

## Appendix IV : Planning Rules

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## Introduction

Previous studies that examined the potential availability of interleaved spectrum were carried out prior to GE-06 and agreement of the UK plan. Whilst these studies did attempt to limit damage to the main multiplexes no assessment of the impact was carried out.

For this study, unlike the previous studies - the UK plan, other than the fine tuning of a number of small relays, is now agreed and there is a firm coverage target for the PSB multiplexes of 98.5% of UK population which must be maintained.

With no rules agreed between industry and Ofcom for assessing the impact of applications using interleaved spectrum on the main multiplexes, NGW, for the purpose of this study, have had to develop a set. In developing the rules it was recognised that the introduction of any service in spectrum shared with the six main multiplexes will result in a loss of gross coverage of co-channel and possibly adjacent channel main multiplex coverage.

Though introducing a new interleaved service will inevitably result in an impact on the main multiplexes, if this impact is limited to areas of overlap coverage where viewers are not expected to watch the affected station there will be no loss of net coverage.

After considering various methods to protect net coverage of the main multiplexes which depend on whether there was a choice of service in an area, a simplified method based on protecting the best service was developed.

For this study the best service was taken as a minimum a 3PSB service and the greatest number of commercial multiplexes.

NGW have had to identify, at any given location where a 3PSB service is available, which station viewers should watch. The method for assigning this digital preferred service area (DPSA) to a station is described in Appendix III.

Having decided which locations need protecting, next the permissible increase in interference had to be decided. At any given location, receiver noise plus interference from agreed co-channel stations in the network and on the Continent results in a minimum usable field strength, the protected field strength (PFS). The addition of any new co-channel interleaved application will result in an increase in the PFS. At present there is no agreed value for this increase in PFS so for the purpose of this study NGW have adopted an increase of 0.5dB for PSB multiplexes and 1dB for COM multiplexes.

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Planning of the main six multiplexes is carried out by the Joint Frequency Planning Project (JPP) using the UK planning model (UKPM) and planning parameters specified in JPP Doc 1<sup>1</sup>.

## The Rules

As part of this study, in line with Ofcom's requirement to protect the UK target of 98.5% coverage of the PSB multiplexes, the following rules governing the deployment of 'high power' applications in interleaved spectrum have been developed.

Rule 1 - The rules will only apply to populated pixels and channels associated with the station assigned as the digital preferred server (DPSA) for the pixel in question.

Rule 2 – To warrant protection a channel must be available for at least 70% of locations or better and for at least 99% of time in the reference network.

Rule 3 - Interference to a PSB multiplex will be limited to an increase in the protected field strength (PFS) of 0.5dB where the PSB service is predicted as being available for between 70% and 90% of locations.

Rule 4 - Interference to commercial multiplexes, at locations where a 3PSB service is available from the same station, will be limited to an increase in the PFS of 1.0dB when the COM service is predicted as being available for between 70% and 90% of locations.

Rule 5 – For a PSB multiplex where, in a given pixel, a service is predicted as being available at more than 90% locations, the PFS can be increased to 0.5dB above that required to bring the availability down to 90% locations served.

Rule 6 - For a COM multiplex where, in a given pixel, a service is predicted as being available at more than 90% locations, the PFS can be increased to 1.0dB above that required to bring the availability down to 90% locations served.

The rules apply to services that are transmitted from the same site as the six main multiplexes.

For the study the reference network was the UK version 5.5 digital plan and with European interference based on the GE-06 agreement.

The rules are not intended for low power applications located at sites distant from those used for the six main multiplexes. In such cases the concept of specified user rights being developed by Ofcom may be more appropriate.

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<sup>1</sup> 'Technical parameters and planning algorithms', July 2003, Doc JPP/MB/1

## Discussion

When originally formulating the rules, for simplicity, it had been hoped to use a power sum method for assessing the 0.5dB and 1.0dB increase in the PFS. Such an approach in the case that a wanted service is available at between 70% and 90% of locations would have meant that for a PSB multiplex the level of the interleaved service would need to be 9.2dB below the existing level of interference and for a COM multiplex 5.2dB below the existing level of interference.

