European Communications Office (ECO)

ECO REPORT 02

THE IMPACT OF RECEIVER PARAMETERS ON SPECTRUM MANAGEMENT REGULATIONS

A PILOT STUDY

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This Report had been created by ECO on request by ECC and was subsequently published as a ECO Report.

Strategic Context and Discussion

Background

There is an increasing attention to the importance of receiver parameters in spectrum management. One of the most prominent developments in this field in the last two years was the RSPG[1] "Opinion on Streamlining" in November 2008. This concluded that the importance of receiver parameters had not always been properly represented in spectrum management. Some outcomes had not been optimum in facilitating new applications. Increasing flexibility in spectrum management would only increase this importance.

The RSPG Opinion [1] recommendations included (5.15) that:

> "…receiver parameters should be included in harmonised and/or product standards for all equipment and administrations should encourage the development of good performance receiver specifications. The RSPG further considers that receiver parameters should be used consistently by CEPT in sharing studies as part of the assumptions for the intended use of the band, taking into account equipment already in use before the adoption of standards including receiver parameters."

ECC Report 127 [2] was published shortly before the RSPG Streamlining Opinion. This considered several examples of spectrum management situations made sub-optimal by the restrictions of inadequate receiver performance (whether real or assumed). The Report recommended that the identification of the appropriate standards, and the mechanism for applying them, should be considered on a case-by-case basis. Further, this should only be done where necessary for spectrum management purposes (including, by implication, unspecified future uses).

ECC Report 127 [1] further recommended that standards (notably Harmonised Standards) should be reviewed periodically to bring them into line with improvements made possible by technological development. However, changes should be subject to an impact assessment, the depth of which would vary from case to case. Further study was recommended to refine that point.

Objectives of the Pilot Study

Against this background the ECC endorsed the Office's proposal in 2008 to conduct a pilot study, the primary objective of which was, for the specific case chosen, to "identify whether and how different choices in the values for receiver parameters, and whether and how to apply them through spectrum regulation or standards, might influence spectrum management such that net economic welfare may be increased". It was hoped that this would reveal "evidence-based arguments in favour of the status quo, or in favour of an alternative approach to this aspect of spectrum management".
A secondary objective was to gain some experience with the use of Impact Assessment.

Principal Conclusions of the Pilot Study

The Impact Assessment carried out within this study considered what the impact would have been of different choices in the regulatory requirements for receiver parameters. It revealed that in the specific case studied (Social Alarms at 868 MHz) different choices would probably have made little or no difference to future spectrum management outcomes. There are two reasons for this. One, related to the present, is that for these systems manufacturers have tended to adopt higher standards than the minimum in order to secure a better performance for the systems which they place on the market. The other, related to the future, is that candidate applications[2] in adjacent bands may have such high deployment densities that even a high performance of alarm receiver would not solve incompatibilities. On the other hand the Impact Assessment draws attention to the uncertainties about the future deployments, so even here it could not be said that receiver standards would not be relevant. In the more general case, for medium-to low density new services, this pilot study's two main workpackages suggest that the receiver parameters of the existing service would indeed have made a difference to the ability to introduce a new service.

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[1] The Radio Spectrum Policy Group, a body of national ministries and regulators from the EU countries.

[2] Tire pressure monitoring and remote metering

Discussion

This pilot study deals with one specific case. It does not alter the basic policy premise that receiver parameters (what parameters are applied and how this is regulated) can impact on spectrum management opportunities at a later stage, and that inadequate or excessive standards can mean an economic and/or social opportunity cost.

However, the pilot study does appear to support the Recommendation of ECC Report 127 [1] that the appropriate standards for receivers, and the mechanism to apply them, should be considered on a case-by-case basis.

Nevertheless, the key decisions about receiver parameters in spectrum management are made when a service is newly introduced. It is generally not possible to anticipate what future uses will be sought in adjacent bands, and therefore what the actual impact of a given set of decisions about receiver standards/parameters will be (other than for the internal efficiency of the service/applications concerned, on issues of link design, deployment topology and density scenarios).

Therefore, although the need to consider and determine receiver parameters on a case-by-case basis appears justified, that consideration should include the systematic objective of maintaining the future flexibility of spectrum usage. The marginal implementation cost of this to the new service should be kept to a reasonable level.

