Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

(O)RLANS IN THE FREQUENCY BAND 2400 – 2483.5 MHz

Dublin, September, 2004

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(O)RLANs in the frequency band 2400 – 2483.5 MHz

1 PURPOSE OF THE REPORT

The purpose of this ECC report is to consider the need to instigate an investigation into the (mis)use of ORLAN equipment in CEPT member countries and to provide information and guidance on enforcing the regulations including recommendations for market enforcement actions against the proliferation of illegal ORLANs or possible adaptation of the regulations. Present regulation may lead to misuse and may also result in the potential risk of interference in the future.

Because of the free from charge use of the 2.4 GHz band with low-priced ORLAN equipment, there might be an assumed risk of misuse due to the need for point-to-point applications with directional antennas, which might not be in conformity with the essential requirements.

In addition, the report also provides information for the market surveillance authorities on the legal use of ORLANs.

2 INTRODUCTION

The market for local area networks using short-range radio links is growing rapidly. Most current equipment is operating in the 2.4 GHz industrial, scientific and medical (ISM) band using the IEEE 802.11b/802.11g standards as well as the Bluetooth and HomeRF specifications. This band has the advantage of being available worldwide on a licence-exempt basis, but is expected to congest rapidly, as RLANs are deployed continuously.

In 1991, CEPT issued Recommendation T/R 10-01 [1] concerning the regulatory constraints under which RLANs could be deployed in the 2.4 GHz frequency band. ETSI followed up on this and published ETSI EN 300 328 [2]. In the meantime CEPT recommendation T/R 10-01 has been replaced by the Recommendation 70-03 [3] covering RLANs as well as other SRD devices.

ERC-Decision (01)07 [4] has been implemented for the use of RLANs in the 2400 MHz to 2483.5 MHz ISM – frequency band. Until now, 24 CEPT administrations have implemented this decision in their countries. Almost all administrations allow the use of the frequency band; but some administrations limit the use only to indoor or private use. Some still require an individual licensing regime.

In 2000, ETSI asked the CEPT ERC to change the current regulation to allow e.i.r.p. levels up to 500 mW with directional antenna using the same 100 mW transmitter power. However, ERC did not agree to allow 500 mW e.i.r.p. ERC concluded that increased e.i.r.p. limit for RLANs would lead to a further congestion in the 2.4 GHz band.

In general, the use of higher radiated power tends to block other applications in the same frequency band.

3 REGULATORY ENVIRONMENT AND TECHNICAL PARAMETERS

The regulatory parameters for the use of RLANs can be found in ERC Recommendation 70-03 on Short Range Devices, Annex 3. In addition, the restrictions on the use of RLAN in some CEPT member countries are listed in Appendix 3 of this recommendation. As such, RLANs are operated on a licence-exempted and non-protected basis (following Art. 4.4 of the Radio Regulations since it is operated in an ISM – frequency band).

The risk of interference between the various different users who may share the 2.4 GHz band and between coexisting RLAN systems has to be accepted by the parties involved.

As long as RLAN users do not cause harmful interference to possible protected users in the same band, the use of the frequency band should not be subject to individual rights nor, to the extent possible, to general authorisation conditions other than currently allowed.

This includes the right for national authorities to impose general authorisation conditions where justified in a proportionate manner for all users in the band having the same status.

The European Commission in their recommendation on the harmonisation of the provision of RLAN services (2003/203/EC) confirmed the above circumstances.

3.1 Users manual

In article 6.1 and 6.3 of the Directive 99/5/EC the need for clear instructions to the installer and user is stated.

Directive 99/5/EC of the European parliament and of the Council of 9 march 1999:

Article 6,
1. Member States shall ensure that apparatus is placed on the market only if it complies with the appropriate essential requirements identified in Article 3 and the other relevant provisions of this Directive when it is properly installed and maintained and used for its intended purpose. It shall not be subject to further national provisions in respect of placing on the market.

3. Member States shall ensure that the manufacturer or the person responsible for placing the apparatus on the market provides information for the user on the intended use of the apparatus, together with the declaration of conformity to the essential requirements. Where it concerns radio equipment, such information shall be sufficient to identify on the packaging and the instructions for use of the apparatus the Member States or the geographical area within a Member State where the equipment is intended to be used and shall alert the user by the marking on the apparatus referred to in Annex VII, paragraph 5, to potential restrictions or requirements for authorisation of use of the radio equipment in certain Member States. Where it concerns telecommunications terminal equipment, such information shall be sufficient to identify interfaces of the public telecommunications networks to which the equipment is intended to be connected. For all apparatus such information shall be prominently displayed.

