Commission for
Communications Regulation

Report

2009 Programme of Measurement of Non-Ionising Radiation Emissions

Third Interim Report

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1. Executive Summary

The Commission for Communications Regulation (ComReg) currently arranges for Non-Ionising Radiation (NIR) surveys to be conducted near a sample number of licensed transmitter sites nationwide. Each survey involves measurement of NIR emission levels at the point of highest emissions (in a public area) associated with the transmitter. Sites are surveyed in order to assess compliance on the part of transmitter operators with their licence conditions relating to NIR emissions.

This report forms part of an ongoing series of interim reports which outline ComReg's programme of measurements, and presents the results of the third set of site surveys (15 sites) undertaken during the 2009 programme.

The site surveys were conducted during September 2009 by engineers of Vilicom Engineering Ltd which was contracted by ComReg to assist it with the programme.

On the basis of this work, ComReg has concluded that the NIR emissions measured from all of the 15 sites were below the relevant ICNIRP guideline limits for general public exposure[1]. The results of the measurements taken at all the sites are presented in this report.

[1] See Annex 2

2. 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 which make use of the radio spectrum include a wide range of services such as radio and television broadcasting, mobile telephony and other telecommunications services such as internet connection.

It is a condition of various licences[2] issued by ComReg that licensees must ensure that non-ionising radiation[3] (NIR) emissions from each transmitter operated under the licence must be within the limits set down in the guidelines published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP)[4]. Levels of NIR emissions from a licensed transmitter must not exceed the ICNIRP limits in any part of the site or surrounding area to which the general public has access.

In order to assess compliance on the part of transmitter operators with their licence conditions relating to NIR, ComReg currently arranges for NIR surveys to be conducted near a sample number of licensed transmitter sites nationwide. Each survey involves measurement of NIR emission levels at the point of highest emissions (in a public area) associated with the transmitter.

This report presents the results of measurements taken at the third set of 15 sites chosen as part of the 2009 Programme of Measurement of Non-Ionising Radiation emissions. The site surveys were conducted during September 2009 by engineers of Vilicom Engineering Ltd which was contracted by ComReg to assist it with the programme.

[2] Issued pursuant to the Wireless Telegraphy Act, 1926 (No. 45 of 1926) e.g. for services such as GSM & UMTS Mobile Telephony, Radio & TV Broadcasting, MMDS, Wireless Broadband etc.

[3] Non-ionising radiation is that part of the electromagnetic spectrum below 3 x 10^{15} Hz (3000 million MHz). Radio waves, infrared radiation and visible light are examples of NIR. (see Annex 1)

[4] See Annexes 1& 2 for further details.

Abbreviated versions of the individual site survey reports are available on the ComReg website[5] as well as on Siteviewer[6], an on-line facility provided by ComReg, which allows the public to view details of GSM and 3G mobile telephony base stations throughout Ireland. Copies of the full site reports are available on request.

[5] www.comreg.ie
[6] www.siteviewer.ie

3. Measurement Results

3.1 Explanatory Note

At the point of highest emissions[7] associated with each site, the engineers measured the electric field strength (or electric field voltage)[8] of emissions in the relevant radio frequency bands.

The tables which follow in the next sub-section present the levels measured at each site. The sites are listed in order by county.

The tables show the measured levels alongside the relevant ICNIRP limits for general public exposure. They include levels measured in respect of emissions from the transmitter site, along with the levels for emissions from nearby sites, if particularly high at the location.

The tables present the measurements for each site under the following headings:

1. Signal Type
2. Frequency
3. Measured Level V/m
4. Adjusted Level V/m
5. ICNIRP guideline limit
6. Total Exposure Quotient

A brief explanation of each of the headings follows:-

[7] See Annex 3 for an outline of the site survey methodology.

[8] See Annex 4 for an outline of how electromagnetic fields are measured.

Signal Type

The type of signal to which an emission on a particular frequency relates e.g. **GSM** (2nd generation mobile phone system), **UMTS** (3rd generation mobile phone system), **FM Radio**, **TV PAL** (analogue television), **FWALA** (wireless broadband) etc.

Frequency (MHz)

Various radio services are transmitted in predefined frequency ranges. For example 3G (or UMTS) mobile telephony base stations transmit signals on a frequency somewhere in the range 2110 – 2170 MHz. At each site transmitting a 3G signal, measurements were taken in that frequency range and the results of those measurements are presented in the tables. Other services such as GSM 900, GSM 1800, TETRA, Television etc. are presented in similar manner in the tables, if applicable. The frequencies of emissions associated with some services (e.g. emergency services) are not shown in the interests of confidentiality and security.

Measured Level V/m

The tables show the electric field strength levels measured for each emission (signal) type from the designated site, along with the levels for emissions from nearby sites, if particularly high. In many instances more than one measured level is shown for each emission type. This is due to the fact that different mobile operators often transmit signals from the same site on different frequency channels.

Adjusted Level V/m

For some emission types an adjusted level has been calculated from the measured level for any or all of the following reasons:

- to compensate for the limited measurement resolution of the spectrum analyser[9]. For example, a measurement of a digital television signal performed with at a resolution of 5 MHz needs to be adjusted upwards

[9] Spectrum analysers are used to measure individual emissions at specific frequencies (see Annex 4).

using a correction factor in order to account for the energy present within the full 7.6 MHz bandwidth of the signal.

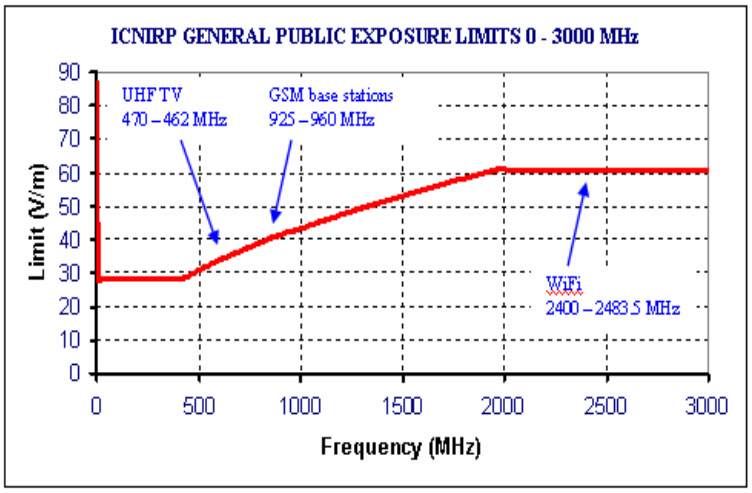
- to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day. The levels measured for the always-on pilot channels of the base stations can be used to extrapolate to a level which would be expected if all voice and data channels were in operation.

- to account for the characteristics of certain complex signal types (e.g. analogue PAL TV).

For further details concerning the calculation of Adjusted Levels, please refer to Annex 5.

ICNIRP guideline limit

For each site the table shows the measured and adjusted electric field strength levels in Volts per metre (V/m) alongside the relevant ICNIRP general public guideline limits. It should be noted that the ICNIRP guideline limits vary according to frequency as illustrated:



For example, for a GSM mobile signal on a frequency of 940.050 MHz, the relevant limit is 42.158 V/m, while for a 3G mobile signal on a frequency of 2147.2 MHz the relevant limit is 61 V/m. Thus the limits for the different measurements presented in the tables will vary as the measurements have been performed at different frequencies.

For further details concerning the ICNIRP Limits, please refer to Annex 2.

Total Exposure Quotient

For each site, Total Exposure Quotients are calculated, in accordance with mathematical formulas specified in the ICNIRP Guidelines in order assess the cumulative effect of emissions from multiple transmitters. The quotients in this report are calculated from the Adjusted Levels rather than from the Measured Levels, in order to account for total potential public exposure under maximum traffic conditions.

In order to satisfy the criteria of the ICNIRP Guidelines, the Quotients must be less than or equal to 1.

The two quotients are as follows:

Quotient for Electrical Stimulation Effects (1 Hz to 10 MHz)

This quotient is calculated only in a small number of cases where strong emissions in the frequency range between 1 Hz and 10 MHz are present at the survey location (e.g. near a long wave radio transmitter site).

Quotient for Thermal Effects (100 kHz and above)

The measurements of any emissions above 100 kHz are used to calculate a Quotient to assess any thermal (heat) effects.

Please refer to Annex 2 for further information concerning the calculation of the Quotients.

