Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

THE POSSIBILITIES AND CONSEQUENCES OF CONVERTING GE06 DVB-T ALLOTMENTS/ASSIGNMENTS IN BAND III INTO T-DAB ALLOTMENTS/ASSIGNMENTS INCLUDING ADJACENT CHANNEL ISSUES

Athens, February 2008

0 EXECUTIVE SUMMARY

This Report provides results of technical studies on operation of T-DAB networks under the interference envelope of DVB-T allotments in Band III.

In particular, the Report focuses on the technical feasibility of the conversion from GE06 DVB-T Plan entry into T-DAB services as well as on interference issues that may occur as a result of this conversion.

It is concluded that DVB-T allotments/assignments can be converted within the provisions of the GE06 Agreement into T-DAB allotments/assignments without additional restrictions on the interference potential and the protection of the concerned systems.

It is also concluded that adjacent frequency block interference occurring within overlapping areas of coverage for converted T-DAB services could be mitigated technically on a case by case basis.

This Report has been based on the technical reference models. Further investigations are required on the actual performance of receivers on the market in order to ensure that they meet or improve on these reference models.

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1 INTRODUCTION

Flexibility of the Geneva 2006 (GE06) Agreement is achieved by allotment planning concept on one hand and by regulatory procedures defined to modify the Plan on the other. Moreover, the provisions of GE06 permit the Plan entries to be used for other services under the interference envelope concept as long as they do not require more protection or cause more interference than is allowed according to the GE06.

Many European countries have one DVB-T layer in the Band III part of the GE06 Plan. The usage of DVB-T Plan entries in the Band III for T-DAB services is one of the possibilities foreseen by many European Administrations. The possibility of conversion of a DVB-T Plan entry into T-DAB networks is constrained by the parameters of the particular Plan entry. Moreover, an interference issue between adjacent T-DAB blocks may occur when splitting a DVB-T channel into four T-DAB blocks.

This report has been prepared in response to the ECC mandate to study the technical aspects in relation to the conversion of DVB-T allotments in Band III into T-DAB assignments. Possible impairments due to the operation of an adjacent frequency block are pointed out and solutions to overcome these impairments are proposed.

2 CONVERSION OF A GE06 DVB-T PLAN ENTRY

2.1 Technical aspects

Regarding the technical feasibility of the conversion, for the implementation of a T-DAB service using a DVB-T Plan entry the interference field strength of the implemented T-DAB network must not exceed the interference potential of the DVB-T Plan entry which, depending on an entry type, is derived from assignment characteristics or the reference network. However, sufficient minimum field strength has to be ensured for a good T-DAB coverage. On the other hand the maximum allowable interfering field strength[1] from other co-channel Plan entries, tolerated at the DVB-T assignment coverage area or DVB-T allotment border, should not affect the functionality of the real T-DAB implementation.

The resulting T-DAB coverage is likely to differ from the original DVB-T coverage, and will depend on the different combinations of system characteristics and/or RPC/RN used for both DVB-T and T-DAB assignments/allotments.

The investigation on converting a DVB-T allotment into T-DAB network shows that a DVB-T channel can be converted into four T-DAB blocks. The interference field strength of the T-DAB blocks, using RPC4 or RPC5, does not exceed the interference potential of the DVB-T reference network RN1 for RPC2 or RPC3. Since no power reduction is needed for the conversion, the required minimum field strength for a satisfactory T-DAB coverage will be achieved. Details of this study can be found in Annex A1.

Another aspect is the interference from other co-channel allotments that may affect the coverage of the resulting T-DAB implementation. The study shows that only in one case the maximum allowable interfering field strength tolerated by the T-DAB implementation is significantly lower than the maximum allowable interfering field strength tolerated by the DVB-T allotment from which the T-DAB implementation stems. This is the situation of the (unlikely) conversion of RPC3 to RPC4. In this case the implemented RPC4 T-DAB network needs a higher protection than the coordinated RPC3 DVB-T allotment. However, the insufficient level of protection of T-DAB can be partially compensated by higher transmitted power.

Less flexibility in implementing T-DAB services is provided by conversion from DVB-T assignments. In particular, severe reduction in the T-DAB service area obtained, in comparison to the service area obtained with the original DVB-T assignments, could be expected because of required limitation of outgoing interference into co-block services. This is because each of the four resultant T-DAB assignments would have to share the power of the DVB-T assignment. It has been shown that only if DVB-T assignments to be converted are registered in the Plan for indoor reception the conversion into T-DAB service is achieved without reduction of the size of the T-DAB service area compared to the original DVB-T service area. The details of the study are provided in Annex A2.

Adjacent frequency block issues may also appear after the conversion; these will be considered in the Chapter 3.

[1] The value of the '*maximum allowable interfering field strength*' depends on the T-DAB or DVB-T reception conditions and system variant and is based on the respective minimum field strength and the appropriate protection ratio and combined location correction factor.