Therefore, a manufacturer has to provide information that the product can be used in all countries following the EU directive 99/5/EC without any limitation except for specific country restrictions which need to be clearly provided.

For ORLANs with integral antennas this also includes the following information:

1. Depending on the type of antenna used, it might be necessary to reduce the output power of the equipment to result in a maximum radiated power of 100 mW eirp or less.

2. Combinations of power levels and antennas resulting in a radiated power level above 100 mW are considered as not compliant with national radio interface regulation of the countries that have implemented the ERC Recommendation 70-03 and are not allowed for use within these countries. Some countries allow higher than 100 mW e.i.r.p on an individual licensing regime. In such a case, the ORLAN is not covered anymore by the abovementioned conditions, which are for Short Range Devices.

However, this is the case only, if the conformity assessment was made for the combination of equipment and antenna and if both are sold together. It is not the case if the equipment is sold without antenna. It is the responsibility of the user to don't exceed the allowed maximum power.

It is noted that RLAN equipment which is operated in the frequency band from 2446.5 MHz to 2483.5 MHz and limited to indoor application only, is included in the "Class 1" category for radio devices as published by the European Commission in their official newsletter for placing radio equipment on the market.

If equipment applies to "Class 2" category, restrictions on usage have to be included in the manual.

3.2 Technical parameters

Modulation	Frequency Hopping Spread Spectrum Modulation, Direct Sequence Spread Spectrum Modulation and similar modulations (e.g. OFDM)
Maximum (e.i.r.p.)	100 mW
Maximum Power Flux Density	FHSS: 100 mW/100 kHz, DSSS: 10 mW/1MHz
Spurious emissions	According to CEPT/ERC/REC 74-01

Table 1: Technical Parameters

The term "Short Range Device" (SRD) is intended to cover radio transmitters which provide either uni-directional or bi-directional communication and which have low capability of causing interference to other radio equipment. SRDs use integral, dedicated or external antennas and all modes of modulation can be permitted subject to relevant standards.

The CEPT Recommendation 70-03 describes the spectrum management requirements for SRDs relating to the allocated frequency bands, maximum power levels, channel spacing and duty cycle.

In addition to Rec 70-03 for ORLANs in the 2400 MHz to 2483.5 MHz frequencies, the following documents apply:

1. ERC/DEC(01)07: Radio-LAN Short Range Devices in 2400 – 2483.5 MHz.
2. ERC Report 109: Compatibility of Bluetooth with other existing and proposed radiocommunication systems in the 2.45 GHz frequency band.
3. ECC Report 011: Strategic Plans for the future use of the frequency bands 862 – 870 MHz and 2400 – 2483.5 MHZ for Short Range Devices.
4. EN 300 328: Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2.4 GHz ISM band and using spread spectrum, modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive.
5. EN 301 489-1; Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements.
6. EN 301 489-17; Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for 2.4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment.
7. ES 202 131: Receiver - Parameter of Wideband Data Transmission Systems for Spectrum Planning Purposes.

The Harmonized European Standard EN 300 328 (covers IEEE 802.11, 802.11b, 802.11g, Bluetooth and HomeRF equipment) includes these parameters and the respective measurement methods, necessary for the declaration of conformity with the Essential Requirements under Article 3.2 of the R&TTE Directive 99/5/EC.

4 MARKET INFORMATION

4.1 Placing on the market

The EC has published guidance documents for those placing on the market, which can be found at:
http://europa.eu.int/comm/enterprise/rtte/gener.htm

