Update of UHF Band Plan Options for Cellular Mobile Services Study

Final Report for

GSM Association

2020/GSMA4-U/R/3.0

13 August 2008



Table of Contents

1 EXECUTIVE SUMMARY 3

2 GE-06 PLAN 4

3 ANALYSIS OF DATA 5

3.1 Analysis Approach 5

3.2 Analysis Results for EU25 6

3.3 Analysis for Individual Countries 7

4 OVERVIEW OF DIGITAL TV 8

4.1 UK 9

4.2 France 9

4.3 Netherlands 10

4.4 Belgium 11

4.5 Germany 12

A IMPACT OF RE-FARMING OPTIONS IN VARIOUS COUNTRIES 14

A.1 Austria 14

A.2 Czech Republic 15

A.3 Finland 16

A.4 France 17

A.5 Germany 18

A.6 Ireland 19

A.7 Italy 20

A.8 Latvia 21

A.9 Lithuania 22

A.10 Netherlands 23

A.11 Poland 24

A.12 Portugal 25

A.13 Slovak Republic 26

A.14 Spain 27

A.15 Sweden 28

A.16 UK 29

1 EXECUTIVE SUMMARY

The switchover from analogue to digital TV broadcasting means that substantially less radio spectrum will be required to maintain the delivery of the previous analogue broadcast services. Some of this spectrum will be used to provide additional TV channels as well as high definition broadcasts but there will still be spectrum that can be released to support other applications such as IMT-2000 or IMT-Advanced. How useful this spectrum might be depends on the extent to which it can be harmonised internationally and two possible options have been considered here, namely Channels 61 – 69 (790 – 862 MHz) and 56 – 69 (750 – 862 MHz), across the European Union based on the GE-06 plan.

Clearly making more channels available for other applications will have an impact on individual country digital TV plans. Overall for the EU25 countries the impact of re-farming Channels 61 – 69 is the percentage of sites with six or more multiplexes is reduced from 100% to 74.52% and there is minimal impact on the percentage of sites with five multiplexers. In the case of Channels 56 – 69 being re-farmed, the percentage of sites with six or more multiplexers is reduced to 46% and the percentage of sites with five multiplexers is also reduced to 74%. Although there is a noticeable decrease in channel usage in the GE-06 plan starting at Channel 61 there would be more of an impact for some countries as they are utilising more of the higher channels.

Since agreement of the GE-06 plan a number of countries have been further developing their plans for switchover to digital and how the channels will be awarded and utilised. Dates for completion of switchover vary from already completed in the Netherlands to planned dates of 2010 in Germany, 2011 in Belgium and France and 2012 in the UK.

Views on the potential to release spectrum also vary by country. In France there is a recommendation that the sub-band 790 – 862 MHz (i.e. Channels 61 – 69 inclusive) should be offered to provide national fixed and mobile high speed broadband services and that they should be in favour of the European Union harmonising this sub-band. In the UK Channels 61 & 62 will carry significant, high-power TV transmissions and it is not clear how useful this spectrum will be for mobile purposes, as these two channels will be very encumbered by DTT interference. In the Netherlands the bandwidth formerly used by analogue TV services has been licensed to KPN until 2017 for digital TV broadcasting and in the longer term the view is that only 48 MHz will be released. Belgium uses more channels in the upper part of the 470 – 862 MHz band but is reluctant to revise the GE-06 plan and in Germany Channels 61 – 63 and 67 – 69 are currently used by the military although there may be civilian use in the near future for these channels. Germany has a preference to harmonise the upper part of the 470 – 862 MHz band as the impact on the existing DTT will be minimal. However it is interesting to note

that in Belgium, Germany and the Netherlands only a small percentage of the population use terrestrial as the primary source of TV with the majority using cable.

2 GE-06 PLAN

The Geneva 2006 frequency plan (GE-06) replaces the Stockholm plan of 1961 (ST61), which was for analogue broadcasting. It provides for T-DAB and DVB-T digital services in the VHF and UHF frequency bands and the planning area is shown in the figure below.



