



Authorisation regime for
GNSS repeaters
1164-1215 MHz, 1215-1300
MHz & 1559-1610 MHz

Consultation

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Executive Summary

- 1.1 This consultation sets out our proposals for a light licence regime to authorise the use of Global Navigation Satellite System (GNSS) repeaters in the UK to operate in any of the following RNSS¹ frequency bands 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz.
- 1.2 A GNSS repeater is a piece of radio equipment that receives, amplifies and transmits signals from a GNSS system (e.g. Galileo, GPS) to provide a GNSS signal in indoor environments that would otherwise have limited or no coverage. A GNSS repeater is comprised of a simple receive antenna placed outside a building, an amplifier, and a transmit antenna inside the building.
- 1.3 CEPT has published two reports (the CEPT Reports), and an ECC Recommendation (the Recommendation) based on a harmonised ETSI standard (the ETSI standard) that seeks to limit the risk of compliant devices causing harmful interference with other GNSS receivers.
- 1.4 Based on the results predicted in the CEPT reports, Ofcom considers that GNSS repeaters compliant with the ETSI standard are unlikely to cause harmful interference effects. As a result, Ofcom proposes that the use of GNSS repeaters should be authorised in the UK.
- 1.5 This proposal relates only to GNSS repeater systems. For other technologies including (but not limited to) GSM, UMTS, WiMAX and LTE, the use of repeater equipment (other than by the licensed network operators), may cause harmful interference effects and such use is a criminal offence under the Wireless Telegraphy Act 2006.
- 1.6 Ofcom has investigated the possibility of licence exemption for GNSS repeaters. However, we are proposing a light touch licensing regime as a precautionary approach taking into account concerns raised by the CAA in relation to the residual risk of interference with aviation equipment. The licence regime we are proposing would be a site licence approach, whereby Ofcom would record the locations of all licensed GNSS repeaters. We consider this provides an adequate basis for the resolution of any harmful interference that might arise.
- 1.7 Ofcom now seeks responses to the questions raised in this consultation by 16th April.

¹Radio Navigation Satellite Service (RNSS). All GNSS systems, such as GPS and Galileo operate within these radio spectrum allocations.

Section 2

Introduction

What are GNSS repeaters?

- 2.1 GNSS repeaters receive, amplify and transmit signals from a Global Navigation Satellite System (GNSS) in order to provide coverage within a building where the GNSS signals do not reach. These GNSS repeaters use a simple set of radio equipment, i.e. a receive antenna, an amplifier and a transmit antenna. The receive antenna is placed at a fixed position outside a building, in view of the GNSS satellites, and the transmit antenna is placed inside the building, where GNSS signal is desired.
- 2.2 GNSS repeaters equipment could operate in any of the following GNSS frequency bands: 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz. We expect that most of the commercial demand will be for equipment operating in the band 1559-1610 MHz, where the use of GPS receivers is ubiquitous.

What benefits would GNSS Repeaters provide to users?

- 2.3 Many consumer and industry products contain GNSS receivers used for positioning and timing applications. GNSS receivers are found in the majority of mobile smart phones and a range of transport, including aircraft and ships. Location reports from GNSS receivers can be used for managing vehicle and personnel resources. They are used by the emergency services, in the military, in agriculture, and civil engineering.
- 2.4 GNSS repeaters can provide continuity of GNSS signals in areas of low or no coverage (e.g. inside buildings)².
- 2.5 Examples of potential uses for GNSS repeaters are:
- Manufacturers and sellers testing products with an integrated GNSS receiver;
 - Transport organisations (e.g. UPS, Securicor, AA and RAC) using GNSS receivers equipment in indoor environments for efficient resource management;
 - Emergency services, for efficient resource management.
- 2.6 The Ministry of Defence (MOD) already use professionally installed GNSS repeater devices for their operations within the UK.

Outline of document

- 2.7 This document is structured as follows:
- Section 3 considers the development of studies on GNSS repeaters;

² It is worth noting that where a GNSS repeater is used, the location derived by the receiver is that of the GNSS repeater receive antenna location and not the actual location.

- Section 4 considers the authorisation regime, taking into account GNSS repeater technical compatibility and impact;
- Section 5 of this consultation describes the licensing proposal and describes how Ofcom intends to implement the licensing regime approach and the next steps;
- Annex 5 provides an impact assessment of the planned regulations;
- Annex 6 provides an overview of GNSS repeater parameters, required installation information for the licence process and installation guidance;
- Annex 7 considers summarise and details the compatibility and impact of GNSS repeaters and relevant references to CEPT reports;
- Annex 8 provides a list of relevant references.