2.2 Regulatory aspects

From a procedural point of view conversion of a DVB-T allotment/assignment into allotments/assignments of mobile multimedia services including T-DAB is, in principle, straight forward using article 5.1.2e or 5.1.3 (envelope concept) of the GE06 Agreement.

3 ADJACENT CHANNEL (FREQUENCY BLOCK) ISSUES

3.1 General description

Adjacent channel/block interference is caused when a receiver tuned to the wanted service is subject to interference in the wanted channel/block from another service operating in an adjacent channel/block. If the two services are transmitted from the same location using appropriate power levels, and an appropriate spectrum mask, it is possible to ensure that there is no harmful interference in the coverage area of either of the two services. However, if the two services are transmitted from different locations, and/or at significantly different power levels, it is much harder to specify how to protect the wanted service across its entire coverage area. The issue appears due to differences in received field strength when using non-co-sited transmitters. In particular, zones of impairment might be expected to a service in the vicinity of transmitters using adjacent channel, for which the wanted service had no such transmitter contributing to its wanted field strength.

Generally, the GE-06 Plan has been optimised to avoid adjacent block interference between existing T-DAB entries in the all-digital Plan. However, adjacent channels (adjacent frequency blocks) working within overlapping areas of coverage would be necessary for T-DAB services converted from DVB-T Plan entries in order to use frequencies efficiently. Such arrangements might pose some technical challenges. In particular, the usage of T-DAB blocks as obtained within the conversion procedure for different coverage purposes (e.g. local or regional coverage) would imply different network topology. Therefore, in general it is expected that adjacent frequency block networks would not necessarily use the same (or nearly co-sited) transmitter sites, unless constrained to do so in order to achieve mutual compatibility.

3.2 Spectrum mask for T-DAB frequency block

In order to protect a victim T-DAB receiver from interference received within its 'own' frequency block, caused by out-of-band emissions from another T-DAB transmitter operating on an adjacent block, the spectrum mask for T-DAB frequency block needs to be carefully specified.

The out-of-band radiated signal in any 4 kHz band shall be constrained by the masks defined in Figure 3.1.

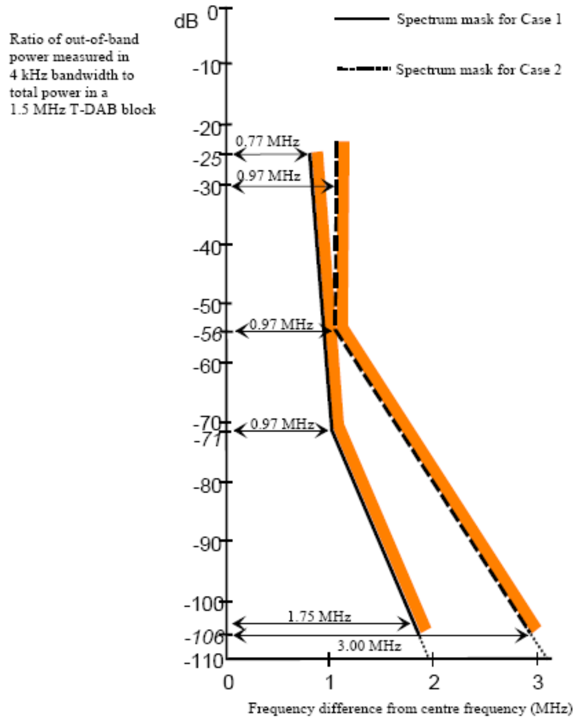


Figure 3.1: Spectrum masks for T-DAB out-of-band emissions

When using a single T-DAB frequency block the radiated signal in any 4 kHz bandwidth should be constrained by the non critical mask defined in Figure 3.2 based on the out-of-band spectrum mask defined by Case 2 in Figure 3.1. Contracting Administrations may elect to apply a sensitive mask based on the out of band spectrum mask defined by Case 1 in Figure 3.1.

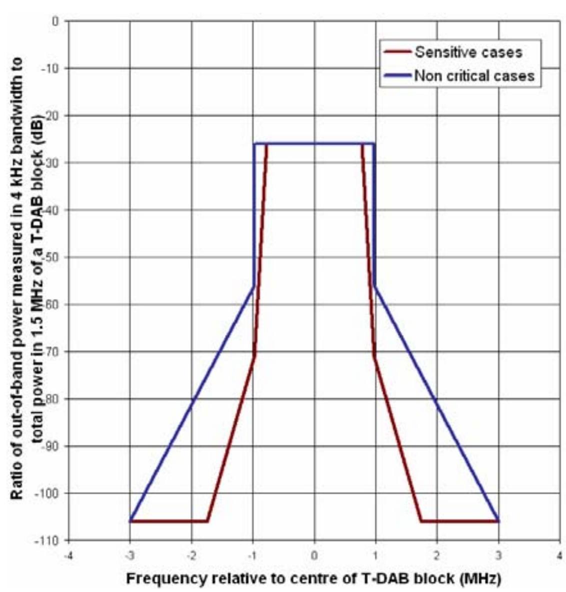


Figure 3.2: Spectrum mask for a single T-DAB frequency block

The DVB-T spectrum masks are specified in Figure 3.3 and the associated Table 3.1. This mask becomes the normalisation template for outer envelope of the group. The group can be up to four T-DAB/T-DMB or similar multimedia transmitters.