Figure 1: GE-06 Planning Area (Ref: EBU Technical Review – October 2006)

Discussions on the new digital plan started in 2001 in the ITU and there were two Regional Radiocommunication Conferences (RRCs) in 2004 and 2006 respectively. The first RRC established the technical basis for the plan and work leading up to and at RRC-06 culminated in the New Agreement and associated Frequency Plans.

The planning process involved a number of iterations (six in total), before and during RRC-06, and for each one the Administrations were required to submit their digital requirements and also any bi- or multi-lateral agreements that indicated that they had agreed two or more digital requirements could use the same channel even though compatibility analysis indicated that interference could occur. In some cases the agreements were subject to ERP reductions in certain directions. Also to minimise planning constraints there was an agreement between some Administrations to accept an increase of up to 5 dB in the acceptable interference level agreed at RRC-04.

At the end of each iteration the results were evaluated to see the number of assignments that had been achieved compared with those requested. Because of the very large numbers of inputs it was not possible to take into account the interference between analogue and digital broadcasting and this had to be taken into account in the transition process and also in some cases some requirements in

the plan are subject to co-ordination and / or time constraints. The inputs from the Administrations were largely on the basis of assignments but in some cases on allotments and these will be eventually converted into a set of one or more assignments usually operating as a single frequency network. It was noticed that in Bands IV / V the channel usage in the lower frequencies was higher and there was a decrease in use starting from channel 61. This was due to the band 790 – 862 MHz being allocated to other services such as mobile and fixed in a number of countries.

Note that the assignments input to GE-06 (and used in our analysis) do not include low power relay transmitters with EIRP levels below 100 watts. The number of low power relay transmitters will vary from country to country but in larger countries like France or the UK there may be as many as ten or more relay sites per main transmitter site. However, in general these sites will re-deploy frequencies that are used within the high frequency transmitter network, hence their impact on the number of multiplexes that can be delivered in the absence of a specified set of frequencies should be negligible. The impact of low power repeater sites is mitigated further by the relatively low cost of re-tuning the sites compared to the main high power sites (typically 1 -2 orders of magnitude less) and the fact that in some countries only a limited set of multiplexes will be relayed at the low power sites. For example, the UK plans to roll out six national multiplexes, only three of which (the public service channels) will be broadcast from all 1,000 low power relay sites. The remaining three commercial channels will be broadcast from only approximately 40 of these sites.

3 ANALYSIS OF DATA

The impact of two re-farming options on the GE-06 data has been analysed. These options are:

- Option I: Channels 61 – 69 are re-farmed
- Option II: Channels 56 – 69 are re-farmed.

3.1 Analysis Approach

An excel spreadsheet has been used to undertake the analysis. The spreadsheet uses the GE-06 plan and the information on transmitter sites and associated channels. The following summarises the approach used in the spreadsheet.

- The base information from the GE-06 plan has been input into the spreadsheet and this information has been manipulated so that at each site the actual channels used in the planning are identified. For example, for the site at Torrente in Spain, Channels 22, 25, 28, 57, 58, 66, 67, 68 and 69 are in the GE-06 plan.
- For each site, three deployment scenarios have been developed.

- In the first scenario (referred as 'GE-06'), it is assumed that up to 14 channels could be deployed at each site. Therefore, for the very few sites (for which more than 14 channels are registered in the plan) some channels have not been included in the analysis.
- In the second scenario (referred as 'Option I'), Channels between 61 – 69 have been filtered out. Therefore, at our example site in Spain, only channels 22, 25, 28, 57 and 58 would be available under this re-farming option.
- In the third scenario (referred as 'Option II'), Channels between 56 – 69 have been filtered out. At our example site, Channels 22, 25 and 28 would be available under this re-farming option.
- For each scenario, statistics have been calculated. These include:
    - total number of sites at which a given number of channels are deployed (for example, in the first scenario there are 35 sites where 12 channels are deployed),
    - cumulative distribution function where total number of sites for which more than a given number of channels are deployed is specified (for example, in the second scenario there are 33 sites at which 10 or more channels are deployed).
- These statistics have been manipulated to derive the final results where percentage of sites at which more than a specified number of channels (i.e. multiplexes) are derived.