Impact Assessment

The Pilot Study used impact assessment as a key part of its methodology. Two associated objectives stated at the start of the study were to (a) "present a case study showing impact assessment integration in the development process of an ECC deliverable" and (b) to test the WG RA IA methodology (which were just proposals at that time). However, the evaluation of these aspects was not included in the scope of the study, neither as proposed nor as carried out. It was proposed that WG RA could consider any implications the study might have for the use of IA within the ECC.
In the context of its own study, the Office believes this use of consultants was an effective way of getting work done, and of securing the relevant independent expertise within the required timescale.
However, the Office's experience since the IA component of the Pilot Study was revealed is that some administrations have two particular areas of concern.

- One concern is a caution about the principle of Impact Assessment, and that a given methodology such as the one used in this case, may become applied in all cases. There appears to be concern that a common set of policy values would come to be used in all cases to evaluate a preferred outcome.
- A second area of concern is the use of external consultants. The concern is that this does not allow for national positions to be adequately taken into account, and therefore it may not always fit with the CEPT's consensus model of working.

Table of contents

0 EXECUTIVE SUMMARY

This Report has been prepared by the European Communications Office (ECO) in response to a request from the CEPT's Electronic Communications Committee (ECC). It develops work undertaken in 2008 relating to the impact of receiver performance on spectrum management, initiated in the ECC and reflected in ECC Report 127 [2]. The study in ECC Report 127 [2] revealed several cases where it would have been possible to make a significant difference to an outcome in spectrum management if the treatment of receiver performance, and particularly the application of receiver parameters, had been different (i.e. an overall economic benefit might be obtained by applying more demanding requirements for receivers, backed by an appropriate regulatory framework).

Historically the extent of technical benefit or disadvantage of having tighter receiver requirements has not been quantified, and so the relevant evidence available to this study is very limited.. In particular, there is a lack of available impact analysis to determine whether and to what extent an alternative approach or alternative receiver parameters would have given a net economic benefit in a given case.

Based on the above considerations, the ECC decided that further to ECC Report 127 [2] a pilot study should be carried out which would reveal how different choices of receiver requirements in a specific band may give different technical and economic outcomes. The objective was to increase the understanding about the role of receiver parameters in spectrum management, and to quantify to a given extent the technical benefit or disadvantage of having tighter receiver requirements. A secondary objective was to exercise Impact Assessment in formulating conclusions and recommendations for the ECC's work. This Report provides an overview of the Pilot Study Project and some of the main conclusions achieved, in particular comparison is made between the findings of this study and those that were achieved in ECC Report 127 [2].

The ECO examined a number of potentially suitable frequency bands for this pilot study and finally decided, following the endorsement by the ECC, to focus the analysis on the sub-band 868.6-868.7 MHz which is designated for the alarm systems which are being interfered by non-specific SRDs operating in both adjacent frequency bands. In accordance with this interference scenario, both victim and interferer operate in non-licensed spectrum which, as it was revealed by the study, appears to be one of the dominant factors driving the choice of receiver parameters. The choice of this band had also the advantage of calculation tools such as SEAMCAT, thus enabling ECO to produce a case study based on recognised calculation methods.

The study consisted of a number of Work Packages (WPs), including the Pilot Inventory (WP1), technical case studies (WP2) and impact assessment (WP3) which were carried out in a successive order.

Three different receiver categories of alarm systems operating in this band were considered (namely 1, 2 and 3), first one being the most stringent in terms of requirements to receiver parameters. The interference modelling carried out in WP2 was based on the interfering non-specific SRDs (at various densities) operating under the regulatory envelope specified by ERC/REC 70-03 [3]. The results confirmed that from a technical perspective there were potential benefits in tightening the alarm receiver performance (i.e. Categories 1, 2 and 3 in the ETSI standard) in terms of a reduced probability of interference.

The main goal of the impact assessment (IA) part was to assess, based on the IA methodology of ECC Report 125 [4], the relevant costs and benefits of adopting more stringent receiver requirements. It was assumed that the objective of tightening the receiver categories was to maximise overall social welfare. The following regulatory options were considered:

- the status quo (maintaining the existing Categories 1, 2 and 3);
- adopting Category 1 only;
- adopting Category 1 and 2 only;
- waiting (until there is more information or an interference problem emerges).

Other stakeholders' options such as adoption of other means of interference mitigation, and the use of wired systems were also considered.

The IA showed that the potential benefits of tightening the receiver performance of alarm systems (revealed in WP2) would not be realised at present, because there appears to be relatively little use of non-specific SRDs in adjacent bands. It also revealed that the candidate future systems in adjacent bands may have such a significant impact that even the use of the most high-performance category receivers would not give protection.

