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IMPACT ASSESSMENT

Impact Assessment

Accompanying the document

SJ-032

Proposal for a Decision of the European Parliament and of the Council on the use of the 470-790 MHz frequency band in the Union

{COM(2016) 43 final}
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1. INTRODUCTION

The Digital Single Market (DSM[1]) for Europe Strategy is a political priority of the Juncker Commission. Connectivity[2] is a building block of the DSM and fixed and wireless access is crucial to provide cost-efficient connectivity to all EU citizens. Wireless connectivity requires access to spectrum with the bands below 1GHz being the "sweet spot" for both wide coverage and high speeds. In the past the frequencies 470-862 MHz were used for analogue TV transmission. With the switch to more efficient digital television technologies some of this valuable spectrum, the 800 MHz band (790-862 MHz), was reallocated for use by wireless broadband services[3] while the 470-790 MHz part is used for digital terrestrial TV (DTT) and audio programme making and special events (PMSE) equipment (essentially wireless microphones). Therefore, this spectrum is heavily used and is of very high value to both the broadcasting and mobile sectors.

In 2012, the World Radiocommunication Conference (WRC), the International Telecommunications Union (ITU) conference which revises the binding Radio Regulations, decided that the 694-790 MHz ('700 MHz') band should be allocated as of 2015 to both Broadcasting and Mobile services in Region 1 (Europe and Africa). This has triggered an international debate over the use of the UHF band[4] more generally. It is highly inefficient to operate broadcasting networks in the same frequency band as wireless broadband (WBB) networks (with both uplink and downlink traffic[5]) because of their respective technical characteristics. Hence each Member State will have to decide how it intends to use the UHF band in the future.

At WRC-15 there were discussions about whether the sub-700MHz band (470-694 MHz) should also be allocated to both Broadcasting and Mobile services. The Commission did not support such action because the EU has a complex set of competing interests of wireless broadband and of its audiovisual model with its tradition of free-to-view public service broadcasting. The proposal was not approved at WRC-15 but it was agreed to review the allocation of the 470-960 MHz at a future WRC in 2023.

This initiative relies on a long and comprehensive stakeholder consultation process. In 2013, Vice President Kroes tasked former Commissioner Pascal Lamy to chair a High Level Group consisting of mobile, broadcasting and media sectors' representatives to find a common position on the UHF band's future use. The Lamy Report, based on this dialogue, recommends repurposing the 700MHz band for WBB while sustaining the European audiovisual model (See Annex 10.5.3) and respondents to its Public Consultation expressed support for coordinated EU action.

Member States' representatives have adopted a Radio Spectrum Policy Group (RSPG) Opinion[6] supporting a coordinated EU approach for the provision of WBB services in the 700MHz band. The RSPG recommended the use of a legislative measure to set a common deadline for making the 700 MHz available for effective use, accompanied by an implementing decision to harmonise the technical conditions of use of the 700 MHz band for WBB on the basis of a report delivered by the European Conference of Postal and Telecommunications Administrations (CEPT). There is therefore an opportunity at the EU level to provide certainty as to the future use of the UHF band and give stakeholders time to prepare and adapt, thereby minimising the cost of change and maximising consumer benefits in line with the DSM's objectives.

[1] COM (2015) 192final
[2] The ability of being pervasively connected to Internet with an acceptable quality of service
[3] Commission Decision 2010/267/EU
[4] In this document the Ultra High Frequency (UHF) band is intended to describe the range from 470 to 790 MHz
[5] "Downlink-only" mode means the restriction of all transmissions in a wireless system, independent of its technology, to unidirectional transmission from central infrastructure stations (such as a TV broadcasting tower or a mobile base station) to portable or mobile terminals (such as TV sets or mobile phones).. Uplink is the transmission path in the reverse direction
[6] Radio Spectrum Policy Group (19 February 2015)

2. Problem Definition

2.1. What is the problem

Fragmented national approaches to meet the growing demand for scarce spectrum below 1GHz could ultimately result in a failure to satisfy the connectivity needs of the DSM.

Innovative applications in sectors such as media and telecommunications as well as transport, healthcare or energy, impose new requirements on connectivity in terms of capacity, quality and ubiquity. Audiovisual services are increasingly being delivered via alternative platforms, including wireless broadband (WBB) and the Internet. Reliable, trustworthy, high-speed and affordable networks are therefore essential to deliver digital products and services.

There are ITU-level actions and discussions concerning the 700 MHz band and the sub-700 MHz band and their availability for wireless broadband. The allocation of the 700 MHz band to both broadcasting and mobile services means that countries are free to use the band for one of those types of services. The EU should decide how it intends to use the UHF band in the future if it wants to avoid divergent national approaches and to influence international spectrum regulation. Many countries outside Europe have already decided to use the 700 MHz band in line with ITU regulations for International Mobile Telecommunications (IMT), so there is a rare opportunity for near-global harmonisation of this band. This will mean EU consumers will be able to benefit from the full set of capabilities of equipment already on the market, i.e. take advantage of the existing quasi-world-wide market for mobile devices already 'tuned' to the 700 MHz band.

The Digital Agenda for Europe (DAE) includes a broadband coverage target of at least 30 Mbps EU-wide by 2020[7]. While both fixed and mobile networks can contribute to achieving the DAE goals, mobile networks are more cost-efficient than fixed ones in rural areas and mobile (on-the-go) services and speed have become part of EU citizens' lifestyles and EU companies' competitiveness. Demand for pervasive wireless connectivity is therefore growing.