In the tables cells are coloured green where 100% of sites can deliver the specified number of multiplexes, yellow where 90% or more can deliver and orange where 80% or more can deliver.

3.2 Analysis Results for EU25

The results of the analysis for EU25 are presented in the following tables.

	GE-06	Option I	Option II
14 Mux/site	1.82%	0.11%	0.11%
13 Mux/site	2.16%	0.23%	0.11%
12 Mux/site	6.14%	1.37%	0.34%
11 Mux/site	8.08%	2.50%	0.91%
10 Mux/site	11.72%	3.75%	2.28%
9 Mux/site	16.38%	8.87%	4.55%
8 Mux/site	42.43%	21.05%	16.27%
7 Mux/site	88.74%	37.88%	25.37%
6 Mux/site	100.00%	74.52%	46.08%
5 Mux/site	100.00%	94.43%	73.95%
4 Mux/site	100.00%	100.00%	94.65%
3 Mux/site	100.00%	100.00%	100.00%
2 Mux/site	100.00%	100.00%	100.00%
1 Mux/site	100.00%	100.00%	100.00%

Table 1: The Impact of Re-farming Options in EU25 (% of Sites)

The results show that when Channels 61 – 69 are re-farmed percentage of sites with six or more multiplexes is reduced from 100% to 74.52%. In the case of Channels 56 – 69 being re-farmed, the percentage is reduced to 46%.

The following table shows the total number of sites for which more than a given number of channels are deployed.



Table 2: The Impact of Re-farming Options in EU25 (Number of Sites)

3.3 Analysis for Individual Countries

The analysis has been repeated for a number of individual countries that have provided information on the frequencies deployed at individual transmitter sites.

The following figures show the coverage (i.e. percentage of transmit sites) that could be achieved with a given number of national multiplexes in various European countries.