3.2 Measurement Results by Site

3.2.1 Dublin: Blackrock - Main Street

Table of Frequency Selective Measurement Results					
Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
PMR	72.261	0.009772	0.009772	28.0	2865
PMR	71.377	0.009016	0.009016	28.0	3106
PMR	71.604	0.006546	0.006546	28.0	4277
PMR	78.439	0.008366	0.008366	28.0	3347
PMR	77.865	0.007745	0.007745	28.0	3615
FM Radio	90.643	0.009099	0.009099	28.0	3077
FM Radio	92.898	0.008017	0.008017	28.0	3493
PMR	156.972	0.003416	0.003416	28.0	8197
T-DAB	227.653	0.006753	0.007980	28.0	3509
T-DAB	223.706	0.006471	0.007647	28.0	3661
TETRA	390.833	0.002480	0.004296	28.0	6518
PMR	456.276	0.000669	0.000669	29.4	43895
TV PAL	530.760	0.010375	0.013148	31.7	2409
TV PAL	613.080	0.007456	0.009449	34.0	3603
TV PAL	769.880	0.008385	0.010626	38.2	3590
GSM	955.450	7.906786	15.813573	42.5	3
GSM	956.850	4.159106	8.318212	42.5	5
GSM	957.433	3.815048	7.630096	42.5	6
GSM	958.600	0.981748	1.963496	42.6	22
GSM	939.350	0.122885	0.245771	42.1	171
GSM	948.683	0.085803	0.171605	42.4	247
GSM	1854.250	0.190766	0.381531	59.2	155
GSM	1838.500	0.177011	0.354022	59.0	167
GSM	1857.000	0.017885	0.035771	59.3	1656
UMTS TDD	1911.000	0.209894	0.767300	60.1	78
UMTS FDD	2148.767	0.026242	0.169701	61.0	359
UMTS FDD	2113.533	0.016088	0.104036	61.0	586
UMTS FDD	2126.133	0.007682	0.049680	61.0	1228
UMTS FDD	2168.367	0.006800	0.043973	61.0	1387
UMTS FDD	2131.733	0.005781	0.037384	61.0	1632
WiFi	2433.957	0.006339	0.024594	61.0	2480
WiFi	2454.275	0.001122	0.006252	61.0	9757
FWALA	3544.667	0.004290	0.010823	61.0	5636
FWALA	3765.200	0.022882	0.057724	61.0	1057
FWALA	3759.800	0.001122	0.031071	61.0	1963
FWALA	3745.700	0.001122	0.026264	61.0	2323
FWALA	3750.500	0.001122	0.022328	61.0	2732
WiFi	5676.550	0.001950	0.007565	61.0	8063

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.211279	1

3.2.2 Dublin: Naas Road - Green Isle Hotel

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.505	0.004130	0.004130	28.0	6779
TV PAL	183.440	0.036308	0.046011	28.0	609
TV PAL	207.600	0.029410	0.037270	28.0	751
TETRA	394.267	0.016014	0.027737	28.0	1009
TETRA	394.017	0.015276	0.026458	28.0	1058
TETRA	393.767	0.013900	0.024075	28.0	1163
TETRA	390.400	0.011574	0.020048	28.0	1397
TETRA	392.383	0.011561	0.020024	28.0	1398
TETRA	391.133	0.011130	0.019278	28.0	1452
PMR	456.410	0.000816	0.000816	29.4	36015
PMR	468.526	0.000792	0.000792	29.8	37598
TV PAL	775.107	0.005735	0.007267	38.3	5268
TV DVB-T	741.133	0.002265	0.005957	37.4	6284
TV DVB-T	791.440	0.001871	0.004920	38.7	7862
GSM	941.217	0.053272	0.106544	42.2	396
GSM	953.466	0.052060	0.104119	42.5	408
GSM	948.100	0.017701	0.035402	42.3	1196
GSM	1845.000	0.174783	0.349567	59.1	169
GSM	1835.500	0.125893	0.251785	58.9	234
GSM	1843.500	0.094733	0.189465	59.0	312
GSM	1857.250	0.028543	0.057086	59.3	1038
UMTS FDD	2127.767	0.471520	3.049198	61.0	20
UMTS FDD	2131.267	0.430527	2.784105	61.0	22
UMTS FDD	2147.133	0.121199	0.783765	61.0	78
UMTS FDD	2166.967	0.096828	0.626160	61.0	97
UMTS FDD	2113.767	0.039719	0.256854	61.0	237
UMTS FDD	2116.800	0.006524	0.042188	61.0	1446
FWALA	3570.000	0.079799	0.201304	61.0	303
FWALA	3549.333	0.001122	0.133460	61.0	457
FWALA	3564.333	0.001122	0.022277	61.0	2738
WiFi	5639.150	0.001093	0.004240	61.0	14388

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.004973	1

3.2.3 Dublin 3: Clontarf Road

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.528	0.004451	0.004451	28.0	6290
FM Radio	102.192	0.011066	0.011066	28.0	2530
FM Radio	88.457	0.010162	0.010162	28.0	2755
PMR	156.159	0.002323	0.002323	28.0	12055
TV PAL	183.280	0.069502	0.088077	28.0	318
TV PAL	207.600	0.061873	0.078409	28.0	357
T-DAB	227.093	0.022803	0.026946	28.0	1039
T-DAB	224.187	0.022413	0.026485	28.0	1057
TETRA	390.933	0.036898	0.063909	28.0	438
TETRA	391.333	0.026730	0.046298	28.0	605
TETRA	391.733	0.013198	0.022859	28.0	1225
TETRA	393.117	0.008730	0.015120	28.0	1852
PMR	456.410	0.003958	0.003958	29.4	7421
PMR	456.521	0.002143	0.002143	29.4	13710
PMR	459.425	0.001272	0.001272	29.5	23169
PMR	466.722	0.000931	0.000931	29.7	31903
TV PAL	567.347	0.111045	0.140723	32.8	233
TV PAL	535.333	0.100462	0.127311	31.8	250
TV PAL	583.680	0.088410	0.112038	33.2	297
TV PAL	799.933	0.259717	0.329128	38.9	118
TV PAL	775.760	0.171002	0.216703	38.3	177
TV PAL	743.747	0.136773	0.173326	37.5	216
TV DVB-T	741.133	0.059841	0.157397	37.4	238
TV DVB-T	790.787	0.048362	0.127203	38.7	304
GSM	955.683	0.721107	1.442215	42.5	29
GSM	946.000	0.373250	0.746500	42.3	57
GSM	946.817	0.085212	0.170424	42.3	248
GSM	953.933	0.086298	0.172596	42.5	246
GSM	1855.750	0.591562	1.183123	59.2	50
GSM	1844.750	0.297852	0.595703	59.1	99
GSM	1867.500	0.136301	0.272603	59.4	218
GSM	1837.750	0.128973	0.257947	58.9	229
GSM	1865.250	0.103276	0.206552	59.4	288
GSM	1863.000	0.093648	0.187297	59.3	317
UMTS FDD	2133.600	0.522396	3.378202	61.0	18
UMTS FDD	2128.000	0.496021	3.207640	61.0	19
UMTS FDD	2113.300	0.408790	2.643539	61.0	23
UMTS FDD	2116.333	0.396735	2.565580	61.0	24

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Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
UMTS FDD	2147.600	0.114025	0.737370	61.0	83
UMTS FDD	2166.733	0.075509	0.488299	61.0	125
FWALA	3558.000	0.004592	0.011584	61.0	5266
FWALA	3564.333	0.001122	0.006207	61.0	9828
FWALA	3572.333	0.001122	0.004445	61.0	13724
FWALA	3530.000	0.001122	0.003584	61.0	17021