Section 3

Proposal to authorise the use of GNSS repeaters

- 3.1 Within Europe, GNSS repeaters have been available for a number of years. Some European countries, including the UK, identified concerns about the availability of devices with no defined radio parameters and which lacked conformance testing to limit and regulate any potential interference. The unregulated use of poorly installed and illegal GNSS repeaters that exceed radio parameters that are now embodied in the ETSI standard, have caused interference events in Germany, USA and Canada. In the German incident, a GNSS repeater at an airport hangar caused false alerts to aircraft taxiing and landing at the adjacent runway. For this reason, Ofcom has prohibited the use of GNSS repeaters in the UK³.
- 3.2 However, over recent years, and at UK's and other countries instigation, CEPT⁴ has considered the technical compatibility of GNSS repeaters, and the methods by which countries might authorise these devices. In 2009 and 2010, CEPT published two reports, ECC Report 129 on technical compatibility and ECC Report 145 on the framework by which GNSS repeaters might be authorised (the "CEPT Reports"). In 2010, CEPT published ECC Recommendation (10)02 (the Recommendation), which recommended that GNSS repeaters be authorised on a licence basis⁵.
- 3.3 The publication of the technical standard (the ETSI standard) EN 302 645 followed completion of the CEPT Reports. The main conditions in the ETSI standard are:
- The GNSS repeater maximum system gain will be limited to 45 dB and the e.i.r.p of amplified GNSS defined signals will be limited to -60 dBm;
 - The maximum output (saturation) power of the GNSS repeater system, when it is subject to signals that are not GNSS type signals, will be limited to -20 dBm. This limit also applies to any emissions of non-GNSS type signals that have been partly amplified and that are adjacent to, but outside of, the GNSS repeater bands;
 - The combining of two or more GNSS repeaters to increase overall system gain above +45 dB at any transmit antenna will not be permitted as this increases the risk of harmful interference;
- 3.4 The CEPT reports consider in detail various operating scenarios for GNSS repeaters and the effect that these may have on other systems. The potential for a GNSS repeater to cause interference is related to its maximum amplifier gain and saturation power. Unlike the examples of unregulated and illegal installations mentioned above, the operational range of an ETSI standard GNSS repeater is around 2 metres. At distances beyond 10 metres, the CEPT reports state that there should be little interference with GNSS receivers. The Recommendation also highlights the importance of correct installation.

³<http://stakeholders.ofcom.org.uk/enforcement/spectrum-enforcement/gpsrepeaters/>

⁴European Conference of Postal and Telecommunications Administrations

⁵Annex 7 contains links to all relevant publications

- 3.5 GNSS signals (and therefore GNSS repeaters) share frequency bands with other systems. The 1164-1215MHz band is shared with aeronautical Distance Measuring Equipment (DME). The 1215-1300 MHz band is shared with two general sorts of radar, long range civil aviation air traffic control radar and also the military equivalent. It is shared with a special type of radar called Wind profiler, which samples and detects the velocity of low altitude wind speeds.
- 3.6 There are a new generation of GNSS (mainly GPS) based aeronautical systems used today for improvement in airspace use and aircraft navigation performance. In light of these aviation and military systems we have discussed potential interference concerns with the MOD and the CAA. More details of our consideration of the potential impact of GNSS repeaters on in-band and adjacent-band services is given in Annex 7.
- 3.7 Both the MOD and the CAA initially identified concerns about the potential interference that GNSS repeaters may cause to GPS operations in the UK. However, both organisations have indicated that they would be in favour of the authorisation of GNSS repeaters, subject to the authorisation regime taking account of their concerns. These concerns are discussed in more detail in sections 4 and 5 below.
- 3.8 The existence of illegal GNSS repeaters operating at higher powers than the ETSI standard are the reason why Ofcom has moved forward carefully in considering the authorisation of these devices in the UK. There is a possibility that users may still buy and install GNSS repeaters that do not comply with the ETSI standard (i.e. non CE marked), and which may have the potential to cause interference due to high power / gain or erroneous installation. However, this risk arises regardless of whether Ofcom authorises the use of these devices. In Ofcom's view, an authorisation regime that legalises the use of ETSI compliant devices should encourage manufacturers to develop compliant equipment.
- 3.9 From the results predicted in the CEPT studies, Ofcom considers that GNSS repeaters compliant with the ETSI standard are highly unlikely to cause harmful interference effects. As a result, Ofcom proposes that the use of GNSS repeaters should be authorised.

Question 1 Do you agree with our proposal to authorise GNSS repeaters on the basis of the ETSI standard?

Section 4

Authorisation Approach

Introduction

- 4.1 A key question for Ofcom is whether to propose a licence exempt approach or a licence-based regime. This section outlines the steps taken to address that question.
- 4.2 Ofcom has moved forward carefully in considering the authorisation regime for these devices taking into account the views expressed by the MOD and CAA, both of which have a strong interest in the operation of radio navigation systems at these frequencies. Ofcom has also taken account of the fact that there is a degree of uncertainty as to how GNSS repeaters may operate in practice, as the CEPT reports are largely based on a theoretical analysis.
- 4.3 The format of the different authorisation options could be broadly as follows:
- To use a licence exempt approach based on the ETSI standard. The Interface Requirement might also include advice on installation as set out in the ETSI standard;
 - To use a light license approach incorporating the ETSI standard. This could be based on the functionality that already exists for other existing Ofcom licensing system, such as the Ofcom Business Radio simple site licence product.
- 4.4 Section 8 of the Wireless Telegraphy Act 2006 (the Act) requires Ofcom to adopt a licence exemption approach if certain conditions as set out in section 8(5) of the Act are satisfied. These include, amongst other things, that the GNSS repeaters are not likely to involve undue interference with wireless telegraphy, or endanger safety of life. Ofcom would only adopt a licence approach if it is not satisfied that these conditions are satisfied.
- 4.5 When weighing up the case for pursuing a licensing or exemption approach for GNSS repeaters, Ofcom has kept in mind the interference potential from spurious and other emissions of other radio services increasing the interference environment experienced by GNSS services.

Potential impact of GNSS repeaters on other systems

- 4.6 Ofcom also approached the Civil Aviation Authority (CAA) and Ministry of Defence (MOD) to seek their views on whether we should propose an exemption regime or a light license regime.
- 4.7 MOD considered the specifications of the ETSI standard for GNSS repeaters and indicated that, from their perspective, GNSS repeaters that meet this standard are unlikely to cause harmful interference to its operations. As a result, the MOD did not object to an exemption regime for civil use outside their operational areas. However, they indicated that for MOD locations and operational areas, they would control the installation of and monitor these devices themselves.