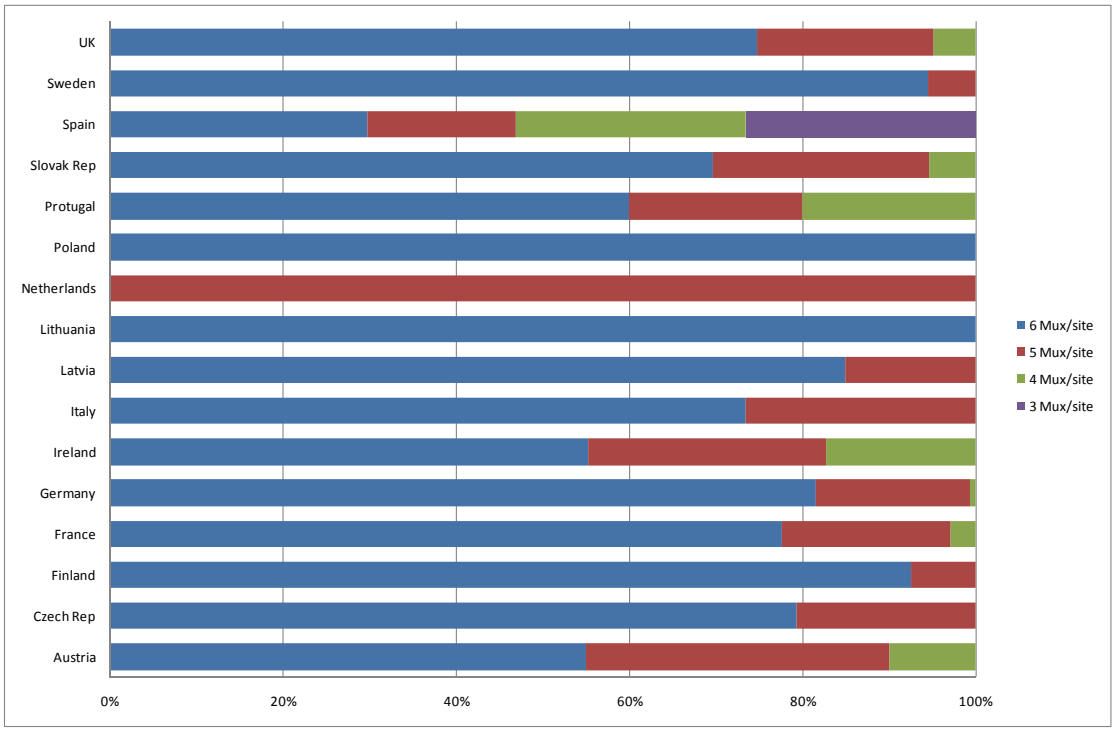


Figure 2: The Impact of Option I for Individual Countries

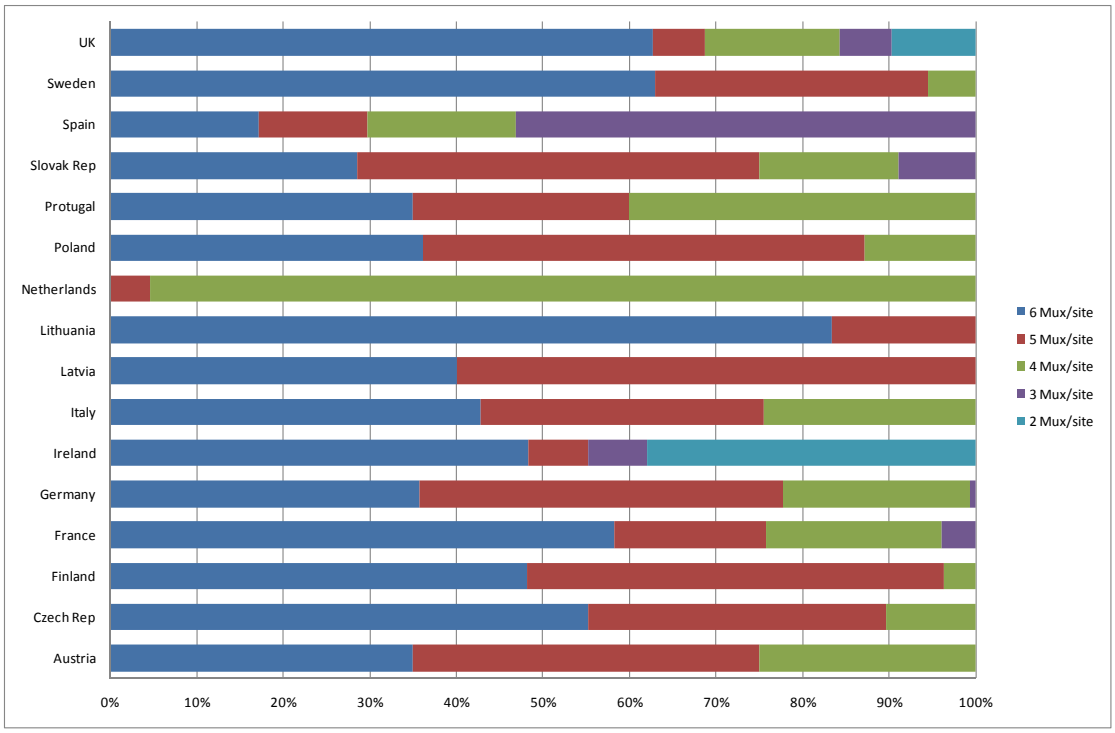


Figure 3: The Impact of Option II for Individual Countries

Tables showing the detailed results for each country are shown in the Annex A.

4 OVERVIEW OF DIGITAL TV

Recent developments in the UK, France, the Netherlands, Belgium and Germany are summarised in the following sections.

4.1 UK

After digital switchover, Channels 21-30 and 41-62 will be used for digital terrestrial television, with the existing transmitter network providing 6 multiplexes from the main and larger relay sites, and three multiplexes from the majority of the smaller relays. Access to this spectrum (except for channels 61 & 62) on an 'interleaved' basis will be the subject of an auction (the 'geographic interleaved awards') in summer 2009. As the spectrum will be usable only on a very fragmented geographical basis, and subject to complex interference constraints, the most likely use will be for local TV and PMSE (radio microphones). Channel 69 has been reserved for PMSE use, and will be awarded to a band manager by beauty contest. Access to the interleaved spectrum by PMSE users will also be within the responsibilities of the band manager.

