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| Frequency assignment practice  Guideline No. 2  Area wide land mobile services used in support of differential GPS and other high duty cycle data applications |
|  |
| July 2012 |

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## Purpose

To provide information to assist with the assignment and licensing of area wide services used in support of Differential GPS (DGPS) and other high duty cycle data applications. In addition to this guideline, reference should be made to the [Land Mobile Licence Licences - Guidelines](http://www.acma.gov.au/theACMA/land-mobile-licences-guidelines) which provides an overview of the licensing arrangements applicable to the land mobile service.

This guideline applies to all services operating in non-government spectrum, including government services operating within non-government spectrum.

Requests for exemptions to the arrangements detailed in this document, or licence applications that appear to fall outside the enunciated framework, should be referred to the ACMA at [FACPolicyExemptions@acma.gov.au](mailto:FACPolicyExemptions@acma.gov.au).

## Background

The selection of channel frequencies for DGPS has not developed in a coordinated way. As a result, many single frequency channels in the VHF and UHF land mobile bands have been assigned and licensed in support of DGPS applications. In many instances, the channels assigned to area wide DGPS services have also been assigned to sited DGPS services and in most cases also to area wide and sited voice services, leading to reported instances of interference.

Given the increasing demand for area wide DGPS operation, a number of single frequency channels in the [400 MHz Band](http://www.acma.gov.au/theACMA/400-mhz-plan) have been reserved exclusively for area wide data applications employing high duty cycle, such as DGPS[[1]](#footnote-1). While the identified channels also contain assignments to sited services, the assignment and licensing arrangements detailed below should allow for the expanded deployment of area wide data services on these channels while minimising the likelihood of interference to existing sited services.

## Differential GPS – Technology Overview

**What is Differential GPS?**

Differential GPS (DGPS) is an enhancement to the Global Positioning System (GPS) in which a local radio signal is used to improve the accuracy of the position coordinates calculated by a GPS receiver.

The coordinates calculated by a GPS receiver will be in error to some degree, possibly by up to 50 metres. The magnitude of this error will vary with time. For some industries such as agriculture, mining and construction, a very high degree of positioning accuracy is required for equipment deployed in field operations. In a differential GPS system a GPS receiver is placed at a fixed location for which the coordinates are very accurately known (such as a surveyed point). The fixed GPS receiver calculates and periodically updates its calculated location using the signals from the GPS satellite system. A linked computer calculates, for each updated set of GPS coordinates, the difference between the surveyed and GPS derived coordinates.

These ‘differentials’ are transmitted to roaming GPS receivers in the vicinity that are being used to position equipment in field operations. The roaming GPS receivers use the received differentials to correct their own GPS derived coordinates, allowing a very accurate set of position coordinates to be determined at any instant in time. This method of location correction is prefaced on the assumption that the fixed GPS receiver and all roaming GPS receivers exhibit the same differential error at any particular time.

**Sited and Area Wide Differential GPS services**

DGPS services may operate in the VHF or UHF land mobile bands as sited or area wide services. A sited DGPS service is licensed to operate from a known fixed location. An area wide DGPS service is authorised to operate within a geographical area on an itinerant basis, moving from one location to another as required by the demands of the particular business operation.

DGPS services are generally single frequency services, although some sited services may operate in two frequency (repeater) mode. In two frequency operation, the error differentials are calculated at a location other than the base station (for example, the business premises) and relayed to the roaming GPS units via the base station repeater.

**Interference considerations**

Area wide DGPS stations are operated at uncoordinated locations and can be deployed over a wide geographical area, possibly extending state or Australia wide.

**Interference between DGPS stations**

DGPS systems operate with a 100% duty cycle, continually transmitting updated corrections to the roaming GPS units. As a result, two area wide DGPS systems operating in the same area, cannot share the same frequency. For this reason, it is generally advisable that applicants seeking to provide area wide DGPS services licence at least two area wide DGPS frequencies. Problems associated with interference between sited and area wide DGPS services are avoided by assigning the two services on different channels.

**Interference between DGPS stations and other radiocommunications users**

An area wide DGPS service operating on a single frequency channel has the potential to cause interference to other radiocommunications users due to receiver desensitisation, particularly if high transmit powers are employed at or near major radiocommunications sites. As the DGPS base station operates with 100% duty cycle any interference is likely to cause significant disruption to other licensed services.