- 4.8 The CAA noted that aviation is becoming more and more reliant on GNSS for safety systems, with approval already granted for the use of GNSS for navigation and for certain categories of landings (where aircraft can land in a reduced visibility conditions). Work also continues on the use of GNSS signals for “Category 3” landings (where aircraft can land in zero visibility conditions), which are totally reliant on radio navigation aids.
- 4.9 The CAA also indicated that aviation communication ground infrastructure is reliant on GNSS signals as a timing source for data synchronisation (such as data links supporting the transport of radar information and voice communications to air traffic control centres).
- 4.10 The CAA was concerned that it would be difficult to undo a policy of licence exemption in the event that GNSS repeaters were found to cause interference with aeronautical systems. The CAA noted that the Recommendation indicates that GNSS repeaters should only be authorised on a site specific basis, that use should be restricted to professional applications and that specific implementation and installation guidance should be provided.
- 4.11 As a result, the CAA was not in favour of a licence exempt regime, at least until there is more experience of the deployment of GNSS repeaters. The CAA’s preference is for GNSS repeaters to be licensed in such a way that:
- a) the operational parameters under which the equipment should be operated can be made clear for the licensee;
 - b) Ofcom records all GNSS repeater locations and that the CAA could be informed of the location of any these GNSS repeaters
 - c) any cases of interference to aeronautical use of GNSS systems can be traced and the relevant remedial action taken quickly.

Proposal

- 4.12 Ofcom understands the precautionary approach of the CAA to the new GNSS repeater products, given the role of GNSS in navigation/landing etc. Ofcom considers that the concerns identified by the CAA would mean that the conditions set out in section 8(5) of the Wireless Telegraph Act would not be satisfied, as there is a risk of undue interference with wireless telegraphy and/or endangering safety of life. As a result, Ofcom is not required to adopt a licence exemption approach.
- 4.13 Under the circumstances, and taking note of the information gathered, Ofcom proposes to adopt a licensed approach for GNSS repeater authorisation.
- 4.14 The main purpose of this licence regime is to record the locations of GNSS repeaters so that the information can be used to resolve any interference concerns. We consider the CAA request for access to this information as reasonable and note that the information on licensees will be publicly available anyway on the Register (on the basis that we make these licences tradable). We also consider that a licensing approach will provide a practical means to communicate installation guidance to the entity responsible for the installation.
- 4.15 This proposal relates only to GNSS repeater systems. For other technologies including (but not limited to) GSM, UMTS, WiMAX and LTE, the use of repeater equipment (other than by the licensed network operators), may cause harmful

interference effects and such use is a criminal offence under the Wireless Telegraphy Act 2006.

Question 2 Do you agree with our proposal to use a licence approach to authorise GNSS repeaters?

Section 5

Licensing proposals

Introduction

- 5.1 This section sets out specific proposals for the licensing of GNSS repeaters in the event that we proceed with a licence approach. The approach is intended to address the concerns raised by the CAA in relation to aviation equipment, and to achieve a minimal regulatory burden, cost, and resource to implement the process. Ofcom has, in particular, taken account of section 9(7) of the Wireless Telegraphy Act 2006, which requires any terms, provisions or limitations on a licence to be objectively justifiable, non-discriminatory, proportionate and transparent.
- 5.2 This section addresses:
- Relevant standards;
 - Interference management and consideration of licence technical coordination;
 - The form of the licence;
 - Frequency bands;
 - Licence fee;
 - Licence duration;
 - Trading;
 - Mobility.
- 5.3 This section concludes with a summary of the proposals and sets out next steps.

Relevant standards

- 5.4 The licensing regime for GNSS repeater devices will require that devices are compliant to the procedures of the RT&TE Directive, and equivalent to ETSI Harmonised Standard EN 302 645.

Interference management and consideration of Licence Technical Coordination

- 5.5 GNSS repeater licence applicants might wish to install GNSS repeaters on, or in proximity to, aerodromes where there is operation of terrestrial GNSS timing receivers or ground based GNSS aviation applications.
- 5.6 As set out in section 3 above, we consider that a GNSS repeater has a low potential interference range and that there is therefore a low probability of interference with other GNSS receivers. Moreover, if interference does occur, it should be possible to quickly identify both installations due to their likely proximity.

- 5.7 Because of the licensing process, Ofcom will hold a database of all authorised GNSS repeaters so it should be possible to identify the location of a GNSS repeater causing interference with a GNSS receiver, and to take any necessary enforcement action. In addition, our licence application process will draw attention to the installation guidelines (see Annex 6 for more detail).
- 5.8 Given the residual concerns raised by the CAA about interference with aviation GNSS receivers, Ofcom has considered with CAA the merits of including a separate stage in the licence application process that would require a prospective licensee to seek CAA approval prior to being issued with a GNSS repeater licence.
- 5.9 Given that this would make the licensing process substantially more burdensome, and given that the licence approach would provide an information database to facilitate remedial action in the event of interference, the CAA has indicated to us that the risks should be manageable and that a separate technical coordination or approval process should not therefore be required.

Form of the GNSS repeater Licence

- 5.10 Ofcom proposes to issue simple site light licences and use the following general license approach for the management of these licences (including interference investigation).
- 5.11 Under a light licence approach, Ofcom would record the locations of all GNSS repeater installations at an address and also the licensee's address, if that is different. Ofcom will record the site locations to 10 metres accuracy; this is a National Grid Reference code with two letters and 8 numbers (effectively five figure easting and northing).
- 5.12 The simple site licence would require the installation to comply with the technical specifications set out in a published UK Interface Requirements document, requiring compliance with the ETSI standard.
- 5.13 The licence application will include authority for Ofcom to provide a copy of the details of the licence or an extract from the GNSS repeater licence database to the Civil Aviation Authority or MOD.