In conclusion, the impact assessment suggested that imposing a higher receiver category for this particular case of alarm systems would involve costs and might result in little benefit (if any). Given the uncertainties over the future deployment of

SRD devices in adjacent bands, the IA suggests the best policy conclusion in such a case would be to maintain the status quo and monitor the developments in use of adjacent bands.

Such a conclusion of the IA posed an interesting question: should the regulator assume the characteristics of applications that are foreseen and going to be used in practice or the characteristics allowed by the regulations? The analysis ECO has carried out suggests, at least for the unlicensed spectrum, that the regulator needs to use information on what is actually happening in the market and the nature of the incentives which market players are facing, before deciding on the most suitable approach to the interference modelling which is a key input to ECC regulatory decisions.

The following main conclusions can be drawn from this Receiver Parameters Pilot Study:

- Whether or not an increase in net economic welfare can be achieved by a particular choice of receiver performance will depend upon factors which include the opportunity cost of restricting future systems which would use adjacent bands[3].
- Mandating particular receiver performance characteristics may or may not be an effective protection against other, as yet unknown future systems. Improved receiver performance increases the probability that new spectrum applications can be introduced at a later stage. On the other hand, the specified performance may be higher and more costly than necessary; therefore a balance should be struck using the best available information at the time of standardisation.
- The incentive to increase the quality of receiver parameters to achieve better performance is usually dominated by the interests of one group of users which is seeking to optimise their collective performance in the bands that they use. Therefore, external regulatory intervention aimed at protecting one group of users from another is also relevant, but at the level of receiver parameters this issue is typically addressed by standardisation rather than by direct spectrum management measures.
- The potential of the available interference mitigation techniques is an important element to consider within any general receiver parameters policy.
- The study addressed a case of licence-exempt bands, and potential interference from other licence-exempt devices. The conclusions drawn in a similar study could be different where licensed use is involved, and additional tools such as spectrum pricing and trading are available. This point requires further consideration.

[3] It might be dependant on the impact of allowing interference from new systems into existing ones. Also this consideration was already recognised at the start of the study; it is included here to give context to the other conclusions.

LIST OF ABBREVIATIONS

Abbreviation	Explanation
CEPT	European Conference of Postal and Telecommunications Administrations
WP	Work Package
ECC	Electronic Communications Committee
ECO	European Communications Office
ETSI	European Telecommunications Standards Institute
RSPG	Radio Spectrum Policy Group
IA	Impact Assessment
LBT	Listen before talk
SRD	Short Range Device
RFID	Radio-frequency identification devices
BEM	Block Edge Mask

1 BACKGROUND AND INTRODUCTION

1.1 ECC Report 127 and other developments

ECC Report 127 [2] was developed in order to consider the impact of receiver performance on spectrum management. It was developed in collaboration with relevant groups within the ECC and ETSI in order to identify examples where an outcome in spectrum management can be different if receiver performance had been treated differently. Typically, these are lost opportunities to develop new services to their full potential or these may result in constraints to existing services due to interference. The hypothesis underlying the study is that by applying more demanding requirements for receivers, backed by an appropriate regulatory framework, an overall economic benefit might be obtained.

The ECC Report 127 [2] does not quantify the extent of technical benefit or disadvantage of tightening the receiver categories. There is a lack of available impact analysis to determine whether and to what extent an alternative approach or alternative receiver parameters would give a net economic benefit.

Nevertheless the ECC Report 127 [2] has revealed sufficient cases to suggest that the role of receiver parameters (also referred to in this report as "Rx parameters") in standards and their related consideration in spectrum engineering should receive greater prominence in order to promote more efficient use of the spectrum, including maximising economic and social welfare.

One significant factor in the equation is that improvements in technology allow for opportunities to improve spectrum management. This presents regulatory opportunities and challenges:

- at some point in time regulatory requirements can be introduced to implement more stringent requirements;
- the modification of Harmonised Standards (HS) may not always address issues relating to legacy receivers.

Frequency scarcity coupled with the wish for more generic, technology neutral spectrum regulation makes technical characteristics of both transmitter and receiver within reasonable limits necessary.. With 'reasonable limits' it means that some applications face certain limitations e.g. as power consumption and size constraints affecting directly some essential receiver and transmitter parameters. However, although we have strict limits for the transmitter performance we have almost no limits for receivers although receiver parameters are in many cases just as important as transmitter parameters for spectrum utilisation and spectrum management.

A current example of this is that ETSI is revising Harmonised Standard EN 300 220-1 [5]. Receiver Category characteristics were recently changed. Stringent Category 1 was relaxed down to Category 2 compared to the previous version of the standard (in relation to the Adjacent Channel Selectivity). The worst Category (Category 3) was also tightened up to Category 2.