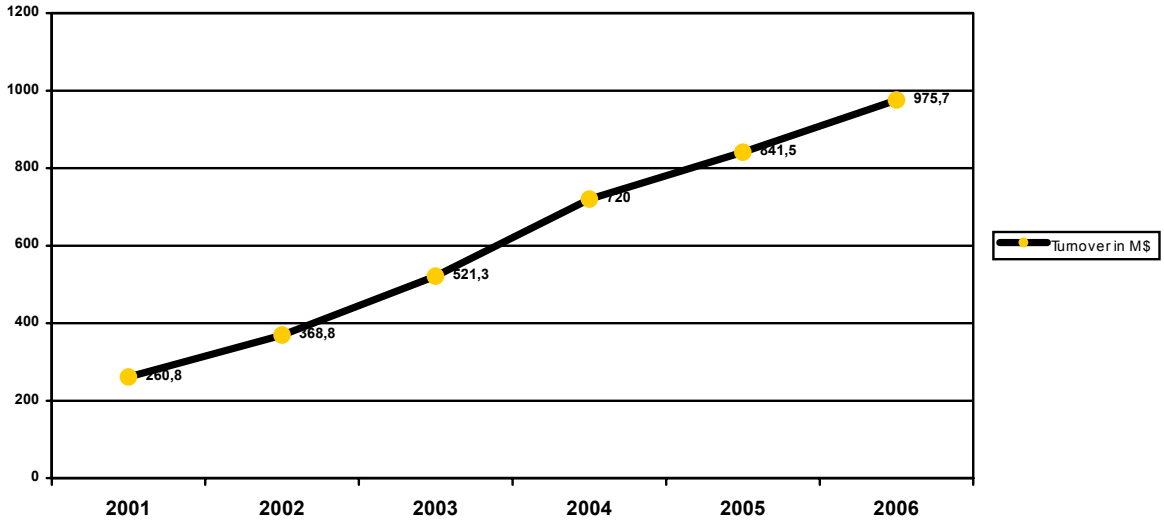
4.2 Market Data and Tendency

The ORLAN market is estimated in Figure 2.

Examples of tangible benefits yielded by advanced applications of R-LAN technology include:

- Wireless connection of Local Area Network infrastructure between buildings on Campuses or in Metropolitan areas delivers high-quality, flexible, and cost-effective alternatives to tariff-based lease-line services.
- Increased alternatives for wireless data services in unlicensed operation resulting in increased competitive substitutes for tariff-based cellular services.
- Broadband Internet access in rural areas where ADSL of cable is not (yet) available.

Market Development for 802.11b in 2.4 GHz indicates a strong growth. Market projections for 2006 indicates 20 million users whereas the existing customers based at the end of 2002 was only 1 million customers on a worldwide basis. These figures are for 802.11b (WIFI) equipment only and do not include Bluetooth and others. At year end 2003 Bluetooth equipment was shipped across the world at the rate of approximately 1 million units per week.



Source: Frost & Sullivan

Figure 2: Market Growth and Projection

4.3 Rationale for Potential Misuse

Besides new applications/possibilities for these directional RLANs in the 2.4 GHz band, using these RLANs would also result in several advantages for users as well as for manufacturers:

- New applications
- Increased competition on local loop broadband access
- Extended range for outdoor applications
- Ideal for covering corridors: less access points/needed to cover the same area
- To better control the coverage in high density areas to guarantee a min throughput for all users,

User advantages:

- Less access points / repeaters needed to cover the same area,
- Reduced Installation costs / less access points/repeaters to be installed,

Manufacturer advantages:

- Frequency re-use / higher density of users in the same area.

Suppliers are also tempted to increase the transmission power of ORLANs to assure the bit rate as advertised to prevent complaints from their customers. The introduction of 802.11g will only aggravate the problem as it is advertised at 54 Mbps, but only for short ranges. At longer ranges the throughput is equal to 802.11b links.

5 DEPICTION OF POTENTIAL CHALLENGE

So far, no major problems of interference to existing services have been reported since the first RLAN systems were installed in 1994 but the use of directional gain antennas on RLAN systems resulting in higher e.i.r.p levels could result in an interference potential that is above the current interference potential.

Increasing the radiated output power does increase the operating distance and therefore increases the probability of interference to existing services in this direction. On the other hand, the interference probability at the backend of the directional antenna is reduced. The drawing below illustrates how using a directional antenna changes the shape over the covered area, but not the size (if conducted power remains the same):

In this example, the operating distance is approximately doubled by increasing the e.i.r.p. from 100 mW to 500 mW by using an directional antenna with a gain of 7 dBi. It is relatively easy to connect antennas with gains of 20 to 30 dBi. In these cases, the operating distance would be increased to 10 x r and 33 x r, respectively.