Frequency Bands

- 5.14 GNSS repeaters will operate in the Radionavigation Satellite bands, where GNSS operate (e.g. GPS, Galileo, and GLONASS). These bands are 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz.
- 5.15 The proposed licence would cover all three GNSS bands. Licence applicants will indicate in the application form the GNSS bands in which they wish to operate

Fees

- 5.16 We propose to apply a license fee of £75 per address, for one or more GNSS repeater installation at that/address.

Duration

- 5.17 We do not propose to impose a requirement to renew or revalidate the licence. The licence will be an indefinite, lifetime licence.
- 5.18 Ofcom will record and retain the records for every licensed GNSS repeater location. If Ofcom placed a renewal or revalidation requirement on these licences, this would add to the regulatory burden. Moreover, if licensees failed to renew or revalidate their licences, but continued to operate the GNSS repeater, Ofcom's database would be inaccurate, with potential implications for the investigation of any future interference.

Trading

- 5.19 Our general policy is to make licences tradable, unless there are reasons not to. Therefore, we propose to make the GNSS repeater licence tradable. We are proposing to only permit the outright or concurrent transfer of the whole licence to a third party. We will not permit frequency or geographical separation. Although we propose to make the licence tradable this would not permit any change of use.
- 5.20 When a company is taken over, our proposal would reduce the regulatory burden by avoiding the need for the existing licensee to surrender their licence and the new owner to re-apply. This would also mean that the new licensee would not have to pay a fee for the new licence. On any trade we will require applicants to inform Ofcom of the new licensee's information and we will record such information⁶. Where licences are tradable, the information includes the licence holder, contact name, telephone, e-mail and address, the licence class, the frequencies in use and the locations and is available on the publicly accessible Ofcom Wireless Telegraphy Act Register (WTR)⁷ and Transfer Notification Register (TNR)⁸.

GNSS repeaters used on mobile platforms

- 5.21 There may also be a market for mobile GNSS repeaters, with possible uses including vehicles with tinted glass (that would not otherwise be able to use an in-car GNSS receiver) The ECC Recommendation specifically excludes the use of such mobile GNSS repeaters because of concerns about interference. As a result, the ETSI standard does not apply to mobile GNSS repeaters and, within the UK, Ofcom Spectrum and Enforcement teams have taken action to prevent the use of such products. Therefore, Ofcom's proposal is that licences will be issued for fixed location GNSS repeaters only, and the use of mobile GNSS repeaters will continue to be illegal.

Summary of the proposal

- 5.22 Ofcom proposes the use of a simple site licence, with one licensed address having one or more GNSS repeater installations listed on it. The fee will be £75 for a tradable lifetime licence.

⁶ All necessary information and forms can be found at <http://licensing.ofcom.org.uk/radiocommunication-licences/trade-licence/>

⁷ <http://spectruminfo.ofcom.org.uk/spectrumInfo/licences>

⁸ <http://spectruminfo.ofcom.org.uk/spectrumInfo/trades>

- 5.23 The GNSS repeater will have no conditional element relating to a requirement to seek prior approval from the CAA. There will also be no technical frequency coordination process.
- 5.24 The Ofcom licence application form and guidance notes will include recommendations as to the factors that should be considered when an installation is designed and installed.
- 5.25 The Authorisation Directive requires us to review licensing regimes to consider whether they can be changed to a general exemption regime. We would expect to review this GNSS repeater licensing approach after an appropriate period of practical experience has been built up over a number of years.
- 5.26 Ofcom considers that the approach we have proposed addresses any concerns about interference caused by GNSS repeaters. The licensing process will include the recording of all locations of GNSS repeater licences, so that Ofcom Spectrum and enforcement can investigate reported and identifiable interference events. In addition, details of licences will be made available to the CAA to enable the swift resolution of any interference with aviation equipment.

Question 3 Do you have any comments on the proposals for the licence terms and conditions?

Ofcom's next steps

- 5.27 This consultation closes on 16th April and we will make a statement on our decisions once we have considered responses to this consultation.
- 5.28 If we proceed with the proposals after consultation we will need to make a number of associated regulations covering licensing procedures, fees, register and trading regulations. There will be no exclusivity on use of the radio spectrum for this particular application and no limitations on the number of available GNSS repeater licences; therefore we will not require any limitations order regulations.
- 5.29 We expect to be in a position to open licence applications in mid-2012, although the timing depends on competing priorities with respect to the work on our IS systems that is required to implement the new licence product.

Annex 1

Responding to this consultation

How to respond

- A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made by 5pm on 16th April 2012.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <https://stakeholders.ofcom.org.uk/consultations/gnss-repeaters/howtorespond/form>, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please steve.harding@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 You may alternatively post or fax responses to the address below, marked with the title of the consultation.
- Steve Harding
Floor 03:49
Department APL
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- Fax: 020 7981 3208
- A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

- A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Steve Harding on 020 7981 3189.

Confidentiality

- A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether

all of your response should be kept confidential, and specify why. Please also place such parts in a separate Annex.

- A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at:
<http://www.ofcom.org.uk/about/accoun/disclaimer/>

Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in December 2011.
- A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see:
http://www.ofcom.org.uk/static/subscribe/select_list.htm

Ofcom's consultation processes

- A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information, please see our consultation principles in Annex 2.
- A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact the Secretary to the Corporation, who is Ofcom's consultation champion:
- A1.16 Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
- Tel: 020 7981 3601
- Email Graham.Howell@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.
- A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate Annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your coversheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing Name/contact details/job title

Whole response Organisation

Part of the response If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name

Signed (if hard copy)

Annex 4

Consultation questions

GNSS Repeater Licensing

A4.1 Ofcom in its consultation has requested responses to the following questions:

Question 1 Do you agree with our proposal to authorise GNSS repeaters on the basis of the ETSI standard?