There is a stronger general acceptance that receiver parameters may be included in Harmonised Standards. This was emphasised by the RSPG in its opinion on "Streaming the regulatory environment for the use of spectrum" (Document RSPG08-246 final [1]), which was agreed in November 2008. This Opinion noted that "receiver parameters play a fundamental role in the policy framework aiming to make spectrum use more flexible. It is recognised that consideration of these receiver parameters are even more important in this context than in frequency bands used in a more traditional way."

Another evidence of the importance of Rx parameters in spectrum management appears to be the recently completed large-scale study "Exploiting the digital dividend – a European approach" which was commissioned by the European Commission and conducted by a group of consultancy companies led by Analysis Mason
(www.analysysmason.com/EC_digital_dividend_study).

That study has revealed the significant potential benefits of defining and harmonising the requirements to DTT receivers across the EU membership. In particular, one of the sector-specific recommended actions (Action 4) suggests that all DTT receivers should be required to conform to the pre-defined technology neutral minimum requirements for interference rejection and compression performance. This would in turn result, according to the study, in the increased efficiency of spectrum use as well as improved economies of scale and certainty of take-up for equipment manufacturers.

1.2 Introduction to this Pilot Study

Having reviewed the history of various cases relevant to receiver requirements policy, ECC decided that a pilot study should be conducted on how different choices for treating receiver requirements in a specific band may give different technical and economic outcomes. The objective was to increase the understanding of the role of receiver parameters in spectrum management. The role of Impact Assessment in formulating conclusions and recommendations in ECC's work was the secondary objective.

The ECO undertook an "Inventory of Cases" (see Annex 2), and based on this developed the Receiver Parameter Pilot Study in the frequency band 863-870 MHz. This band was identified because it is used by a number of un-licensed SRD applications and had the advantage that it was already considered in details in developing ECC Report 037 [6]. Therefore, accepted calculation tools were available (SEAMCAT), thus enabling ECO to produce a case study based on recognised calculation methods.

This proposal was supported by the ECC (Cordoba, 27–31 October 2008) which decided to conduct the Receiver Pilot Project in this band and tasked the ECO to take the lead on the development of this Project in consultation with ECC Working Groups and ETSI ERM. The Project Plan associated with the development of this Report is provided in Annex 1. This Report provides an overview of the Project and some of the main conclusions achieved, including a comparison between the findings of this Receiver Parameters Pilot Study and those of ECC Report 127 [2].

2 OVERVIEW OF THE COMPATIBILITY STUDY

This section highlights some of the main points relating to the compatibility study (WP2). Additional details can be found in Annex 2.

2.1 Identification of the band for the study

An EFIS search shows that the range of applications operating in the identified frequency range of 863-870 MHz is quite large. In order to reduce the scope of the study, it was decided to consider 868-869 MHz as a first step. The selected 868-869 MHz falls within the 868-870 MHz range which is historically the first band that was regulated on the basis of ECC Report 037 [6]. The 868-870 MHz range is the most highly used band by all types of SRDs.

The following applications are identified for the frequency range 868-869 MHz

- Defense systems;
- Non-specific Short Range Devices;
- RFID;
- Alarm systems.

It has to be noted that:

- For Defense systems no detailed characteristics are available.
- Non-specific Short Range Devices may operate in the frequency range 869-870 MHz except for the sub-bands for alarms according to the restrictions given in Annex 1 of ERC/REC 70-03 [3].
- RFID are operating only in the frequency ranges in sub-bands within the frequency range 865-868 MHz (see Annex 11 of ERC/REC 70-03 [3]).
- Alarm systems are operating in the sub-band 868.6-868.7 MHz (see Annex 7 of ERC/REC 70-03 [3]).

For the purpose of the Receiver Parameter Pilot Project it was decided to consider the simple scenarios where the alarm system (victim), operating in the frequency range 868.6-868.7 MHz is possibly impacted by interfering applications as non-specific Short Range Devices operating in 868-869 MHz (excluding the alarm band).

2.2 Regulatory framework for the study

2.2.1 ECC Recommendations

The framework for SRD operations can be found in Annexes 1 and 7 of ERC/REC 70-03 [3] for non-specific SRDs and alarm systems respectively.

Some of the technical parameters defining operational conditions for non specific SRDs and alarms systems are provided in Annex 2 of this Report.

2.2.2 ETSI EN 300 220

The technical requirement specification is given in EN 300 220-1 [5]. This covers also alarms systems.

