CEPT Report 23

Complementary Report to Report B (CEPT Report 22) from CEPT to the European Commission in response to the Mandate on:

"Technical considerations regarding harmonisation options for the Digital Dividend"

"Technical Options for the Use of a Harmonised Sub-Band in the Band 470 - 862 MHz for Fixed/Mobile Application (including Uplinks)[1]

Final Report on 21 December 2007 by the

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

[1] *The main part of this report was prepared before the WRC-07 decision on the mobile allocation and IMT identification in the band 790-862 MHz was taken.*

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0 EXECUTIVE SUMMARY

Justification

The first step towards harmonisation of a sub-band for fixed/mobile applications in the band 470 - 862 MHz has been made in CEPT Report B (CEPT Report 22) to ECC on the technical feasibility of harmonising a sub-band of Bands IV and V for mobile applications (including uplinks), minimizing the impact on GE-06. In order to progress further with the non-mandatory harmonised introduction of fixed/mobile services in the band 470 - 862 MHz, CEPT Report B listed a number of technical issues requiring careful consideration.

This CEPT report supplements CEPT Report B by addressing above technical issues with the aim to facilitate the operation of fixed/mobile, broadcasting and other service applications in the band 470 - 862 MHz.

Findings

This Report provides example band plans for the fixed/mobile services in the harmonised sub-band. The most suitable arrangements vary depending on the system or technology to be implemented in the harmonised frequency range.

Noting that any decision about usage of the harmonised sub-band for fixed/mobile applications is not mandatory, it is stressed that the issue of cross border interference will have to be addressed between individual Administrations.

The studies on channelling arrangements have not been finalized within TG4 and therefore CEPT should pursue the development of channelling arrangements taking into account the elements given in this report.

This Report identifies also areas where future compatibility studies are needed in order to assist administrations in assessing the interference situation when implementing sub-bands for fixed/mobile communication services.

Glossary of terms (some lines are double entries here)

3GPP	3rd Generation Partnership Project
Band IV	Channels 21 - 34 (470 - 582 MHz)
Band V	Channels 35 - 69 (582 - 862 MHz)
DVB-T	Digital Video Broadcasting – Terrestrial
DVB-H	Digital Video Broadcasting – Handheld
FDD	Frequency Division Duplex
GE06	The Geneva 2006 Agreement and Plan
IF	Intermediate Frequency
IMT	International Mobile Telecommunications
ITU	International Telecommunication Union
ITU-R	ITU Radiocommunication sector
MCL	Minimum Coupling Loss
SEAMCAT	Spectrum Engineering Advanced Monte Carlo Analysis Tool
TDD	Time Division Duplex
TPC	Transmit Power Control
WiMAX	Worldwide Interoperability for Microwave Access
WRC	World Radiocommunication Conference

1 INTRODUCTION

Operation of fixed/mobile applications in the band 470 - 862 MHz would provide improvements in coverage inside buildings, and extension of these applications into rural areas.

The first step towards harmonisation of a sub-band for fixed/mobile applications in the band 470 - 862 MHz has been made in CEPT Report B [1] to ECC on the technical feasibility of harmonising a sub-band of Bands IV and V for mobile applications (including uplinks), minimizing the impact on GE-06.

Together with the conclusion on the feasibility of harmonisation and the indication of a preferred option for such sub-band CEPT Report B stipulates that sub-band harmonisation should not be made mandatory. Statements and reservations on the conclusions of Report B made by some CEPT administrations are also noted in that report.

In order to progress further with the non-mandatory harmonised introduction of fixed/mobile services in the band 470 - 862 MHz, CEPT Report B listed a number of technical issues requiring careful consideration. Moreover, any use of the harmonised sub-band for fixed/mobile services in the band 470 - 862 MHz is subject to coordinated technical arrangements. In particular, band plan options for the harmonised sub-band, including guard bands between the fixed/mobile and broadcasting services as well as duplex gap and duplex spacing, need to be explored. The arrangements that are most suitable will vary depending on the system or technology to be implemented in the harmonised frequency range.

Regulation of the harmonised sub-band should not be made in such a way that certain uses are excluded in advance. The harmonisation must be flexible so that administrations may choose different implementations depending on local evolving conditions. The harmonisation should preferably not lead to a situation where different subsets of an allocated frequency band are made incompatible with each other.

To allow for the long term development of technology used in the band 470 - 862 MHz administrations may want to assign frequencies based on the principle of technology and service neutrality. This requires that frequencies to be assigned in a flexible manner. For example, future systems may operate with a variety of different bandwidths. The demand for different technologies may also vary from country to country.

This CEPT report is intended to supplement CEPT Report B with additional technical investigations required to facilitate introduction of fixed/mobile applications in the band 470 - 862 MHz and sharing this band with broadcasting and other services.

This report will indicate example band plans and findings on necessary guard bands between broadcasting and fixed/mobile services. Further work on channelling arrangements for the mobile applications is to be carried out. For example the determination of the usage by paired/unpaired applications, the determination of an appropriate duplex gap etc. Considerations regarding IMT in other bands (e.g. 2.6 GHz range) have shown the complexity of this issue.

WRC-07 co-allocated the band 790 - 862 MHz (channels 61 - 69) to the mobile service (except aeronautical mobile), on a primary basis from 17 June 2015 in Region 1 with an identification of the band for IMT. However, the most of the report context was prepared before WRC-07 and only limited time was available to develop example band plans presented in this report to cover channels 61 - 69.

The development of detailed channelling arrangements and findings on necessary guard bands for the mobile service will be carried out by another body.

2 GUARD BANDS BETWEEN NETWORKS AND SERVICES

As pointed out in Report B [1], interference into/from broadcasting occurs from/into both downlink and uplink paths of fixed/mobile applications. In order to ensure that broadcasting and fixed/mobile services can transmit simultaneously without mutual interference, a guard band separating these two services is required.

Several studies have been carried out to determine the required frequency separation to avoid mutual interference in the case of adjacent bands operation of fixed/mobile and broadcasting services. Because of the complexity of the issue, not all possible options have been covered by these studies so far. In particular, interference into digital broadcasting has been mainly assessed for the case of fixed reception, whereas portable indoor and hand-held reception, which may be critical cases, have not yet been considered with due attention. Moreover, further measurements on protection ratios for DVB-T/H interfered with by IMT are required.

It should be also noted here that ITU Working Party 8F conducted some studies on sharing and compatibility between digital terrestrial broadcasting and IMT, which were not adopted by ITU-R Study Group 8, which met in June 2007. Therefore, further compatibility work will be conducted in the next study period under in response to WRC-07 Resolution 224 [2] and to WRC-07 Resolution 749 [3]. WRC-11 will also review the results of the sharing studies carried out in accordance with WRC-07 Resolution 749.

Moreover, the protection of the services above 862 MHz as well as potential incoming interference from these services was not considered in this report.

2.1 Compatibility between broadcasting and fixed/mobile downlinks

The protection of DVB-T from fixed/mobile downlink in adjacent band has been already studied and the conclusion in CEPT Report B is as follows:

"Co-existence of IMT/UMTS downlink with DVB-T fixed reception will require the application of the same available mitigation techniques and careful network planning as in the case of interference from downlink "cellular / low-power transmitter" networks and "larger coverage / high power/tower" type of networks"

As explained in CEPT Report A, the issue of protection of DVB-T from low power dense networks (e.g. multimedia mobile transmitters or fixed/mobile base stations) could be relevant for any type of reception mode of the DVB-T wanted signal (fixed, portable outdoor/mobile or portable indoor) but the potential interference is highly dependent on the DVB-T wanted signal level, thus it is mostly significant for fixed reception (i.e., RPC-1).

Even without guard bands, the risk of adjacent channel interference exists only in close vicinity of the interfering mobile/fixed base station, located within the broadcasting coverage area. Generally speaking, in order to avoid/minimize interference from IMT downlink into DVB-T reception some mitigation techniques as described in CEPT Report A can be applied together with careful planning of transmitter sites where the channel adjacent to the mobile/fixed downlink transmission is used for broadcasting (see Annex A1 for details). Where suitable and efficient mitigation techniques are not applicable, a guard band may be required for the DVB-T protection from fixed/mobile downlink paths.