Question 2 Do you agree with our proposal to use a licence approach to authorise GNSS repeaters?

Question 3 Do you have any comments on the proposals for the licence terms and conditions?

Annex 5

Impact Assessment

Introduction

- A5.1 The analysis presented in this Annex, together with that elsewhere in this document, represents an impact assessment, as defined in section 7 of the Communications Act 2003 (the Act).
- A5.2 You should send any comments on this impact assessment to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals.
- A5.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally, we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on our website:
http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf

The citizen and consumer interest

- A5.4 GNSS Repeater equipment has a defined ETSI standard against which compliance with the R&TTE Directive is possible. GNSS Repeater equipment has been put into service and countries within the European Union have authorised these under individual licence regimes. Within the UK, we are aware of the illegal use of these devices.
- A5.5 We would intend to make available the GNSS repeater licence product in 2012. A measure of its success will be the lack of need for any interaction with applicants or interference events, because available installation guidance and processes were successful in assisting the licensee in solving any particular cases of concern.
- A5.6 This is a single licence issue and not a general policy objective for Ofcom.
- A5.7 We expect UK manufacturing industry, providing products with embedded GNSS receivers to take advantage of the GNSS repeater licence. Some verbal information exchanges suggested that the current UK regulatory regime prohibiting GNSS repeaters resulted in the loss of some product development in the UK.
- A5.8 We do not expect mass market application to use GNSS repeaters.

Ofcom's policy objective

- A5.9 We have a number of duties under section 3 of the WT Act, these include having regard when carrying out our radio spectrum functions to:

- i) the extent that spectrum is available for use; and
- ii) the desirability of promoting the efficient management and use of the spectrum for wireless telegraphy.

A5.10 Our objective is to seek a practical and low regulatory burden authorisation regime for these devices.

Options considered

A5.11 We considered the following options:

- To retain the current UK framework by which GNSS repeaters are prohibited from use by UK citizens and consumers.
- To provide the simplest authorisation for GNSS repeaters, a licence exemption approach.
- An alternative approach with reduced regulatory burden is a simple licence approach.
- An alternative to the approach of using a simple site licence is to have a licence requiring a detailed technical co-ordination check, or prior approval from the CAA.

Analysis of the different options

A5.12 Options

- Do nothing –we considered this in section 3.9 of this document. We are providing a route for UK stakeholders to operate equipment legally;
- We considered the option of a licence exemption approach in section 4. The use of a simple site licence process as an alternative is also considered in section 4 and we identify a low regulatory burden process;
- In section 5.4, we consider the need for a detailed technical coordination process.

The preferred option

A5.13 In section 4 and its conclusions and section 5.4, we identify the reasons for providing a simple site licensing approach. We believe that the devices are unlikely to cause harmful interference and that, in any event, the recording and retention of all licensed GNSS repeater locations will assist any interference investigation and enforcement action.

Equality Impact Assessment

A5.14 Following an initial assessment of our policy proposals we considered that it was reasonable to assume that any impacts on consumers and citizens arising from the proposals in this document would not differ significantly between groups or classes of UK consumers and citizens, all of whom would have access to these services, potentially at end-user prices reflective of all general input costs, including opportunity costs of spectrum used.

- A5.15 We do not consider that there is evidence to suggest that costs imposed on stakeholders, would differ significantly by these aforementioned groups of consumers and citizens relative to consumers in general. This is because one would not expect the impact of supplying these consumers and citizens to differ significantly between these groups and consumers in general.
- A5.16 Therefore we have not carried out a full Equality Impact Assessment in relation to race equality or equality schemes under the Northern Ireland and disability equality schemes. This was because we were not aware that our decision was intended (or would, in practice) have a significant differential impact on different gender or racial groups, on consumers in Northern Ireland or on disabled consumers compared to consumers in general.

Annex 6

General Characteristics and Licence Conditions

R&TTE and the UK interface Requirements

- A6.1 The ETSI standard sets out certain technical requirements in relation to GNSS repeaters. Some of these characteristics are:-
- a) The GNSS repeater maximum system gain will be limited to 45 dB and the e.i.r.p of amplified GNSS defined signals will be limited to -60 dBm.
 - b) The maximum output (saturation) power of the GNSS repeater system, when they are subject to signals that are not GNSS type signals, will be limited to -20 dBm.
 - c) This limit also applies to any emissions of non-GNSS type signals that have been partly amplified and that are adjacent to, but outside, the GNSS repeater bands.
 - d) Chaining two or more GNSS repeaters to increase overall system gain above +45 dB at any transmit antenna should not be permitted as this increases the risk of harmful interference to unacceptable levels.

Installation Guidance

- A6.2 The ECC Recommendation texts include site licence implementation guidance for those countries that authorise GNSS repeaters. We recall some of this guidance here:
- a) The GNSS repeater transmit antennas should be located as close as possible to the operating GNSS application's receiving antenna so that the re-radiator can operate at the minimum EIRP level necessary to perform the intended function. It would be preferable to provide RF attenuation or shielding for directions away from the area required for the re-radiated GNSS signals.
 - b) Users should direct any re-radiating antenna away from any large open apertures, which would increase signal levels in places accessible by the public or other GNSS operations.
 - c) The person or organisation authorised must take all necessary additional measures to ensure that installed GNSS repeater does not affect the accuracy of GNSS receivers located outside the building, in places accessible by the public or by other GNSS operations.
 - d) Military or other government/authorities might impose particular site limitations.