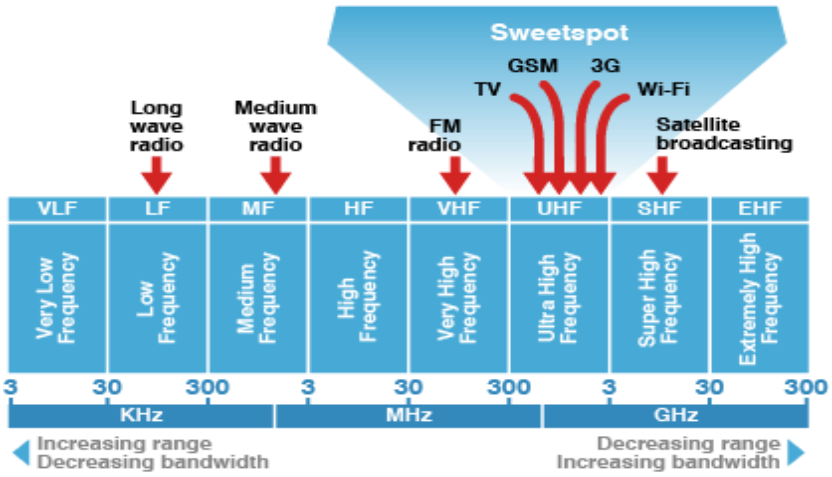
Radio spectrum is a scarce resource essential to the operation of wireless networks; it is a crucial asset for the DSM connectivity needs but still suffers from fragmentation in its use and management. The challenge lies in making additional spectrum available to meet this demand.

Parts of the UHF band are licensed for Digital Terrestrial Television (DTT) services while wireless microphones operate on a licence exempt basis (general authorisations) in the 'white spaces'[8] left unused by the licensed user. This band is in high demand because its coverage characteristics for rural areas and its in-door penetration capabilities in urban areas mean it is a particularly valuable spectrum band for high speed WBB deployment with nation-wide coverage (Figure 1).

It is technically extremely challenging and very inefficient to use both WBB and DTT in the same spectrum at the same location, because they have fundamentally different technical characteristics. A Commission study published in 2014[9] concluded that technological developments that would remove this constraint (convergence) are not currently sufficiently advanced to offer a solution in the coming years. The UHF band is hence subject to competing claims from two wireless ecosystems, WBB and DTT.

[7] And 50% of the EU to be subscribed to broadband above 100 Mbps by 2020
[8] White spaces are portions of spectrum left unused at a specific time and location for technical reasons.
[9] Plum & Farncombe (2014)

Figure 1 - Radio spectrum – UHF band



Source: BBC

Any long term commitment relating to access to spectrum in the sub-1GHz band should meet demand and be attentive to the rapid developments in media and mobile technologies and markets. Consumer trends show that the viewing of television content on TV sets increases with age while the viewing on the Internet decreases (*Figure 22*). It remains open whether this is a generational difference or a permanent evolution which would have an impact on TV audiences in the future, i.e. whether current youngsters will move to more linear TV viewing when they become older. Thus it is not possible to say now whether linear TV viewing (broadcasting service) will decline in the long term future or not.

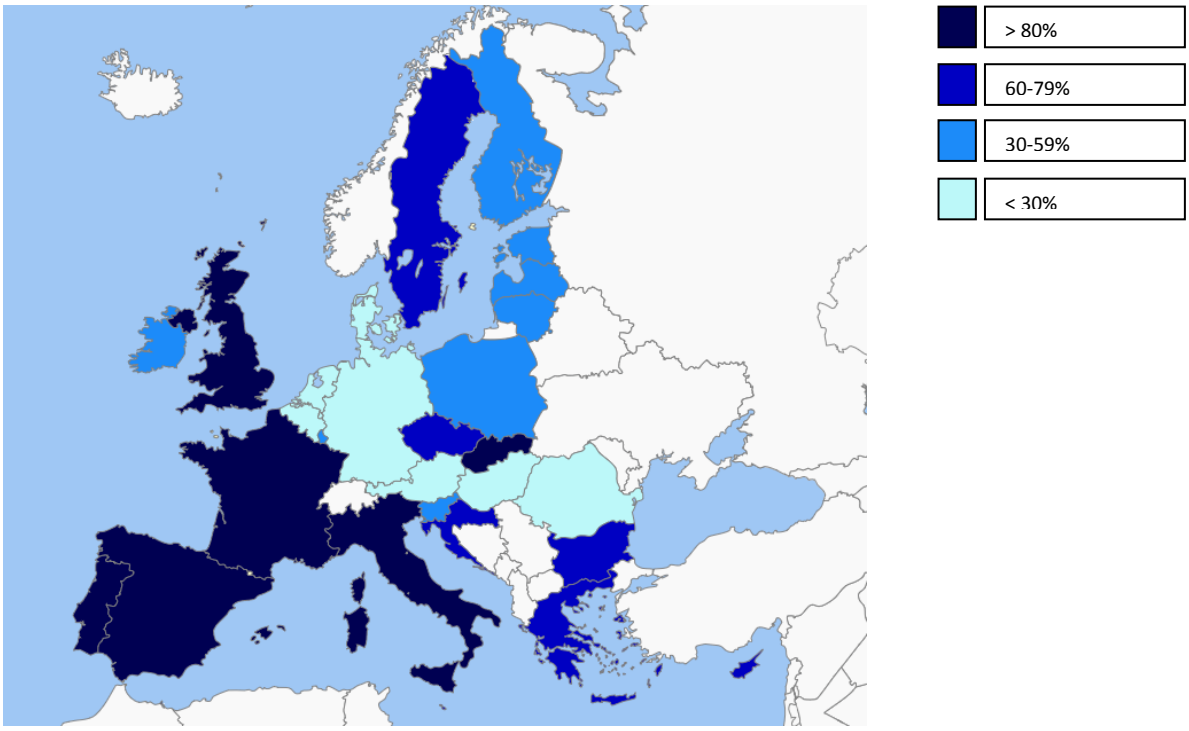
The UHF band has historically been a crucial asset for the free-to-air European audiovisual model promoting media pluralism and cultural diversity in many EU countries. The transition from analogue to digital television in the EU freed some spectrum, the 'digital dividend', in the 800MHz band and this spectrum was then made available for wireless broadband use (Annex 10.5.5). Although cultural and media policies are the competence of the Member States, Article 167(4) TFEU requires the Union to take cultural aspects into account in its action, and in particular, to respect and promote the diversity of cultures[10]. In particular Digital Agenda for Europe action 82[11] aims to ensure the implementation of the provisions of the Audiovisual Media Services Directive. In some Member States DTT is the only platform distributing public service channels free-to-air while in others a free-to-view satellite service exists.