The product family of short range radio devices is divided into three receiver categories each having a set of relevant receiver requirements and minimum performance criteria. The set of receiver requirements depends on the choice of receiver Category by the equipment provider.
Manufacturers shall choose one of the three receiver categories when designing their SRD receivers according to the grade of operational reliability they provide, therefore the provider shall specify the receiver Category of his choice and this shall be declared in the product literature provided to the user.

In particular, where an SRD may have an inherent safety of human life implications, manufacturers and users should pay particular attention to the potential of interference from other systems operating in the same or adjacent bands. Detailed information on receiver categories can be found in Annex 2 of this Report. Three different Categories (namely 1, 2 and 3) of alarm systems operating in this band were considered in the study - first one being the most stringent in terms of requirements to receiver parameters.

2.3 Description of the Victim system – Alarm system

- It is worth noting that even though there is an option for the alarm systems operating in this band to use 25 kHz channels or the whole band as a single 100 kHz channel, it appears that there is little or no use of the 100 kHz channel option.

The 100 kHz bandwidth is not required by the application which inherently transfers very small amounts of data.

These alarm systems consist of one or more control panels containing a radio receiver and the necessary processing equipment associated with a number of devices/sensors each of which contains a radio transmitter. The control panel is likely to be connected to a central security monitoring site or directly to the authorities (e.g. the police). The devices/sensors include such items as motion, smoke and door/window opening detectors, but also include alert/emergency transmitters relating to personal safety. These latter devices are mainly related to the security of workers rather than social alarms which have their own designated frequency bands, although it is difficult to distinguish between the two applications from a regulatory point of view.

2.4 Results of compatibility studies conducted between alarm systems (868.6-868.7 MHz) and Non-Specific SRDs (868.0-868.6 and 868.7-869.2 MHz)

The following parameters may be considered relevant to the receiver performance: IM free dynamic range, Blocking, Desensitization, Sensitivity / Noise figure, IF rejection, Selectivity, LO phase noise and stability. However for this particular example only the most relevant parameters were assessed, consistent with the parameters in the EN 300 220-1 standard [5].

In the framework of WP 2, when assessing the possible interference on the three categories of receivers described in EN 300 220-1 **Error! Reference source not found.**, following receiver parameters: adjacent channel selectivity (ACS) and blocking or desensitization were considered. Two interference phenomena were considered in the compatibility study through SEAMCAT simulations (Fig. 1 illustrates two mechanisms simulated by SEAMCAT):

- Unwanted emissions[4]
- Blocking characteristic[5]

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[4] The term “unwanted emission” is defined by No 1.146 (Article 1 of the RR)
[5] The term “blocking characteristic” includes both receiver selectivity and receiver blocking phenomena as described in ECC Report 127 [2].

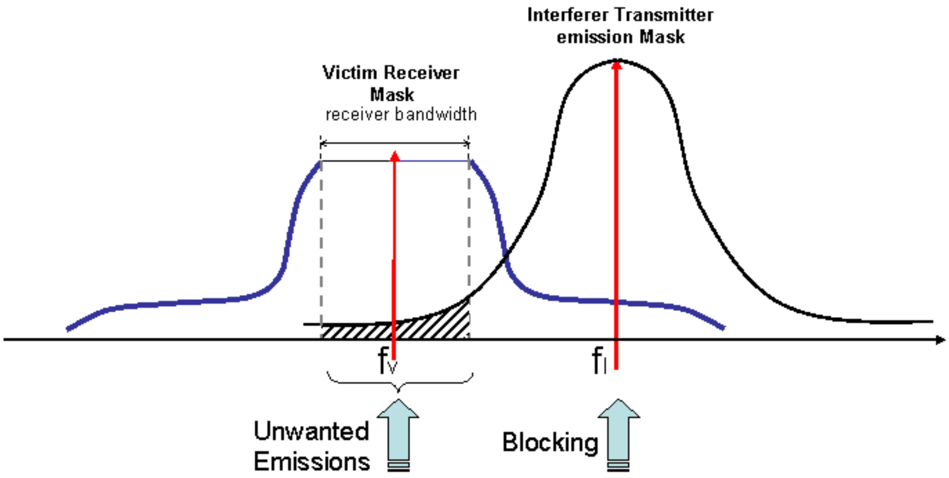

Figure1: Illustration of unwanted emission arriving from transmitter and blocking characteristic of the receiver

Compatibility study, which considered the three categories of receivers, demonstrates that:

- The probability of interference due to unwanted emissions remains at the same level for all three categories.
- The probability of interference due to the blocking effect increases from no interference (0%) up to more than 6%. This showed that interference due to blocking effect depends on the characteristics of the receiver (receiver blocking mask) and became stronger when Category 3 (less stringent) was considered.