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.011976	1

3.2.4 Dublin 8: Kilmainham Garda Station

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.505	0.004320	0.004320	28.0	6481
FM Radio	92.898	0.013552	0.013552	28.0	2066
FM Radio	96.725	0.011015	0.011015	28.0	2542
PMR	153.183	0.005855	0.005855	28.0	4783
PMR	156.325	0.002716	0.002716	28.0	10308
TV PAL	183.120	0.033612	0.042596	28.0	657
TV PAL	207.600	0.022156	0.028078	28.0	997
T-DAB	227.787	0.007079	0.008366	28.0	3347
T-DAB	223.573	0.006769	0.007998	28.0	3501
TETRA	393.033	0.362660	0.628146	28.0	45
TETRA	393.650	0.358922	0.621671	28.0	45
TETRA	392.417	0.335351	0.580845	28.0	48
PMR	450.223	0.005521	0.005521	29.2	5285
PMR	451.675	0.005508	0.005508	29.2	5305
PMR	453.417	0.004097	0.004097	29.3	7146
PMR	452.099	0.003420	0.003420	29.2	8549
PMR	454.534	0.001337	0.001337	29.3	21932
PMR	456.343	0.001237	0.001237	29.4	23738
PMR	460.608	0.005702	0.005702	29.5	5176
TV PAL	567.347	0.015722	0.019923	32.8	1644
TV PAL	535.333	0.014825	0.018787	31.8	1693
TV PAL	583.680	0.011844	0.015009	33.2	2213
TV PAL	743.747	0.011858	0.015027	37.5	2495
TV PAL	775.107	0.009616	0.012186	38.3	3141
TV PAL	799.933	0.007861	0.009962	38.9	3904
TV DVB-T	797.320	0.007595	0.019975	38.8	1944
TV DVB-T	740.480	0.006871	0.018072	37.4	2070
GSM	953.000	0.963829	1.927658	42.4	22
GSM	955.100	0.161622	0.323244	42.5	131
GSM	944.833	0.086996	0.173992	42.3	243
GSM	937.950	0.082699	0.165398	42.1	255
GSM	1856.250	0.327341	0.654681	59.2	90
GSM	1857.500	0.122603	0.245205	59.3	242
GSM	1855.250	0.084625	0.169251	59.2	350
GSM	1862.250	0.060117	0.120235	59.3	494
GSM	1831.250	0.023878	0.047756	58.8	1232
GSM	1864.750	0.021062	0.042124	59.4	1410

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Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
UMTS FDD	2113.767	0.230409	1.489998	61.0	41
UMTS FDD	2117.733	0.230409	1.489998	61.0	41
UMTS FDD	2148.767	0.152933	0.988976	61.0	62
UMTS FDD	2166.267	0.032211	0.208298	61.0	293
UMTS FDD	2127.533	0.005774	0.037341	61.0	1634
WiFi	2463.180	0.006427	0.024936	61.0	2446
FWALA	3549.333	0.001056	0.002663	61.0	22907

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.005206	1

3.2.5 Dublin 9: Whitehall - Collins Ave. West

Table of Frequency Selective Measurement Results					
Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
PMR	74.528	0.004797	0.004797	28.0	5837
FM Radio	104.447	0.007980	0.007980	28.0	3509
FM Radio	100.961	0.007568	0.007568	28.0	3700
TV PAL	207.440	0.027542	0.034903	28.0	802
TV PAL	182.960	0.025439	0.032238	28.0	869
T-DAB	223.600	0.017519	0.020701	28.0	1353
T-DAB	227.493	0.013868	0.016387	28.0	1709
TETRA	391.383	0.007439	0.012884	28.0	2173
TETRA	393.217	0.003771	0.006532	28.0	4286
TV PAL	583.027	0.010952	0.013879	33.2	2392
TV PAL	567.347	0.007745	0.009814	32.8	3337
TV PAL	799.933	0.018707	0.023706	38.9	1640
TV PAL	775.106	0.013032	0.016514	38.3	2318
TV PAL	743.093	0.009863	0.012499	37.5	2999
TV DVB-T	790.787	0.008720	0.022935	38.7	1686
TV DVB-T	735.253	0.006958	0.018302	37.3	2037
GSM	952.650	1.547035	3.094069	42.4	14
GSM	955.917	0.628058	1.256117	42.5	34
GSM	951.833	0.374973	0.749946	42.4	57
GSM	949.267	0.032397	0.064793	42.4	654
GSM	940.867	0.025823	0.051645	42.2	817
GSM	1854.500	0.959401	1.918801	59.2	31
GSM	1867.500	0.314775	0.629550	59.4	94
GSM	1833.500	0.202768	0.405537	58.9	145
GSM	1832.000	0.102683	0.205367	58.9	287
GSM	1857.000	0.076384	0.152767	59.3	388
UMTS FDD	2167.667	0.087197	0.563879	61.0	108
UMTS FDD	2118.667	0.067220	0.434696	61.0	140
UMTS FDD	2114.000	0.055399	0.358250	61.0	170
UMTS FDD	2146.900	0.049831	0.322245	61.0	189
UMTS FDD	2133.833	0.045342	0.293215	61.0	208
UMTS FDD	2127.067	0.032584	0.210710	61.0	289
FWALA	3547.667	0.091939	0.231928	61.0	263
FWALA	3566.333	0.001122	0.096906	61.0	629
FWALA	3543.333	0.001122	0.032274	61.0	1890
FWALA	3760.100	0.049261	0.175739	61.0	347
FWALA	3773.000	0.001122	0.105528	61.0	578
FWALA	3738.800	0.001122	0.018508	61.0	3296

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Table of Frequency Selective Measurement Results

Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
FWALA	3721.700	0.001122	0.007850	61.0	7771
WiFi	5675.700	0.001654	0.006417	61.0	9506

Total Exposure Quotients [calculated from Adjusted Levels]

Quotient	Frequency Range	Calculated Quotient Value	Limit
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.008001	1

3.2.6 Dublin 14: Goatstown Cross

Table of Frequency Selective Measurement Results					
Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
PMR	74.505	0.004634	0.004634	28.0	6042
FM Radio	104.447	0.030726	0.030726	28.0	911
FM Radio	103.832	0.022131	0.022131	28.0	1265
FM Radio	102.260	0.021232	0.021232	28.0	1319
FM Radio	106.018	0.019815	0.019815	28.0	1413
T-DAB	227.627	0.057544	0.067998	28.0	412
T-DAB	223.893	0.045973	0.054325	28.0	515
TETRA	393.017	0.012218	0.021162	28.0	1323
TETRA	392.583	0.011169	0.019345	28.0	1447
TETRA	391.267	0.003686	0.006384	28.0	4386
TETRA	399.867	0.006295	0.008903	28.0	3145
PMR	541.385	0.002185	0.002185	32.0	14640
PMR	452.055	0.001229	0.001229	29.2	23790
PMR	453.015	0.000688	0.000688	29.3	42546
PMR	457.057	0.001007	0.001007	29.4	29194
TV PAL	567.347	0.032322	0.040960	32.8	800
TV PAL	583.680	0.021478	0.027219	33.2	1220
TV PAL	535.333	0.021111	0.026752	31.8	1189
TV PAL	743.093	0.006310	0.007996	37.5	4688
TV DVB-T	735.253	0.004212	0.011079	37.3	3365
TV DVB-T	792.747	0.002559	0.006730	38.7	5753
GSM	953.700	0.012560	0.025121	42.5	1690
GSM	951.017	0.011995	0.023990	42.4	1768
GSM	946.233	0.011259	0.022518	42.3	1878
GSM	938.417	0.010877	0.021754	42.1	1936
GSM	1861.250	3.634963	7.269926	59.3	8
GSM	1835.750	0.904690	1.809381	58.9	33
GSM	1832.500	0.782528	1.565056	58.9	38
GSM	1862.750	0.457615	0.915229	59.3	65
GSM	1843.000	0.221309	0.442619	59.0	133
UMTS	2147.367	0.261216	1.689218	61.0	36
UMTS	2111.433	0.069103	0.446875	61.0	137
WiFi	2448.430	0.027071	0.105035	61.0	581
FWALA	3542.333	0.001122	0.002830	61.0	21551
FWALA	3566.333	0.001122	0.002451	61.0	24887
FWALA	3555.000	0.001122	0.002228	61.0	27383
FWALA	3528.333	0.001122	0.001916	61.0	31840
FWALA	3722.300	0.005902	0.014889	61.0	4097

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Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
FWALA	3736.400	0.001122	0.010265	61.0	5942
WiFi	5558.400	0.001416	0.005493	61.0	11104
FWA (Lic-exempt)	5870.000	0.001006	0.002537	61.0	24042
FWA (Lic-exempt)	5845.000	0.001122	0.002491	61.0	24489