The current use of the UHF band varies considerably between Member States with parts of this band licensed for broadcasting, WBB services and other uses, such as wireless microphones. The proportion of DTT households varies from less than 5% in Belgium to over 90% in Spain (*Figure 2*).

[10] UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005) which has been reinforced by Council of the European Union (2008), *Conclusions of the Council and of the Representatives of the Governments of the Member States, meeting within the Council, on the Work Plan for Culture 2008-2010* (2008/C 143/06), OJ C 143.

[11] http://ec.europa.eu/digital-agenda/en/pillar-vii-ict-enabled-benefits-eu-society/action-82-implement-audiovisual-media-services-directive

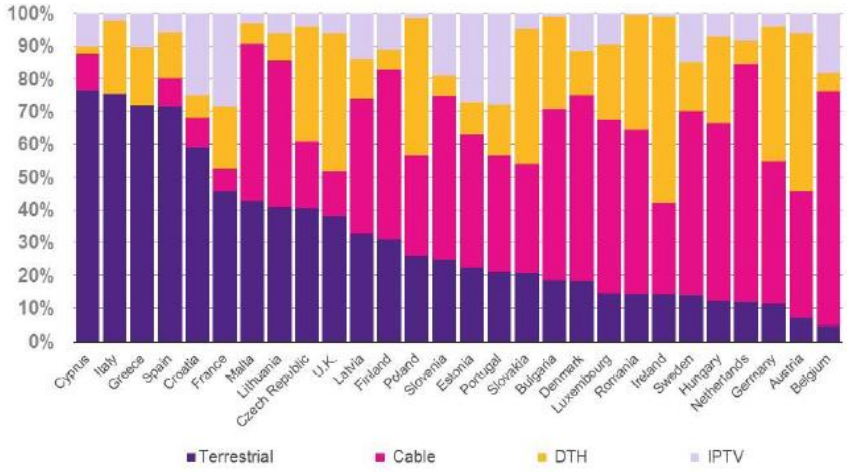
Figure 2 – Penetration of total DTT by country as a percentage of television households[12], 2014



Source: IHS Technology (2015)

Some of these households are so-called primary DTT households (i.e. their primary TV receives the DTT channels) while others are not, meaning that their primary TV receives channels from another platform (cable, satellite or IPTV). This is related to the availability and penetration of other TV platforms illustrated in Figure 3. For example both Italy and France have a total DTT penetration of over 80%. However, while in Italy DTT represents a share of about 75% of TVs, in France DTT represents a share of only about 45% of TVs, because the alternative platforms have a considerably greater presence in that country.

Figure 3 – Market shares of television platforms across Europe



[12] Households with a TV

Source: EAVO (2011, 2012), e-Communications Household Survey (2013), Yearly/Quarterly reports from National Regulatory Authorities, Digitalisierungsbericht 2013 (die medienanstalten) Farncombe analysis and research

Therefore, in response to the increasing demand for spectrum in the UHF band, Member States are also likely to have different approaches to its future use. 'Early movers' such as France and Germany have already proceeded to assign the '700 MHz band' to mobile broadband services on the basis of the ITU co-allocation decision (Annex 10.5.6). These countries have taken into account the constraints that will arise from the need for cross-border coordination and have set long deadlines for the coverage obligations associated with the 700 MHz band.

Other Member States such as Sweden and the UK have made public commitments to follow along the same lines. The current DTT licence expiry date, the public commitments, the auction dates and the auction revenues are detailed in Figure 4 below

Figure 4 – Current status of the current licences and future intentions with respect to the 700MHz band in EU 28

	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI*	FR	HR	HU
Expiry dates national licenses	2016-2022	2024	2025	2025	2021-2023	2025	--	yearly	N/A	2025	2016	2015-2022	2019-2021	2020
Political decision	No	No	No	No	No	**Yes**	**Yes**	No	No	No	**Yes**	**Yes**	No	No
Authorization/ Auction						2015						2015		
Auction revenue						€ 1,1B						€ 2,8B		

	IE***	IT	LT**	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Expiry dates national licenses	2019	2023	2022	2020	2013	2021	2017	2020-2021	2023	N/A	2014	2018-2026	2029	2022-2026
Political decision	**Yes**	No	No	No	No	No	**Yes**	No	No	No	**Yes**	No	No	**Yes**
Authorization/ Auction	2018												Q4 2016	2018
Auction revenue														

* one DTT MUX in 2026
** one DTT MUX in 2031
*** repurposing the 700MHz band would result in a positive net benefit of € 77million according to the Frontier Economics study

The absence of an EU-wide vision and common legislation for the UHF band will create fragmentation in the use of the UHF band within the Union. Member States will act within their country but will be unable to control how and when neighbouring countries might act. This will lead to uncertainty for investors wishing to deploy innovative mobile-based services across Europe. Such fragmentation could be detrimental to the Union's internal market for several reasons explained in detail in the next section.

Figure 5 below summarises the problem and indicates the problem's drivers and consequences. This Impact Assessment accompanies a Decision of the European Parliament and the Council to coordinate the use of the UHF band, in particular to coordinate the change of use of the 700 MHz band and a Commission implementing measure to harmonise its technical conditions of use as well as to ensure regulatory certainty for the use of the 'sub-700MHz band'.