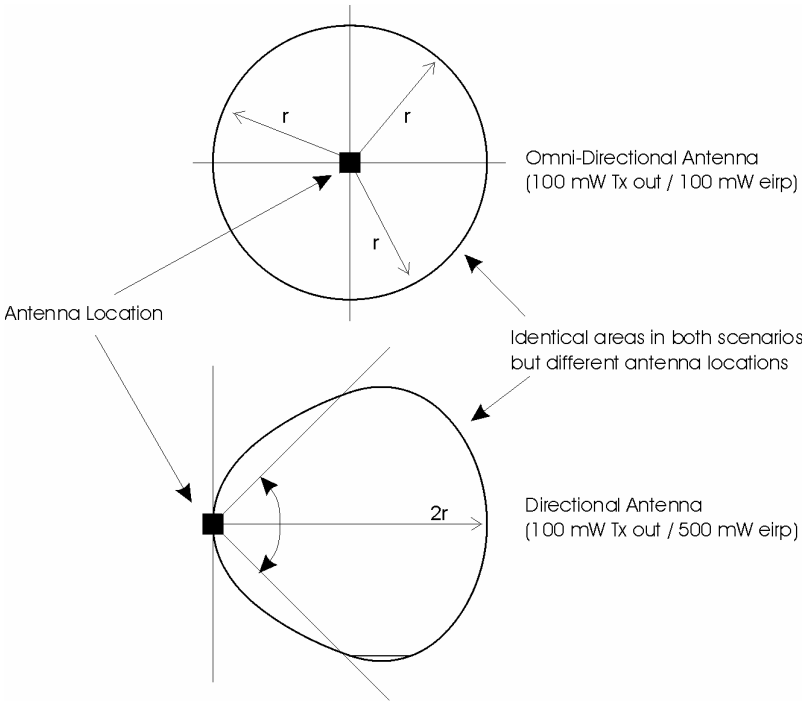


Figure 1: Increase of Operating Distance by Using a Directional Antenna

In addition, the consequence of transmitting with higher power levels, 100 mW output power in connection with a directive antenna, will lead to an increase of the noise level in this frequency band. The quality of the services in this band will be reduced. To counteract this effect the users of impacted systems are tempted to increase their own transmitter power and this again, will lead to more noise.

6 COUNTRIES EXPERIENCE

WGRA/RA11 has performed an investigation and requested information on the use of ORLANs and the enforcement of the applicable rules and regulations in the CEPT member countries. The questionnaire contained the 5 following questions:

- Is the use of Fixed Links in the frequency band 2400 – 2483.5 MHz allowed in the CEPT member countries?
- Is the use of directional antennas in combination with (O)RLANs allowed ?
- Are there complaints about interference?
- Is your administration planning enforcement action against this application?
- If you are planning preventive actions, what kind of monitoring or DF equipment will your agency be using?

Country	Fixed links	Directional antenna	Complaints	Enforcement actions	Equipment	Remarks
Austria	Yes	Yes, 100 mW e.i.r.p. only	No	Yes		Actions based on suspicious advertisements and by looking at rooftops for suspicious antennas
Belgium	Yes	Yes, 100 mW e.i.r.p. only	No	Planned in 2004		
Czech	Yes	Yes, 100 mW e.i.r.p. only	Yes	Not planned	Visual inspection of rooftops	ORLANS require Licence. Preventive actions are considered to be ineffective.
Denmark	Yes	Yes, but 100 mW e.i.r.p. only	No	Not planned		
Finland	Yes	Yes, 100 mW e.i.r.p. only	No	Not planned		Complaints in general are not investigated, since protection against interferences is not given in the bands freed from licensing.
France	Yes	Yes, 100 mW only on the frequency band 2400-2454 Mhz, 10 mW only on the frequency band 2454-2483,5 Mhz	Yes, very few.	Rooftop inspections performed with the agreement of the user	SHF equipment (EB 200), spectrum analyser with dish antenna.	Even if the regulation is not yet stable in France, public prosecutions might be introduced against illegal uses.
Germany	Yes	Yes, 100 mW e.i.r.p. only	Yes	ORLAN measurements performed in Q4/2003	EB200, High gain DF up to 1 km from TX	There is an enforcement procedure to find them..
Greece		Indoor and private only				
Hungary	Yes	Yes, 100 mW e.i.r.p. only	Yes	Yes	EB200	
Netherlands	Yes	Yes, 100 mW e.i.r.p. only	Yes	Considered	EB200, and visual inspection of rooftops	4 complaints, only 1 due to high power (O)RLAN
Norway	Yes	Yes, 100 mW e.i.r.p. only	Yes	Yes	EB200 and applicable antennas. Visual inspection of rooftops	Only a few complaints yet
Portugal	Yes	Yes, 100 mW e.i.r.p. only	No	Not planned	Not yet defined	Use only with integrated or dedicated antennas allowed
Sweden	Yes	Yes	A few (<5)	Not planned		Complaints are in general not investigated, since protection against interferences is not given in the bands freed from licensing.
Switzerland	Yes	Yes, 100 mW e.i.r.p. only	Yes	Yes	Advantest 3641 R&S FSP7 or EB200	Only 1 complaint
U.K.	Yes	Yes, 100 mW e.i.r.p. only	Yes	Complaints are about unfair competition with concern about home made antennas and over power		Inspections will be made as part of work programme to check installations