Channels 31-40 and Channels 63-68 will be cleared and awarded by auction (the 'cleared spectrum awards'). Channel 36 is currently used for aeronautical radar at one airport and Channel 38 for Radioastronomy, but these uses will cease by 2009 and 2012 respectively. The spectrum at Channels 63-68 (i.e. 806-854 MHz) does not fit well with the band identified for future mobile use by WRC-07 which includes Channels 61-69 (i.e. 790-862 MHz). Therefore, the proposed treatment of Channels 61 & 62 (i.e. 790-806 MHz) has been modified.

Channels 61 & 62 will carry significant, high-power TV transmissions after digital switchover, and had therefore originally been included in the geographic interleaved awards. Because of their strategic significance, they will now be auctioned in the same process as the cleared spectrum. The channels will, however, be subject to similar constraints as for the other interleaved spectrum. It is not clear how useful such spectrum will be for mobile purposes, as these two channels will be very encumbered by DTT interference. In particular, Channel 61 is used by the very high power, high aerial sites at Mendip (Bristol Channel), Pontop Pike (Newcastle) and Winter Hill (Lancashire, Manchester), while Channel 62 is assigned to high power sites at Pontop Pike, Winter Hill, Oxford, Tacolneston (Norwich) and Dover. In total, 233 DTT sites use these channels.

4.2 France

A study conducted by Analysys and Hogan & Hartson has examined the most efficient way of using the spectrum released by the digital switchover in France which is expected to take place before the end of November 2011.

The study considered two distinct scenarios where, in the first scenario (referred to as 'sharing the digital dividend'), it is assumed that the part of the spectrum is allocated to services other than broadcasting (e.g. mobile TV and mobile broadband) and, in the second scenario (referred to as 'audiovisual only'), it is assumed that the entire spectrum is allocated to broadcasting service.

The results have shown that the 'sharing the digital dividend' scenario satisfies the quantitative tests set by the French parliament (i.e. minimum number of multiplexes

and minimum population coverage). Therefore, it is concluded that allocating a sub-band of the UHF frequencies to other services ensures more efficient use of the spectrum.

In line with the study results, the digital dividend commission has presented its recommendations to the prime minister (23.July.2008). The main recommendations are outlined below.

- By 2012, part of the released spectrum should be used to provide 11 DTT multiplexes providing coverage of 95% of the population and to create 2 multiplexes for the provision of mobile TV covering 80% of the population. 11 DTT multiplexes could allow 40 HD channels under an assumption of 4 channels per multiplex.
- The sub-band 790 – 862 MHz (i.e. Channels 61 – 69 inclusive) should be offered to provide national fixed and mobile high speed broadband services.
- France should be in favour of harmonising the sub-band 790 – 862 MHz by the European Union.

There are between 110 and 130 main high powered transmitters (e.g. Tour Eiffel, Pic du Midi and le Mont Pilot) which cover 80 – 85% of the population. Several thousand (up to 3500) repeaters will also be required with variable coverage.

CEPT Report 22 (Technical Considerations Regarding Harmonisation Options for the Digital Dividend, published in 1.July.2008) states that the lower part of the 470 – 862 MHz has been used intensively in France. The report notes that one DVB-H network is planned for in Channel 55. Furthermore, it is proposed that the use of channels above Channel 60 for fixed / mobile broadband services would be more appropriate as the impact on broadcasting would be limited.

4.3 Netherlands

In the Netherlands, 93% of households rely on cable platform for their primary TV reception. IPTV and satellite TV are also offered. The terrestrial reception for primary TV is used by only 75,000 households and 250,000 households use the terrestrial TV for secondary TV reception. In total, approximately 5% of Dutch households use the terrestrial platform.

The Dutch switchover took place in December 2006. The bandwidth formerly used by analogue TV services has been licensed to KPN until 2017 for digital TV broadcasting. Under its agreement with the government, KPN would build digital broadcasting masts and continue to broadcast state-supported channels and regional public programmes free-of-charge. The rest of the bandwidth would be used to provide digital pay-TV channels.