Figure 5 - Parts of the problem, drivers and consequences table

Drivers	Problem	Consequences
• New mobile services and improved audiovisual content quality resolution need additional capacity • Pervasive connectivity is most efficiently achieved with the support of wireless technologies using spectrum resources • Mobile connectivity has become an inherent element of lifestyle and competitiveness • Current wireless broadband and broadcasting technologies cannot co-exist in the same area using the same spectrum band	Limited availability of UHF spectrum to meet the growing demand	• Constraints on mobile and audiovisual services due to lack of capacity • Lower network investments leading to loss of competitiveness and innovation • Geographically limited and expensive high-speed broadband connectivity across the Union • Bands need to be allocated for wireless broadband or DTT services while encouraging spectrally efficient technologies
• Diversity of DTT use and penetration in Member States • Diversity of wireless broadband use and penetration in Member States • Uncertain evolution of DTT and wireless broadband demand • Repurposing of the 700MHz band at different times • Different assignment approaches and licensing conditions for the 700MHz	Fragmented national approaches to meet spectrum demand	• Variable impact of the different options in different Member States • Increased risk of cross-border interference • EU-wide investments hindered due to lack of economies of scale • Discrepancy in the availability of public broadcasting service channels

2.2. Who is affected, in what ways and to what extent?

The existing EU harmonised spectrum for WBB below 1 GHz has been assigned in nearly all Member States (Annex 10.5.6). Mobile operators request that additional spectrum below 1GHz be made available to wireless broadband services to allow them to meet increasing demand for mobile data traffic through better coverage of high speed broadband in rural areas and improved indoor coverage in urban areas.

Given radio waves travel across national borders, the use of the UHF band in one Member State has an impact on the type of use possible in neighbouring countries. In practice, if a Member State introduces WBB in the 700MHz band before its neighbours, it could cause interference to DTT users in neighbouring countries in areas up to 100 kilometres from the border which represents about 13% of the EU population[13]. This problem would hence be particularly relevant in Member States where a large proportion of the population lives within reach of signal transmissions from neighbouring countries. Hence this Member State might have to limit WBB deployment in border areas and/or conclude cross-border coordination agreements with its neighbours. For smaller Member States this could mean that they would not be able to clear the 700 MHz without international coordination.

Thus, a fragmented approach to the UHF band and in particular to the release of the 700 MHz band can generate uncertainty and hinder investments in high-speed mobile networks in the EU. It therefore risks depriving EU citizens of access to better and lower cost broadband services with speeds of at least 30MB/s, especially in rural areas, and of enhanced indoor penetration. Also, EU citizens will not benefit fully from the economies of scale (generated by markets outside of Europe) for the equipment that uses the 700MHz band.

A Union UHF band strategy should encourage vibrant telecoms and audiovisual markets and sustain the European audiovisual model.

2.3. How would the problem evolve

There is consensus that mobile traffic is growing, particularly due to the increase of video streaming, and that more spectrum will be needed to increase the capacity of mobile networks. The precise extent of this growth remains controversial but even the most conservative estimates have mobile traffic growing at about 25% per year. This will lead to demand for spectrum in excess of what is currently available in the short and medium term in all Member States[14].

This traffic is carried partly over mobile networks (3G and 4G) and partly (about 70%) offloaded, i.e. carried over Wi-Fi onto fixed networks (*Figure 19*). Wi-Fi operates at higher frequencies (e.g. the harmonised 5 GHz band) where unused spectrum is still available. The offloaded traffic hence alleviates the pressure on spectrum below 1 GHz but Wi-Fi cannot offer mobility (on-the-go) services and is only available if there is a fixed network; it will thus only partially absorb mobile traffic growth.

The extent of future demand for DTT audiovisual services to large screens for home use remains uncertain. The roll out and the technological developments of fixed broadband (cable and fibre) and of satellite broadcasting services could change the role and cost-effectiveness of the different TV platforms. Consumer trends in the consumption of audiovisual content, with the increasing importance of non-linear content, user-created content and sharing as well as consumption on mobile devices,

[13] Based on a proxy from espon.eu (20% of EU27 population living within 45 minutes of the border) and average EU28 DTT penetration (63%) from IHS Technology

[14] Analysis Mason (2013)

might have an impact on the demand for traditional linear TV. A change in DTT demand would have an impact on spectrum demand and/or on the efficiency of use of current DTT spectrum.

3. Why the European Union should act

EU action is desirable because of the following considerations:

Efficient use of spectrum: given the ITU international framework, a common EU-level frequency designation would incentivise DTT and WBB actors to make timely transitions towards more spectrum efficient technologies needed to cope with growing demand for spectrum below 1GHz.

Securing investment for 5G networks: an early EU decision will ensure regulatory consistency and is therefore likely to provide increased certainty to investors and companies over the future availability of spectrum for DTT and WBB use. This is likely to foster the substantial network investments needed to meet the Union's connectivity needs. Mobile services using such improved networks will help drive innovation and growth in telecommunications and in other sectors. An EU approach would facilitate scaling-up these services in the European market.

Stakeholder alignment: The Lamy Report recommends that the 700 MHz band should be made available for wireless broadband by 2020 and that downlink-only wireless broadband use could be flexibly introduced in the sub-700 MHz band. High Level Group members supported it in public statements. The subsequent Public Consultation on the Lamy Report also clearly showed respondents' support for EU action (see Annex 10.2.3). Member States adopted an RSPG Opinion[15] that also supports such EU action. The RSPG recommends that the EU develops a strategy on the future use of the UHF band taking into account decisions and developments on the 700MHz band as well as all political, economic, regulatory and technical elements.

Benefits from economies of scale and promoting innovation: a common frequency designation and common adoption of technical conditions would result in a 500 million consumer market, simultaneously benefiting from and further contributing to the near-global harmonisation of the 700 MHz band. Device and network equipment manufacturers will benefit from the consequent economies of scale flowing from a near-global harmonisation of the 700 MHz band.

The European audiovisual model: The audiovisual model is based on the rationale that public funding should support public service broadcasting, that cultural diversity, freedom of information and media pluralism are maintained and that broad access is given to events of societal importance. In some Member States a free television[16] based model is established with related public interest obligations such as universal coverage (see Annex 10.5.3). It will be important to respect these founding values when addressing the long term future of the UHF band, while recognising that the implementation of such values must be adapted to a future characterised by multiple networks and platforms, including OTT[17] delivery, distributing both linear (programmed) and non-linear (on-demand) audiovisual media content.