Nearly all the respondents allow the use of fixed links in the band 2400 – 2483.5 MHz.

Field force staffs in the Netherlands and France have proved, that when directional antennas are used the power limit is nearly always surpassed.

Apart from a large number of suppliers of directional antennae there is ample information on how to build a 2.4 GHz antenna available on the Internet. The UK Radiocommunications Agency (now subsumed into the Office of Communications) has tested some of these designs and found they gave up to 8 dB gain.

So far, there are a negligible number of complaints about interference.

7 CONSEQUENCES

Maintaining the integrity of the 2.4 GHz spectrum and a fair and balanced situation for all applications is important for regulators and market participants (users/operators as well as sellers and installers). Users will turn away from new products and services if new facilities being rolled-out fail to operate due to misuse and pollution of the spectrum.

Recommended actions for regulators include:
The market participants need to be better informed about the regulatory environment. This target could be achieved by organizing meetings with suppliers and trade organizations. Information on the internet (for users on how to access technical information for specific products and configurations with regards to the declaration of conformity), newsletters, brochures or other means of providing the necessary information pertaining to ORLANs is very also helpful.

Enforcement Actions
It should be necessary to improve the national Enforcement activities. Preventive actions based on normal spectrum monitoring are deemed to be ineffective. Especially when trying to find fixed links using directive antennas.

Rooftop inspections to find these external antennas are more useful, especially when there are complaints.

Inspectors have to be instructed to be on the alert for “suspect” antenna configurations.

Market surveillance Actions
A less intrusive action is an administrative inspection, i.e. checking the necessary documentation that must be supplied by the party that integrated the link components (art 6.3 of the R&TTE Directive).

A regulatory authority can also conduct from time to time a measurement campaign in order to find out the real market environment and to manage a better estimation of the actual misuse.

Advertisements promoting the illegal use of ORLAN need to be followed actively by the authorities.

Interference Complains
In the case of a justified complaint due to equipment being used illegally, the regulatory authority has the right to force the user to stop transmission or cease operation.

Technical Enforcement actions
Encountered difficulties / Experiences

Power measurement on rooftops is very difficult. Besides the fact that the antennas are mounted on inaccessible locations the measurements are severely hampered due to reflections and inaccurate distance between the antennas. Disconnecting links causes operational unavailability and financial loss for the users.

In most cases during a rooftop inspection, the use of a highly directive antenna in combination with known transmitter parameters is sufficient to conclude that the set is not in compliance with the regulations. A better assumption can be achieved if all gains and losses of involved technical entities (e.g. transmitter, connectors, cables, antenna) are considered.

8 CONCLUSIONS

There is a big demand for Point – to – Point and Point – to – Multipoint links.
Suppliers and network installers are very creative in meeting this demand by using licence-exempt equipment without proper knowledge and understanding of the applicable regulations.

The only available information for the end user is the user's manual of the transmitter. However the manufacturer or the person responsible for the placing of the apparatus on the market has no influence on the use of a particular type of (directive) antenna.

The European Commission has recommended in their Commission Recommendation of the 20 March 2003 (2003/203/EC) that Member States should not make use of the available 2.4 GHz band for the operation of RLAN systems subject to the grant of any individual right.

In addition, it would only be in line with the European Competition Rules, if the same general authorisation rules would be imposed to all users in this category.

The main reason for illegal operation is the use of a directive antenna without reducing the output power accordingly. Market enforcement found that this was despite of the fact that the operators were aware of the regulatory restrictions. Private operators even use self-made antennas.

Recent inspections showed that the usage density, especially in urban areas, is increasing quickly. However, due to the exponential growth of the market, it is hardly possible to make predictions on the amount of future complaints. It can only be assumed that the problem will spread to areas and countries not having seen complaints yet.

