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Le sens des marges de planification/coordination

1. Introduction

À la suite de décisions prises lors de la CRR-04, le concept des marges de protection a été mis en place afin de simplifier l'interprétation des résultats des calculs de compatibilité. En outre, les valeurs des marges ont été définies pour indiquer lorsque les besoins en fréquences sont compatibles et pourraient utiliser la même fréquence. Un document explicatif a été produit au cours de la période intersession et est disponible à l'adresse:

http://www.itu.int/md/R05-WP.IPG-C-0009/en

Pour plus de commodité l'attachement du document est joint au présent document (Existe seulement en langue anglaise).

2. Marges et dividende numérique

En pratique, il est très rare qu'une station puisse recevoir des niveaux importants de brouillage uniquement d'une seule autre station. Il est normal qu'une station soit perturbée par plusieurs stations en co-canal et canaux adjacents qui sont utilisées à un niveau normal ou élevé de saturation. Dans le logiciel d'analyse de compatibilité, six brouilleurs équivalents égaux (égaux à des valeurs de nuisances combinées d'intensité de champs) pourraient être considérés comme une situation normale.

Afin de prendre des dispositions pour six brouilleurs, la valeur minimale du champ médian voulue pour les assignations a été augmentée de 3 dB (l'effet est de réduire la zone de couverture d'une valeur de 3 dB). En appliquant ce concept et la sommation de puissance, la marge de la contribution d'un seul brouilleur arrive à 1,25 dB (à noter que la marge d'un brouilleur individuel est calculée comme indiqué en annexe), où ces six brouilleurs équivalents égaux seraient «utiliser» la Marge mise en œuvre 3 dB.

En plus de ce qui précède, des relaxations supplémentaires ont été prises en compte comme suit:

- la marge inférieure de protection sera de -3 dB au lieu de 0 dB.

- la probabilité de l'emplacement 90% sera appliquée dans le cas de protection contre la combinaison d'interférence et de bruit et non dans le cas de protection contre le bruit seul, excepté pour ATSC car pour ce système, 50% de la probabilité de l'emplacement est appliquée.

Sur la base de ces considérations, les marges limites sont calculées pour les différents cas comme indiqués dans le tableau ci-dessous (la méthode de calcul est jointe en annexe):

Relaxation possible	***Cas***		***Marge limite***
Besoin numérique (pas de relaxation)	-		1.25
- 3 dB de marge de protection	-		2.21
90% probabilité d'emplacement	A l'extérieur	VHF, UHF	2.14
	A l'intérieur	UHF	2.64
		VHF	2.30
90% probabilité d'emplacement et - 3 dB de marge de protection	A l'extérieur	VHF, UHF	3.57
	A l'intérieur	UHF	4.26
		VHF	3.80

Les chiffres dans le tableau ci-dessus ont été limités à deux décimales

Les marges limites impliquent, dans le cas d'un brouilleur individuel, si sa marge individuelle est égale ou inférieure à la valeur de marge limite spécifique, que les besoins utiles et brouilleurs sont compatibles et peuvent utiliser la même fréquence. Si la marge individuelle est supérieure à la marge limite alors les besoins utiles et brouilleurs sont incompatibles et ne devraient normalement pas utiliser la même fréquence. Dans certains cas, il serait possible d'accepter des niveaux plus élevés de niveaux de marges individuels, par exemple là où les obstacles de terrain sont présents ou lorsque moins de six brouilleurs égaux combinés sont présentes et aucun brouilleur supplémentaire ne sera ajouté à un stade ultérieur. En outre, il est clair, à la lumière du dividende numérique et de la bande de fréquences réduite pour la planification des besoins de radiodiffusion télévisuelle qu'il peut y avoir un besoin d'accepter des niveaux plus élevés de marge individuelle que les niveaux de marge limites indiquées ci-dessus afin d'être en mesure d'assigner un canal de fréquence à un besoin. Ces niveaux de marge individuels élevés impliqueraient des réductions supplémentaires dans les zones de couverture dans le cas de fréquence utile. Il est également évident que l'acceptation de marges individuelles trop élevées donnerait lieu à des assignations qui ne peuvent en pratique être mises en œuvre

En particulier, dans la replanification pour la télévision numérique dans les bandes 174 – 216 MHz et 470 à 698 MHz, les administrations pourraient considérer, excepté pour ATSC, la probabilité d'emplacement de 90% et -3 dB de relaxation de la marge de protection à l'extérieur et, pour les cas à l'intérieur, 3.57 dB et 4.26 dB respectivement.