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.017805	1

3.2.7 Dublin 20: Chapelizod - West County Hotel

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.483	0.003949	0.003949	28.0	7090
TV PAL	183.280	0.025293	0.032053	28.0	874
TV PAL	207.280	0.022336	0.028305	28.0	989
TETRA	392.317	0.005649	0.009785	28.0	2862
TETRA	390.983	0.004949	0.008572	28.0	3267
TETRA	391.950	0.003424	0.005930	28.0	4722
PMR	452.100	0.000612	0.000612	29.2	47799
TV PAL	535.333	0.014077	0.017839	31.8	1783
TV PAL	567.347	0.011143	0.014121	32.8	2319
TV PAL	583.680	0.009131	0.011571	33.2	2871
TV PAL	743.093	0.016199	0.020529	37.5	1826
TV PAL	775.107	0.007482	0.009481	38.3	4038
TV PAL	799.280	0.006138	0.007778	38.9	4998
TV DVB-T	740.480	0.009750	0.025645	37.4	1459
TV DVB-T	791.440	0.005023	0.013213	38.7	2928
GSM	954.983	0.012431	0.024862	42.5	1709
GSM	941.100	0.008063	0.016126	42.2	2616
GSM	951.950	0.005882	0.011763	42.4	3606
GSM	1836.250	0.012868	0.025735	58.9	2289
GSM	1840.250	0.011169	0.022337	59.0	2641
GSM	1841.750	0.010435	0.020870	59.0	2827
UMTS FDD	2118.667	0.061731	0.399196	61.0	153
UMTS FDD	2114.233	0.051227	0.331273	61.0	184
FWALA	3542.667	0.000774	0.001954	61.0	31223

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.000078	1

3.2.8 Dublin 24: Tallaght Garda Station

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.528	0.004335	0.004335	28.0	6459
PMR	86.926	0.006769	0.006769	28.0	4137
FM Radio	93.513	0.042121	0.042121	28.0	665
FM Radio	89.072	0.032999	0.032999	28.0	849
FM Radio	91.258	0.028907	0.028907	28.0	969
FM Radio	100.893	0.023254	0.023254	28.0	1204
FM Radio	98.707	0.021257	0.021257	28.0	1317
FM Radio	92.898	0.017358	0.017358	28.0	1613
TV PAL	183.440	0.039765	0.050392	28.0	556
TV PAL	207.760	0.024462	0.031000	28.0	903
T-DAB	227.653	0.009572	0.011311	28.0	2475
T-DAB	224.400	0.007745	0.009152	28.0	3060
TETRA	390.200	0.217520	0.376756	28.0	74
TETRA	390.450	0.197015	0.341241	28.0	82
TETRA	394.583	0.155776	0.269812	28.0	104
TETRA	390.800	0.118713	0.205618	28.0	136
PMR	451.988	0.075509	0.075509	29.2	387
PMR	456.700	0.001877	0.001877	29.4	15654
PMR	453.015	0.001712	0.001712	29.3	17095
PMR	458.755	0.025852	0.025852	29.5	1139
PMR	459.514	0.005218	0.005218	29.5	5649
PMR	457.169	0.000999	0.000999	29.4	29433
PMR	457.370	0.000905	0.000905	29.4	32504
PMR	465.996	0.034995	0.034995	29.7	848
PMR	463.818	0.008110	0.008110	29.6	3652
PMR	464.874	0.005433	0.005433	29.6	5457
PMR	466.964	0.000773	0.000773	29.7	38454
TV PAL	567.347	0.041543	0.052646	32.8	622
TV PAL	583.680	0.025793	0.032686	33.2	1016
TV PAL	535.333	0.014538	0.018423	31.8	1727
TV PAL	743.747	0.032322	0.040960	37.5	915
TV PAL	775.760	0.012868	0.016307	38.3	2349
TV DVB-T	739.827	0.014997	0.039445	37.4	948
TV DVB-T	796.667	0.010691	0.028119	38.8	1380

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Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
GSM	952.533	0.126911	0.253822	42.4	167
GSM	953.467	0.103276	0.206552	42.5	206
GSM	946.467	0.068549	0.137098	42.3	309
GSM	950.200	0.061589	0.123177	42.4	344
GSM	955.333	0.030549	0.061098	42.5	696
GSM	938.067	0.023578	0.047155	42.1	893
GSM	1857.000	0.941890	1.883779	59.3	31
GSM	1854.750	0.265461	0.530921	59.2	112
GSM	1831.250	0.081470	0.162941	58.8	361
GSM	1835.500	0.079983	0.159967	58.9	368
GSM	1834.000	0.050408	0.100816	58.9	584
GSM	1865.250	0.021528	0.043056	59.4	1379
UMTS FDD	2118.667	0.122039	0.789197	61.0	77
UMTS FDD	2146.200	0.113501	0.733982	61.0	83
UMTS FDD	2113.533	0.110790	0.716450	61.0	85
UMTS FDD	2166.733	0.025003	0.161691	61.0	377
WiFi	2410.855	0.018945	0.073508	61.0	830
FWALA	3549.333	0.004457	0.011242	61.0	5426
FWALA	3560.333	0.001122	0.002081	61.0	29307
FWALA	3542.667	0.001122	0.002039	61.0	29921
FWALA	3713.900	0.001263	0.003187	61.0	19142
FWALA	3711.800	0.001122	0.001881	61.0	32432
FWA (Lic-exempt)	5778.000	0.028543	0.072003	61.0	847
FWA (Lic-exempt)	5774.500	0.001122	0.006114	61.0	9976
FWA (Lic-exempt)	5834.000	0.001122	0.003179	61.0	19186

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.002155	1

3.2.9 Kildare: Naas Town Hall

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	77.496	0.008640	0.008640	28.0	3241
PMR	86.045	0.019566	0.019566	28.0	1431
FM Radio	93.513	0.008650	0.008650	28.0	3237
PMR VHF Mid	141.024	0.002143	0.002143	28.0	13066
TV PAL	183.440	0.024406	0.030929	28.0	905
TETRA	393.833	0.011259	0.019501	28.0	1436
TETRA	392.617	0.008433	0.014607	28.0	1917
TETRA	391.783	0.005702	0.009876	28.0	2835
TV PAL	799.280	0.010035	0.012716	38.9	3057
TV DVB-T	790.787	0.001352	0.003556	38.7	10873
GSM	939.467	3.622430	7.244860	42.1	6
GSM	953.583	1.289734	2.579467	42.5	16
GSM	948.800	0.074388	0.148775	42.4	285
GSM	1854.750	1.028016	2.056033	59.2	29
GSM	1831.750	0.053027	0.106055	58.8	555
GSM	1863.250	0.037584	0.075167	59.4	790
GSM	1879.000	0.022568	0.045137	59.6	1320
UMTS FDD	2128.933	0.191205	1.236476	61.0	49
UMTS FDD	2132.900	0.183443	1.186276	61.0	51
UMTS FDD	2168.133	0.011272	0.072893	61.0	837
UMTS FDD	2147.833	0.010839	0.070095	61.0	870
UMTS FDD	2111.433	0.008570	0.055422	61.0	1101
UMTS FDD	2119.133	0.008260	0.053418	61.0	1142
FWALA	3542.667	0.000716	0.001807	61.0	33766
FWALA	3555.967	0.001122	0.001696	61.0	35973
FWALA	3733.400	0.020941	0.074708	61.0	817
FWALA	3747.800	0.001122	0.059892	61.0	1019
FWALA	3762.200	0.001122	0.018939	61.0	3221
FWALA	3786.200	0.001122	0.013239	61.0	4607
FWA (Lic-exempt)	5831.000	0.001521	0.003836	61.0	15903