Because of similar use and design of Outdoor RLAN equipment in the 2.4 GHz as well as 5 GHz frequency range and by taking into account that the market for 5 GHz RLAN has just commenced to be developed, it can be expected that market enforcement will face the same problems with 5 GHz Outdoor RLAN in future.

9 RECOMMENDATIONS

National investigations in the use of directional antennas and the transmission power of ORLAN equipment is recommended.

Based on the conclusions the need for enforcement actions against the proliferation of ORLANs with an improper combination of output power and directional antenna or adaptation of the regulations should be considered.

Adaptations of the regulations need also to address concerns and complaints from the market participants over unfair competition.

Industry and operators need to be adequately informed by the administrations about the regulations with the aim to reduce the misuse of ORLAN equipment.

It is recommended that WGFM should be informed of the situation and the assumed risk of misuse due to the need for point to point applications. WGFM might consider the demand for a separate frequency band for un-coordinated point-to-point installations under general-authorisation-with-no-individual-rights operation

ECC/REC T/R 22-03 should be considered on whether or not it could provide a solution to satisfy this demand.

Since the main reason for illegal operation is the use of a directive antenna without reducing the output power, it should also be considered whether the regulations can suffice with a specification of transmitter output power in combination with a rule that relates the scaling of transmitter output power and antenna gain. Such a regulation would take into account that ORLAN equipment is normally designed to have an antenna connector and that transmitter and antenna are often not sold together. Hence, it has a potential to reduce misuse of ORLAN equipment.

ANNEX A: ORLANS IN CEPT MEMBER COUNTRIES

The Netherlands
In the Netherlands the frequency band 2400 – 2483.5 MHz has been allocated to the mobile communication service, electronic newsgathering, outside broadcast, short-range devices and ISM in compliance with footnote 5.150 of the Radio Regulations.

This report focuses on Outdoor Radio Local Area Networks ((O)RLAN) covered by the regulations for short-range devices.

Until June 2002 a licence was required for the use of Outdoor RLAN. In this licence it was stated that transmitter power of (O)RLANs was limited to 100 mWatt e.i.r.p. Since June 2002 a new "Nationaal Frequentieplan" (national allocation table) was issued and a licence for (O)RLAN was no longer required. During the first half of 2002 the Dutch Radio Agency received information from network operators and suppliers of (O)RLAN equipment, regarding interference caused by (O)RLANs transmitting over 100 mW e.i.r.p. This information triggered the Dutch Radio agency to inspect a number of (O)RLAN installations of licence holders.

There were 194 licenses issued in the Netherlands for (O)RLANs. Of this group 25 licence holders were selected for an inspection. The inspection consisted of a questionnaire and a physical inspection of the transmitter and antenna.

Analysis of the questionnaire led to the conclusion that most licence holders or users are unfamiliar with the regulations applicable to (O)RLANs and also that they were unable to answer the questions pertaining to the technical parameters of the equipment they used.

Results of the physical inspection was that of the 25 installations:

- All were used for fixed Point to Point connections
- All were used 24 hours a day
- 24 were installed with a directional antenna with up to 24 dB gain
- 24 operated in the frequency band 2400 – 2483.5 MHz
- 4 were used for commercial services to third parties.
- 70 % used FHSS and 30 % used DSSS (explain Bluetooth and 802.11b RLAN based on DSSS)
- 2 sets operated within the licensed transmitter power of 100 mW e.i.r.p.10 operated with more power. Of the remaining 13 sets the transmitter power could not be accurately determined.

On basis of these results the Radio Agency organized a meeting with the suppliers of (O)RLAN equipment. During this meeting the Radio Agency explained the regulations concerning (O)RLANs and the risks users take in using this frequency band for vital network connections.

During the last year the Netherlands Radio communications Agency received 4 complaints about interference in this frequency band. Three of these complaints were due to ISM equipment operating in this frequency band. Only 1 complaint was caused by interference due to a "high" power (O)RLAN in the vicinity of the interfered (O)RLAN. This problem was solved, by choosing a different DSSS channel.