As the potential for interference is greatest in areas of high spectrum demand due to the higher density of licensed services, the ACMA will limit the radiated power of area wide DGPS services operating in high and medium density areas[[2]](#footnote-2). Outside of these areas higher radiated powers may be employed, but restrictions will apply to operations in the vicinity of sited services.

**Frequency assignment and licensing arrangements**

Noting the operational characteristics of DGPS systems, and the interference considerations associated with area wide operation, the following frequency assignment and licensing arrangements have been formulated for sited and area wide DGPS services:

1. Single frequency channels 362, 363, 364, 365 and 366, from within segments ‘S’ and ‘X’ of the [400 MHz Band](http://www.acma.gov.au/theACMA/400-mhz-plan), may be assigned to area wide data applications employing high duty cycle, such as DGPS. The use of 12.5 kHz channel bandwidth systems is preferred, however adjacent channels may be aggregated to accommodate 25 kHz systems provided the aggregation scheme detailed in section 2.1 of the [400 MHz Band](http://www.acma.gov.au/theACMA/400-mhz-plan) is employed.

The corresponding frequencies and channel bandwidths are set out in Table 1.

|  |  |  |
| --- | --- | --- |
| **Segment Channel** | **Frequency (MHz)** | |
| **12.5 kHz Bandwidth** | **25 kHz Bandwidth** |
| Segment S |  |  |
| 362 | 457.0250 |  |
| 363 | 457.0375 | 457.04375 |
| 364 | 457.0500 |
| 365 | 457.0625 | 457.06875 |
| 366 | 457.0750 |
|  |  |  |
| Segment X |  |  |
| 362 | 467.0250 |  |
| 363 | 467.0375 | 467.04375 |
| 364 | 467.0500 |
| 365 | 467.0625 | 467.06875 |
| 366 | 467.0750 |
|  |  |  |

**Table 1: Area wide single frequency channels reserved for Differential GPS (DGPS) and other high duty cycle data applications**

1. All applications for area wide DGPS services should be licensed to operate on one or more of the above channels. No sited services, or area wide voice (including low duty cycle data) services, may be assigned to these channels. Arrangements for area wide services supporting voice communications or low duty cycle data applications are detailed in [***Frequency Assignment Practice Guideline No.1***](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Frequency-assignment-and-coordination/frequency-assignment-practices-i-acma).
2. As there is limited scope for frequency sharing between DGPS systems operating in the same area, it is generally advisable that applicants licence at least two area wide DGPS frequencies per system.
3. Attachment 1 provides a list of spectrum access areas for which area wide operation may be authorised. An area wide service should only be assigned to an area for which there is an operational requirement. As an example, if operation is not required in high and medium density areas of Australia, then the area wide service should be restricted to low and remote density areas only (Area ID 74).
4. An area wide licence authorises operation on a ‘short term’ basis at unspecified locations within the designated geographic area(s). The ACMA will generally consider operations of 4 weeks or less at a given location as ‘short term’. Restricting the period of operation at any one location ensures that area wide frequencies are not used to provide semi-permanent services, assists with interference mitigation by limiting the period of uncoordinated operation at any one location and maximises flexibility in the use of area wide frequencies.
5. For extended operation at a particular location, the licensee should apply for a sited licence. A sited service has the benefit of being coordinated with other radiocommunications services in the area of operation, and is therefore able to operate without the constraints applied to area wide services. Given requirements (1) and (2) above, and the need to coordinate with surrounding sited services, the frequency assigned to the service will be different to that made available for area wide use.
6. An area wide service may operate only on condition that it does not cause interference to other radiocommunications services, and cannot claim protection from any interference caused by other services. This requirement is enforced through the application of a special condition on the licence (refer Special Condition 27 at Attachment 2).
7. A DGPS base station authorised under an area wide licence is restricted to low power (maximum 8.3 Watts EIRP) in high and medium density areas as defined in the [Apparatus licence fees](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma). In low and remote density areas powers up to 83 Watts EIRP can be authorised, however frequency assigners should endeavour to restrict the power to that necessary for the given application.  
     