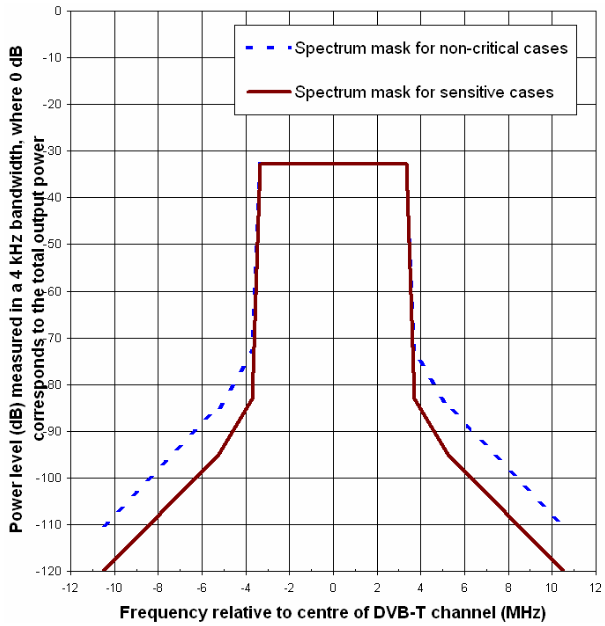


Figure 3.3: Spectrum mask for DVB-T in 7 MHz channel

	Non-critical cases	Sensitive cases
Relative frequency (MHz)	Relative level (dB)	Relative level (dB)
-10.5	-110	-120
-5.25	-85	-95
-3.7	-73	-83
-3.35	-32.8	-32.8
+3.35	-32.8	-32.8
+3.7	-73	-83
5.25	-85	-95
+10.5	-110	-120

TABLE 3.1
DVB-T spectrum masks for non-critical and sensitive cases in Band III.

The T-DAB spectrum mask needs to be normalised to the peak DVB-T transmission. Transmissions that may occur across the guard bands between the individual T-DAB blocks shall not exceed the DVB-T spectrum mask limit as defined by the red line in Figure 3.4 (example of four aggregated T-DAB frequency blocks).