Some additional simulations were performed in order to investigate impact of the transmitter density to the probability of interference. It was demonstrated that if the density of generic SRDs was increased the probability of interference was significantly increased.

This leads to consideration of receiver parameters as options to improve possible spectrum management issues that would result in improving the response to blocking, and to identifying the following options:

- maintaining the existing Categories of receivers (referred to as Categories 1, 2 and 3);
- Adopt the most tight category of receivers (Category 1);
- Adopt the 2 most stringent category of receivers (Categories 1 and 2).

It has to be noted that the transmitter density may increase the probability of interference to an extent where other parameters, such as receiver category, will no longer have any impact on the other users and could not worsen the interfering situation.

3 OVERVIEW OF THE IMPACT ASSESSMENT

This section highlights some of the main points relating to the Impact Assessment (WP3). The impact assessment itself can be found as Annex 3.

3.1 Scope of Impact Assessment (WP3)

WP3 was aimed to assess the differences in cost between the three categories of receivers considered under WP2 and also the distribution of the three categories of receivers currently on the market. Account was taken, to the extent possible, of the economies of scale, which would apply if all receivers would comply with a higher standard.

It was assumed for the Impact Assessment study that the objective of the receiver standards is to maximise the overall social welfare. IA has an aim to assess the costs and benefits of adopting Category 1, or Category 1 and Category 2 receivers only, instead of the status quo where three categories are available. Consideration was made in relation to the applications operating in the band 863-870 MHz and the costs and benefits of limiting allowed ETSI receiver Categories to 1 and 2 or 1 only. The general approach could have wider application. However, conclusions in relation to the 863-870 MHz would not necessarily apply to other frequencies. No general conclusion, regarding the appropriateness of changing receiver category, should therefore be inferred from the IA study.

For more detailed references on how this Impact Assessment study was conducted see Attachment 2 to of this document.

3.2 Summary of findings of the Impact Assessment conducted by Plum&Aegis

As mentioned above, the report on Impact Assessment (IA) (WP3) aimed at assessing the costs and benefits of adopting Category 1 only, or Category 1 and Category 2 receivers only, instead of the status quo where three categories are available. In summary, it was concluded that:

- the incremental costs of mandating Category 1 receivers will exceed the incremental benefits for some and possibly many countries in Europe;
- in terms of costs, mandating Category 1 receivers would impose financial costs and added size in relation with the devices which are currently manufactured according to Category 2. The cost penalty of adopting Category 2 rather than Category 3 devices is more modest and likely there will be no size penalty;
- there would be little, if any, benefit from adopting Category 1 (or potentially Category 1 and 2) mainly because the population of devices is not large enough and they are operating according to the regulatory envelope.

The IA study has shown that the regulator therefore is faced with a dilemma. Should the regulator assume the characteristics of applications that are foreseen and going to be used in practice or the characteristics currently allowed by the regulations? It appears that there is no unique and definitive answer to this question.

Indeed market players may anticipate the interference problems and adjust their behaviour accordingly or may have other reasons for operating below the regulatory envelope. The analysis suggests that the regulator needs to use information on what is actually happening in the market and the nature of the incentives facing market players before deciding the appropriate approach to interference modelling.

Finally, the Impact Assessment study makes a conclusion that the spectrum management outcomes may not have been so different if more stringent receiver characteristics had been required at the regulatory level. However, that was in part based on the observation that candidate adjacent-band applications would be of a very density for deployment. That is quite a particular case which could not have been predicted when the Social Alarms first moved in to this band. On a more general case, the analysis of Work Package 2 shows that more stringent receiver characteristics would have made a significant difference to how feasible it would be to introduce new services in the adjacent band with a more moderate implementation density than that of remote metering and vehicle tire monitoring. And in that case, the conclusions of an Impact Assessment may well be different from those made in the case of this study (this is also reported in the Impact Assessment report itself).

4 CONSIDERATION OF THE RECEIVER PARAMETERS PILOT STUDY WITH REFERENCE TO ECC REPORT 127

The findings of the Receiver Parameters Pilot Study appear to be broadly consistent with the conclusions of ECC Report 127 [2] 'On the Impact of Receiver Standards on Spectrum Management'. Some findings reinforce the earlier report, while others neither support nor contradict it.

