communications network transmission facilities and/or infrastructure are located and where such facilities and or infrastructure is not primarily or solely used to facilitate the provision of mobile telephone services in Ireland. The measurements conducted at these sites included all radio services which are present at these sites. These services include, GSM, 3G Mobile, Broadcasting, fixed links, MMDS, FWA. Point to Point links, among others.

Methodology

An initial survey of the area was conducted to determine the location(s) of highest non-ionising radiation emissions. This was done by using a broadband probe attached to a field strength meter to identify the position of maximum field strength. The probe used for this initial investigation measured and summed the contributions of all signals in the frequency range 100 kHz to 3 GHz.

Once the locations of the highest field strength emissions were identified the field strength meter and broadband probe were mounted on a non-conductive tripod and the field strength in Volts per meter was recorded on a laptop computer for a period exceeding six minutes.

The field strength meter was then fitted with a 300 kHz to 40 GHz probe and measurements were recorded at the same location for a further 6 minutes. This probe measured the field strength as a percentage of the permitted exposure allowed by ICNIRP occupational guideline limits. The results were multiplied by a factor of 5 to get the percentage exposure allowed by the ICNIRP general public guideline limits.

A narrowband survey was then carried out at the same location using a spectrum analyser and a range of antennas matched to the frequencies being measured. The spectrum analyser was set to sweep a frequency range continuously for a period of six minutes and the results were stored in the spectrum analyser.

This procedure was repeated at different frequency ranges until the electromagnetic fields at all relevant frequencies were recorded. The results were later transferred to a computer for analysis and comparison to the ICNIRP general public guideline levels.