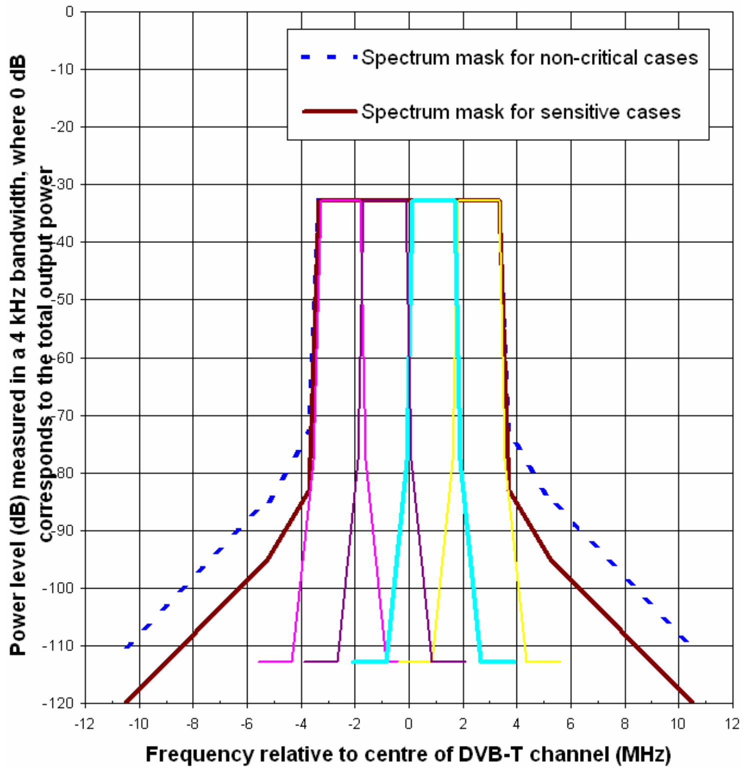


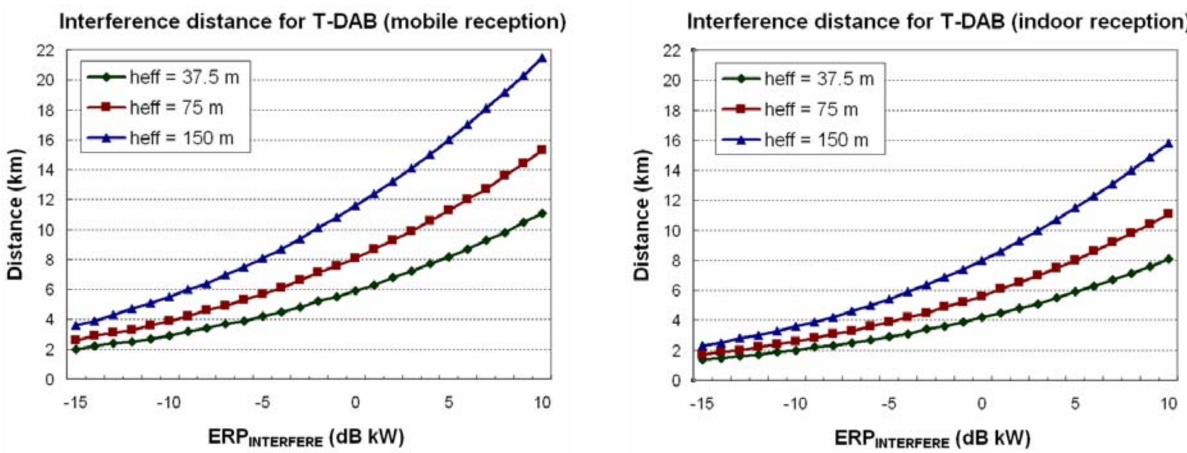
Figure 3.4: Spectrum mask for four aggregated T-DAB frequency blocks

3.3 Compatibility assessment

The impact of adjacent T-DAB block interference depends mainly on the field strength difference between wanted and interfering signals. Clearly, when the wanted signal is on its minimum, e.g. corresponds to the minimum median field strength value, the impact from the interfering signal would be the greatest. Different techniques could be employed to minimise the impact of adjacent block interference. One is to locate an interfering transmitter at a certain distance from the edge of a wanted coverage area.

A study has been performed to calculate the separation distances between a T-DAB interfering transmitter and a T-DAB victim receiver at the edge of a wanted T-DAB transmitter coverage area, with the transmitters operating on adjacent blocks. The size of the zone of impairment is a function of the ERP of the interfering T-DAB transmitter in any given direction, the reception conditions, the wanted T-DAB signal level, and the T-DAB receiver performance with regard to out-of-block interference.

Theoretical results for assessment the impairment zone are presented in Figure 3.5 for different transmitter antenna heights and different reception modes. Details of calculations are provided in Annex A3.



(a) *(b)*

Figure 3.5: Minimum separation of a T-DAB interfering transmitter from the edge of a T-DAB transmitter coverage area for adjacent block interference: (a) mobile reception, (b) indoor reception

3.4 Mitigation techniques

In order to bring about an efficient use of T-DAB frequencies converted from DVB-T Plan entries, some planning techniques are necessary to enable adjacent frequency block working in overlapping areas, while mitigating harmful interference. These mitigation techniques may include some compromises.

In general, the best technique consists in co-locating conflicting T-DAB services and using the same antenna system. A less good solution could be to use the same site but with different antenna systems or to use very close sites. The most difficult configuration is to use different and widely separated transmitter sites. In this case several measures are recommended in order to ensure the compatibility between the non co-sited T-DAB transmitters operating on adjacent frequency blocks.

Mitigation is aimed to reduce the difference in the wanted and interference field strength values. Measurements on the capabilities of receivers on the market need to be carried out.

For protection of a T-DAB service from a non co-sited T-DAB transmitter operating on adjacent frequency block, the following actions could be recommended:

- Use of more stringent spectrum mask for a T-DAB frequency block for the interfering T-DAB service transmitter;
- Adjusting the power of the interfering T-DAB transmitter, taking into account the local conditions, in particular the level of the wanted T-DAB field strength received in the area covered by the interfering T-DAB transmitter;
- Adjusting the antenna height of the interfering T-DAB transmitter with regard to the surrounding T-DAB receiving antennas, with correct usage and control of its vertical radiation pattern;
- Increasing the field strength of the wanted T-DAB transmitter. This could also be realised by installing additional T-DAB transmitter(s) in an SFN configuration to improve coverage in the concerned area;

Summarizing, it can be stated that careful network planning aimed to reduce as much as possible the zone of impairment is necessary to ensure compatibility between T-DAB services operating on adjacent frequency blocks.

4 CONCLUSION

In respect of the technical feasibility, DVB-T allotments can be converted within the provisions of the GE06 Agreement into T-DAB allotments/assignments without additional restrictions on the interference potential and the protection of the concerned systems.