Therefore, it should be considered as a domestic problem and be treated on a national basis and on a bilateral level when it extends across a local border. In general, the problem should be assessed technically on an area by area basis. DVB-T transmitters can interfere with mobile/fixed reception, increasing the total noise level in the receiver and reducing the available bit rate. This has been characterised in terms of a capacity loss to the UMTS cell. Two studies have been carried out:

- One study has shown that the IMT/UMTS downlink capacity loss averaged over the whole cell is about 5 % in case of operation in adjacent channel (i.e. no guard band).
- Another study has shown that with 3 MHz guard band between DVB-T and UMTS channel edges the capacity loss is around 20 % when the broadcast interference is at its maximum and coincident with the UMTS wanted signal at its minimum (i.e. at the cell edge). Repeating the simulation at 8 MHz guard band still results in a 14% capacity loss. The results will however depend strongly on the spatial distribution of mobiles and the profile of the services offered.

Therefore, mobile/fixed operators may have to accept a certain level of capacity loss when operating fixed/mobile networks in channels adjacent to broadcasting. They should assess this issue in greater details for areas where broadcasting would be used in the adjacent channel.

2.2 Compatibility between broadcasting and fixed/mobile uplinks (including image channel operation)

Guard band widths to protect DVB-T fixed reception from IMT uplink interference on an adjacent channel, as suggested by studies using SEAMCAT simulation tool, are around 8 MHz All studies took into account the specified emission mask of UMTS terminals and the protection ratio (specified or measured depending on the study). Even with 8 MHz guard band, the interference probability would be about 1% to 1.4 % based on Monte-Carlo simulations. That corresponds to up to about 5 % to 10 % loss in broadcast coverage area. The reference location probability of 95% was used deterministically in the broadcast coverage calculations. For 5 % coverage loss, this would result in the increase of power to reach the same location probability of about 0.5 dB.

It should be noted that some measurements have shown that the protection ratio measured with TPC is degraded by up to 20 dB compared to the protection ratio measured without TPC (depending on the power level used by the mobile station). The protection ratio measured with TPC is also worse by about 5 dB compared to the protection ratio specified in EMC standards. These values need to be verified by further investigations. Furthermore, the effect of such degradation has to be carefully analysed.

Administrations may decide on larger guard bands if such interference probability is considered to be high.

According to recent measurements of the protection ratios for the DVB-T receivers in the presence of interference from UMTS user equipment, interference on image (N + 9) channel requires a protection ratio similar to that for the second (N + 2) adjacent channel. Therefore, protection of DVB-T fixed reception at the image channel will be similar to the protection of DVB-T fixed reception at the channel separated by a guard band of 8 MHz.

The frequency separation required to protect DVB-T portable indoor reception from a mobile uplink channel has not yet been fully assessed. The required isolation distance with 16 MHz guard band, based on MCL method and free space propagation, is of the order of several metres (about 7 m). This isolation distance is too large to be met within the same room.

Measurements have confirmed that there is a serious concern about the protection of the DVB-T portable reception from UMTS Mobile terminal located up to 2.5 metres from the portable receiving antenna with interference to some of the tested DVB-T receivers at frequency separation of several channels and at the image channel N+9. At 4 meter, there was still some equipment interfered in the first and second adjacent channel or even at larger frequency separation for the USB TV receiver under test. Some more detailed information about measurement findings is given in Annex A2.

It should be noted that the N+9 relation currently exists between GSM uplink channels (located between 880 and 915 MHz) and DVB-T channels 63 to 68. However, the GSM channel is narrowband (200 kHz) compared to DVB-T channel (8 MHz). When a GSM signal is in the N+9 channel of a DVB-T wanted channel, the GSM interfering signal, attenuated by the RF filter falls into the DVB-T channel at IF. But, as GSM is a narrowband signal, it affects only a small number of the COFDM carriers, which is tolerable by the COFDM system. This is not the case for the UMTS which has 5 MHz of signal bandwidth.

Although the N+9 issue could be considered as a domestic problem and could therefore be treated on a national basis, it should be noted that, unlike the case of interference from downlink, it is not possible to mitigate the interference by network planning, as the mobile terminal movement is unpredictable and there is no way to control its radiation characteristics (antenna pattern and transmit power for example).

Possible ways to mitigate the interference may include limiting the maximum transmit power of the UMTS terminal as well as improving the characteristics of future DVB-T receiver including DVB-T rejection performance at the image channel. Different issues in relation to mitigating adjacent interference are provided in Annex A2. The issue of overloading DVB-T antenna/receiver is also discussed in Annex A2.

Guard band widths to protect mobile/fixed base station from DVB-T interference on an adjacent channel, have been studied:

- One study concluded that a sufficient frequency separation between DVB-T and UMTS UL between 10 and 20 MHz would be needed in order to define a sufficient UMTS BS out of band blocking level
- Another study has shown that without guard band, the required mitigation level would be in the range of 30 to 45 dB. With 5 MHz guard band, the required mitigation level remains in the range of 20 to 35 dB. It would be advantageous to undertake a careful analysis across the broadcasting coverage area when fixed/mobile base stations are receiving with no or limited guard bands.

It should be noted that interference cancellation method can be used to mitigate the interference (see Annex A3). Assuming single co-channel interferer with unknown signal properties, e.g. an interfering signal from the dominant DVB-T transmitter, achieved interference suppression is in the range of 8-10 dB for a 2 antenna receiver and an additional 4-5 dB suppression when 4 antennas are used.

2.3 Compatibility between FDD and TDD

Mixing TDD and FDD systems presents a challenging co-existence scenario.

Systems operating with different duplex methods in close frequency proximity to one another may cause unacceptable levels of inter-system interference, because the uplink and downlink operations are in adjacent frequency bands. Figure 2.1 shows most severe interference paths in the FDD-TDD co-existence scenario. The guardband between FDD and TDD is approximately the same as the duplex gap for half-duplex FDD.

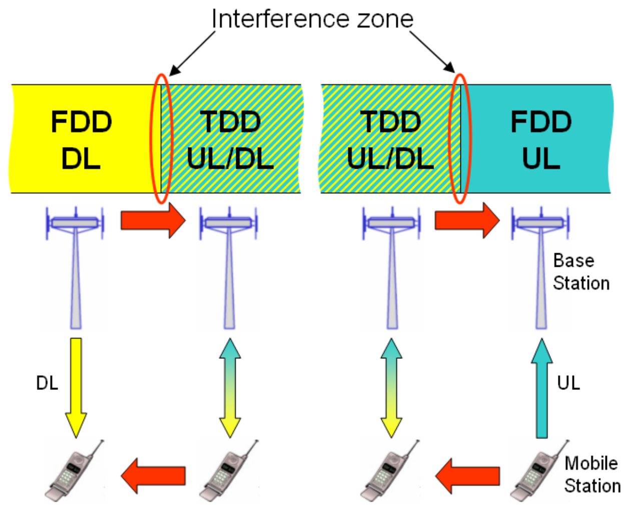


Figure 2.1: The sources of adjacent channel interference in the FDD-TDD co-existence scenario.

In the assessment of the guard band between TDD and FDD systems, the dominating interference scenario is the interference from base station to base station, in particular when both are used for macrocells. ITU-R Report M.2030 [2] for the 2.6 GHz band has concluded that based on the existing specifications and minimum coupling loss (MCL) assumptions, even a guardband of 5 MHz and 10 MHz would not be sufficient to solve the compatibility. ITU-R Report M.2045 [4] identifies a set of interference mitigation techniques that are useful in facilitating coexistence between TDD and FDD systems. However, these mitigations techniques have to be combined and have potential drawbacks.

3 TECHNICAL PARAMETERS AND EXAMPLE BAND PLANS FOR THE HARMONISED SUB-BAND

The development of wireless radio technology is advancing. The regulative environment need to be flexible enough, both to allow current systems to be developed, and also to allow new systems. Frequency regulation should not unnecessarily put obstacles to technological development.

The process of standardization can be initiated as soon as it is known which maximum and minimum frequency ranges can be offered by administrations to be used in a more flexible manner.

This would allow for assigning frequencies according to a later ECC decision on the specific arrangements to be used, which should be as flexible as possible. This will then form the basis that industry will need to comply with and adapt to.

For example, it is difficult to decide in advance on the “correct” amount of paired or unpaired spectrum. Making band plans compulsory to administrations, risks to hamper future technological and commercial development.