Based on Article 114(1) TFEU, the European Parliament and the Council adopted Decision 676/2002/EC[18] on a regulatory framework for radio spectrum policy in the European Community. The

[15] Bibliography reference (RSPG, 2015)
[16] As defined in the Audiovisual Media Services Directive 2010/13/EU, free television means broadcasting on a channel, either public or commercial, of programmes which are accessible to the public without payment in addition to the modes of funding of broadcasting that are widely prevailing in each Member State (such as licence fee and/or the basic tier subscription fee to a cable network)
[17] Over the top services provided over broadband
[18] O.J. L 108, 24.4.2002, pp. 1–6

results of the ongoing evaluation and review of the EU telecoms framework will be presented at the earliest by mid-2016 and, given its complexity and wide-ranging nature, it might take two years for legislative measures flowing from that review to be adopted and enter into force, which would be too late for an orderly reallocation of the 700 MHz band. The review of the telecoms framework will address broad policy objectives, while the aim of this initiative is a targeted intervention on a specific frequency band.

In its Work Programme for 2015, the Commission has indicated that it will complement the review of the telecoms regulatory framework with a timely and coordinated release of the 700MHz band in Europe.

This initiative is an integral part of Decision 2012/243/EU[19] establishing a multiannual radio spectrum policy programme (RSPP). Article 3(b) of the RSPP states that Member States and the Commission shall cooperate to allocate at least 1200 MHz of appropriate spectrum by 2015 to meet the increasing demand for wireless data traffic thereby allowing the development of commercial and public services, while taking into account important general interest objectives such as cultural diversity and media pluralism. Article 4 of the RSPP provides the legal basis to harmonise the technical conditions for the availability and use of frequency bands for a specific application at EU level; such technical harmonisation measures are expected to ensure more efficient use of spectrum and enhance the internal market. Such harmonised spectrum will ensure that innovative services can be provided to EU citizens and promote development and innovation in priority sectors such as audiovisual or WBB services, including the Internet of Things (IoT). The EU currently counts 1030MHz of harmonised spectrum for wireless broadband (*Figure 33*). Timely release of the 700 MHz band can thus be achieved within the context of the current framework and in pursuit of the RSPP and DAE broadband target objectives.

The EU will act with two initiatives:

i) the proposal of a European Parliament and Council Decision for the entire UHF broadcasting band including 700MHz and sub-700Mhz band, and

ii) an implementing decision, adopted through comitology procedure, to designate and make available the 700MHz for the use of wireless broadband services with harmonised technical conditions of use based on technical parameters agreed within the CEPT.

4. Policy objectives

Any EU action should comply with the ITU Radio Regulations and the Geneva Agreement of 2006 (GE06) which protects digital terrestrial television in cross-border territories and could thus geographically constrain WBB deployment. EU action will have to include the effective management of interference to digital terrestrial television outside EU borders.

Our proposed legal measures aim to avoid a fragmented approach by Member States to meeting the demand for UHF spectrum as a means of providing ubiquitous low-cost, high-quality WBB services. Two general objectives have been detailed, accompanied by specific objectives.

Figure 6 – General and specific objectives table

General Objectives	Specific Objectives
Foster the development of the Digital Single Market which is built on reliable	• Identify spectrum bands which can be used to meet growth in wireless broadband services, while sustaining the founding principles of the European audiovisual model

[19] O.J. L 81, 21.3.2012, pp. 7–17

high-speed networks	(Annex 10.5.3) • Ensure wireless broadband connectivity (coverage) across the European territory • Promote competition, innovation and technological neutrality.
Encourage an efficient management and use of the radio spectrum reflecting its social, cultural and economic value	• Avoid interference between WBB and DTT services • Ensure that the use of the UHF band contributes to secure the public interest and consumer benefits while facilitating investments and market transformation • Support the use of more efficient technologies and standards

5. Policy options

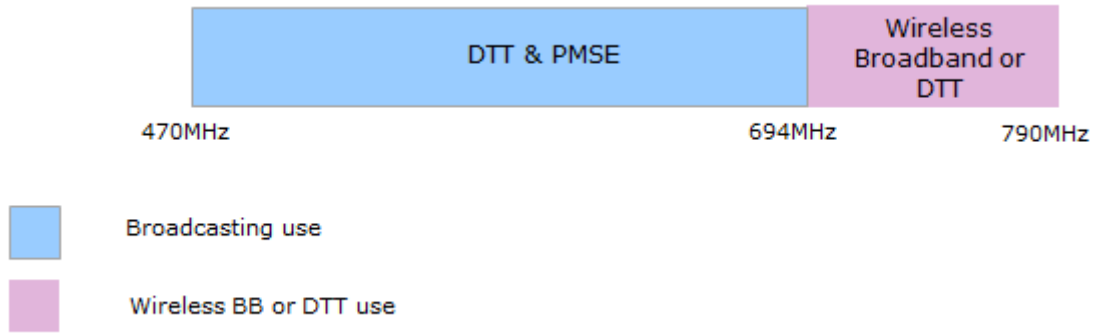
5.1. Identified policy options

A future strategy for the UHF band should be able to adapt to the evolving broadcasting and mobile market realities while taking into account trends in technology and consumer behaviour. It should include the timely and coordinated repurposing of sufficient additional spectrum (including the 700MHz band) in the EU territory to ensure the full economic benefits of wireless broadband connectivity in the EU.

Any EU action should comply with ITU Radio Regulations. The Geneva Agreement of 2006 (GE06) governs the use of the frequency band 470-862 MHz and protects DTT in cross-border territories. Thus, a release of the 700MHz band for WBB in Europe will have to include the effective management of interference with DTT outside the Union. Deployment of WBB along external borders is subject to bilateral cross-border coordination agreements. Cross-border coordination with Russia was concluded in October 2015.