ATTACHMENT (IN ENGLISH ONLY)

Reconsideration of calculation margins

Introduction

This paper is a revision and extension of the information which appeared in IPG1/34. The revision is needed to correct some errors and omissions in the earlier paper, to take account of further work which has taken place since the IPG-1 meeting and to take account of discussions which took place in the PXT-5 meeting.

General considerations

When assessing the impact of any potential new source of interference, it is normal practice to calculate the incremental increase of some value related to the wanted service.

For example, in the case of analogue broadcasting services, it is common to allow for an increase in the usable field strength (ufs) of 0.5 dB (although the value may not be the same in all broadcasting plans).

For some Other Services (OS), it is common to allow for an increase in the minimum field strength (equal in this case to the minimum ufs) of 1 dB.

The above values may be applied when there are no considerations of coverage in statistical terms and, implicitly, a coverage limit of 50 % of locations is being assumed.

In the case of digital broadcasting, where there is a very rapid transition to failure for only small increases in interference or noise, it is normal to specify some high percentage of locations as a service target, say 95 or 99 %, in order to allow for the statistical variation of the wanted field strength as a function of location.

When it is also necessary to consider the impact of interference, the combined effect of the variation with location of the wanted signal and the interfering signal needs to be taken into account.

In the case of a *single* interfering signal, a wanted service is protected against noise and interference if the relationship

median wanted field strength - (median interfering field strength + protection ratio – receiving antenna discrimination + combined location correction)

is greater than or equal to zero. This relationship is usually called 'protection margin'; it was described in § 5.3.1.2.1of the RRC-04 Report and the relationship given above was given in the final paragraph of §5.3.1.1.1.2 of the RRC-04 Report. For simplicity, the terms

median interfering field strength + protection ratio – receiving antenna discrimination

are usually replaced by the term

nuisance field strength

where there is an implicit assumption that it is the median value of the nuisance field strength that is being referred to.

It must be stressed that the nuisance field strength is not a physical field strength. Its value cannot be measured directly. Instead, it is a way of referring to the combined effect of a physical interfering field strength and values which are related to the protection of a wanted signal.

The origins of the nuisance field strength concept were based in an era when only 50% of locations were being considered for protection against interference. As can be seen from the first of the

expressions given above, in the case of wanted digital requirements it is also necessary to add a term which allows for the protection of a larger percentage of locations against the combined effect of noise and interference – the combined location correction. This additional term is not needed when results for wanted analogue broadcasting or wanted OS are being dealt with. In order to provide some consistency in the way in which the results of compatibility calculations were presented and could be used (see also the discussion below on the 'margin' value that is presented in the compatibility calculation results), it was decided to add the value of the combined location correction to the nuisance field strength before putting the resultant value into the column labelled 'nfs'.

As this use of 'nfs' has caused some confusion, an alternative column heading will be used for future sets of compatibility analysis results.

The new column heading will be 'cnfs', standing for 'the combined value of nuisance field strength and combined location correction' and will only be used in those cases where a digital requirement is the wanted service as the value of the combined location correction is zero if the wanted service is analogue broadcasting or OS.

Allowance for multiple interference

The expression given above for the protection margin is valid in the case of a *single* interferer; where there are multiple interferers, their contributions must be summed using an appropriate summation process.

An allowance must be made for multiple interference when constructing a plan otherwise any post-plan coverage analysis will show that there are coverage deficiencies. Such an allowance was included in the considerations of RRC-04, but in different ways for digital allotments and digital assignments.

For allotments, there was a power increase of 3 dB to all of the transmitters in the relevant reference network.