However, as coverage of the main DTT multiplexes is calculated using the UKPM which uses the Schwartz and Yeh method for summing sources with a log-normal distribution, the use of a simple power sum was found to underestimate the interference potential of an interleaved application.

Given a mean value for the sum of the existing interference and an associated standard deviation, adding another interferer, the interleaved channel, with a given level and standard deviation - the Schwartz and Yeh summation method provides a modified mean level of interference and modified associated standard deviation. The result of the summation depending on the relative levels of the existing and interleaved interference and their associated standard deviation. Figures 1 and 2 show the level in dB below the existing interference that an interleaved application need's to be to limit the increase in PFS to 0.5dB and 1.0dB when using the Schwartz and Yeh summation method. It is assumed that the standard deviation associated with the interleaved application is 5.5dB.

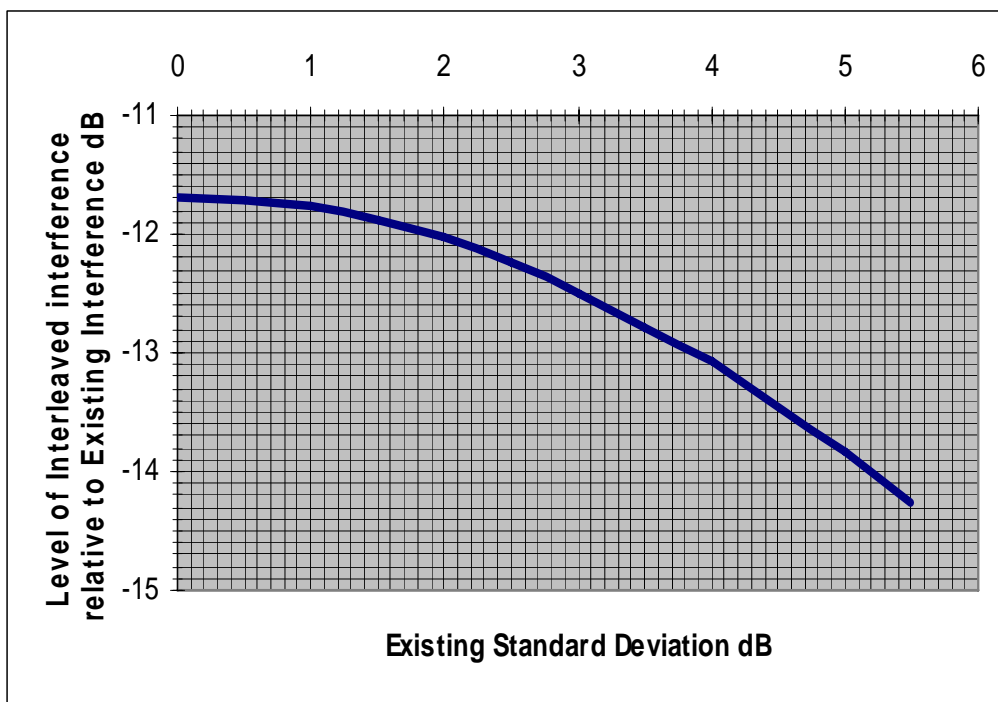


Figure 1 : Level of Interleaved application rel. to existing Interference for a 0.5dB increase in PFS.