Field inspectors of the Dutch Radio Agency encountered the following difficulties during their inspections:

- Field strength measurements of air were proved to be unreliable due to reflections, multi-path propagation and the inaccessible location of the transmitter aerials.
- Power measurements using a power meter or a directional coupler. Since this kind of measurement requires the equipment to be turned off, to enable the inspector to install the measurement equipment, the users objected that their network operations would suffer severely. Also they required guarantees that their network operations would resume normal working after the tests were performed. These guarantees could not be given.
- Since this inspection a licence is no longer required the Radio Agency no longer has any knowledge about the location of ORLANs.

Placing on the market
A quick survey of the availability of the equipment was performed. The (O)RLAN components are freely available in several price ranges. The intended use varies between access points with integrated antennas for a home network to professional equipment with external antennas and adjustable power settings.

Remarkable in this survey is that most suppliers of this equipment are specialists in computer or network installations. They have a very limited understanding of the particulars of RF equipment and the pitfalls of installing RF components. Especially the risks of combining a 2.4 GHz transmitter of 100 mW with an aerial with 24 dB gain are unknown

Site coordination procedures; site clearance procedures.
OOB-Emissions normally do not remain in compliance with the limits in ERC REC 74-01!!!

Be aware of stricter limits for SRDs in Broadcast Frequency Ranges

Class 1 ===?
Directional antennas with up to 24 dB gain are freely available in several price ranges. On the Internet a quick search resulted in a multitude of companies producing said aerials. The sale of these aerials is not restricted.

Problems in enforcement are encountered due to the fact that RLAN equipment with external antennas can be equipped with any type of aerial that is available. The rules and regulations do not require a dedicated antenna in combination with the transmitter.

The R&TTE directive stipulates that the sale of equipment conforming to the essential standards cannot be restricted. The transmitters are in compliance with this directive. Antennas are not covered by the R&TTE Directive. Only the combination of both results is a breach of the applicable rules and regulations governing this frequency band.

United Kingdom
In the UK the band 2400-2483.5 MHz is allocated for the use of RLANs on a licence exempt basis. This allocation is specified in UK Interface Requirement IR 2005, which permits a maximum e.i.r.p of 100 mW in accordance with Recommendation 70-03.

This allocation is understood to be on a non-interference, no protection basis and accordingly OFCOM does not take active measures to police the band but will investigate complaints relating to alleged use of non-conforming equipment. If such equipment is found to be in operation OFCOM will take action to ensure that transmission ceases and the offending equipment is removed.

Anecdotal evidence suggests that illegal equipment may be more widely used than it is found.

Equipment compliant to IR 2005 may be used to provide fixed links and indeed is widely used in this configuration in the UK, especially in the education sector.
All equipment configurations must comply with the IR 2005 maximum e.i.r.p limit, whether directional antennas are employed or not.

OFCOM has recently become aware of widespread dissemination of information relating to self-build antennas made of household waste (principally metal packaging) that are claimed to provide significant gain.

As a research project some of these were constructed according to information found on the Internet. The initial results of this work show that with extremely cheap and easily obtainable materials it is possible to make a simple antenna giving around 8 dB of gain. This has implications for the use of this band. OFCOM therefore will take enforcement action in future against any installation where these antennas are found if their use exceeds the e.i.r.p limits of IR 2005.

Portugal
Subject: equipment that complies with R&TTE Directive but cannot (eventually) be placed on the Portuguese market nor used.

Introduction
RLANs are used more and more all over Europe, and sometimes its use does not comply with the purposes for which they were created. The issue was raised when several RLANs were detected (in The Netherlands, for example) using directional antennas with up to 24dB gain sometimes with a 10dB power amplifier in between. These stations could reach distances of up to 30 km, which makes them not LOCAL but REGIONAL.

Portuguese Legal Framework
In Portugal, RLANS are allowed to operate in the frequency band 2400 – 2483.5 MHz, with an e.i.r.p. not exceeding 100 mW and integrated or dedicated antenna (as mentioned in ERC DEC (01) 07). If they comply with these requirements then they are exempted from licensing and can be used in a non interference basis.

These requirements are part of our SRD interface specifications and are also part of Administrative Rule 217/2001, which adopts most of ECC REC/70-03 and regulates licence exemption for several types of equipment, including SRD. The definitions of integrated antenna ("non removable antenna") and dedicated antenna ("removable antenna delivered with the equipment") are also included in the abovementioned Administrative Rule.

Enforcement
Enforcement of Portuguese legislation for these devices has two components.

Market surveillance
RLANs are in the scope of R&TTED, and if they comply with the Directive Member States cannot impede placing on the market. If there are restrictions for use in a certain country, information to the user mentioning that should be available in the package and in the user's manual.