Four policy options, presented in the table below with their provisions for the 700MHz and the sub-700MHz bands, have been considered to address the problem and to meet the policy objectives. The following main inputs have been considered: (i) the Lamy report of 2014, (ii) the results of the public consultation on the Lamy report, (iii) the RSPG Opinion and (iv) the Commission study on the Economic and Social Impact of Repurposing the 700MHz band for Wireless Broadband Services in the European Union.

Option 1 *- Baseline scenario – No action at Union level*



In the baseline scenario, the EU will neither take action on the 700MHz band nor on the sub-700MHz band.

Option 2 *- Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020 and reservation of the sub-700MHz frequency band for DTT and audio PMSE.*

Option 2 entails the coordinated release of the 700MHz band for wireless broadband and reservation of the sub-700 MHz band for DTT and audio PMSE.

A Commission proposal to the European Parliament and Council would provide for a timely and synchronised release of the 700MHz band for WBB and provide clarity as to the future use of the sub-700 MHz band.

A Commission Implementing Decision would require Member States to put the 700MHz band into effective use for electronic communication services under harmonised technical conditions (such as common channelling arrangements and power limits to avoid harmful interference).

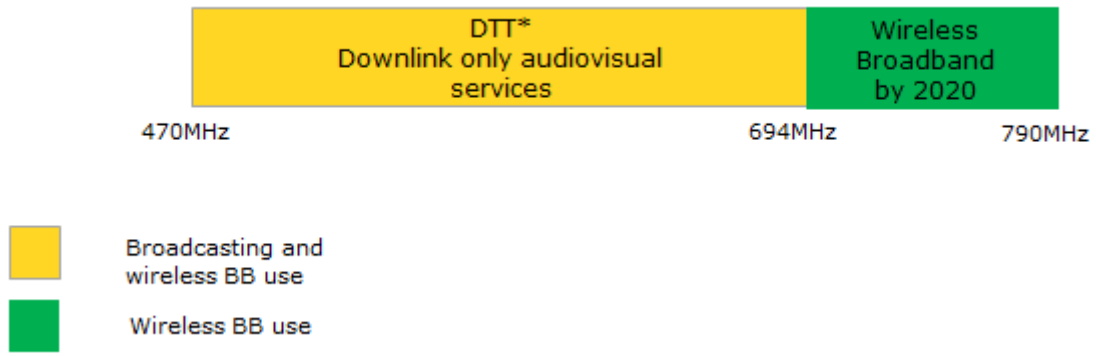
To mitigate the disruption caused by the changing conditions of use of the band, a transition roadmap is included in this Option. Member States should:

i) adopt and communicate to all other Members States and the Commission a national roadmap (including the planning and preparations, the international frequency coordination, frequency management, technical activities, communications, support to trade stakeholders and potential compensatory measures) by June 2017;
ii) conclude all necessary cross-border coordination agreements within the Union by the end of 2017; and
iii) implement measures to ensure a minimum impact on audiovisual services broadcasters and audio PMSE users – i.e. legal certainty and protection.

Member States will also be encouraged to consider imposing *coverage obligations* when granting licenses in the 700 MHz band, possibly linked to incentives such as network/spectrum sharing in order to achieve coverage targets, with a view to meeting the DAE broadband objectives and fostering connectivity in line with the DSM strategy.

Option 2 provides for the sub-700MHz band to be reserved for DTT and PMSE. This legal protection will be reassessed by 2025 based on an evaluation of DTT and WBB demand and technological developments.

Option 3 *– Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020 and coordinated designation of the sub-700MHz band for flexible use which safeguards the provision of audiovisual media services (AVMS) to mass audience, via maintenance of DTT or other downlink-only distribution, including free-to-view distribution, as well as audio PMSE, subject to national demand.*



* PMSE use in 'white spaces'

Option 3 entails the adoption of EU measures to ensure a coordinated release of the 700MHz band for wireless broadband as in Option 2.

Option 3 differs from Option 2 in the provisions for the sub-700MHz band. In this Option, Member States can decide whether to maintain their current DTT platform (and in this case it should have priority vis-à-vis wireless broadband services in neighbouring Member States) or whether to gradually reduce available (and possibly underutilised) spectrum serving DTT or to lift current restrictions on technology and service neutrality and introduce other uses besides DTT within the sub-700MHz band according to their national circumstances (Articles 9 and 9a of the Framework Directive 2002/21/EC).

Access to spectrum for DTT is safeguarded to the extent judged necessary by individual Member States. Traditional DTT broadcasting services may thus co-exist in the sub-700MHz band with wireless broadband services limited to downlink-only mode[20]. In practice, flexible use of the sub-700 MHz band means that specific channels or locations not used for terrestrial broadcasting could become available for downlink-only services or applications served by an alternative technology (such as WBB), operated by existing right holders or newcomers, depending on national circumstances. A widening of possible uses of a band, in terms of either technology or services, does not necessarily require a change in the assignee of the band, so such a change could effectively enlarge existing rights – while still being potentially subject to national general-interest service restrictions.

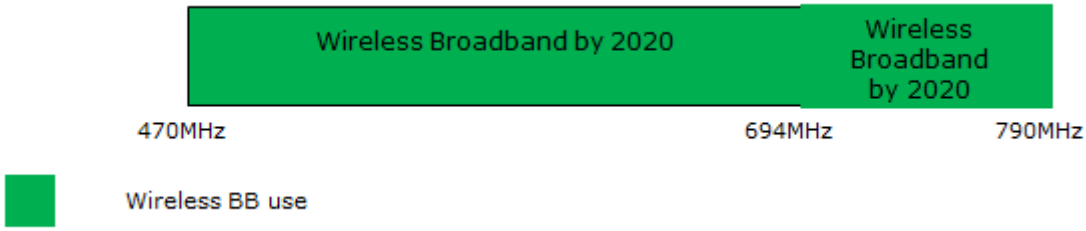
[20] This technical solution is supported by broadcasting and mobile manufacturers in a paper from Digital Europe

Member States which choose to allow downlink-only services will have to ensure cross-border coordination with countries where DTT is operational. The use of downlink-only services and their co-existence will have to be technically harmonised at Union level subject to studies and a subsequent technical implementing measure adopted by the Commission pursuant to Article 4 of the Radio Spectrum Decision. Studies to clarify the conditions of co-existence of DTT and 'down-link only' WBB should be launched as soon as possible and could be conducted in the framework of a mandate to CEPT.