   For areas of operation which encompass a single area density (for example, Sydney/Wollongong HD), the restriction is enforced directly through the licensed power. For areas of operation which encompass more than one area density (for example Australia wide), and which include a high density or medium density area, the restriction is enforced through the licensed power in conjunction with Special Condition LM02 (refer Attachment 2).
8. A DGPS base station authorised under an area wide licence and operating with a radiated power exceeding 8.3 Watts EIRP may not be sited within 200 metres of a radiocommunications site with licensed 400 MHz band services. This requirement will be enforced by application of Special Condition LM03 on the licence (refer also Attachment 2).
9. A DGPS system comprising a base station and mobiles/personal mobiles will be licensed as a Land Mobile System. Further information on licensing arrangements is contained in the [Land Mobile Licence Licences - Guidelines](http://www.acma.gov.au/theACMA/land-mobile-licences-guidelines) and [Apparatus licence fees](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma).
10. A sited DGPS service should be assigned a two frequency land mobile channel, regardless of whether it is actually operating as a single frequency or two frequency service. The use of two frequency spectrum for a single frequency service is preferable, as this will generally result in less spectrum denial in the vicinity of the sited service and will allow the service to evolve, in future, to operate in a two frequency (repeater) mode if required.
11. A sited single frequency DGPS service operating on a two frequency channel must use the base transmit frequency for its DGPS transmissions.

(13) Assignments made in support of area wide land mobile services must comply with all other applicable requirements, including those detailed in [Spectrum Embargoes](http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Frequency-assignment-and-coordination/spectrum-embargoes-spectrum-planning-acma), [Band Plans](http://www.acma.gov.au/Industry/Spectrum/Spectrum-projects/400-MHz-band/band-plans-spectrum-planning-acma) and Radiocommunications Assignment and Licensing Instruction LM08 ([RALI LM08](http://www.acma.gov.au/~/media/Spectrum%20Engineering%20and%20Space/Regulation/pdf/Radiocommunications%20Assignment%20and%20Licensing%20Instructions%20LM8%20Frequency%20Assignment%20Requirements%20for%20the%20Land%20Mobile%20Service.pdf)).

## Further information

Please contact the [Radiocommunications Licensing and Telecommunications Deployment Section](mailto:LAIS@acma.gov.au).

**Attachment 1**

**SPECTRUM ACCESS AREAS**

|  |  |  |
| --- | --- | --- |
| **Area ID** | **Name** | **Density Area** |
| 1 | Australia Wide | High/Medium/Low/Remote |
| 2 | New South Wales | High/Medium/Low/Remote |
| 3 | Victoria | High/Low/Remote |
| 4 | Queensland | High/Low/Remote |
| 5 | South Australia | Medium/Low/Remote |
| 6 | Western Australia | Medium/Low/Remote |
| 7 | Tasmania | Low/Remote |
| 8 | Northern Territory | Low/Remote |
| 9 | Antarctica | Remote |
| 10 | Norfolk Island | Remote |
| 11 | Cocos/Keeling Island | Remote |
| 12 | Christmas Island | Remote |
| 16 | Macquarie Island | Remote |
| 17 | Heard Island | Remote |
| 18 | Australian Capital Territory | Low |
| 36 | Lord Howe Island | Remote |
| 68 | Brisbane/Gold Coast HD | High |
| 69 | Newcastle MD | Medium |
| 70 | Sydney Wollongong HD | High |
| 71 | Melbourne/Geelong HD | High |
| 72 | Adelaide MD | Medium |
| 73 | Perth MD | Medium |
| 74 | Low and Remote Density Areas | Low/Remote |
| 75 | Remote Density Area | Remote |
| 76 | Low Density Areas | Low |

**Table A1: Spectrum access and corresponding licence density areas**

Table A1-1 provides a list of spectrum access areas for which area wide operation may be authorised. The licence fee density area(s), corresponding to each spectrum access area, are identified in the corresponding ‘Density Area’ column. Fee density areas are defined in the [Apparatus licence fees](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma). The Area ID is a unique identification number used in the ACMA’s licensing system to reference a particular spectrum access area.

**Attachment 2**

**SPECIAL CONDITIONS TEXT**

Conditions of operation which apply to an individual licence are printed on the apparatus licence under the heading ‘Special Conditions’.

The ACMA’s policy is that an accredited person should specify on the Frequency Assignment Certificate all the conditions the frequency assignment will be subject to, including those conditions required by ACMA documentation. Information about this policy is available on the ACMA [website](http://www.acma.gov.au/theACMA/accredited-persons-responsibility-for-special-conditions).