More specifically, we have found that the findings of our Pilot study reinforce the following conclusions of ECC Report 127 [2] (namely, conclusions 2, 3 and 4 in section 5 of ECC Report 127 [2]):

- receiver parameters are a crucial element of co-existence calculations and thus in spectrum management;
- carefully chosen values for receiver parameters should be available for compatibility studies;
- field surveys are necessary in many cases to determine the actual performance of receivers.

Indeed, the choice of receiver parameters and the role of market survey appear to be crucial elements for interference modelling which in turn is a key input to ECC regulatory decisions and other deliverables.

However, not all conclusions of ECC Report 127 [2] have been wholly confirmed as a result of this pilot study; rather the complexity and some of the relevant factors have been demonstrated.
In particular, in ECC Report 127 [2] the following conclusion was made (namely Conclusion 8):

- Some interference, especially in short range devices, affects the general public in a manner that they may not be aware of the real cause. An example is car locks in the 433 MHz band, where receiver performance is the cause of the problem. So the weakness of the feedback mechanism to the market can make market forces an unreliable mechanism for maximising consumer welfare. That is to say, there are several points of market failure in markets using radiocommunications. The role and further potential of standards and/or regulation to compensate for these market failures is significant.

Although the observation from Report 127 [2] still appears valid, the Pilot Study has analysed a case where market forces, appear to have delivered a welfare-maximising outcome. In other words, potential market failures have not been significant. In the case of the pilot study, even under a relatively relaxed framework for Rx requirements in the alarms' sub-band (3 different categories, but all being "recognized"), competing manufactures appear to make a good use of the available interference mitigation techniques in order to ensure the acceptable quality of their alarm systems. A significant difference between that and the car locks in the 433 MHz band is that the information available to the relevant players in the car locks case is less complete.

The sensitivity of outcomes to the differences of market dynamics in the different situations suggests that an optimum Rx parameters policy would, if possible and proportionate, take these differences into account.

This pilot study appears to reveal further considerations beyond those articulated in ECC Report 127 [2].

The most important one is perhaps the significant difference between non-licensed and licensed spectrum. Indeed, one can reasonably claim that licensees authorised, for example, based on the Block Edge Mask (BEM) approach within the WAPECS concept may well seek to use the assigned spectrum up to the regulatory envelope. This could create much more interference to the adjacent bands (both licensed and non-licensed) compared to the situation where the spectrum used by the interferer is "free" (non-licensed). However, further study would be required to confirm this particular consideration.

A specific case, where using the regulatory envelope would be fully justified without extra market surveys, appears to be one when safety related systems are involved.

Overall, in line with the sense of the conclusions drawn in ECC Report 127 [2], we conclude that there appears to be no "one-solution-fits-all receiver parameters policy" which would in all cases maximise economic and social welfare. Therefore the case-by-case approach in the regulatory toolkit towards Rx parameters policy still appears justified. However, it is beyond the scope of this study to suggest which approach to use in which case.

5 SOME REFLECTIONS CONCERNING IMPACT ASSESSMENT

As well as the substantive conclusions relating to receiver parameters set out in Section 5 below, some experiences were also gained in relation to the use of Impact Assessment, which was a secondary objective of the pilot project. Many of these reinforce existing thinking within WG RA.

The need to enrich any technical study with Impact Assessment should be justified and considered at an early stage when developing compatibility studies. Indeed, having made the initial plan of conducting the technical compatibility studies (WP2) and impact assessment (WP3) in a successive order, we realised later that these two stages could not be conducted entirely separately and sequentially in practice.

Continuous cooperation between people involved from technical and economic sides is needed in order to facilitate the necessary understanding. The use of external consultancy was in particular our experience when conducting the impact assessment part of the study.

Another observation is related to the method used by the consultancy companies for collection of the required data, which was quick and proportionately informative. This was done by series of interviews with the alarms' manufacturers. It should be considered whether this approach could be substituted within the ECC by issuing questionnaires for gathering statistical data and similar information required under any Impact Assessment exercise.