This flexibility is compliant with the ITU Radio Regulations (RR) on the sub-700 MHz band, which stipulate an allocation solely to the broadcasting service[21] for ITU Region 1. Uplink services will not be allowed as they would entail severe service limitations due to the necessary interference mitigation with respect to broadcasting services required to comply with the ITU RR and with the GE-06 agreement, in particular at the EU outer borders.

As in Option 2, an evaluation process is envisaged by 2025 to reassess the provisions for the sub-700MHz band. In this Option, the evaluation will also be a means to re-examine the relevance of prioritising audiovisual media services in the 470-694 MHz band and the need to limit its use for downlink-only. Any significant changes resulting from such evaluation would take until about 2030 to be implemented, thus giving the relevant market actors predictability up to this date.

Option 4 *– Coordinated designation and authorisation the whole UHF broadcasting band for wireless broadband services by 2020.*



Option 4 implies the complete clearance of DTT from the UHF band (700MHz and sub-700MHz) and the designation and assignment of the whole UHF band to WBB services (and possibly other sectorial services[22], including audio PMSE) by 2020. Comprehensive coverage obligations would be linked to WBB licences in the UHF band in order to establish a fully connected Union.

In this Option, EU coordination will define a *common UHF roadmap for clearing DTT from the UHF band* (as opposed to transition) that should serve as high-level guidance to national and EU-level policies.

Figure 7 – Policy options

	Sub-700MHz band	**700MHz band**
Option 1	No action	No action
Option 2	Reservation for DTT and audio PMSE to exist and develop	Vacate DTT, make available for WBB
Option 3	Flexibility of use: Member States can maintain DTT or introduce WBB in downlink-only mode, provided	Vacate DTT, make available for WBB

[21] The broadcasting service in ITU terminology is "a radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions or other types of transmission".
[22] Other services could include Public Protection and Disaster Relief (PPDR) or Internet of Things applications.

	audiovisual media services to mass audiences are safeguarded	
Option 4	Vacate DTT, make available for WBB	Vacate DTT, make available for WBB

5.2. Discarded Options

Non-regulatory options have been discarded as spectrum is limited, implying the need for a certain form of public management and regulation that guarantees equal opportunity for use and prevents interference. The policy options envisaged in this report are based on regulatory action as any non-binding measure (i.e. to stimulate voluntary agreements and self-coordination between stakeholders) is unlikely to ensure efficient use of spectrum.

The timeframe of the proposed legal measures to release the 700MHz band could range from 2018 to 2022 as proposed in the Lamy Report and in the Lamy Report Public Consultation responses (see Annex 10.2.3). An earlier date than 2020 cannot be envisaged as a transition period is required to clear the band and designate and assign it to its new use.

Option 3 allows Member States to decide on the scope of the sub-700MHz band according to their national circumstances, and therefore could result in greater technology and service neutrality than is currently prevalent. The obligation for Member States to reserve part of the sub-700MHz band for WBB (i.e. with uplink as well as downlink) before the 2025 evaluation was discarded as this could undermine future DTT investments and unlike the case of the 700MHz band itself, does not appear to be uniformly necessary across the EU to achieve the right balance between growing WBB demand and audiovisual distribution in keeping with widespread policy preferences of the Member States. This Option was discarded at it is not possible to identify a portion (or even a certain quantity of spectrum) that would be appropriate in each Member State to provide DTT with enough spectrum to maintain its current offering and develop in the future. A 'one size fits all' solution cannot be envisaged in this case. If the Union decides there is a value to sustaining its audiovisual model, it should not deny one of the main platforms the opportunity to compete and innovate.

6. Impacts of the different options

The aim of this section is to assess the social and economic impacts of the policy options considered covering actions on both parts of the UHF band: the 700MHz band and the sub-700MHz band.

The categories of impacts considered are described in the table below.

Figure 8 – Key categories of impacts considered

Category of Impact	Key Issues
Specific EU region and/or Member State	Member State geography and actual use of the UHF band
Macroeconomics and capital expenditure	Economic growth and employment: investments and transition costs for incumbent operators in the 700MHz band
Consumer welfare	Consumer benefits from wider and better availability of wireless broadband to provide on-line services and from the availability of TV through the DTT platform
Digital Single Market and Digital Economy	Completion of the Digital Single Market and EU companies and SMEs benefits from the digital economy
Legal and Administrative changes	Network re-planning and re-assessment of regulatory conditions of spectrum use and potential coverage obligations
Cultural diversity	Impact on the quality, quantity and distribution of audiovisual content

There is no specific environmental impact in any of the options. Introducing WBB services in the 700 MHz band would not require the installation of more masts as the base stations already used for 800MHz and 900MHz would be sufficient.

Member States are already required to draw up waste management planning as foreseen in the Waste Framework Directive[23] for the disposal of consumer equipment (TVs and set-top-boxes). TV life cycles are shorter than in the past mainly due to improvements in design and resolution while DVB-T2 compliant TVs are already in the market. From studies conducted by Sky TV[24] 93% of the carbon footprint comes from customer use of the equipment rather than manufacturing, distribution and disposal. An accelerated replacement driven by this initiative would be compensated by the more efficient energy consumption characteristics of newer equipment. A timely decision on the 700MHz band would allow the integration of any technical adjustments in the next TV models.