For assignments there was a reduction in the size of the calculated service area equivalent to a 3 dB increase in the wanted field strength at the edge of the service area. (These two approaches are equivalent if the assignment boundary does not cross a national boundary and where such a crossing would occur, the national boundary is taken as the service boundary and the wanted field strength is calculated on that boundary.)

It must be noted that this allowance for multiple interference is related *only* to consideration of interference from separate allotments or assignments (the latter may be digital requirements or analogue broadcasting assignments or OS assignments). The interference contributions from the individual transmitters in a reference network are combined by power summation and are then considered to form a single interference source. In any case where there are linked assignments and, possibly, an allotment forming a single requirement, each potentially interfering assignment is treated separately and no summation is considered, only the worst case source of interference being retained for subsequent processing. Similarly, any potential interference from the reference networks forming the allotment is not summed with that from any of the assignments in the same linked requirement.

It can be argued that in the case of a linked set of assignments which form a composite requirement, the potential interference from the assignments should be summed. However, this can lead to errors with regard to summation of potential interference from an allotment and any linked assignment(s), so no summation was undertaken.

Complications

The allowance of 3 dB referred to above was originally calculated on the basis that there would be 5 or 6 separate sources of interference with comparable values of nuisance field strength plus combined location correction. (It is to be expected that there will be 5 or 6 interferers at any given location near the boundary of a service area in a fully developed plan.) However, it was not assumed that all of these sources would have protection margins of 0 dB with respect to the minimum median wanted field strength value.

The RRC-04 decided, in § 5.3.1.2.6, to specify the use of power summation for interfering signals and it is then easy to see that there are some complications to be taken into account. For example, even two sources of interference with equal values of nuisance field strength plus combined location correction will 'use up' all of the 3 dB allowance and any additional interference will then cause coverage reductions. These reductions can be regarded as a decrease in the size of the coverage area in the case of wanted assignments or a possible decrease in the percentage of locations which are protected in the case of an allotment. It is assumed that it will be a task for RRC-06 to define exactly how coverage reductions are to be calculated and presented.

It must also be noted that the use of a 0 dB protection margin does not lead to protection of either analogue broadcasting or OS because in those cases it would lead to an increase in ufs of 3 dB and not the 0.5 dB or 1 dB which is the normal target. In fact, the RRC-04 Report discussions in the final paragraph of § 5.3.1.1.2.2 and in § 5.3.1.2.1 are really related only to the case of digital requirements and it is not advisable to apply those considerations to either analogue broadcasting or to OS without making the relevant necessary changes to the values.

Compatibility calculations

When compatibility calculations are made it is normal to discard any values that are of no interest in further processing, for example when preparing the input to a synthesis process. Many of the calculations give as a result interference levels which are much too low to have any significant effect in practice and such values do not need to be retained for further processing.

It is necessary to be careful not to discard too many results, because they seem to be too low to be of any interest, because it could then be impossible to consider alternative approaches which are more critical than those previously considered without re-doing all of the analysis calculations and the latter is a very time consuming process. (For the first analyses of the data for the first planning exercise, it was decided to adopt stringent protection margins in order to ensure that any likely decisions about the acceptable margins could be accommodated in a relatively fast post-analysis calculation process. The discussion in the following section provides information about the limiting margins adopted for the second analysis of the same data.)

It was also decided to adopt a consistent approach to the calculation of potential increases in minimum ufs values, independent of the service under consideration. These increases are shown in the calculated results in the column 'margin'.

As a result of these considerations, the value of the 'margin' in the files which result from the analysis calculations is given. The symbols '{' and '}' have been added in the following expressions to make it clearer which are the terms being 'power summed':

> in the case of a wanted digital allotment, by the power sum {of the minimum median ufs and the value in the column 'cnfs' (previously called 'nfs')}, expressed in dB, from which is subtracted the value of the minimum median ufs;

in the case of a wanted digital assignment, by the power sum {of the wanted median field strength - 3 dB and the value in the column 'cnfs'}, expressed in dB, from which is subtracted the value of the wanted median field strength - 3 dB;

in the case of a wanted analogue broadcasting assignment, by the power sum {of a value X and the value in the column 'cnfs'}, expressed in dB, from which is subtracted the value of X;

in the case of a wanted OS assignment, by the power sum {of the minimum ufs and the value in the column 'cnfs', expressed in dB}, from which is subtracted the value of the minimum ufs.