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.035264	1

3.2.10 Kildare: Newbridge - Courtyard Shopping Centre

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	68.544	0.008294	0.008294	28.0	3376
PMR	69.111	0.007754	0.007754	28.0	3611
PMR	68.091	0.006645	0.006645	28.0	4214
PMR	70.357	0.006471	0.006471	28.0	4327
FM Radio	98.707	0.010902	0.010902	28.0	2568
FM Radio	100.893	0.010728	0.010728	28.0	2610
TETRA	392.467	0.139476	0.241580	28.0	116
TETRA	392.117	0.120642	0.208959	28.0	134
TETRA	394.517	0.011363	0.019682	28.0	1423
PMR	456.209	0.005604	0.005604	29.4	5241
PMR	454.087	0.001401	0.001401	29.3	20911
TV PAL	775.760	0.007186	0.009107	38.3	4205
TV PAL	799.280	0.007088	0.008982	38.9	4328
TV DVB-T	796.013	0.001510	0.003972	38.8	9767
GSM	953.000	3.341950	6.683901	42.4	6
GSM	955.450	0.662217	1.324433	42.5	32
GSM	946.350	0.170805	0.341610	42.3	124
GSM	950.667	0.140929	0.281858	42.4	150
GSM	948.450	0.091728	0.183455	42.3	231
GSM	938.533	0.032621	0.065242	42.1	646
GSM	1857.750	0.978363	1.956726	59.3	30
GSM	1855.250	0.097724	0.195447	59.2	303
GSM	1837.500	0.060954	0.121907	58.9	483
GSM	1862.750	0.036099	0.072199	59.3	822
GSM	1844.500	0.039446	0.078891	59.1	749
GSM	1865.250	0.025351	0.050703	59.4	1171
UMTS TDD	1906.267	0.005754	0.021036	60.0	2854
UMTS FDD	2168.133	0.381066	2.464255	61.0	25
UMTS FDD	2148.300	0.008185	0.052928	61.0	1153
UMTS FDD	2128.467	0.007771	0.050256	61.0	1214
UMTS FDD	2132.667	0.006584	0.042578	61.0	1433
UMTS FDD	2118.433	0.005675	0.036702	61.0	1662
UMTS FDD	2113.067	0.004864	0.031455	61.0	1939

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Emission Type	Frequency	Measured Level (V/m)	Adjusted Level (V/m)	ICNIRP Limit (V/m)	Times below Limit [adjusted Values]
FWALA	3555.333	0.036224	0.091380	61.0	668
FWALA	3542.667	0.001122	0.091065	61.0	670
FWALA	3581.000	0.001122	0.009170	61.0	6652
FWALA	3763.700	0.203939	0.972240	61.0	63
FWALA	3715.700	0.001122	0.020910	61.0	2917
WiFi	5676.550	0.020207	0.078403	61.0	778
WiFi	5554.150	0.001122	0.055761	61.0	1094
WiFi	5597.500	0.001122	0.015429	61.0	3954
FWA (Lic-exempt)	5730.000	0.078705	0.198542	61.0	307
FWA (Lic-exempt)	5750.000	0.001122	0.077242	61.0	790
FWA (Lic-exempt)	5770.000	0.001122	0.037441	61.0	1629
FWA (Lic-exempt)	5835.000	0.001122	0.025284	61.0	2413

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.029046	1

3.2.11 Kilkenny: Goresbridge, Co. Kilkenny

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.528	0.004597	0.004597	28.0	6091
FM Radio	91.805	0.023686	0.023686	28.0	1182
FM Radio	93.992	0.021652	0.021652	28.0	1293
FM Radio	101.440	0.021208	0.021208	28.0	1320
FM Radio	99.185	0.021208	0.021208	28.0	1320
FM Radio	89.618	0.015488	0.015488	28.0	1808
PMR	153.845	0.002138	0.002138	28.0	13097
TV PAL	191.600	0.053333	0.067587	28.0	414
TV PAL	215.600	0.039948	0.050625	28.0	553
TETRA	391.000	0.002773	0.004804	28.0	5829
TETRA	393.533	0.002205	0.003820	28.0	7330
TV PAL	487.100	0.024350	0.030858	30.3	983
TV PAL	511.167	0.022233	0.028175	31.1	1103
TV DVB-T	667.407	0.007780	0.020464	35.5	1736
GSM	954.633	0.272584	0.545168	42.5	78
GSM	946.350	0.038815	0.077630	42.3	545
GSM	950.550	0.030130	0.060260	42.4	703

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.000184	1

3.2.12 Louth: Termonfeckin

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.505	0.003776	0.003776	28.0	7416
TV PAL	751.587	0.004710	0.005968	37.7	6316
GSM	947.050	1.508343	3.016685	42.3	14
GSM	951.483	0.017080	0.034161	42.4	1242
GSM	940.167	0.005105	0.010210	42.2	4129

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.005083	1

3.2.13 Meath: Bettystown

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.505	0.004325	0.004325	28.0	6474
PMR	79.505	0.004462	0.004462	28.0	6276
TETRA	392.933	0.028807	0.049895	28.0	561
TETRA	392.433	0.013474	0.023338	28.0	1200
TETRA	393.383	0.002061	0.003569	28.0	7845
PMR	456.454	0.001708	0.001708	29.4	17199
PMR	456.209	0.001459	0.001459	29.4	20132
TV PAL	831.947	0.015435	0.019560	39.7	2028
TV PAL	719.573	0.011790	0.014940	36.9	2469
TV PAL	751.587	0.011066	0.014024	37.7	2688
TV PAL	847.627	0.009528	0.012074	40.0	3315
GSM	938.417	1.377209	2.754419	42.1	15
GSM	939.350	0.539511	1.079021	42.1	39
GSM	947.867	0.501187	1.002374	42.3	42
GSM	941.100	0.449262	0.898525	42.2	47
UMTS FDD	2133.600	0.312608	2.021555	61.0	30
UMTS FDD	2127.067	0.265461	1.716665	61.0	36

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.007841	1

3.2.14 Wexford: Bunclody

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.505	0.004188	0.004188	28.0	6686
FM Radio	101.440	0.022516	0.022516	28.0	1244
FM Radio	93.992	0.018323	0.018323	28.0	1528
FM Radio	99.185	0.016596	0.016596	28.0	1687
FM Radio	89.550	0.014980	0.014980	28.0	1869
FM Radio	91.737	0.009441	0.009441	28.0	2966
TV PAL	191.440	0.022233	0.028175	28.0	994
TV PAL	215.280	0.020022	0.025373	28.0	1104
TETRA	393.550	0.002021	0.003500	28.0	8000
GSM	947.750	0.073198	0.146396	42.3	289
GSM	947.050	0.070632	0.141264	42.3	300
GSM	945.533	0.038681	0.077362	42.3	547
GSM	954.283	0.029923	0.059845	42.5	710
UMTS FDD	2119.133	0.049374	0.319290	61.0	191
UMTS FDD	2111.900	0.041448	0.268031	61.0	228
UMTS FDD	2166.033	0.006202	0.040104	61.0	1521

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.000079	1

3.2.15 Wicklow: Carnew

Table of Frequency Selective Measurement Results					
Emission Type	**Frequency**	**Measured Level (V/m)**	**Adjusted Level (V/m)**	**ICNIRP Limit (V/m)**	**Times below Limit** [adjusted Values]
PMR	74.550	0.003895	0.003895	28.0	7189
FM Radio	101.440	0.014639	0.014639	28.0	1913
FM Radio	89.550	0.013884	0.013884	28.0	2017
FM Radio	91.805	0.013820	0.013820	28.0	2026
FM Radio	93.992	0.013351	0.013351	28.0	2097
FM Radio	99.185	0.011117	0.011117	28.0	2519
TV PAL	191.600	0.024350	0.030858	28.0	907
TV PAL	215.280	0.021454	0.027187	28.0	1030
TETRA	393.633	0.011535	0.019978	28.0	1402
TETRA	393.533	0.002360	0.004088	28.0	6849
TV PAL	511.167	0.032961	0.041770	31.1	744
TV PAL	487.100	0.031117	0.039433	30.3	770
TV PAL	668.753	0.005272	0.013867	35.6	2564
GSM	954.983	0.948418	1.896837	42.5	22
GSM	940.400	0.042609	0.085218	42.2	495
GSM	946.233	0.022594	0.045189	42.3	936
GSM	1832.500	0.029040	0.058080	58.9	1013
GSM	1845.750	0.007551	0.015102	59.1	3912
UMTS FDD	2147.367	0.006245	0.040382	61.0	1511
UMTS FDD	2118.200	0.005266	0.034055	61.0	1791
FWALA	3525.333	0.002118	0.005344	61.0	11415
FWALA	3748.400	0.002143	0.005406	61.0	11284
FWALA	3757.400	0.001122	0.002437	61.0	25031

Total Exposure Quotients [calculated from Adjusted Levels]			
Quotient	**Frequency Range**	**Calculated Quotient Value**	**Limit**
Electrical Stimulation Effects	**1 Hz to 10 MHz**	n/a	1
Thermal Effects	**100 kHz and above**	0.002007	1

4. Conclusion

The conclusion of this report is that at all 15 licensed transmitter sites surveyed on behalf of ComReg during September 2009 as part of the 2009 Programme of Measurement of Non-Ionising Radiation Emissions:

(1) Measurements undertaken of non-ionising radiation emission levels on individual frequencies were found to fall below the international ICNIRP reference levels for general public exposure.