Ofcom Guidance documents for GNSS repeaters installations

- A6.3 We will publish a policy guidance leaflet on the Ofcom website concerning installation guidance. This will take into account the recommendation of CEPT in the ECC Recommendation and the Interface Requirements.

- A6.4 The Interface Requirements document will cross refer to the ETSI standard for GNSS repeaters. The IR will also be referenced in the GNSS repeater license and is subject to EU approval.

Mobile GNSS repeaters

- A6.5 The ETSI standard does not apply to the mobile use of GNSS repeaters and within the UK, Ofcom has taken action to have mobile products, removed from sale over the internet. Consequently, GNSS repeater licences will not permit the use of mobile GNSS repeaters.

Register of licences

- A6.6 We will propose that the following parameters are special conditions relating to the operation of the radio equipment:

- a) “During the period that this Licence remains in force, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of the following details relating to the GNSS repeater station, which must be produced if requested by a person authorised by Ofcom:
- postal address (including post code);
 - transmit antenna National Grid Reference (to 10 metres resolution - two letters, four numbers); Or its Latitude and Longitude (in the form “DDMMSS.SS;
 - internal GNSS repeater transmit antenna height (if above ground level);
 - for information only, Ofcom will request the location in latitude and longitude of the GNSS repeater receive antenna location. (This information identifying the real source of the original signal)
 - radio frequencies which the Radio Equipment is able to use;
 - the technical characteristics of the Radio Equipment both in terms of reception and transmission of wireless telegraphy.”
- b) “The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed above shall be kept.”
- c) “The Licensee must submit to Ofcom copies of such parts of the records detailed above at such intervals as Ofcom shall notify to the Licensee. Without prejudice to any information which Ofcom is required by law to publish or disclose, Ofcom may, from time to time, publish extracts of this information as it sees fit, in particular regarding:
- the total number of GNSS repeaters of the Radio Equipment which are operational;
 - the locations, aggregated by outward postcode, of GNSS repeater stations;
 - the frequencies used by the Radio Equipment.”

- d) “The Licensee must also submit in hard copy or electronic form to Ofcom all information relating to the establishment, installation or use of the Radio Equipment, as reasonably requested for the purposes of verifying compliance with this Licence, for statistical purposes and more generally for the purpose of ensuring that Ofcom can perform its spectrum management functions.”

Licence Procedures

- A6.7 Taking into account the responses to this consultation, we will publish the procedures as to how we will process GNSS repeater licence applications.

Annex 7

In-band and adjacent band services

Introduction

- A7.1 GNSS repeaters can operate in all, or part, of the Radionavigation Satellite bands, where GNSS systems operate (e.g. GPS, Galileo, and GLONASS). These bands are 1164-1215 MHz, 1215-1300 MHz and 1559-1610 MHz.
- A7.2 GNSS signals in different bands also allow aviation and other applications to correct for ionospheric propagation delays. The reduction of propagation errors allows a more accurate GNSS position, with the goal of enabling zero visibility landing.
- A7.3 GNSS signals share the band with DME (Distance Measuring Equipment) in the 1164 MHz -1215 MHz range. It shares with and “L band” and Wind Profiler Radar (WPR) in the 1215 MHz -1300 MHz range. While GNSS signals in the band 1559 MHz-1610 MHz, do not share with any other application.
- A7.4 CEPT studied extensively the use of GNSS repeaters in these bands, and this led to the development of the ETSI standard.

General Comments on GNSS Repeaters in the bands 1164-1215, 1215-1300 and 1559-1610 MHz

- A7.5 The GNSS repeater characteristics in the ETSI standard should provide an operational range of about 2 metres. The expected interference range with other GNSS receivers is about 10 metres (which assumes no building attenuation). Ofcom expects that devices compliant with the ETSI standard will pose very little risk of harmful interference with GNSS receivers outside the 10 metre range. Moreover, this range will be further reduced when these devices are located outside a building, due to building attenuation.
- A7.6 Although GNSS repeaters have been studied extensively by CEPT they have not been measured in simulated scenarios to help support aeronautical safety cases. Ofcom considers there is no requirement to conduct a general campaign of GNSS repeater measurements, particularly in light of the expected very short interference range.
- A7.7 Ofcom notes that ETSI took into account the CEPT study results when it developed its harmonised standard for GNSS repeaters. The ETSI standard recommended a value of -20 dBm amplifier saturation power output compared to the initial CEPT study assumptions of +10dBm, i.e. a 30dB reduction.
- A7.8 The CEPT report recommended that GNSS repeater standards be more stringent in terms of the maximum possible output power for the amplifier at saturation (when exposed to in-band and out-band signals from non-GNSS systems, i.e. DME and Radar). Noting that any repeated GNSS satellite signals could not reach this level (GNSS received signal powers are approximately -160dBW and with a 45dB gain this equals to approximately -85dBm). Ofcom concludes that limiting the amplifier to 45 dB gain and applying the more stringent ETSI harmonised standard saturation power parameter of -20 dBm will mean that harmful interference with GNSS receivers is very unlikely.

General Comments on GNSS Repeaters near to ground based GNSS receivers

- A7.9 The CAA noted a general concern about the potential for interference with their terrestrial aeronautical GNSS receivers. This could include GNSS timing reference receiver applications for data link synchronisation or GNSS receivers for example those on aircraft parked at a departure gate.
- A7.10 There is a low probability for a GNSS repeater to be sited close to a terrestrial aeronautical GNSS receiver used for a safety application (due to the small 10 metre protection distance).
- A7.11 In this consultation, Ofcom proposes that the CAA will have access to the details of GNSS repeater licences to enable the resolution of any interference problems.