Adjacent frequency block interference may occur within overlapping areas of coverage for T-DAB services converted from the same DVB-T Plan entry. However, this is solely an internal national issue that could be mitigated technically on a case by case basis.

ANNEX A1

POSSIBILITY FOR CONVERSION OF DVB-T ALLOTMENTS IN BAND III INTO T-DAB ASSIGNMENTS

Regarding the technical feasibility of a conversion from a DVB-T allotment into T-DAB assignments, there are two main aspects which have to be checked. For the implementation of a T-DAB network under the interference envelope of a DVB-T allotment the interference field strength of the T-DAB implementation must not exceed the interference field strength of the DVB-T reference network; but sufficient minimum usable field strength has to be ensured for a good T-DAB coverage. On the other hand the maximum allowable interference field strength from other co-channel allotments at the boundary of the original DVB-T allotment should not affect the functionality of the real T-DAB implementation.

The following study deals with DVB-T reference networks RN1 RPC2 and RN1 RPC3 only. Other reference network types e.g. RN1 RPC1, have not been investigated here.

The maximum interference field strength is calculated at the re-use distance of a homogeneous RPC2 or RPC3 layer. For a DVB-T layer consisting of only RPC2 allotments the re-use distance is 162 km, for a layer consisting of only RPC3 allotments the re-use distance is 118 km. At this distance the interference field strength of four RPC4 blocks and four RPC5 blocks respectively are calculated. This field strength has to be compared with the interference field strength of the RPC2 and RPC3 reference networks. The results are given in the Table A1 and Table A2.

RN1 RPC2 ←→	**RN1 RPC2**	**RN RPC4**	**RN RPC5**
Interference field strength at 162 km	34 dBµV/m	25 dBµV/m	34 dBµV/m

TABLE A1
Comparison of interference field strength for 4 T-DAB blocks within RPC2

RN1 RPC3 ←→	**RN1 RPC3**	**RN RPC4**	**RN RPC5**
Interference field strength at 118 km	44 dBµV/m	30 dBµV/m	39 dBµV/m

TABLE A2
Comparison of interference field strength for 4 T-DAB blocks within RPC3

As shown in Table A1 and Table A2 the interference field strength of four T-DAB blocks does not exceed the interference field strength of the DVB-T reference network. The additional 3 dB power margin of the DVB-T reference network gives the advantage of a higher allowable transmitter power of the T-DAB network. Provided that the frequency plan is based on a re-use distance, which ensures the compatibility of the coordinated DVB-T allotment with the rest of the plan, also the T-DAB implementation will keep within the limits. Therefore, no power reduction of the T-DAB network is necessary and the required minimum usable field strength for a satisfying T-DAB coverage is achieved. The conversion is possible even for the situation of four T-DAB blocks within the same DVB-T channel.

The previous investigation has checked the conformity of the networks considering the total power of the signals. Since T-DAB and DVB-T, both being COFDM systems, show a uniform distribution of the power across the channel/block bandwidth this is also information on the spectral power density.

A further constraint which has to be fulfilled is the compliance with the mask concept. For this purpose the peak power density in any 4 kHz of the implementation shall not exceed the spectral power density in the same 4 kHz of the digital plan entry. It is not necessary to check this criterion independently, because this investigation is already done with the check of total power. Due to the uniform power distribution across the bandwidth of DVB-T and T-DAB signals, the mask concept will be fulfilled automatically, if the conformity in respect of the total power is given.

There is one remaining aspect: that is the investigation of the maximum allowable interference field strength. It is necessary to check if the interference of other co-channel DVB-T allotments may affect the resulting T-DAB implementation. Using *formula (1)* and assuming a homogeneous DVB-T layer, the maximum allowable field strength of RPC2 and RPC3 are 34 dBµV/m and 44 dBµV/m, respectively.

$$F\_int\_max = F\_min - C/N - 1{,}41421 \times Loc\_corr\_fac \qquad (1)$$

F_int_max: maximum allowed interference field strength

F_min: minimum median field strength according to RRC06

C/N: protection ratio according to RRC06

- 21 dB for RPC1
- 19 dB for RPC2
- 17 dB for RPC3
- 15 dB for RPC4 and RPC5

Loc_corr_fac: Location correction factor

- 9 dB for RPC1 and RPC2 (95% outdoor)
- 10 dB for RPC3 and RPC5 (95% indoor)
- 13 dB for RPC4 (99% mobile)

For the calculation of the maximum allowable interference field strength of a DVB-T reference network at the border of a T-DAB allotment the protection ratio “T-DAB interfered with by DVB-T” has to be used. The protection ratio for the system variant 64QAM 2/3 is given in the Recommendation ITU-R BS.1660-1. According to the latest technical expertise the C/N value is greater than assumed in the Recommendation. Therefore a C/N value of 9 dB was defined at the RRC06. Using this value the result of the maximum allowable interference field strength of RPC4 and RPC5 is 33 dBµV/m and 43 dBµV/m, respectively.