Size of guard bands need to be explored, but it should also be recalled that guard band, if not used at all, is a loss of frequencies. It is therefore questionable if it is wise to make certain guard band permanent. Agreed guard bands can be part of recommendations or decisions, to be considered by industry and administrations when planning particular systems. Furthermore, guard bands can be assigned as part of a license under certain criteria.

In this document, band plans are explored to exemplify the capacity of the frequency band, based on technical criteria and systems that are known today.

In order to provide sufficient certainty for standardization of fixed/mobile equipment operating in FDD paired blocks, the main parameter that needs to be known is the available frequency spectrum. From this, a system can be designed with the following main parameters:

- the duplex direction of the uplink and downlink blocks (i.e. reversed or conventional);

- the minimum size of the duplex gap between FDD uplink and downlink blocks that is technically feasible;
- the minimum duplex spacing between the frequency pair to mitigate self-interference between uplink and downlink transmissions;
- the minimum and maximum size of the FDD uplink and downlink blocks;

Moreover, potential sharing of the harmonized sub-band between FDD and TDD fixed/mobile applications needs perhaps to be planned as well.

Use of the spectrum in the duplex gap and guard band is yet another issue that requires consideration.

3.1 Duplex direction, duplex gap and spacing

In the conventional FDD terrestrial mobile systems, the mobile terminal transmits at the lower frequencies and the base station at the higher frequencies. This is because the system performance is generally constrained by the uplink link budget due to the limited transmit power of terminals. However, the compatibility studies between IMT and digital broadcast systems suggest that the reversed duplex direction results in better spectrum efficiency due to more limited guard bands. Moreover, as the path loss difference between the highest frequency 862 MHz and the frequency 798 MHz is only about 0.6 dB, the reversion of the duplex direction will not impact greatly the uplink coverage. Therefore, it is proposed that the duplex direction for fixed/mobile applications in the top-end of the band 470 - 862 MHz should be reversed, i.e. the uplink should be at the top of the harmonized sub-band.

The width of duplex gap has a direct impact on the design of a duplex filter, which is the one of the most dominating RF components when setting the size for the terminal. A larger duplex gap can facilitate design of duplex filters with lower insertion loss. Standards from 3GPP indicate that the minimum duplex gap is 10 MHz for UMTS900. Mobile terminal sensitivity degradation due to a small duplex gap will impact downlink capacity, especially at cell edge, but will not reduce cell range, since base station sensitivity and mobile terminal transmit power are not reduced. Taking account of constraints the band 470 - 862 MHz imposes on sharing, CEPT considers the technically required duplex gap between FDD uplink and downlink blocks in the harmonized sub-band to be maximum 10 MHz.

Current FDD systems are designed to operate with a minimum 45 MHz transmit to receiver frequency separation in the 900 MHz band (3GPP TS 25.101 V7.8.9 (2007-06 [5]). FDD systems could also support both fixed and variable transmit to receiver separation, but variable duplex separation distance has not yet been used in civil mobile systems. Variable duplex separation would increase the complexity and cost of mobile stations. Moreover, the use of other frequency separations is not precluded and is subject to technological developments and technical constraints stemming from a frequency band being made available.

According to CEPT Report B [1] the minimum sub-band for fixed/mobile services in the band 470 - 862 MHz should be 64 MHz wide. In such circumstances the pairing arrangements of a FDD system should be such that to enable the uplink to downlink services to operate with small frequency separation. The UMTS 900 system parameters (45 MHz for duplex spacing) may not be suited and will require some adjustments in this case.

3.2 Deployment of FDD (including full and half duplex) and TDD applications

Mobile services will be deployed in the harmonised band using FDD and/or TDD depending upon the application. Each of these access techniques offers advantages and disadvantages in deployment and these are summarised below.

- **FDD**

FDD arrangements are used to provide simultaneous transmission and reception by assigning paired frequencies that are sufficiently well separated. Self-interference in a terminal or base station is limited by the use of a duplex filter (or duplexer). In addition to limiting self-interference this arrangement helps facilitate inter operator interference when appropriate planning techniques are used. Inherently FDD is more suitable for coverage provision than TDD in mobile communication application.

Due to filter duplex implementation, FDD need sufficient duplex gap space. The amount of duplex filters implemented in a terminal needs to be limited due to the issues cost and complexity in the terminal.

- **HD-FDD**

HD-FDD is a hybrid of FDD and TDD with transmission and reception separated in frequency and time. It is used in GSM for voice traffic though only the terminals operate in HD-FDD in order that the Base Station can serve other terminals when transmission or reception from a given terminal in not possible. The main advantage of this technique is that the terminal does not require a duplex filter because the terminal does not transmit and receive at the same time.

The minimum size of the duplex gap is now only an issue for the base station and therefore can be smaller than in conventional FDD. The terminal still uses transmit and receive filters but the roll-off of these filters is not a stringent as that for duplex filters because there is no need to isolate the terminal receiver from its own transmitter. This reduction in complexity of the filters could allow a terminal to operate even if the duplex gap is moved in a particular country as the terminal could support more than one set of filters.

As mentioned above HD-FDD can used with the base station in full duplex mode which results in little capacity degradation compared to pure FDD systems. Synchronisation requirements between the base station and terminal are normally present for a number of reasons so there are no additional timing synchronisation requirements.

- **TDD**

In TDD arrangements the transmission and reception are separated in time so spectrum does not need to be paired or the use of a duplex filter is required. Interference between operators in the same area needs to be managed by either synchronization techniques or the use of guard bands. Inherently TDD is suitable for short range mobile applications with high capacity capabilities

3.3 Example band plans in the sub-band consisting of channels 62 - 69

CEPT Report B identifies the range of channels 62 - 69 (798 - 862 MHz) as a minimum sub-band for non-mandatory harmonised fixed/mobile use in the band 470 - 862 MHz. A number of general issues can be raised when defining a band plan within the sub-band:

- The arrangement of spectrum to support the needs identified in individual European countries for fixed/mobile applications should be as flexible as possible.
- Technologies supported should include, but not be limited by IMT mobile technologies.
- Administrations should have as much flexibility as possible in deciding the balance between paired (FDD) and unpaired (TDD) spectrum given equipment constraints. Unpaired spectrum provides advantages in being able to select individual channels according to the compatibility of interference constraints with the desired service level, and provides flexibility of bandwidth allocation. Paired spectrum provides a high degree of compatibility with existing mobile technologies and good separation of uplink and downlink to ensure compatibility with broadcasting services, thus reducing mutual interference effects without the need for base station synchronisation.
- Channel raster should be flexible, potentially to support technologies requiring bandwidths for example as narrow as 1.25 MHz and as wide as 20 MHz.
- A limited set of fixed duplex spacing or variable duplex spacing addressing the different requirements of various administrations may be offered by equipment manufacturers. (This may have an impact on the link budget- see other section – filter/cost issue)
- It reduces equipment complexity if the centre gap for paired spectrum (FDD) is placed in the centre of the channels 62 - 69. However if administrations are in a position to authorise fixed/mobile services in only a part of the sub-band, it would be better if the centre gap could be located in a flexible manner.

Example band plan options for the use of the sub-band of channels 62 - 69 for fixed/mobile applications are shown in Figure 3.1. The width of broadcasting, paired and unpaired blocks as well as the size of guard bands and a duplex gap are expressed by variables in a generic example. The limits of the technical feasibility to implement variable duplex separation have yet to be determined.

Example A: TDD only use of sub-band

62	63	64	65	66	67	68	69
798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Guard band	**Unpaired**						
min 8 MHz approx.	**56 MHz**						

Example B: FDD use of sub-band (37 MHz duplex separation)

62	63	64	65	66	67	68	69
798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Downlink			**Duplex gap / other use?**		**Uplink**		
27 MHz			**10 MHz**		**27 MHz**		

Example C: Enlarged duplex gap (47 MHz separation) Shared FDD and TDD use of sub-band

62	63	64	65	66	67	68	69
798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Downlink		**Guard band**	**Unpaired (or ext FDD downlink)**		**Guar d band**	**Uplink**	
17 MHz		**30 MHz**				**17 MHz**	

Example D: Reduced duplex separation (24 MHz) FDD use of sub-band

62	63	64	65	66	67	68	69
798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Other use	**Downlink**		**Duplex gap / other use**	**Uplink**		**Other use**	
13MHz	**14MHz**		**10 MHz**	**14MHz**		**13 MHz**	

Figure 3.1
Example technical band plans for fixed/mobile services (use in FDD or TDD) in the Band 798 - 862 MHz

Example A illustrates that all spectrum of the sub-band except a guard band could be made available on an unpaired basis (TDD use only).