Specific Comments 1164-1215 MHz –Aircraft and Ground Based DME Equipment

- A7.12 In the band 960-1215 MHz, Distance Measuring Equipment (DME) is the standard system used to support aircraft navigation requirements both in the air and on the ground.
- A7.13 DME is a ground based system, which when interrogated by an aircraft allows an accurate slant range to be calculated. The interrogator and transponder channels operate on different frequencies. Aircraft can also navigate by determining an accurate position, from interrogating three or more of these DME.
- A7.14 Within this part of the radio spectrum, the ground based transponder receiver channels receive up to 1151 MHz and the aircraft receiver channels operate in 1164-1215 MHz.
- A7.15 Depending on the filter characteristics of a GNSS repeater, there is the potential for aircraft DME transmitter signals to enter the GNSS repeater chain and also for DME ground based transponder transmitted signals to be amplified.
- A7.16 The particular band edge where the aircraft DME interrogator and ground based DME transponder channels change require analysis is around 1164 MHz. The CEPT studies on this matter are summarised in ECC Report 129 (see A8.2).
- For the out of band scenario, when an aircraft DME interrogator signal (up to 1151 MHz) is transmitting towards a ground based DME transponder receiver (receiving operating up to 1151 MHz). If some of that signal is re-broadcast due to poor filtering in the out of band area of a GNSS repeater, then multiple signals from many aircraft might be re-broadcast. The CEPT analysis, was based on a repeater with +10dBm saturation power limit and that a GNSS repeater should be more than 250 metres away from a DME transponder receiver site, or from an aircraft runway edge. The ETSI standard is a 30 dB reduction on the assumed CEPT worst case power. This reduces the relevant distance to around 8 metres. Ofcom considers that the more stringent ETSI conditions for a -20dBm saturation power limit for a GNSS repeater will result in little risk of harmful interference with a DME transponder receiver from GNSS repeaters. There is no apparent need to coordinate against the ground based receivers as it is unlikely that a GNSS repeater would be installed so close to one these equipment.

- A7.17 The ground based DME systems installed are covered in the ECC Report 129 in sections 6.2.4 and 6.2.5 (see A8.2).
- A7.18 For the in band scenario, when a ground based DME transponder in the band 1164-1215 MHz is transmitting towards aircraft DME receivers, then some of that signal may be re-broadcast by a GNSS repeater. The CEPT report indicates that the operation of GNSS repeaters in this scenario is not an interference issue for aircraft DME receivers.

Specific Comments 1215-1300 MHz – L band Radar

- A7.19 In the band 1215-1300 MHz, the CAA and MOD operate a few very high power radar. These are used for long range aircraft detection (around 200-250 NM).
- A7.20 GNSS services are co-frequency with radar in this band. A GNSS repeater will therefore have the potential to re-broadcast radar transmissions back towards the radar receiver.
- A7.21 There are several aeronautical L band radar sites in the UK, most are located in rural areas and very few are located within urban areas. NATS, as the UK's main air traffic navigation provider, controls the aeronautical L-band radar. The MOD also has radars and these are located on sites under the control of the military. For those civil L-band radars located near urban areas (e.g. Heathrow), it is unlikely that the air traffic navigation provider fully controls access to locations close to the radar site. However, CEPT studies and initial assumptions showed that close to the radar, at distances less than 500 metres and compared to a building with an assumed reflecting cross sectional area of 20 sq.m then the repeater return signal, may be larger. However, a 20 sq.m area is extremely small compared to the many reflected signals from other local buildings. In addition, Ofcom assumes that the pulse width of any of the aeronautical L-band radar transmissions may be down to around 1µs, (a bandwidth of about 2 MHz). The minimum detectable distance of the L-band radar for any GNSS repeater signal in this case is around 150-300 metres. In addition, Radar discounts data at short range due to local clutter reflections; the GNSS repeater would be static and have a zero component for any Doppler effect.
- A7.22 The CEPT studies concluded that a more stringent value of -20dBm should be used, a 30dBm reduction on the initial CEPT study assumptions, which used a value of +10dBm. The more stringent value of -20dBm is used in the ETSI standard. Ofcom has concluded that with these more stringent ETSI conditions and the CEPT study results in ECC Report 129 see Section 7.1 (see A8.2), there is little risk of harmful interference to radar from GNSS repeaters compared to other building reflections and local clutter signals in the radar returns.

Specific Comments Wind profiler radar – L band 1270-1295

MHz

- A7.23 Wind Profiler Radar (WPR) are used by the UK Meteorological Office and others, and operate in very few locations in the UK. These use the band 1270 MHz -1295 MHz. As with other radar systems above, there is the possibility that the radar signals will be re-radiated by a GNSS repeater and the repeated signal subsequently received by the WPR receiver.
- A7.24 The CEPT 129 report in section 7.3.2 (see A8.2), uses the assumption that non-GNSS repeated signal of power up to +10 dBm could occur, CEPT concluded that a

GNSS repeater may cause an effect to WPR data collection up to 1 km range from the WPR receiver. However, the CEPT report also suggested that such situation is alleviated if the maximum saturation power is, -20 dBm, this was accepted by ETSI and is the limit stated in the ETSI standard (a 30 metre separation). Ofcom understand that WPR are usually sited away from other building, so as to avoid errors in wind velocity measurements and therefore it is unlikely that a repeater would be installed so close to one these equipment, GNSS repeaters would likely be on the same site as the WPR and thus controllable by the site owner. In addition, any, such a local interference would be quickly identifiable if it occurred. Therefore, Ofcom considers that there is no apparent need to coordinate GNSS repeaters against the WPR

Specific Comments 1559-1610 MHz

- A7.25 In this band, the only repeated signals are those of the GNSS system.
- A7.26 As with the other bands, GNSS systems operate across the band such as GPS, Galileo, COMPASS, GLONASS, and the Japanese system, QZSS, each system overlaying each other.
- A7.27 The GNSS repeater amplifies any signals found in the band and for a certain gain, will allow receivers to re-acquire the GNSS signals, within a certain distance of the repeater.