The study shows that there is only one case in which the maximum allowable interference field strength of the T-DAB implementation is significantly lower than the maximum allowable interference field strength of the DVB-T allotment. This is the situation for the conversion of RPC3 to RPC4. In this case the implemented RPC4 network needs a higher protection than the coordinated RPC3 allotment, due to this interference from other co-channel allotments could arise. But comparing RPC4 with RPC3, there is a margin concerning the minimum median field strength (75 dBµV/m for RPC3, 66 dBµV/m for RPC4 – T-DAB with 4 blocks) and the outgoing interference (44 dBµV/m for RPC3, 30 dBµV/m for RPC4 – T-DAB with 4 blocks). Therefore, the insufficient protection of T-DAB can be partially compensated by higher transmitter power.

In respect of the technical feasibility, DVB-T allotments can be converted into T-DAB assignments without additional restrictions on the interference potential and the protection of the concerned systems. The study shows that the conversion is feasible for all investigated combinations. A conversion from DVB-T into T-DAB is possible regardless of the given DVB-T reference network (RN1 RPC2 or RN1 RPC3). The demand on a T-DAB indoor coverage could be satisfied easier with a coordinated RPC3 allotment due to the higher allowable transmitter power.

ANNEX A2

CONVERSION OF DVB-T ASSIGNMENTS IN BAND III INTO T-DAB ASSIGNMENTS

The conversion of broadcasting services has been considered for the case of two transmitters as shown in Figure 1. As a starting point their effective radiation power (e.r.p.) is set to 1 kW (30 dBW). The antenna height is taken to be 150 m. Recommendation ITU-R P. 1546 has been used as a field strength prediction model.

For the case of 7-MHz DVB-T transmission the system variant 16 QAM 2/3 has been considered for different reception conditions: fixed antenna, portable outdoor, portable indoor, all at 95 % of locations, and mobile reception at 99 % of locations. Portable indoor reception at 95 % of locations has been set as a target for T-DAB transmission.

An example of an initial planning situation is presented in Figure A2.1. Both transmitters are assumed to transmit the DVB-T service using the same frequency channel. First, the distance $D_{cov1\ DVB\text{-}T}$ of the first transmitter is calculated, at which the minimum median field strength for reception ($E_{med1\ DVB\text{-}T}$) is still guaranteed. The separation distance to the second transmitter is set according to the maximal allowable interfering field strength ($E_{maxint1}$) at the distance $D_{cov1\ DVB\text{-}T}$ of the first transmitter as shown in Figure 1. Thus, $E_{med1\ DVB\text{-}T}$ and $E_{maxint1}$ define the distance (D_{tot}) between the two transmitters. The coverage distance of the second transmitter $D_{cov2\ DVB\text{-}T}$ is then calculated depending on $E_{med2\ DVB\text{-}T}$ and $E_{maxint2}$.

It should be noted that the distance between two transmitters is fixed to 100 km when it is not possible to set the distance to an "optimal" one, e.g. when the coverage radius at both planning sides is equally limited by the power and interference. Such a situation appears when the two transmitters operate different types of services (e.g. DVB-T vs. T-DAB) at an initial stage.

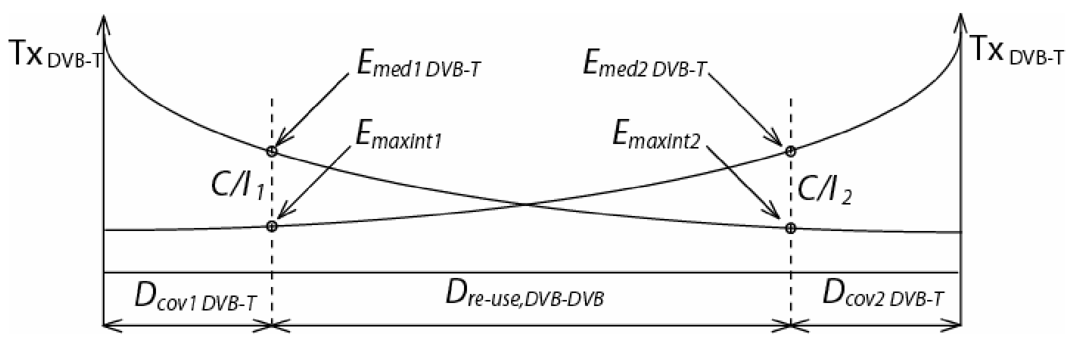


Figure A2.1: Initial planning situation.