Example B shows alternatively how paired channels could be created within the sub-band (FDD use only (37 MHz duplex separation, 10MHz duplex gap).

Example C envisages combined use of the sub-band by paired channels and unpaired spectrum (sharing between FDD (47 MHz duplex separation) and TDD). The need for guard bands between paired and unpaired spectrum is the issue requiring further studies. This example also proposes as the possibility to use part of the spectrum for downlink channels paired with uplink channels outside the sub-band (sharing between internal and external FDD)

Example D foresees FDD paired channels within the sub-band with 25 MHz duplex separation.

Figure 3.2 shows an example band plan for FDD usage of the harmonised sub-band if a less amount of the spectrum is available within a country.

Example E: FDD use of sub-band (25 MHz duplex separation)

62	63	64	65	66	67	68	69
798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
			downlink		**duplex**	**Uplink**	
8 MHz	**8 MHz**	**8 MHz**	**15 MHz**		**10 MHz**	**15 MHz**	

Figure 3.2: Example technical band plan in the band 64 - 69, but not limited to this example.

3.4 Example band plans in the sub-band consisting of channels 61 - 69

Following the WRC-07 outcome Figure 3.3 presents some example band plan for the use of the sub-band of 61 – 69 for fixed/mobile applications.

Example A: TDD only use of sub-band

61	62	63	64	65	66	67	68	69
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Guard band	**Unpaired**							
Min 8 MHz approx	**64 MHz**							

Example B: FDD use of sub-band (42 MHz duplex separation)

61	62	63	64	65	66	67	68	69
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Downlink				**Duplex gap**		**Uplink**		
31 MHz				**10 MHz**		**31 MHz**		

Figure 3.3
Example technical band plans for fixed/mobile services (use in FDD or TDD) in the Band 790 - 862 MHz

In the cases where an administration is in a position to authorise fixed/mobile services in only a part of the band options for implementation of fixed/mobile services in the non mandatory harmonised sub-band can be still indicated. Possible example deployments by administrations of the sub-band for fixed/mobile applications and other services (e.g. broadcasting) are given in Figure 3.4.

Example F: FDD use of sub-band (41 MHz duplex separation)

61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Other Use	**Down link**	**Down link**	**Other use**	**Duplex gap / other use?**	**Other use**	**Up link**	**Up link**	**Other use**
31 MHz				**10 MHz**	**31 MHz**			

Example G: FDD use of sub-band (41 MHz duplex separation)

61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Other Use	**Down link**	**Other Use**	**Down link**	**Duplex gap / other use?**	**Other use**	**Up link**	**Other use**	**Up link**
31 MHz				**10 MHz**	**31 MHz**			

Example H: FDD use of sub-band (41 MHz duplex separation)

61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Other Use		**Down link**	**Other Use**	**Duplex gap / other use?**	**Other use**		**Up link**	**Other use**
31 MHz				**10 MHz**	**31 MHz**			

Example I: FDD use of sub-band (41MHz duplex separation)

61	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Other Use			**Down link**	**Duplex gap / other use?**	**Other use**			**Up link**
31 MHz				**10 MHz**	**31 MHz**			

Figure 3.4: Possible example deployments by administrations

3.5 Potential extension of the sub-band below channel 61 or 62 and example band plans

Some CEPT countries may wish to make more than 8 or 9 channels available for fixed/mobile applications by extending the core band below channel 61 or 62. This could be used both with asymmetrical fixed/mobile implementation or symmetrical implementation.

- **Asymmetrical use**

The size of the uplink block(s) and the size of the downlink block(s) do not need to be identical. For example there can be a greater amount of downlink relative to uplink depending upon the asymmetry and number of operators and number of carriers per operator. An asymmetric band plan allows supporting asymmetrical traffic (as discussed in Report B). It should be noted, however, that the asymmetry would require a variable duplex spacing. The impact of such implementation still needs to be considered.

It is unlikely that Administrations foreseeing an extension of the harmonised sub-band below channel 61 or 62 will do it to the same extent. Therefore, the lower border of the sub-band will vary from country to country. However, the GE06 technical and administrative framework can be indeed used in order to facilitate coordination and implementation of downlink services on frequencies below channel 61 or 62.

Different examples of an asymmetric band plan are given in Figure 3.5.

Example A: with channel 62 as the lower border of the sub-band.

58	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
766-774	774-782	782-790	790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Downlink				**Downlink**			**Duplex gap**		**Uplink**		
32 MHz				**27 MHz**			**10 MHz**		**27 MHz**		

Example B: with channel 61 as the lower border of the sub-band.

57	**58**	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**
758-766	766-774	774-782	782-790	790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854	854-862
Downlink				**Downlink**				**Duplex gap**		**Uplink**		
32 MHz				**31 MHz**				**10 MHz**		**31 MHz**		

Figure 3.5: Asymmetric band plan examples

- **Symmetrical use**

Alternative symmetrical examples can be derived for the use of an extended sub-band (Figure 3.6). The width of paired and unpaired blocks as well as the size of guard bands and a duplex gap is given for illustrative purposes.

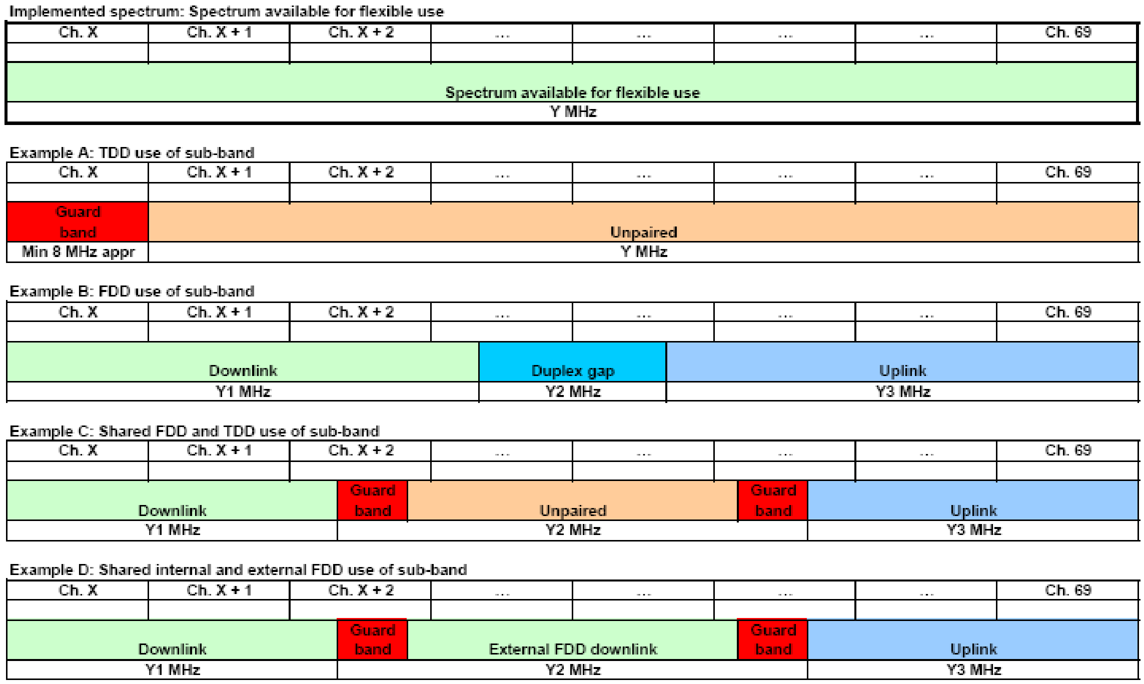


Figure 3.6: Example of possible symmetrical arrangements in an extended sub-band

In addition, an example of support of multiple band plans by half duplex FDD is given in Figure 3.7.