(2) The levels measured were not found to cause the aggregate of non-ionising radiation emissions to exceed the criteria for simultaneous exposure to multiple frequency fields specified in the guidelines published by ICNIRP.

Annex 1 - NIR and Emissions Standards

Definition

Non-ionising radiation (NIR) is that part of the electromagnetic spectrum below 3000 million MHz (3 x 10^{15} Hz). Non-ionising radiation includes all radiations and fields of the electromagnetic spectrum that do not normally have sufficient energy to produce ionisation in matter and is characterised by energy per photon of less than about 12 eV and wavelengths greater than 100 nm. Radio waves, infrared radiation and visible light are examples of NIR. Electromagnetic waves at frequencies above 3000 million MHz are known as ionising radiation and this includes X-rays and Gamma rays as well as some Ultraviolet radiation.

Standards for limiting exposure to 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 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 published guidelines[10] for limiting exposure to NIR (up to 300 GHz). Many countries have adopted the 1998 ICNIRP document as the reference for setting emissions limits. It should be noted that in 1999 the Council of the European Union issued a recommendation[11] to limit exposure of the general public to electromagnetic fields 0Hz - 300GHz

[10] "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.

[11] Recommendation of the European Council 1999/519/EC of July 12, 1999

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. An outline of the ICNIRP Guidelines is presented in Annex 2.

Non-ionising radiation licence conditions

It is a condition of various licences[12] issued by ComReg pursuant to the Wireless Telegraphy Act, 1926 (No. 45 of 1926) that licensees must ensure that NIR emissions from each radio installation operated thereunder must be within the limits specified in the guidelines published by ICNIRP.

[12] e.g. GSM, 3G Mobile, Radio and TV Broadcasting, MMDS, FWA (Wireless Broadband), among others.

Annex 2 – The ICNIRP Guidelines

SUMMARY OF THE ICNIRP GUIDELINES FOR LIMITING EXPOSURE TO TIME-VARYING ELECTRIC, MAGNETIC, AND ELECTROMAGNETIC FIELDS (UP TO 300 GHz)

In 1974, the International Radiation Protection Association (IRPA) formed a working group on non-ionising radiation (NIR), which examined the problems arising in the field of protection against the various types of NIR. In 1977, this working group became the International Non-Ionizing Radiation Committee (INIRC).

In cooperation with the Environmental Health Division of the World Health Organization (WHO), the IRPA/INIRC developed a number of health criteria documents on NIR as part of WHO's Environmental Health Criteria Program, sponsored by the United Nations Environment Program (UNEP). Each document includes an overview of the physical characteristics, measurement and instrumentation, sources, and applications of NIR, a thorough review of the literature on biological effects, and an evaluation of the health risks of exposure to NIR. These health criteria have provided the scientific database for the subsequent development of exposure limits and codes of practice relating to NIR.

At the Eighth International Congress of the IRPA, a new, independent scientific organization—the International Commission on Non-Ionizing Radiation Protection (ICNIRP)—was established as a successor to the IRPA/INIRC. The functions of the Commission are to investigate the hazards that may be associated with the different forms of NIR, develop international guidelines on NIR exposure limits, and deal with all aspects of NIR protection.

ICNIRP has defined two guideline exposure limits, one for members of the general public and one for people classified as occupational (e.g. telecommunication engineers). The occupationally exposed population consists of adults who are generally exposed under known conditions and are trained to be aware of potential risk and to take appropriate precautions. By contrast, the general public comprises individuals of all ages and of varying health status, and may include particularly susceptible groups or individuals. In many cases, members of the public are unaware of their exposure to EMF. Moreover, individual members of the public cannot reasonably be expected to take precautions to minimize or avoid exposure. It is these considerations that underlie the adoption of more stringent exposure restrictions for the public than for the occupationally exposed population.

ICNIRP has defined basic restrictions and reference levels. Depending on frequency, the physical quantities used to specify the basic restrictions on exposure to electromagnetic fields (EMF) are current density, specific absorption rate (SAR), and power density. SAR is not easily measurable in living people therefore reference levels have been obtained from the basic restrictions by mathematical modelling and by extrapolation from the results of laboratory investigations at specific frequencies.

The reference levels are provided for comparison with measured values of physical quantities; compliance with all reference levels given in these guidelines will ensure

compliance with basic restrictions. If measured values are higher than reference levels, it does not necessarily follow that the basic restrictions have been exceeded, but a more detailed analysis is necessary to assess compliance with the basic restrictions.

Frequency Range	E – Field Strength (Vm^{-1})	H – Field (Am^{-1})	B – Field (μT)	Equivalent plane wave power S (Wm^{-2})
up to 1 Hz	-	1.63×10^5	2×10^5	-
1 – 8 Hz	20,000	$1.63 \times 10^5/f^2$	$2.5 \times 10^5/f^2$	-
8 – 25 Hz	20,000	$1.63 \times 10^5/f$	$2.5 \times 10^4/f$	-
0.025 – 0.82 kHz	$500/f$	$20/f$	$25/f$	-
0.82 – 65 kHz	610	24.4	30.7	-
0.065 – 1 MHz	610	$1.6/f$	$2.0/f$	-
1 – 10 MHz	$610/f$	$1.6/f$	$2.0/f$	-
10 – 400 MHz	61	0.16	0.2	10
400 – 2000 MHz	$3f^{1/2}$	$0.008f^{1/2}$	$0.01f^{1/2}$	$f/40$
2 – 300 GHz	137	0.36	0.45	50

Table 1: Reference levels for <u>occupational exposure</u> to time-varying electric and magnetic fields (unperturbed rms values). f in units as indicated in the Frequency Range column.

Frequency Range	E – Field Strength (Vm^{-1})	H – Field (Am^{-1})	B – Field (μT)	Equivalent plane wave power S (Wm^{-2})
up to 1 Hz	-	3.2×10^4	4×10^4	-
1 – 8 Hz	10,000	$3.2 \times 10^4/f^2$	$4 \times 104/f^2$	-
8 – 25 Hz	10,000	$4{,}000/f$	$5000/f$	-
0.025 – 0.8 kHz	$250/f$	$4/f$	$5/f$	-
0.8 – 3 kHz	$250/f$	5	6.25	-
3 – 150 kHz	87	5	6.25	-
0.15 - 1 MHz	87	$0.73/f$	$0.092/f$	
1 – 10 MHz	$87/f^2$	$0.73/f$	$0.092/f$	-
10 – 400 MHz	28	0.16	0.092	2
400 – 2000 MHz	$1.375f^{1/2}$	$0.0037f^{1/2}$	$0.0046f^{1/2}$	$f/200$
2 – 300 GHz	61	0.16	0.20	10

Table 2: Reference levels for <u>general public exposure</u> to time-varying electric and magnetic fields (unperturbed rms values). f in units as indicated in the Frequency Range column.

Simultaneous Exposure to Multiple Frequency Fields (Total Exposure Quotients)

ICNIRP has specified a means of assessing additivity of exposures in situations of simultaneous exposure to fields of different frequencies. Additivity is examined separately for the effects of electrical and thermal stimulation, and ICNIRP has set out basic restrictions which should be met for both considerations.

For practical application of the basic restrictions, ICNIRP has advised that the following criteria[13] regarding reference levels of field strengths should be applied:

Induced Current Density and Electrical Stimulation

For induced current density and electrical stimulation effects, relevant up to 10 MHz, the following two requirements should be applied to the field levels:

$$\sum_{i=1\ \mathrm{Hz}}^{1\ \mathrm{MHz}} \frac{E_i}{E_{L,i}} + \sum_{i>1\ \mathrm{MHz}}^{10\ \mathrm{MHz}} \frac{E_i}{a} \leq 1,$$

and

$$\sum_{j=1\ \mathrm{Hz}}^{65\ \mathrm{kHz}} \frac{H_j}{H_{L,j}} + \sum_{j>65\ \mathrm{kHz}}^{10\ \mathrm{MHz}} \frac{H_j}{b} \leq 1,$$

where

E_i = the electric field strength at frequency i;

$E_{L,i}$ = the electric field reference level from Tables 1 and 2;

Hj = the magnetic field strength at frequency j;

$H_{L,j}$ = the magnetic field reference level from Tables 1 and 2;

a = 610 V m^{-1} for occupational exposure and 87 V m^{-1} for general public exposure; and

b = 24.4 A m^{-1} (30.7 μT) for occupational exposure and 5 A m^{-1} (6.25 μT) for general public exposure.