6 CONCLUSIONS

The following main conclusions can be drawn from this Receiver Parameters Pilot Study:

- Whether or not an increase in net economic welfare can be achieved by a particular choice of receiver performance will depend upon factors which include the opportunity cost of restricting future systems which would use adjacent bands[6].
- Mandating particular receiver performance characteristics may or may not be an effective protection against other, as yet unknown future systems. Improved receiver performance increases the probability that new spectrum applications can be introduced at a later stage. On the other hand, the specified performance may be higher and more costly than necessary; therefore a balance should be struck using the best available information at the time of standardisation.
- The incentive to increase the quality of receiver parameters to achieve better performance is usually dominated by the interests of one group of users which is seeking to optimise their collective performance in the bands that they use. Therefore, external regulatory intervention aimed at protecting one group of users from another is also relevant, but at the level of receiver parameters, this issue is primarily addressed by standardisation.
- The potential of the available interference mitigation techniques is an important element to consider within any general receiver parameters policy.
- The study addressed a case of licence-exempt bands, and potential interference from other licence-exempt devices. The conclusions drawn in a similar study could be different where licensed use is involved, and additional tools such as spectrum pricing and trading are available. This point requires further consideration

[6] It might be dependant on the impact of allowing interference from new systems into existing ones. Also this consideration was already recognised at the start of the study ; it is included here to give context to the other conclusions.

ANNEX 1: DESCRIPTION OF THE WORK PACKAGES AND PROJECT PLAN

Work Package	Description	Project Members Responsible
WP1: Pilot Inventory	Identification of the regulatory framework and associated technical provisions in one sub-band of the frequency range 863-870 MHz Analysis of the current regulatory framework established by CEPT. Identification of the use of the band (as noted in the EFIS system). List relevant CEPT and ETSI documents Identify technical parameters in the above documents. Summarise receiver parameters per system in the identified sub-band and compatibility cases to be considered (i.e. definition of possible scenarios in view of WP2). List relevant ECC Recommendations List relevant ECC Decisions Completion: 25 February 2009	Project Officer (ERO) WGSE
WP2: Case studies	Define one or more specific case studies including hypothetical scenarios featuring different alternative parameter values in receiver standards. ERO Project Officer reports in WG SE First Draft Report to ECC March 2009 Report and collect comment from WG SE via SE24 Further work complementary to Impact Assessment, then completion July 2009	Project Officer (ECO) WGSE
WP3: Impact Assessment	Analysis of potential regulatory and economic impacts of introduction of different hypothetical Rx standards, as compared to those observed for the existing Rx standard, for each identified case based on the IA methodology presented in ECC Report 125 on Guidelines for Impact Assessment ERO project officer reports in WG RA Results to be discussed in WG FM Interim report to ECC June 2009 Completion: end July 2009	Project Officer (ECO) WGRA
WP4: Conclusions	Drawing conclusions on the main regulatory and economic consequences of the introduction of hypothetical Rx standards as compared to those observed for the existing Rx standards for the considered sub-band Completion: end August 2009]	Project Manager (ECO) WGRA, Project Reviewers
WP5: Interim report	Develop a second interim report based on the conclusions of WP 4 which will draw together the previous work packages. This should offer conclusions of the sensitivity of spectrum management outcomes to alternative standards of regulation in the bands examined. Commentary would be offered on the potential to apply more or less stringent receiver planning standards in spectrum management, to the extent that this may be	Project Managers, (ECO) Project Reviewers

	more generally applicable in other bands. This will generally refer to the existing regulatory environment. Completion: mid-October 2009 (for input to October ECC meeting)	
WP6: Consultation	This will be in two phases: The conclusions drawn from the technical work packages and the Impact Assessment will be sent to Working Groups FM, SE and RA to be considered in their autumn meetings. The Interim Report from WP 5 will be sent to the ECC and comments will be received. The ECC may decide on the scope of any further consultation. Completion: phase (i) mid-October; phase (ii) mid-January 2010.	Project Managers
WP7: Final deliverable	Final report This will further develop the Interim Report, taking account of the consultation with the ECC. Completion: February 2010.	Project Managers, Project Director

ANNEX 2: THE ECO REPORT ON INVENTORY OF CASES AND CASE STUDIES OF INTERFERER TO VICTIM INTERACTIONS

ECO Report on cases study_WP2.doc

ANNEX 3: IMPACT ASSESSMENT FOR THE RECEIVER PARAMETERS PILOT PROJECT

Impact
Assesment_Plum_WP

ANNEX 4: LIST OF REFERENCES

[1] RSPG08-246 RSPG OPINION on “Streamlining the Regulatory Environment for the Use of Spectrum”.
[2] ECC Report 127 on the impact of receiver standards on spectrum management.
[3] ERC/REC 70-03 Relating to the use of Short Range Devices (SRD).
[4] ECC Report 125 on guidelines for the implementation of impact assessment in relation to spectrum matters.
[5] ETSI EN 300 220-1 on Radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods.
[6] ECC Report 037 on compatibility of planned SRD applications with currently existing radiocommunication applications in the frequency band 863-870 MHz.