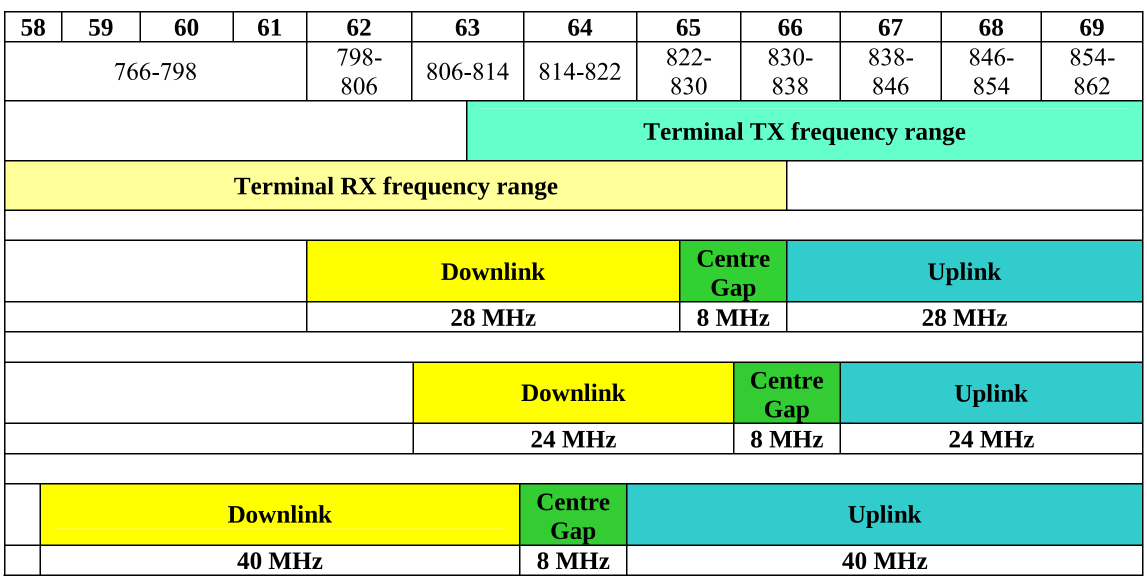


Figure 3.7: Example of support of multiple bandplans by half duplex FDD

4 CONCLUSION

Within the supplementary report (to Report B) to ECC the CEPT studied appropriate technical arrangements for the usage of the harmonised sub-band for fixed/mobile communication applications.

4.1 Coordination between neighbouring administrations

As it is stated in Report B the accordance of the harmonised sub-band to fixed/mobile applications is not made mandatory and any decision about use of the harmonised sub-band is left to individual Administrations. These issues will have to be addressed between countries.

4.2 Recommendations for the development of detailed band plan(s)

Example band plans for the fixed/mobile services in the harmonised sub-band are presented in this report. The development of detailed channelling arrangements will need to be carried out. CEPT should pursue the development of a channelling arrangement taking into account the elements given in this report.

4.3 Further compatibility studies needed

Compatibility studies are one important element to support the development of detailed channelling arrangements for fixed/mobile applications in the band 470 - 862 MHz. Annex A4 presents a tentative compilation of further studies which would assist administrations in determining the precise situation in terms of compatibility in relation to the creation and implementation of a sub-band.

The following investigations are needed to help administrations to form a basis for the implementation of a non-mandatory harmonised sub-band:

- Additional measurements on protection ratios
- Conduct sharing studies between the mobile services and other services in order to assist the work of ITU-R JTG 5-6
- Establishment of common methodology for administrations for coordination

ANNEX A1: POSSIBLE TECHNIQUES TO MITIGATE INTERFERENCE FROM MOBILE SERVICE DOWNLINK TRANSMISSIONS

Different methods can be used on an area by area basis in order to minimise the impact of adjacent channel interference. Use of one or other technique or their combination depends largely on planning assumptions made both for DVB-T and Mobile services. Some Mobile networks target services mostly in urban areas, whereas others foresee operation across large territories.

In general, the best transmitting configuration to cover the same area by several transmitters still is to co-site them and to use the same antenna system noting that coverage area of the Mobile service Base station will be smaller than the fixed reception DVB-T coverage. 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 sites. In this case several measures are recommended in order to ensure the compatibility between the non co-sited DVB-T and Mobile service Base stations.

The following are non-exhaustive examples of possible techniques that could be recommended when a Mobile service network is planned, to minimise interference into DVB-T fixed reception service from non co-sited Mobile service Base stations:

- Use of cross polarization between the DVB-T and the Mobile service Base station.
- Use of critical spectrum mask (as defined in the GE06 Agreement for DVB-T) for the Mobile service Base station. This critical spectrum mask may be more stringent than the spectrum mask specified for the Mobile system subject to implementation. For example Appendix 1 to this Annex shows that the DVB-T critical spectrum mask is more stringent than the spectrum mask defined in the ETSI specifications of the UMTS Base Station transmission (ETSI TS 125 104 V3.1.0 (2000-01)
- Adjusting the power of the interfering Mobile service Base station, taking into account the local conditions, in particular the level of the wanted (DVB-T) field strength received in the area where the Mobile service Base station is to be implemented.
- Adjusting the antenna height of the interfering Mobile service Base station with regard to the surrounding DVB-T receiving antennas, with correct usage and control of its vertical radiation pattern.

Summarizing, it can be stated that careful network planning is necessary to ensure compatibility between DVB-T and Mobile service networks. This requires that the protection criteria, including protection ratio figures, be fully defined through studies and measurements as indicated in Annex A4.

For Mobile service using cellular sites, to a large extent the mitigation techniques may potentially need to be applied for a large number of sites.

After the design phase of the Mobile service network, if interference cases were encountered despite the application of the previous mitigation techniques the following measures could be taken:

- Installing rejecting filters on the fixed reception installations located near the Mobile service transmitter to reduce the interferer signal level. When relevant, this helps to avoid the possible overload of the DVB-T receiver input or any wideband antenna amplifier used in the receiving installation.
- Increasing the power of DVB-T transmitters to increase the wanted field strength within the GE06 constraints. Alternatively, installing additional DVB-T transmitter(s) to cover the area concerned.

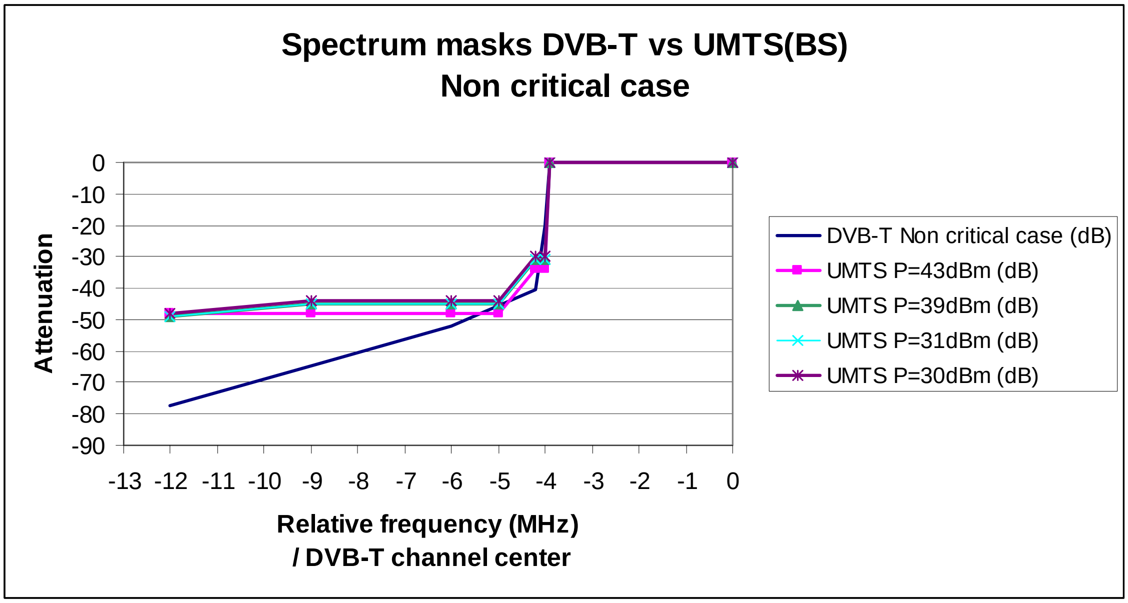
In the context of sub-band implementation, it is recommended that the transmitters of both services (DVB-T and Mobile service) using the channels located at the edge of the respective sub-bands should use the critical spectrum mask defined in GE06 for DVB-T with regard to each other.