Aggregate effect on aeronautical GNSS receivers

- A7.28 We cannot well define the likely geographical distribution for GNSS repeater deployment, as there is lack of the GNSS repeater density information (the level of demand cannot be really known until, devices are built and installed), Therefore, the CAA asked a question as to the aggregate effect of GNSS repeaters on GNSS receivers used when an aircraft is in flight. Especially as aviation are considering the use of GNSS position data from aircraft, to perform some surveillance applications.
- A7.29 For comparison, we first consider other consumer electronic products. Ofcom notes that these products, such as personal computers, games machines, spurious emissions are defined in the more general ETSI standards for Electro Magnetic Compatibility(EMC)

The current EMC specification ETSI EN 301 489 for electronic devices gives a radiated disturbance emission limit for signals > 1GHz of 50dBuV/m (potential signals in the GNSS bands and for 1MHz bandwidth this equates to -66dBm/m²/MHz at the specified 3 metres).

A GNSS satellite signal repeated and then received at 3 metres separation would equate to -116 dBm/m²/MHz (a 1MHz bandwidth received GNSS signal of -130 dBm with repeater amplifier gain of 45 dB is a radiated signal of -85dBm, and at 3 metres this is a power density of -116 dBm/m²/MHz).

Therefore, the radiated disturbance emission limit of consumer devices could exceed those of a GNSS repeated signal.

- A7.30 Now considering the aggregate question, for an aircraft at a height of less than 1000ft, Ofcom and CEPT conclude that, based on the low range effect of any single GNSS repeater (<10 metres), many thousands of GNSS repeaters would need to

be in view for there to be any noticeable effect. Even then as each GNSS repeater is uncorrelated with any other GNSS repeater transmission, the combined effect would not appear as a GNSS signal, it would just look like noise.

- A7.31 If we compare GNSS repeaters to other interference sources, such as consumer electronic device EMC requirements we do not believe GNSS repeater aggregation will cause harmful interference. This is described in section 8.2.6 “En-route navigation scenario, aircraft GPS receivers at an altitude of 1000ft” of the CEPT ECC Report 129 (see A8.2). Therefore, Ofcom considers that there is little potential for any aggregate GNSS repeater interference effect.
- A7.32 For an aircraft at altitude, operating in the band 1164-1215 MHz in view to ETSI standard GNSS repeaters (or an aggregation of these repeaters), Ofcom has concluded from the CEPT co-frequency studies, that compared to other interference sources, GNSS repeaters retransmitting DME transponder signals will have no effect on aeronautical GNSS receivers on board an aircraft in flight. See section 6.2.2 of ECC Report 129 (see A8.2).

Summary of conclusions

- A7.33 For GNSS repeater locations near to the DME system.
- Ofcom reviewed the parameters of the ETSI standard EN 302 645, together with the CEPT report results, and consider that a GNSS repeater should not cause interference effects to DME ground transponders.
 - Studying the CEPT reports, Ofcom consider that airborne GNSS receivers in the band 1164-1215 MHz will not be affected by ETSI standard GNSS repeaters.
- A7.34 For GNSS repeaters in locations near to L band aeronautical and military radar Ofcom consider that interference effects should not be apparent. To avoid errors in wind velocity measurements, Ofcom understand that wind profiler radar (WPR) are usually sited away from other buildings. Therefore, GNSS repeaters at the same site are unlikely to be installed near WPR and therefore the likelihood of interference effects is very small.
- A7.35 For other GNSS receivers, specifically for terrestrial ones, the CEPT reports indicated that potential interference with GNSS repeaters will be over a very small radius. Ofcom’s assumption is that for sites on an aerodrome there is a low possibility of installing a GNSS repeater near to a terrestrial based GNSS timing receiver that provides support to an aviation application.
- A7.36 Ofcom considers that there is little potential for any aggregate GNSS repeater interference effect

Annex 8

References and Glossary

References

- A8.1 CEPT ECC Reports and Recommendations: These are available from:
<http://www.ecodocdb.dk/>
- A8.2 ECC Report 129 “ECC Report 129 Technical and operational provisions required for the use of GNSS repeaters”
- <http://www.erodocdb.dk/Docs/doc98/official/Word/ECCREP129.DOC>
- A8.3 ECC Recommendation (10)02 “A framework for authorisation regime of GNSS repeaters”
- <http://www.erodocdb.dk/Docs/doc98/official/Word/REC1002.DOC>
- A8.4 ECC Report 145 “Regulatory Framework for GNSS repeaters”
- <http://www.erodocdb.dk/Docs/doc98/official/Word/ECCREP145.DOC>
- A8.5 ETSI EN 302 645 “Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Global Navigation Satellite Systems (GNSS) Repeaters; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive. Download available to ETSI members at:
- http://webapp.etsi.org/workprogram/Report_WorkItem.asp?WKI_ID=28872

Glossary

CAA	Civil Aviation Authority
CEPT	Conference European Post and Telecommunications
COMPASS	Chinese GNSS system
DME	Distance Measuring Equipment
ECC	European Communications Committee
EMC	Electro-Magnetic Compatibility
e.i.r.p.	effective isotropic radiated power
ETSI	European Telecommunications Standards Institute
Galileo	European GNSS system
GLONASS	Russian GNSS system
GNSS	Global Navigation Satellite System

GPS Global Positioning System - a USA GNSS system

MoD Ministry of Defence