The wanted median field strength - 3 dB was used in the case of digital assignments in order to ensure that the calculated 'margin' had a consistent basis regardless of whether the test point for which it was calculated was on a national boundary or not. It is necessary to subtract 3 dB from the calculated wanted median field strength in order to take account of the 3 dB allowance above the minimum median field strength value.

The value of X used in the case of an analogue broadcasting assignment is the larger of the ufs and the wanted field strength calculated on the boundary of the analogue service area.

It is to be recalled that for a wanted digital service, the combined location correction value is included in the column 'cnfs' while there is no such value in the cases of wanted analogue broadcasting or OS.

Limiting margins

In the case of wanted analogue broadcasting assignments, the limiting value of the margin has been taken to be 0.5 dB. This is the ufs increase accepted in the relevant broadcasting plans.

In the case of wanted OS assignments, the limiting value of the margin has been taken to be 1.0 dB. This is the increase in the minimum field strength value, equivalent to the minimum ufs value, accepted for OS.

In the case of wanted digital requirements, with none of the additional relaxations addressed in Annex 17 of the IPG-1 Report applied, the limiting value of the margin has been taken to be 1.25 dB. The derivation of this value is given below.

The value of 1.25 dB is based on the assumption that there can be 6 separate interfering sources, each producing the same value of 'cnfs', that the power sum method is used to calculate the combined effect of these interference sources and that their combined effect 'uses up' the 3 dB allowance that was built into the definitions of service boundaries. (This applies to separate interference sources, not to the contributions from the transmitters in a reference network.)

It is to be noted that the value of 1.25 dB represents a relaxation of approximately 4.5 dB in the 'cnfs' value relative to the equivalent value in the first analyses of the data for the first planning exercise; this value of relaxation is a direct result of the power summation process.

It is also to be noted that if the summation of interference from separate sources were to use an approach other than the power sum method, then a different limiting 'margin' may be applicable. However, the differences may not be significant, at least, not in the case of a single wanted signal and 5 or 6 interfering signals.

Calculation of limiting margins

Although t is necessary to know the values of individual wanted and nuisance fields in order to calculate the margin in any particular situation, the values of the limiting margins may be calculated

in an absolute manner. The term 'limiting margin' is to be interpreted in the sense that any calculated margin which is less than the relevant limiting margin indicates a compatible situation.

Limiting margin = 10 log (1.0 + 10(-4.771 + x + y) / 10)**

The value of -4.771 takes account of the 3 dB allowance described above and in the RRC-04 Report and the assumption that there are 6 interference sources each with the same value of combined nuisance field strength. The values of x and y depend on what additional relaxations are included and are both zero if there are no additional relaxations.

The PXT proposes to take account of the possible additional relaxations described in Annex 17 of the IPG-1Report in the following way:

the lower protection margin will be - 3 dB in place of 0 dB and will be applied to both DVB-T and T-DAB;

the 90% location probability will be applied to the case of protection against the combination of interference and noise and not to protection against noise alone as the latter would imply changes to the planning parameters agreed at RRC-04. This relaxation will be applied in the case of DVB-T only.

Possible relaxation	***x***	***y***			***Limiting margin***
None	0.0	0.0			1.25
- 3 dB protection margin	3.0	0.0			2.21
90% location probability for DVB-T	0.0	Outdoor		2.82	2.14
		Indoor	UHF	3.99	2.64
			VHF	3.22	2.30
90% location probability for DVB-T and - 3 dB protection margin	3.0	Outdoor		2.82	3.57
		Indoor	UHF	3.99	4.26
			VHF	3.22	3.80

Note that all of the numbers in the above table have been limited to only two decimal places.

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