Appendix 1 to Annex A1: Spectrum masks

This annex shows the differences between the spectrum mask specified for DVB-T, for non critical and critical cases, and the spectrum masks specified for UMTS base station. IT can be seen that the spectrum masks for DVB-T are more stringent, so providing more protection to the service using an adjacent channel. Therefore, the use of the DVB-T critical spectrum mask as defined in GE06 could be recommended also to UMTS or any other system using adjacent channels to DVB-T.

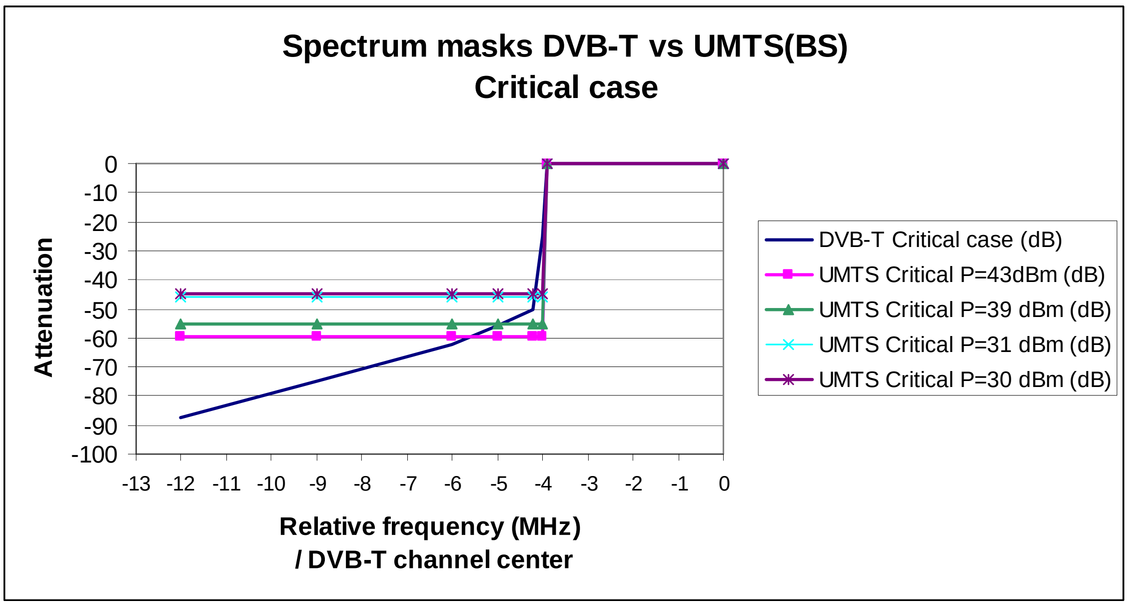
Comparison between Non critical spectrum mask of DVB-T (GE06 Final Acts, section 3.6.2) and UMTS spectrum emission mask (ETSI TS 125 104 V3.1.0 2000-01, section 6.6.2.1)

Relative frequency (DVB-T)	DVB-T Non critical case	Relative frequency (UMTS)	UMTS P=43dBm	UMTS P=39dBm	UMTS P=31dBm	UMTS P=30dBm
(MHz)	(dB)	(MHz)	(dB)	(dB)	(dB)	(dB)
-12	-77.2	-10.5	-48	-48.8	-48.8	-47.8
-9	-64.7	-7.5	-48	-44.8	-44.8	-43.8
-6	-52.2	-4.5	-48	-44.8	-44.8	-43.8
-5	-45.5	-3.5	-48	-44.8	-44.8	-43.8
-4.2	-40.2	-2.7	-34	-30.8	-30.8	-29.8
-4	-20.1	-2.5	-34	-30.8	-30.8	-29.8
-3.9	0	-2.4	0	0	0	0
0	0	-1.5	0	0	0	0



Comparison between critical spectrum mask of DVB-T (GE06 Final Acts, section 3.6.2) and UMTS spectrum emission mask specified for protection outside a licensee's frequency block(ETSI TS 125 104 V3.1.0 2000-01, section 6.6.2.3)

Relative frequency (DVB-T)	DVB-T Critical case	Relative frequency (UMTS)	UMTS Critical P=43dBm	UMTS Critical P=39 dBm	UMTS Critical P=31 dBm	UMTS Critical P=30 dBm
(MHz)	(dB)	(MHz)	(dB)	(dB)	(dB)	(dB)
-12	-87.2	-10.5	-59.3	-55	-46	-44.8
-9	-74.7	-7.5	-59.3	-55	-46	-44.8
-6	-62.2	-4.5	-59.3	-55	-46	-44.8
-5	-55.5	-3.5	-59.3	-55	-46	-44.8
-4.2	-50.2	-2.7	-59.3	-55	-46	-44.8
-4	-25.2	-2.5	-59.3	-55	-46	-44.8
-3.9	0	-2.4	0	0	0	0
0	0	-1.5	0	0	0	0



ANNEX A2: UMTS UPLINK INTERFERENCE INTO DVB-T PORTABLE RECEPTION

A set of measurements was carried out at the EBU premises in Geneva from 15 to 20 October 2007 with the aim to provide answers to some of the questions asked at the last ECC/TG4 meeting in Copenhagen from 2 to 5 October. The full report is available in document TG4(07)134.

Measurements

The level of the UMTS interfering signal received by a DVB-T receiver using a portable antenna was measured at different separation distances and compared to the maximum tolerable interfering signal level. Based on these measurements, it is required to reduce the maximum transmit power of the Mobile terminal (assumed to be 24 dBm) by 10 to 12 dB in order to avoid overloading the digital TV receiver at distances between 2 and 6 metres for all digital terminal categories. For a separation distance of 1 m, the power reduction required to avoid overloading would be more than 20 dB.

Objective measurements based on C/N and MER (Modulation Error Rate) assessment using DVB-T test-receiver show that out of band emission of the mobile terminal has a significant impact on the protection of DVB-T in the adjacent channel. At 2.5 metres between the mobile terminal and the portable antenna, a guard band of 6 channels (48 MHz) would be required if the out of band emission level was at the maximum level specified in the ETSI reference document (TS 125 101 V3.1.0 (2000-01)). Even a very low level of out of band emissions, although not realistic for a commercial terminal, would still require a minimum guard band of 2 channels (16 MHz).

The effect of TPC on the protection ratios and on the required frequency separation is still to be assessed accurately, taking into account TPC operation as made in a real network.

Further measurements were carried out with commercial receivers, including 7 set top boxes and 3 USB stick receivers (for laptops) to assess the risk of interference from the Image channel (N+9). The measurements were made also at 2.5 m between the mobile terminal and the portable antenna. They show that 4 Set top boxes (out of 7) and 2 USB stick receivers (out of 3) are subject to interference from the image channel[2].

Mitigation techniques

Although interferences into portable and mobile receivers including overloading of antenna / receiver input as well as the receiver N+9 issue could be considered as domestic problems and therefore treated on a national basis, it should be noted that, unlike the case of interference from downlink, it is not possible to mitigate the interference by network planning, as the mobile terminal movement is unpredictable and there is no way to control its radiation characteristics. In general, there are several ways to mitigate interferences:

1. To reduce the out of band emission limits of the Mobile terminal: The current specifications of UMTS User Equipment in TS 125 101 V3.1.0 (2000-01) are not stringent enough and would lead to a required guard band of 6 x 8 MHz channels. Sufficient reduction of these out of band emissions, for example to a level which is in line with the critical spectrum mask of DVB-T as defined in GE06, might reduce the required guard band down to 2 x 8 MHz channels, subject to confirmation by further detailed studies. These figures however do not take into account the N+9 interference case, which is dealt with below.

2. To limit the maximum transmit power of the mobile phones to a level which minimises the risk of overloading the front end of the DVB-T receiver: This requires further studies in order to determine the acceptable maximum transmit power with regard to the protection of DVB-T portable reception, especially with regard to the N+9 interference. However, based on the tests realized so far, it might by required to reduce the

[2] The interference by the N+9 channel is due to the use of a local oscillator in the super heterodyne receivers located around 36 MHz (4.5 channels of 8 MHz) above the wanted signal. This allows to down-convert the wanted signal to the Intermediate Frequency, at around 36 MHz. In the same time the N+9 channel, symmetrical of the wanted channel with regard to the local oscillator is also down-converted to the IF. In order to attenuate the image channel interference, a tuneable RF filter is used, but its performance in terms of attenuation of the image channel varies from a receiver to another. All the protection ratio measurements presented in ECC/TG4 indicate that the vast majority of the existing receivers are super heterodyne, for which the possible interference by N+9 channel should be considered.

maximum transmit power by 10 to 12 dB to avoid overloading and to reduce the risk of N+9 channel interference.