Let's assume that the second DVB-T transmitter is converted into a T-DAB transmitter (Figure A2.2). Under such a conversion the coverage radius of the first DVB-T transmitter is supposed to be maintained (protected). For this, a higher carrier-to-interference ratio has to be satisfied at the coverage radius ($D_{cov1DVB\text{-}T}$) due to the higher power density of a T-DAB signal with respect to a DVB-T signal. Therefore, the e.r.p. of the new T-DAB transmitter should be reduced by 6.4 dB. This leads to the distance (D_{cov2P}) at which minimal field strength ($E_{med2\ T\text{-}DAB}$) is satisfied. The minimal signal-to-interferer ratio (C/I_2) defines the distance ($D_{cov2C/I}$) where the reception of the T-DAB signal is interference limited. In practice, both conditions must be fulfilled. Thus the smaller of the two distances defines the coverage radius $D_{cov2\ T\text{-}DAB}$ of the second (T-DAB) transmitter.

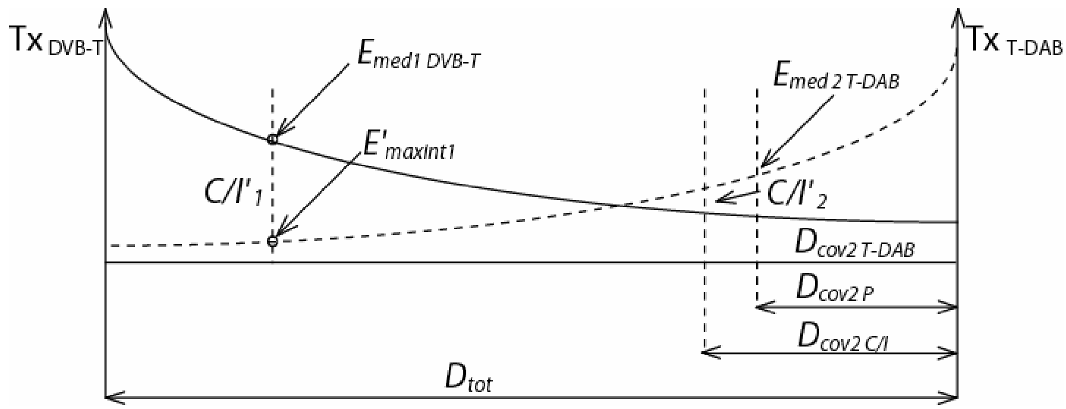


Figure A2.2: Planning situation after conversion of a DVB-T transmitter into a T-DAB transmitter.

An example of detailed calculations is presented below. The initial planning situation is represented by two DVB-T transmitters targeted at portable outdoor reception. One DVT-T transmitter is assumed to be converted into a T-DAB transmitter targeted at portable indoor reception.

PTx_{DVB} = 30 dBW
$E_{med1\ DVB\text{-}T}$ = 62.2 dB□V/m
$D_{cov1\ DVB\text{-}T}$ = 19.1 km

$C/I_1 = C/I_2 = C/I_{system} + Cm = C/I_{system} + g\sqrt{(\sigma_{wanted})^2 + (\sigma_{interferer})^2} = 14.2 + 1.64 \cdot \sqrt{2} \cdot 5.5 = 27$ dB

$E_{maxint1} = E_{med1\ DVB\text{-}T} - C/I_1$ = 35.2 dB□V/m

$D_{re\text{-}use\ DVB\text{-}DVB}$ = 41.4 km

$D_{tot} = 2 \cdot (D_{cov\ DVB\text{-}T}) + D_{re\text{-}use\ DVB\text{-}DVB}$ = 79.6 km

We mark the corresponding planning parameters after conversion with a prime mark (’).

$E'_{maxint1}$ = 35.2 dB□V/m – SPD = 28.8 dB□V/m

where SPD = 6.4 dB is the correction factor for Spectral Power Density .

$PTx_{DAB} = PTx_{DVB} - (E_{maxint1} - E'_{maxint1})$ = 23.6 dBW

$C/I'_2 = C/I_{system} + g\sqrt{(\sigma_{wanted})^2 + (\sigma_{interferer})^2}$ - SPD = $15 + 1.64 \cdot \sqrt{2} \cdot 6.3$ - 6.4= 23.2 dB

$D_{cov2C/I}$ = 17.6 km

$E_{med2\ T\text{-}DAB}$ = 66 dB□V/m

D_{cov2P} = 10.4 km

$D_{cov2\ T\text{-}DAB} = \min(D_{cov2C/I}, D_{cov2P}) = D_{cov2P}$ =10.4 km

The change in the coverage radius of the converted transmitter is presented in the Table A2.1 for different conversion situations. In the table FO, PO, PI, MR stand for fixed outdoor, portable outdoor, portable indoor, mobile reception, respectively. IL and PL stand for interference limited and power limited coverage, respectively. The unchanged DVB-T/T-DAB service, by definition of the intended conversion process, should not experience any change in coverage distance, indicated in Table A.2.1 by an * next to the percentage change of 0.0.