The Dutch DTT platform offers a combination of free-to-air and pay-TV channels. It is operated by Digitenne (whose parent company is KPN) with several other operators. The current platform offers 23 TV and 17 radio programmes.

The digital dividend is primarily used to extend the DTT coverage. Prior to the switch off 50% of population could access to the DTT services. Digitenne aims to provide indoor DTT coverage throughout the country. Unlike, for example, France and the UK, the transmitter network has been substantially re-modelled at switchover, with a higher density of medium-power sites providing a greater uniformity of field strength for portable use. Single Frequency Networks are generally used. The full DTT network will comprise 45 major transmission sites.

CEPT Report 22 indicates that, as of the second half of 2007, digital TV is available for the entire population for roof-top reception, 70% of population for portable indoor reception and 80% of population for outdoor portable reception. Services are provided using 5 multiplexes. The frequencies used in the multiplexes are scattered throughout the band IV/V. The use of DVB-H is possible under the current licence conditions. Channel 38 is used for radio astronomy. Wireless microphones are allowed in Channels 21 – 31, 41 – 60, 63 and 64 – 67. Audio links are allowed in Channels 31 – 41 and 49. Channel 63 will remain dedicated to wireless microphones.

The CEPT report notes that the harmonisation of the parts of the band IV/V will be constrained as 5 multiplexes are licensed until 2017. It is stated that the current multiplexes use all available frequencies. Some frequencies are not available due to the protection requirements of analogue TV in neighbouring countries and the military use. These frequencies are expected to be available in 2012. The results of the impact study show that, after 2012, it should be technically possible to harmonise the spectrum in the upper part of the 470 – 862 MHz. It is proposed that the amount of spectrum that could be made available will be limited to 6 x 8 MHz.

4.4 Belgium

97% of the population use cable systems to access TV programmes. 60,000 homes are dependent on the terrestrial platform for primary TV viewing and a further 80,000 to 180,000 households access TV using both cable and over the air TV. There are two public TV networks: VRT (operates in the Flemish part of the country) and RTBF (operates in the French-speaking part of the country). Currently VRT and RTBF provide a number of TV and radio channels to their community using a single DTT multiplex in each of the two parts of the country.

Analogue switch-off in the Flemish part of the country is set to take place by the end of 2008 to support more DTT multiplexes. However, the national communications regulator (BIPT) has applied to the Supreme Court to declare the Flemish government's decision null and void in March 2008. The dispute centres on the competence and authority to regulate and assign frequency allocations within the country.

The government of the French-speaking part of the country has approved the digital switchover plan in July 2007. The plan calls for analogue TV to be switched off by

November 2011. The plan aims to promote mobile and portable TV in order to provide services that cannot be delivered by cable.

After the switchover, commercial broadcasters are expected to gain access to new DTT multiplexes.

In the CEPT Report 22, it is stated that Flemish, French and German speaking communities have decided to use the 470 – 862 MHz spectrum for broadcasting applications including the provision of higher number of digital TV channels, mobile and portable TV reception, mobile multimedia broadcasting applications and HDTV. The impact analysis undertaken by Belgium concludes that the idea of an introduction of sub-band for non-broadcast applications will have a significant impact on the existing broadcast services. In particular, it is noted that more allotments are in the plan using channels located in the upper part of the 470 – 862 MHz band.

In the CEPT report, it is stated that a significant re-planning of GE-06 will be needed and this is not acceptable to the communities in Belgium.

4.5 Germany

In Germany, sixteen state governments control and allocate broadcasting spectrum. The control of the excess spectrum that will be available after the switchover is retained at a state level. The switchover process started in 2003 and is expected to be completed in 2010. In the process, each state sets its own switch over date and the areas to be covered. In some cases (such as in Northern and Central Germany) multiple states work together.

There are three public and three private free-to-air analogue TV channels operating in Germany. The broadcasters plan to use the freed-up spectrum to increase the TV channels from six to twenty four.

After intense negotiations, sixteen states have agreed to hold three-year trials for the mobile handheld TV (DVB-H) in an 8 MHz channel of the freed spectrum. Different channels will be used in different states.