3. To improve the receiving characteristics of future DVB-T receivers: On the victim receiver side, the only possible solution would be to add a rejecting filter in the front end of the DVB-T receiver, to reduce the signal level received in the channels used for the mobile uplink transmissions. However, it is considered that such a solution could not be applied to the existing set top boxes but only to new set top boxes manufactured from a certain (future) date, after the final channelling for the uplink transmissions is known. Furthermore, such a rejecting filter have to be removed in the countries where the concerned sub-band is still used for Broadcasting.

ANNEX A3: TECHNICAL UPDATES SINCE REPORT B

I. UMTS base station interference cancellation of DVB-T signals

1. Introduction

Future evolution of UMTS will include more advanced antenna systems using multiple antennas. 2 receive antennas are already today widely used at the base station in order to employ antenna diversity.

Beamforming is one of the possibilities with multiple antennas and it can be used to reshape the horizontal antenna diagram to achieve maximum suppression for external interference sources directions. This will reduce the impact from an interfering source (Interference cancellation). Interference cancellation of a single co-channel interferer with unknown signal properties, e.g. an interfering signal from the dominant DVB-T transmitter is investigated in the following.

The vertical antenna pattern and downtilt are not considered. In a situation with an interferer placed in a high tower (>100 m) and a victim base station (BS) at 30-50 m is it also possible to use the BS vertical antenna lobe, via antenna tilt, to suppress interference. An antenna tilt of 4-5 degrees suppresses an incoming horizontal interferer signal with up to 6-10 dB.

2. Simulation set-up

The study was originally performed for an UMTS enhanced uplink interfered from a mobile terminal in a neighbouring cell and later converted to an interference situation between a DVB interferer and a UMTS BS victim.

Victim system.

- UMTS enhanced uplink system with 2 different user categories:
  - A high data rate user (HDR) with 11 Mbps.
  - A low data rate user (LDR) with 177 Kbps.
- Propagation model is independent channels of type Pedestrian A, 3 km/h.
  The model uses a power delay profile consisting of 4 different paths components between Tx and Rx with different time delays and path loss.
- Interfering signal modelled as Gaussian noise.
- BS receiver with 2 or 4 antennas, with the possibility of beamforming in the horizontal antenna plane.

Original interferer.

- A mobile terminal in an adjacent cell using same frequency.
- No knowledge of interferer signal properties
- Propagation model is independent channels of type Pedestrian A, 3 km/h.
- Generating an average interference level of C/N=15 dB at the victim.

The conversion to DVB/UMTS is made according to:

- Vertical antenna gain is not included in simulation, i.e. different interferer height does not affect the results. In reality the downtilt of UMTS base station antennas would achieve a few dB additional discrimination in the direction of the interfering DVB-T transmitters.
- Beamforming in the original set-up with a moving interferer is expected to be more difficult to optimize compared with a fixed interferer.
- no changes needed for Victim system
- Interferer changes to the following.

DVB-T interferer system.

- Single co-channel source.

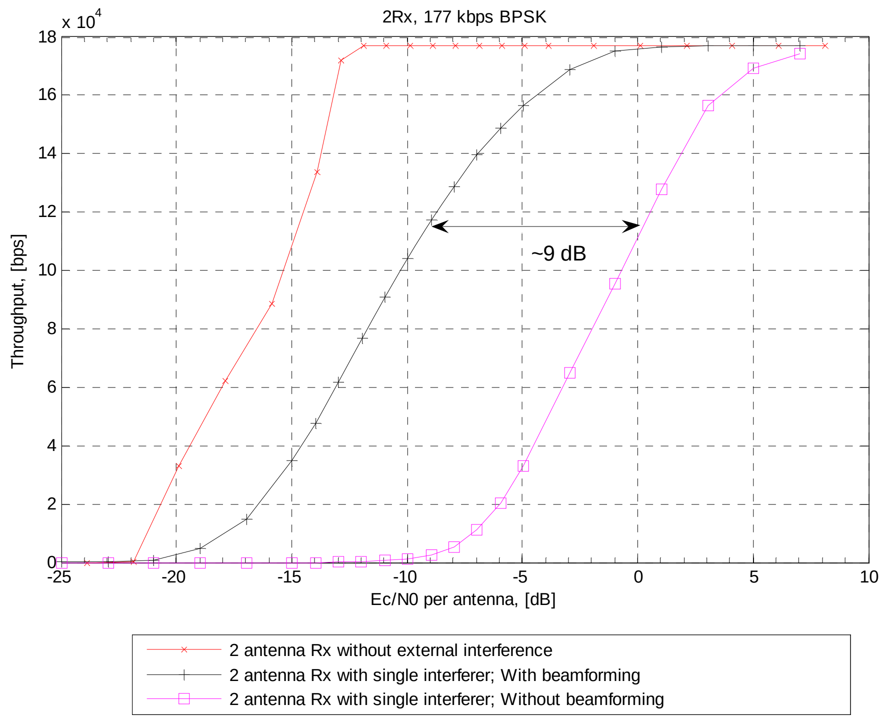
- Generating an average interference level of C/N=15 dB at the victim.
- No knowledge of the interferer signal properties. This is a worst case assumption. With some knowledge of the interferer signal, better interference cancellation could be achieved.
- Interfering signal band limited to the UMTS bandwidth of 3.84 MHz

The simulations shows similar performance for both LDR and HDR users, hence this contribution only presents the LDR results.

The graphs are plotted with x-axis Ec/N0 instead of Ec/(No+I). This is done to express the effectiveness of interference suppression, i.e. the gaps between the non interfered curve and the other curves are the “rest” which can not be suppressed by the receivers in the different scenarios.

3. Results for receiver with 2 receive antennas

The graph below shows the throughput of the user versus the ratio of energy per chip to thermal noise level (Ec/N0, similar to SNR) from the user at the UMTS bases station.

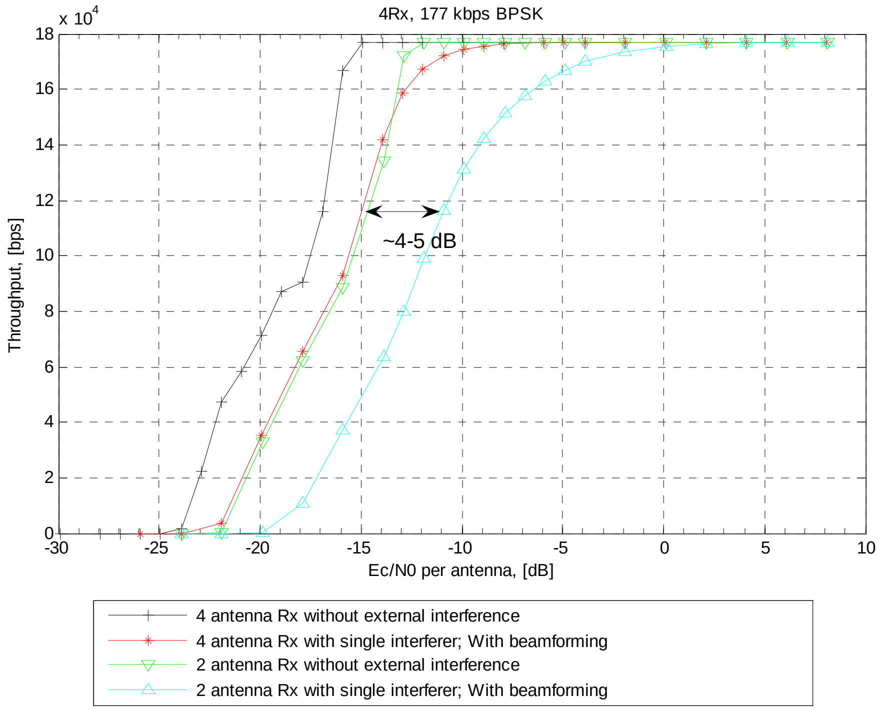


The graph shows:

- Throughput performance for a 2 antenna receiver with no interferer.
- Throughput performance for a 2 antenna receiver without beamforming with single interferer. 15 dB higher signal level from the UMTS terminal needed, due to external interference.
- Interference suppression of approximately 9 dB for a 2 antenna receiver using beamforming with single interferer.