№	Initial planning situation	D_{tot} (km)	D_{cov} (km)	Planning situation after conversion	D_{cov} (km)	Change in D_{cov} (%)
1	DVB-T FO	165.9	49,9 PL+IL	DVB-T FO	49.9 PL+IL	0.0*
	DVB-T FO		49.9 PL+IL	T-DAB PI	10.4 PL	-79.2
2	DVB-T PO	79.6	19.1 PL+IL	DVB-T PO	19.1 PL+IL	0.0*
	DVB-T PO		19.1 PL+IL	T-DAB PI	10.4 PL	-45.5
3	DVB-T MR	79.4	15.3 PL+IL	DVB-T MR	15.3 PL+IL	0.0*
	DVB-T MR		15.3 PL+IL	T-DAB PI	10.4 PL	-32.0
4	DVB-T PI	54.5	10.5 PL+IL	DVB-T PI	10.5 PL+IL	0.0*
	DVB-T PI		10.5 PL+IL	T-DAB PI	10.1 IL	-3.8
5	T-DAB PI	100.0	10.4 PL	T-DAB PI	10.4 PL	0.0*
	DVB-T FO		28.0 IL	T-DAB PI	10.4 PL	-62.9
6	T-DAB PI	100.0	10.4 PL	T-DAB PI	10.4 PL	0.0*
	DVB-T PO		19.1 PL	T-DAB PI	10.4 PL	-45.5
7	T-DAB PI	100.0	10.4 PL	T-DAB PI	10.4 PL	0.0*
	DVB-T PI		10.5 PL	T-DAB PI	10.4 PL	-1.0
8	DVB-T PO	100.0	19.1 PL	DVB-T PO	19.1 PL	0.0*
	DVB-T PI		10.5 PL	T-DAB PI	10.4 PL	-1.0

TABLE A2.1

ANNEX A3

EXCLUSION ZONE ASSESSMENT NEAR THE EDGE OF T-DAB SERVICE AREA IN BAND III

An interference issue between adjacent T-DAB blocks may occur when splitting a DVB-T channel into four T-DAB blocks – the most likely scenario for many European countries implementing their GE06 Plan. The impact of adjacent T-DAB block interference depends mainly on the field strength difference between wanted and interfering signals. Clearly, when the wanted signal is on its minimum, e.g. corresponds to the minimum median field strength value, the impact from the interfering signal would be the greatest. Different techniques could be employed to minimise the impact of adjacent block interference. One is to locate an interfering transmitter at a sufficient distance from the areas of low usable field strength (e.g. away from the edge of a wanted coverage area).

In this study, the separation distances between a T-DAB interfering transmitter and a T-DAB victim receiver at the edge of a wanted T-DAB transmitter coverage area, with the transmitters being operat on adjacent blocks, have been calculated.

For the wanted T-DAB service the minimum median field strength ($E_{\min med}$) value of 60 and 66 dB(µV/m) has been assumed for mobile and portable indoor reception, respectively (RRC-06 Final Acts). The effective radiated power (ERP) of the interfering transmitter has been varied from 15 to 40 dBW and the transmitter antenna height h_{eff} has been taken to be 37.5, 75.0, and 150.0 m. Propagation calculations have been made at 200 MHz using 1% curves of Recommendation ITU-R P.1546-2.

The following formula for the maximum allowed interference field strength ($E_{\max \text{int}}$) is used to take into account location probability:

$$E_{\max \text{int}} = E_{\min med} - Q\sqrt{\sigma^2_{T-DAB,W} + \sigma^2_{T-DAB,I} + \sigma^2_{BL,W} + \sigma^2_{BL,I}} - PR \text{ dBµV/m},$$

where:

PR is the appropriate protection ratio. The value of -30 dB has been used for the adjacent block interference as specified in European Broadcasting Union, BPN 003, 3rd issue, February 2004: 'Technical bases for T-DAB services network planning and compatibility with existing broadcasting services';

$Q = 1.645$ for 95% of locations (indoor reception);

$Q = 2.327$ for 99% of locations (mobile reception);

$\sigma_{T-DAB,W}$, $\sigma_{T-DAB,I}$ are the standard deviations of the lognormal distribution of the victim and interfering outdoor T-DAB signals (5.5 dB);

$\sigma_{BL,W}$, $\sigma_{BL,I}$ are the standard deviations of the lognormal distribution of the victim and interfering indoor T-DAB signals (6 dB);

For a given level of ERP the interfering transmitter has been located in such a way that the interfering field strength at the edge of the wanted transmitter coverage area does not exceed the maximum allowed interference field strength. The results are presented in Figure 3.5 of the main text for different transmitter antenna heights.