Monitoring surveillance actions and response to complain.
RLANs must not interfere with licensed, emergency or security stations.
Complains are investigated in order to determine the origin and the characteristics of the interfering signal.

Practical case
An RLAN equipment in the frequency band 2400 – 2483.5 MHz, with an e.i.r.p. not exceeding 100 mW, delivered without an integrated antenna and with an external socket, CE mark, D.o.C., etc, is put on the Portuguese market. The package shows no information to the user warning him for restrictions in Portugal.

Possible Action
This equipment cannot be used without an integrated or dedicated antenna, and cannot be placed in the market unless there's a warning to the user. But even if there was such a warning saying for example that "this equipment must be used with a dedicated or integrated antenna" that wouldn't make sense because by definition, integrated or dedicated antennas should have been included in the equipment / package.

France
An inspection of a community RLAN network in the town of La Rochelle gave the following results:
The builder of the network was convinced the network was within the regulations because he used transmitters with 50 mWatt power. However these transmitters were combined with directional antennae with up to 30 dB gain resulting in over 30 Watt e.i.r.p.
To measure the power there has to be a continuing data stream available to guarantee a constant transmission.
Only reliable method proved to be calculating the e.i.r.p. on basis of transmitter parameters, antenna gain and cable loss.
The personnel of the IT department of La Rochelle had a background of network and computer technology and were ignorant about RF terminology and regulations.

Germany
The RegTP performed during the 4th quarter 2003 measurements at ORLANs in Berlin, Hamburg, Munich and the Ruhr area.

Main Results:

1. The e.i.r.p. limit of 20 dBm was exceeded in most ORLAN cases. The limit of 100 milliwatts was regularly exceeded by about 6 dB to 10 dB with exceptions even higher.
2. Main reason for illegal operation was the use of a directive antenna without reducing the output power accordingly. This was despite of the fact that the operators were aware of the regulatory restrictions. Private operators even use self-made antennas. Several fora were found in the Internet that provides construction manuals.
3. The results were comparable to the ones from ANFR.
4. Field inspectors were surprised by the existing high usage density of 2.4 GHz ORLAN in the cities. (This can be monitored by means of e.g. a software tool <<Netstumbler>>).
5. Several different devices showed a transient response during settling time (measured according to EN 300 328, clause 7.2) with excessive output power up to 10 – 15 dB higher than during operations.
6. In most cases the operation of the equipment was not protected at all.
7. More measurements / campaigns needed in future.

ANNEX B: DEFINITIONS AND ABBREVIATIONS

Definitions
Abbreviations

802.11b	Wireless network standard for 2.45 GHz max. 11 Mb/s
802.11g	Wireless network standard for 2.45 GHz max. 54 Mb/s
CEPT	Conférence Européenne des administrations des Postes et des Télécommunications
DF	Direction Finder
DSSS	Direct Sequence Spread Spectrum
E.I.R.P.	Equivalent Isotropic Radiated Power
EC	European Community
ERC	European Radiocommunications Committee (now: ECC)
ERM	Electromagnetic compatibility and Radio spectrum Matters
ETSI	European Télécommunications Standardisation Institut
FHSS	Frequency Hopping Spread Spectrum
HomeRF	Wireless network standard.
IEEE	Institute of Electrical and Electronics Engineers
ISM	Industrial, scientific and medical
OFDM	Orthogonal Frequency Division Multiplex
ORLAN	Outdoor RLAN
R&S	Rhode und Schwarz
R&TTE	Radio Terminal Telecommunication Equipment
RLAN	Radio Local Area Network
SRD	Short Range Devices
TX	Transmitter
WiFi	Wireless Fidelity

ANNEX C: REFERENCES

[1] ERC Recommendation T/R 10-01; Wide band data transmission systems using spread-spectrum technology in the 2.5 GHz band.

[2] EN 300 328: Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2.4 GHz ISM band and using spread spectrum, modulation techniques; Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive.

[3] ERC Recommendation 70-03 relating to the use of Short Range Devices (SRD).

[4] ERC/DEC/(01)07; ERC Decision of 12 March 2001on harmonised frequencies, technical characteristics and exemption from individual licensing of Short Range Devices used for Radio Local Area Networks (RLANs) operating in the frequency band 2400 - 2483.5 MHz.

[5] ERC Recommendation 74-01 relating to Spurious emissions.