**Special Condition 27 – no interference / no protection**

The following special condition must be applied to all licences authorising the operation of an area wide land mobile service:

*No interference shall be caused to any radiocommunication station or service and no protection from interference by such stations or services shall be afforded.*

**Special Condition LM02 – high power operation**

Where the area of operation encompasses more than one area density, of which one is high density or medium density, the service is to be licensed at a maximum EIRP of 8.3 Watts. Operation at higher powers (maximum 83 Watts) outside of high density and medium density areas is authorised through application of the following condition:

*To the extent permitted by the licensed area of operation, the land (base) station authorised under this licence may operate at a maximum equivalent isotropic radiated power (EIRP) of 83 Watts when operating in low or remote density areas, as defined in the Apparatus Licence Fee Schedule.*

**Special Condition LM03 – siting of area wide services**

If the licence authorises the operation of a Land Mobile System at powers exceeding 8.3 Watts EIRP, the following special condition is to be applied to the licence:

*A land (base) station authorised under this licence, when operating with an equivalent isotropic radiated power (EIRP) exceeding 8.3 Watts EIRP, shall not be sited within 200 metres of a radiocommunications site with licensed 400 MHz band services, as recorded on the Register of Radiocommunications Licences (RRL). Reference to 400 MHz band services is taken to mean radiocommunications services licensed in accordance with Radiocommunications Assignment and Licensing Instruction MS22 (the 400 MHz Plan).*

Table A2-1 lists the maximum licensed power and corresponding special condition(s), applicable to each spectrum access area for which area wide operation may be authorised.

**Attachment 2**

(Continued)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Area ID** | **Name** | **Density Area** | **Maximum Licensed**  **EIRP** | **Special Conditions** |
| 1 | Australia Wide | High/Medium/Low/Remote | 8.3 | 27, LM02, LM03 |
| 2 | New South Wales | High/Medium/Low/Remote | 8.3 | 27, LM02, LM03 |
| 3 | Victoria | High/Low/Remote | 8.3 | 27, LM02, LM03 |
| 4 | Queensland | High/Low/Remote | 8.3 | 27, LM02, LM03 |
| 5 | South Australia | Medium/Low/Remote | 8.3 | 27, LM02, LM03 |
| 6 | Western Australia | Medium/Low/Remote | 8.3 | 27, LM02, LM03 |
| 7 | Tasmania | Low/Remote | 83 | 27, LM03 |
| 8 | Northern Territory | Low/Remote | 83 | 27, LM03 |
| 9 | Antarctica | Remote | 83 | 27, LM03 |
| 10 | Norfolk Island | Remote | 83 | 27, LM03 |
| 11 | Cocos/Keeling Island | Remote | 83 | 27, LM03 |
| 12 | Christmas Island | Remote | 83 | 27, LM03 |
| 16 | Macquarie Island | Remote | 83 | 27, LM03 |
| 17 | Heard Island | Remote | 83 | 27, LM03 |
| 18 | Australian Capital Territory | Low | 83 | 27, LM03 |
| 36 | Lord Howe Island | Remote | 83 | 27, LM03 |
| 68 | Brisbane/Gold Coast HD | High | 8.3 | 27 |
| 69 | Newcastle MD | Medium | 8.3 | 27 |
| 70 | Sydney Wollongong HD | High | 8.3 | 27 |
| 71 | Melbourne/Geelong HD | High | 8.3 | 27 |
| 72 | Adelaide MD | Medium | 8.3 | 27 |
| 73 | Perth MD | Medium | 8.3 | 27 |
| 74 | Low and Remote Density Areas | Low/Remote | 83 | 27, LM03 |
| 75 | Remote Density Area | Remote | 83 | 27, LM03 |
| 76 | Low Density Areas | Low | 83 | 27, LM03 |

**Table A2-1: Maximum licensed power and corresponding special condition(s) for each spectrum access area.**

1. Refer to the Notes to Table 1 (Appendix A) of [400 MHz Plan](http://www.acma.gov.au/theACMA/400-mhz-plan) (RALI MS22) [↑](#footnote-ref-1)
2. In this guideline, reference to density areas is taken to mean the density areas defined in the [Apparatus licence](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma)

   [fees](http://www.acma.gov.au/theACMA/About/Making-payments/Apparatus-licence-fees/apparatus-licence-fees-acma). [↑](#footnote-ref-2)