[13] The calculated values are referred to as '**Total Exposure Quotients'** elsewhere in this report.

Thermal Considerations

For thermal considerations, relevant above 100 kHz, the following two requirements should be applied to the field levels:

$$\sum_{i=100\ \mathrm{kHz}}^{1\ \mathrm{MHz}} \left(\frac{E_i}{c}\right)^2 + \sum_{i>1\ \mathrm{MHz}}^{300\ \mathrm{GHz}} \left(\frac{E_i}{E_{L,i}}\right)^2 \leq 1,$$

and

$$\sum_{j=100\ \mathrm{kHz}}^{1\ \mathrm{MHz}} \left(\frac{H_j}{d}\right)^2 + \sum_{j>1\ \mathrm{MHz}}^{300\ \mathrm{GHz}} \left(\frac{H_j}{H_{L,j}}\right)^2 \leq 1,$$

where

E_i = the electric field strength at frequency i;

$E_{L,i}$ = the electric field reference level from Tables 1 and 2;

Hj = the magnetic field strength at frequency j;

$H_{L,j}$ = the magnetic field reference level from Tables 1 and 2;

c = $610/f$ V m^{-1} (f in MHz) for occupational exposure and $87/f^{1/2}$ V m^{-1} for general public exposure; and

d = $1.6/f$ A m^{-1} (f in MHz) for occupational exposure and $0.73/f$ for general public exposure.

Annex 3 – Survey Methodology

The purpose of the surveys was to quantify the electromagnetic field (EMF) present at each area and to identify the frequency and intensity (or level) of the principal emissions contributing to the field. The locations of the survey were chosen by ComReg.

Some of the typical emission types encountered when measuring EMF are AM and FM broadcast radio, broadcast television signals, wireless CCTV, mobile radio, emergency services radios, pager base station radios, taxi base station radios, mobile phone base station signals and wireless broadband signals.

Measurements of the non-ionising radiation emissions from the site were conducted in accordance with the methodology outlined in document ComReg 08/51[14], which incorporates many of the measurement methods and procedures outlined in ECC Recommendation (02)04[15].

Surveys were, in most cases, conducted in three stages as follows:

1 Initial Site Survey

At all sites surveyed, initial investigations were carried out using a field strength meter and a broadband probe to find the position of the maximum field strength. The probe used for the initial investigation measured and summed all emissions present in a broad frequency range (typically 100 kHz to 3 GHz).

2 Broadband Measurements

Once the location was identified, the field strength meter and broadband probe were mounted on a non-conductive tripod and the aggregate field strength in Volts per meter was recorded over a period exceeding six minutes.

[14] http://www.comreg.ie/_fileupload/publications/ComReg0851.pdf

[15] ECC REC (02)04 (revised Bratislava 2003, Helsinki 2007), "Measuring Non-Ionising Electromagnetic Radiation (9 kHz – 300 GHz), published by the European Communications Committee on www.ero.dk.

3 Frequency Selective Measurements

Measurements of emissions at specific frequencies were 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 up to 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 with the ICNIRP general public guideline levels.

Annex 4 – Measurement of Electromagnetic Fields

Electromagnetic fields can be sub-divided into two components:

(1) Electric field **E** [measured in Volts per metre or V/m]

(2) Magnetic field **H** [measured in Amperes per metre or A/m]

The E-field and the H-field are mathematically interdependent[16] in the **far-field** which is the region[17] where the distance from the radiating antenna exceeds the wavelength of the radiated electromagnetic field. The measurement locations for most transmitter installations lie well within the far-field, as the wavelengths of the transmitted signals are relatively short and the antennas are typically located many metres from any public area. The following table shows wavelengths for commonly transmitted signals:

Transmitter Type	Frequency	Wavelength
PMR Low Band VHF	68 MHz	4.41 m
UHF TV	470 MHz	0.64 m
GSM 900 (mobile phone base)	925 MHz	0.32 m
GSM 1800 (mobile phone base)	1805 MHz	0.17 m
UMTS (mobile phone base)	2110 MHz	0.14 m

In the far-field only one component needs to be measured, as the other component can be easily derived from it. Normally it is only the electric field which is measured in this region.

In the case of transmitters of very long wavelength signals, such as long wave radio (1.19 km wavelength), the H-field and E-field must be measured separately as the point of measurement will most likely lie within the **reactive near-field** region. This is the region located less than one wavelength from the radiating antenna. Here, the

[16] $E = H \times Z_0$ where Z_0 (characteristic impedance of free space) $\approx 377\ \Omega$

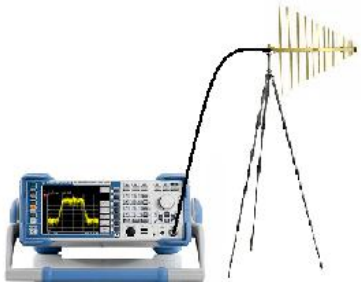
[17] Beyond a distance of $\lambda + 2D^2/\lambda$ where λ is the wavelength and D is the antenna's largest dimension

relationship between E and H becomes very complex and there is no direct correlation between both components of the electromagnetic field.

Measurement Equipment

The measurement of electromagnetic fields is a complex process which involves the use of various meters, spectrum analysers, probes and antennas, which are appropriate to the frequencies of the emissions being measured.

The table below shows examples of equipment typically used to measure electromagnetic fields in non-ionising radiation surveys.

<table>
<tr><th>Initial Site Survey and Broadband Measurements</th><th colspan="2">Frequency Selective Measurements</th></tr>
<tr><td> 
</td><td>SPECTRUM ANALYSER WITH TRIPOD MOUNTED ANTENNA CONNECTED
  </td><td>PORTABLE SPECTRUM ANALYSER WITH ANTENNA DIRECTLY CONNECTED
  </td></tr>
<tr><td>Used to measure the overall electric or magnetic field present over a range of frequencies. (e.g. 100kHz to 3GHz)</td><td colspan="2">Spectrum analysers are used to measure individual emissions at specific frequencies. The individual emissions contribute to the overall electromagnetic field. Examples of individual emissions are a TV signal and a mobile phone signal for a particular mobile operator. There may be a number of emissions from different transmitters contributing to the overall electromagnetic field at a particular location.</td></tr>
</table>

Annex 5 – Derivation of Adjusted Levels

In the case of some services an adjusted level is calculated from the measured electric field level and is presented in the relevant frequency selective measurement table for comparison with the applicable emission limit. For a particular measurement, the adjustment may be performed for any or all of the following reasons

(a) to compensate for when the bandwidth of the emission exceeds the maximum resolution bandwidth (RBW) of the spectrum analyser used.

(b) to extrapolate to an estimate of the level of emissions from a transmitter under maximum traffic conditions (e.g. when a mobile phone base station is serving its maximum number of calls and data clients).

(c) to account for the characteristics of emissions with complex signal structures (e.g. PAL TV)

Compensating for the limited measurement resolution of the spectrum analyser

In many cases it is necessary to compensate for the limited measurement resolution of the spectrum analyser, as the bandwidth of the signal measured may be greater than the resolution bandwidth (RBW) of the analyser. For example, a measurement of a digital television signal performed with at an RBW setting of 5 MHz needs to be adjusted upwards by multiplying it by a correction factor in order to account for the energy present within the full 7.61 MHz bandwidth of the signal.

The correction factor is derived as follows:

RBW CORRECTION FACTOR: $K_{RBW} = 10 \times \log_{10} (B_{Signal} / B_N)$

Where B_{Signal} is the signal/emission bandwidth

B_N is the noise bandwidth of the analyser filter

(for a Gaussian Filter: $B_N \approx 1.1 \times B_{3dB}$)

Example: Measuring a 7.61 MHz DVB-T signal with 5 MHz RBW:

B_{Signal} = 7.61 MHz

B_{3dB} = RBW = 5 MHz => $B_N = 1.1 \times 5 = 5.1$

$K_{RBW} = 10 \times \log_{10} (7.61 / 5.1) = 1.74$ dB

Extrapolation to Max Traffic Signal Level

In the case of some networks it is necessary to extrapolate to an estimate of the level under maximum traffic from the transmitter. For example, the base stations of mobile telephone networks produce emissions which vary according to the changing volume of calls or data traffic over the course of the day.