4. Results for receiver with 4 receive antennas

The graph below shows the result.



The graph shows:

- A 4 antenna receiver improves the throughput without interferer with approximately 3 dB compared with a 2 antenna receiver.
- With single interferer and a 4 antenna receiver is the improvement of the throughput approximately 4-5 dB compared to a 2 antenna receiver case.

5. Conclusions

Simulations performed in this study shows interference suppression in the range of 8-10 dB, without any knowledge of the interferers signal when using a receiver with 2 antennas.

The study also shows that the use of more antennas improves the interference suppression even further. (With more antennas is it also possibly to allow an effective suppression of more than one interferer.)

ANNEX A4: FURTHER COMPATIBILITY STUDIES

1. Introduction

This annex is a tentative compilation of further compatibility studies needed.

Compatibility studies consist of four parts:

1) System compatibility parameters: They define the compatibility between wanted and unwanted signals.

2) Propagation parameters: They define the parameters and models for the "air interface".

3) Parameters for the simulation of interference scenarios: They define the receiving and interfering situation to be considered. It includes the network topology and the already existing interference levels.

4) Compatibility criteria and method of assessment of interference: They define the tolerable level of interference.

When all these parameters are available and agreed the conditions of compatibility can be defined leading to, for example, separation distances and guard bands.

2. Compatibility studies between DVB-T/H and IMT

2.1. System compatibility parameters

- DVB-T/H protection ratios for adjacent channels (n+-1, n+-2, …) are not defined in the official standard ETSI specification for DVB-T receivers. Some protection ratios may be found in other specifications, e.g., IEC. There is a need for these compatibility studies to define additional representative protection ratios and receiver sensitivities for the adjacent channel cases and for different types of interfering signals. This is due to the fact that different generations of receivers are currently in use which results in different signal processing types.

  While there are a high number of different of set-top box types, the number of front end manufacturers is limited. In order to limit the number of compatibility measurements, it should be possible to classify the set-top boxes according to their front end chipset. Receiver manufacturers may provide information on the set-top box front-end

  Receivers may differ in the following aspects:
  One chip technology
  DVB-T/DVB-H architecture
  Chipset optimization for pulse-killing and portable/mobile reception
  USB sticks for DVB-T reception
- The effect of saturation should be quantified with measurements for the aspects mentioned above as well as for active antennas.

- The measurements of protection ratios for adjacent channels should be carried out for different variants and combinations of IMT signals, including
  single and combination of uplink signals
  compressed mode
  DPCH-64 and DPCH-128
  Power control
  UTRA TDD

- The measurements may need to consider power control and the temporal structure of the interfering signal and the possible effect of spurious emissions.

- For the measurements realistic channel profiles and appropriate methods for the assessment of protection ratios should be applied, i.e., Rice and Rayleigh channel profiles for fixed roof-top and portable/mobile DVB-T reception, and an error criterion capable of coping with bit error bursts, as for example the ESR5 criterion.

- In addition, aggregation effects induced by interference from more than one adjacent channel need to be considered.

2.2. Propagation parameters and models

- For broadcasting services the generic propagation model in use is ITU-R P.1546. When explicit coverage calculations are carried out, more sophisticated propagation models are used in order to take into account geographical topography. For mobile services normally the HATA model is used.

  In several recent compatibility studies the HATA model and the ITU-R P.1546 model have been applied, but suitable propagation models, combining elements of both approaches, should be studied and agreed for the different interference scenarios.

  Since some of the simulations have been conducted with SEAMCAT there may be a need to consult the CEPT project team responsible for SEAMCAT in order to assess the differences between the models as implemented in the tool.
- In the broadcasting and mobile services fields very different values for building penetration loss are used. Also different classifications for indoor reception can be found. In order to achieve reliable results in compatibility studies it is necessary to find an agreed set of parameters describing indoor reception, i.e., a common set of parameters for building penetration loss.

2.3. Parameters for network planning and compatibility scenarios

- In general, the parameters used for compatibility studies should be as close as possible to the planning parameters for broadcast and mobile services.

- Up to now, fixed roof-top reception of DVB-T has been investigated in compatibility studies with IMT. Compatibility studies should also be carried out with respect to portable/mobile reception of DVB-T.

  In addition to the existing simulations, for specific deployments, there may be a need to consider scenarios of interference of IMT into DVB-T/H services.
- There may be a need to take into account improved roof-top antenna patterns for DVB-T reception which are commonly in use.

- Most studies presented to date consider only one isolated broadcast transmitter serving one area. However, in the implementation of a real DVB-T network more factors have an impact on the interference tolerance from mobile services. In particular, the fact should be taken into account that DVB-T networks will often be implemented in an SFN mode resulting in a different sensitivity to interference.

- Regarding interference to IMT services, as broadcast networks typically have high power/high tower transmitters, it is necessary to assess the interference from DVB-T to IMT with all surrounding transmitters.

2.4. Compatibility criteria and method of assessment of interference

- Where the information is available on link budget parameters and system compatibility the criteria for the tolerated interference remain to be defined. These criteria should be expressed in a way such that any degradation of the DVB-T service can be identified in terms of coverage loss. This could be in terms of coverage or in terms of field strength level, either evaluated over the whole coverage area or at the border only, and should define the type of assessment to be used (Minimum Coupling Loss, statistical methods, coverage percentages).

3. Compatibility studies for Other Primary Services in Band IV/V vs. IMT

Apart from Broadcasting there are also Other Primary Services allocated in Europe in the Band IV/V.

In accordance with No. 5.312 of the Radio Regulations, the 645 - 862 MHz frequency band is allocated on the primary basis in a number of countries of Region 1, including CEPT countries to the Aeronautical Radionavigation Service (ARNS), which ensure the safety of aircrafts during their flights.

The 790 - 862 MHz frequency band is also allocated on the primary basis in Region 1 to the Fixed Service.

At the present moment the conditions of sharing between IMT systems, considered in the Report with the Aeronautical Radionavigation Service and the Fixed Service have not been defined. In case of sharing the frequencies within the band 645 - 862 MHz by any new applications and the other primary services mentioned above, cross border interference issues should be taken into account.

The typical characteristics of some systems in the Aeronautical Radionavigation Service operating in the 645 - 862 MHz frequency band are provided in Recommendation ITU-R M. 1830 “Technical characteristics and protection criteria of aeronautical radionavigation service systems in the 645 - 862 MHz frequency band” The current version of Recommendation ITU-R M. 1830 does not contain the protection criteria for aeronautical radionavigation service systems from mobile systems.

WRC-11 will consider under agenda item 1.17[3] the technical and regulatory provisions to protect aeronautical radionavigation service and other primary services from mobile service. Therefore, during the new study period, compatibility studies will be carried out in preparation of such agenda item within CEPT and ITU-R for final decision at WRC-11.

[3] WRC-11 agenda item 1.17 *"to consider results of sharing studies between the mobile service and other services in the band 790-862 MHz in Regions 1 and 3, in accordance with WRC-07 Resolution* ***749 (WRC-07)****, to ensure the adequate protection of services to which this frequency band is allocated, and take appropriate action"*

REFERENCES

[1] CEPT Report B (CEPT Report 22): Final Report from CEPT to the EC on Technical feasibility of harmonising a sub-band of bands IV and V for Fixed/Mobile applications (including uplinks), minimising the impact on GE06, 2007

[2] Resolution 224: Frequency bands for the terrestrial component of International Mobile Telecommunications below 1 GHz

[3] Resolution 749: Studies on the use of the band 790 - 862 MHz by mobile applications and by other services

[4] ITU-R Report M.2045: Mitigating techniques to address coexistence between IMT-2000 time division duplex and frequency division duplex radio interface technologies within the frequency range 2 500 - 2 690 MHz operating in adjacent bands and in the same geographical area

85] 3GPP TS 25.101 V7.8.9 Universal Mobile Telecommunications System (UMTS);User Equipment (UE) radio transmission and reception (FDD)