The country's telecoms industry association (Bitkom) claims that 95% of German households access TV services via cable and satellite. This, in turn, means that there is no need for a large number of free-to-air channels as proposed by the broadcasters. It is claimed that the private free-to-air operators are not planning to roll-out the promised new channels now but they will do so in the future while the public broadcasters will be able to roll-out new channels by increasing the licence fee.

It appears that the telecoms industry is keeping the pressure on the states to allow the part of the freed spectrum to be used for other services, for example providing broadband services to rural areas. It is stated that one state has agreed to allow trials for wireless broadband service in the 700 MHz spectrum in 2008.

CEPT Report 22 states that the public broadcasters will have completed their roll-out for three nationwide DTT multiplexes by the end of 2008. Three private

broadcasters also use three DTT multiplexes providing regional coverage. A nationwide DTT coverage by a private broadcaster is not expected. One DVB-H network is planned for Channel 55.

The report notes that all channels between Channel 21 and Channel 69 (except Channels 38, 61 – 63, 67 – 69) are in use for the provision of DTT. Channels 61 – 63 and 67 – 69 are used by military. There may be civilian use in the near future for these channels.

It is suggested that the preferred choice for the harmonisation is the upper part of the 470 – 862 MHz band as the impact on the existing DTT will be minimal.

A IMPACT OF RE-FARMING OPTIONS IN VARIOUS COUNTRIES

A.1 Austria



Table 3: The Impact of Re-farming Options in Austria (% of Sites)



Table 4: The Impact of Re-farming Options in Austria (Number of Sites)

A.2 Czech Republic



Table 5: The Impact of Re-farming Options in Czech Republic (% of Sites)



Table 6: The Impact of Re-farming Options in Czech Republic (Number of Sites)

A.3 Finland



Table 7: The Impact of Re-farming Options in Finland (% of Sites)



Table 8: The Impact of Re-farming Options in Finland (Number of Sites)

A.4 France



Table 9: The Impact of Re-farming Options in France (% of Sites)



Table 10: The Impact of Re-farming Options in France (Number of Sites)

A.5 Germany



Table 11: The Impact of Re-farming Options in Germany (% of Sites)



Table 12: The Impact of Re-farming Options in Germany (Number of Sites)

A.6 Ireland



Table 13: The Impact of Re-farming Options in Ireland (% of Sites)



Table 14: The Impact of Re-farming Options in Ireland (Number of Sites)

A.7 Italy



Table 15: The Impact of Re-farming Options in Italy (% of Sites)



Table 16: The Impact of Re-farming Options in Italy (Number of Sites)

A.8 Latvia



Table 17: The Impact of Re-farming Options in Latvia (% of Sites)



Table 18: The Impact of Re-farming Options in Latvia (Number of Sites)

A.9 Lithuania



Table 19: The Impact of Re-farming Options in Lithuania (% of Sites)



Table 20: The Impact of Re-farming Options in Lithuania (Number of Sites)

A.10 Netherlands



Table 21: The Impact of Re-farming Options in Netherlands (% of Sites)



Table 22: The Impact of Re-farming Options in Netherlands (Number of Sites)

A.11 Poland



Table 23: The Impact of Re-farming Options in Poland (% of Sites)



Table 24: The Impact of Re-farming Options in Poland (Number of Sites)

A.12 Portugal



Table 25: The Impact of Re-farming Options in Portugal (% of Sites)



Table 26: The Impact of Re-farming Options in Portugal (Number of Sites)

A.13 Slovak Republic



Table 27: The Impact of Re-farming Options in Slovak Republic (% of Sites)



Table 28: The Impact of Re-farming Options in Slovak Republic (Number of Sites)

A.14 Spain



Table 29: The Impact of Re-farming Options in Spain (% of Sites)



Table 30: The Impact of Re-farming Options in Spain (Number of Sites)

A.15 Sweden



Table 31: The Impact of Re-farming Options in Sweden (% of Sites)



Table 32: The Impact of Re-farming Options in Sweden (Number of Sites)

A.16 UK



Table 33: The Impact of Re-farming Options in UK (% of Sites)



Table 34: The Impact of Re-farming Options in UK (Number of Sites)