In the cases of GSM, TETRA and UMTS (3G), the estimated electric field levels for maximum traffic conditions are extrapolated from the constant pilot channels (BCCH for GSM and TETRA and P-CPICH for UMTS) as follows:

GSM and TETRA:

V/m Calculation	dB Calculation
$\mathbf{E_{MAX}} = E_{BCCH} \times \sqrt{n_{channels}}$	$\mathbf{E_{MAX}} = E_{BCCH} + 10\mathrm{Log}_{10}(n_{channels})$
$n_{channels}$ includes the BCCH plus the number of traffic channels. If the Number of traffic channels per BCCH is not known, $n_{channels}$ is taken as: **GSM:** 4 **TETRA (Emergency):** 3 **TETRA (Civil):** 2	

UMTS:

V/m Calculation	dB Calculation
$\mathbf{E_{MAX}} = E_{UMTS} \times \sqrt{R_{P\text{-}CPICH}}$	$\mathbf{E_{MAX}} = E_{UMTS} + R_{P\text{-}CPICH}$
$R_{P\text{-}CPICH} = P_{MAX} / P_{P\text{-}CPICH}$ The P-CPICH transmits with a constant power typically 10 dB below the maximum possible power (P_{MAX}) for a UMTS signal. Therefore $R_{P\text{-}CPICH}$ = 10 dB $\sqrt{R_{P\text{-}CPICH}} = \sqrt{10} = 3.1623$	

If necessary, as in the case of GSM and TETRA, the frequencies of the pilot channels present have been identified prior to recording the standard frequency selective scan of the band.

Accounting for characteristics of certain complex signals:

In the case of some signals with a complex structure, such as analogue PAL television, it is necessary to apply a correction factor for reasons such as the following:

- to take into account characteristics of the signal shape, which make it difficult to measure an RMS level directly, which is indicative of worst case exposure.

- to derive a level more indicative of the aggregate of emissions attributable to the individual signal components.

Analogue PAL TV

The peak field strength caused by the synch pulses of the picture (luminance) carrier is measured. The field strength from the picture signal is at its highest when a synch pulse is being transmitted.

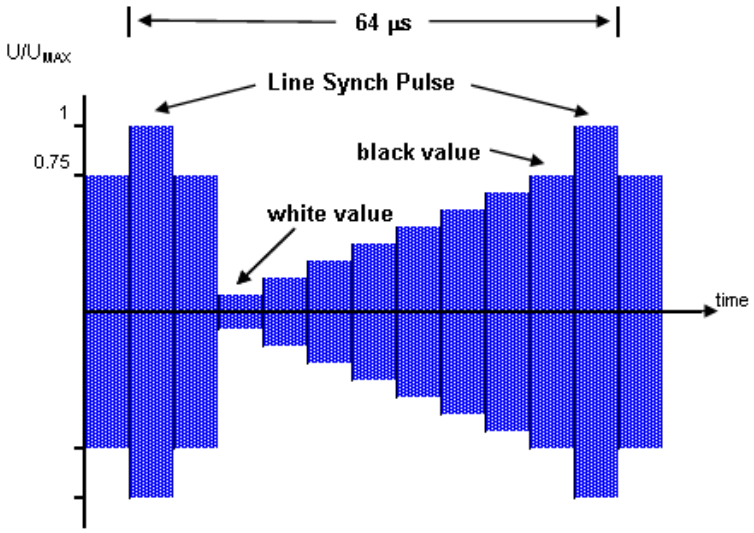


Figure 1: Luminance Signal in the Time Domain

For a black picture, the mean power is 2.5 dB below the peak power (i.e. for a synch pulse). It is assumed that 100% black picture is transmitted permanently for worst case exposure evaluation. The mean (RMS) level for a black picture is then calculated from the peak synch pulse level by applying a correction factor to the peak synch pulse level. The value of this **correction factor** is **-2.3 dB** rather than -2.5 dB, in

order to take into consideration the small contributions of the FM and NICAM sound signal components.

The level for the full PAL signal is thus derived by applying the correction factor to the measurement for the peak luminance signal:

$$\mathbf{E_{PAL}} = E_{LUM} \times k \qquad \text{corr factor } k = -2.3 \text{ dB} = 0.767$$

Annex 6 – Glossary

Antenna: - A conductive structure specifically designed to couple or to radiate electromagnetic energy.

BCCH: - Broadcast control channel. BCCH is a constant carrier on GSM base stations. Essentially it is the 'always on' pilot channel. The constant signal level of the BCCH allows for extrapolation to a maximum traffic signal level for a base station.

Broadband Measurement: - A measurement carried out using a meter and probe combination that simultaneously measures and sums all received signals within the frequency range of the probe. Generally this meter and probe combination is not as sensitive as the equipment used for narrowband measurements but is useful for getting an overall picture of the level of electromagnetic fields present at a site.

ComReg: - The Commission for Communications Regulation. ComReg is the statutory body responsible for the regulation of the electronic communications sector (telecommunications, radiocommunications and broadcasting transmission) and the postal sector in Ireland.

Electric Field Strength: - Electric field strength is a quantitative expression of the intensity of an electric field at a particular location. The standard unit is the Volt per meter (V/m). A field strength of 1 V/m represents a potential difference of one volt between points separated by one meter.

Electromagnetic Field (EMF): - Combined electric and magnetic fields, in this case radiating from an antenna.

Electromagnetic Spectrum: - The complete range of the wavelengths of electromagnetic radiation, beginning with the radio waves and extending through microwaves and visible light (a very small part of the spectrum) all the way to the extremely short gamma rays that are a product of radioactive atoms. The electromagnetic spectrum contains both non-ionizing and ionizing radiation

Frequency: - The number of cycles completed in one second by an electromagnetic wave. It is expressed in Hertz (Hz) or a multiple of Hertz, e.g. kHz (kilohertz, 1,000 Hertz), MHz (MegaHertz, 1,000,000 Hertz) and GHz (GigaHertz, 1,000,000,000 Hertz).

Frequency Range: - A group of frequencies between a selected start and stop frequency. E.g. the frequency range of the FM broadcast band includes all frequencies between 88 and 108 MHz.

Frequency Selective Measurement: - A measurement carried out using a receiver and an antenna which measures the received signal strength at specific frequencies. A spectrum analyser is usually used as the receiver, and a range of antennas is used which are suitable for reception of all the frequencies to be measured.

ICNIRP: - The International Commission on Non-Ionizing Radiation Protection.

Ionising radiation: - Ionising radiation, also called radioactivity, is electromagnetic (EM) radiation whose waves contain energy sufficient to overcome the binding energy of electrons in atoms or molecules, thus creating ions. It occurs at frequencies higher than ultraviolet light and includes x-rays and gamma rays. The sources of electromagnetic fields measured in this survey do not produce any ionising radiation.

Isotropic probe: Receives electromagnetic signals regardless of polarisation or direction of travel. An isotropic probe is designed to give the same reading, no matter which way it is pointed.

Non-ionising radiation (NIR): - Includes all radiations and fields of the electromagnetic spectrum that do not normally have sufficient energy to produce ionization in matter; characterized by energy per photon less than approximately 12 electron Volts, wavelengths greater than 100 nm, and frequencies lower than 3×10^{15} Hz.

Occupational Exposure: - All exposure to EMF experienced by individuals who are exposed under known conditions in the course of performing their work and who are trained to be aware of potential risk and to take appropriate precautions.

Public Exposure: - All exposure to EMF experienced by members of the general public, excluding occupational exposure and exposure during medical procedures.

P-CPICH: - Primary Common Pilot channel. P-CPICH is a downlink channel broadcast by UMTS Node-Bs (i.e. 3G base stations) with constant power. It allows extrapolation to a maximum traffic signal level for a UMTS channel.

Radiofrequency (RF): - For this survey any radio signals between the frequencies 100 kHz to 40 GHz.

Spectrum analyser: - An instrument that displays signal amplitude (strength) as it varies by signal frequency. The frequency appears on the horizontal axis, and the amplitude is displayed on the vertical axis. It can be set to sweep a frequency band where the amplitude of the received signals show up as spikes on the recorded trace.