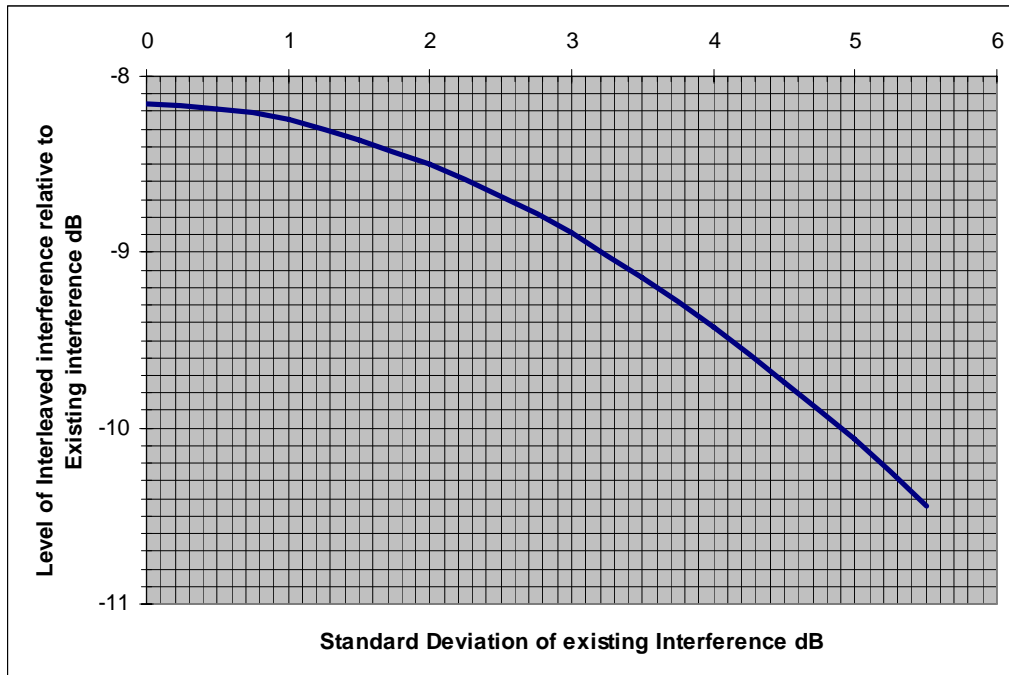


Figure 2 : Level of Interleaved application rel. to existing Interference for a 1.0dB increase in PFS.

When the availability of the channel being protected lies between 70% and 90% locations served the level of the interleaved application relative to the existing level of interference for a given increase in PFS can be readily calculated from knowledge of the existing PFS and its associated standard deviation.

When the availability of the channel being interfered with is predicted as being more than 90% locations served the method for determining the level of the interleaved application is more complicated.

As direct calculation of the level is not possible, an iterative approach has been used to determine the level of the interleaved application required to reduce the availability to 90% locations.

Taking the level of combined interference resulting from the first iteration, a second iteration is carried out to determine the increase in the level of the interleaved application to permit an increase in PFS of either 0.5dB (PSB) or 1.0dB (COM) on the level of interference required to achieve an availability of 90% locations served.

The method developed by NGW ensures protection of the main DTT services whilst allowing deployment of the interleaved services.

However, the rules would benefit from further refinement.

The algorithms used can, in some cases be argued, as being too conservative as they only consider a channel in isolation. There are instances where a main multiplex and an interleaved channel are co-channel with another station, for example Beacon Hill COM4 ch42 and COM5 ch45 and the interleaved channel ch49 are all co-channel with relay at Poulner. In this case whilst the main channels operate at between 2kW and 4kW ERP towards Poulner, the interleaved channel is subject to a 17dB restriction (200W ERP) to limit the increase in PFS on ch49 to 0.5dB.

A similar relationship occurs between Winter Hill and Waltham. In this instance Winter Hill PSB1 ch54, COM4 ch58 and COM5 ch61 operating at 100kW ERP are co-channel with the PSB multiplexes at Waltham. The interleaved channel, ch56, at Winter Hill has restrictions up to 11.6dB relative to 10kW to protect COM4 at Waltham.

In both these cases core coverage of the affected stations, Poulner and Waltham, will be determined by interference from the main multiplexes at Beacon Hill and Winter Hill respectively and not by the interleaved application.

To permit more flexibility in planning the interleaved channel without materially damaging the coverage of the main multiplexes, in instances where the main multiplexes already have a relationship with the site being protected the interleaved channel could be allowed to increase the PFS to a point where the percentage of locations served matches that of the multiplexes that are co-channel with the main multiplexes, i.e. equalises the interference.