If the EU decides to repurpose the 700MHz band, the date set to clear the band is important when assessing the impact of timescales on the costs of transition. The impact of the options can be assessed separately for mobile network operators, broadcasters (distribution and content), creative industries, equipment manufacturers, citizens and regulatory authorities.

6.1. Option 1 – Baseline scenario – no action at Union level

In Option 1, Member States in addition to France and Germany and probably starting with the ones that have made public commitments in this regard, will act independently or in small groups for coordination purposes and the future designation of the 700MHz and the sub-700MHz band will be decided on a national or regional basis. It is difficult to predict which countries will act and when, beyond the information already provided in Figure 4.

Some Member States facing the biggest difficulties in clearing the band might decide not to act and maintain their current DTT use in the 700 MHz band. Member States would be able to determine the amount of spectrum made available for wireless broadband in the 700MHz and/or the sub-700MHz bands and be able to change the available frequencies and their relevant technical conditions unilaterally, even though a non-binding agreement has been reached by the CEPT on the technical conditions of use of the 700 MHz band for WBB. Member States are also likely to take action according to national timescales, so that where the 700MHz is repurposed, the 700MHz band will be made available for wireless broadband at widely different times. This will substantially decrease the efficiency of spectrum use and the benefits of the WBB services operating in the 700MHz band as WBB services availability will be constrained by high-power DTT interference. This will lead to delays in WBB network roll-out, in particular in border rural areas, which will experience a lack of or poor WBB coverage. Also border urban areas might encounter capacity bottlenecks for high-speed broadband due to spectrum shortage. Member States will have to invest considerable effort in concluding cross-border coordination agreements with each of their neighbours to try and limit the interference problems.

A lack of EU coordination thus means that the interference issues will last over several years. Until the last Member State has released the 700 MHz band from DTT there will be a need for cross-border coordination agreements between neighbouring countries using different technologies within the 700 MHz band, i.e. WBB and DTT. Cross-border coordination will be applicable to every Member State from the beginning of the transition and will have to be reviewed every time a Member State performs the step change in use of the 700 MHz band from DTT to WBB. First movers (like Germany and France) will have to conclude early cross-border coordination agreements and may need to postpone WBB deployment in the 700 MHz along their borders, thus depriving their citizens living in border areas of the possibility to access high-speed WBB. This problem would be most acute at the outer

[23] Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives

[24] Sky+ HD Box Environment Factsheet

borders of the Union such as between the Baltic Member States and Russia, where the conclusion of cross-border agreements and their conditions (subject to ITU coordination rules) may impose significant restrictions on WBB deployments.

As the Union (and the rest of the world) is increasingly relying on connectivity and ubiquitous access to online goods and services, lagging behind in the digital market would have a potential spill-over effect on other sectors. In addition, the EU market will not benefit fully from the available economies of scale in terms of network roll-out and equipment availability and interoperability.

The transition to more efficient spectrum technologies is already taking place as DTT seeks to stay competitive vis-à-vis other TV platforms like cable and satellite. All countries in Europe are using DVB standards but different countries use different compression technologies (Annex 10.5.4). An uncoordinated timing for release of the 700 MHz could also limit the incentive to upgrade DTT technologies and roll out new high-speed networks. This would have a stagnating effect on the DTT market and the completion of the DSM, as well as delaying the availability of equipment for the 700MHz band. The overall risk is that Option 1 would hinder the Union's innovation and reduce its competitiveness.

Neither stakeholders in the context of the Lamy Report nor Member States in the RSPG Opinion envisaged this option.

It was not possible to quantify the impact of this option which is by its very nature varied and unpredictable. The lack of a coordinated EU action means it is not possible to pre-determine which Member States will take which decision within which deadline, thus making the variables of the cost and benefit analysis too wide to determine an estimate.

6.2. Option 2 – Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020; reservation of the sub-700MHz frequency band for DTT and audio PMSE.

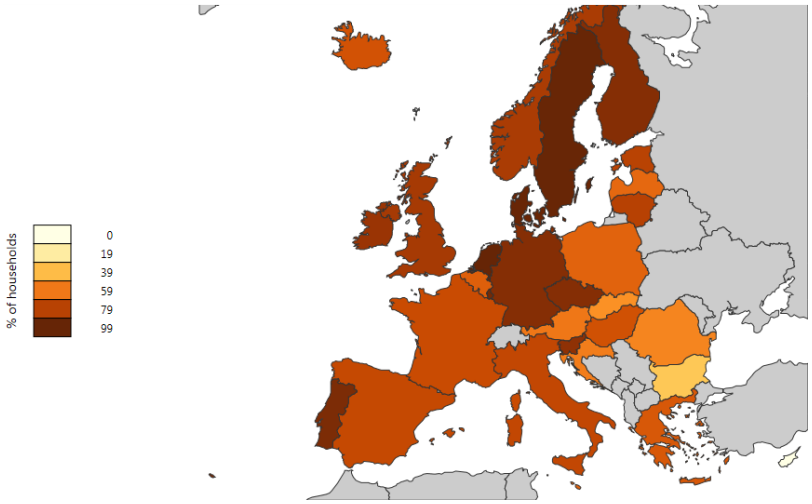
6.2.1. Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020

The designation of the 700MHz band for WBB by 2020 would identify additional spectrum to meet the increasing demand of wireless data traffic (*Figure 15*-19) and contribute to the RSPP and DSM objectives. Only adding the 700 MHz band to existing EU harmonised spectrum for WBB in the 800 MHz and 900 MHz bands would allow mobile operators in a competitive 3-4 player market to efficiently offer citizens ubiquitous broadband connectivity at 30 Mb/s or more by 2020[25] as they would benefit from spectrum holdings of at least 20 MHz for the deployment of 4G technology[26]. Figure 7 below illustrates the current variations in LTE coverage in EU Member States. The coverage is provided as a country average and will in fact be higher in urban areas than in rural ones.

Figure 9 – 4G mobile broadband (LTE) coverage as a percentage of households

[25] In line with DAE and RSPP connectivity targets

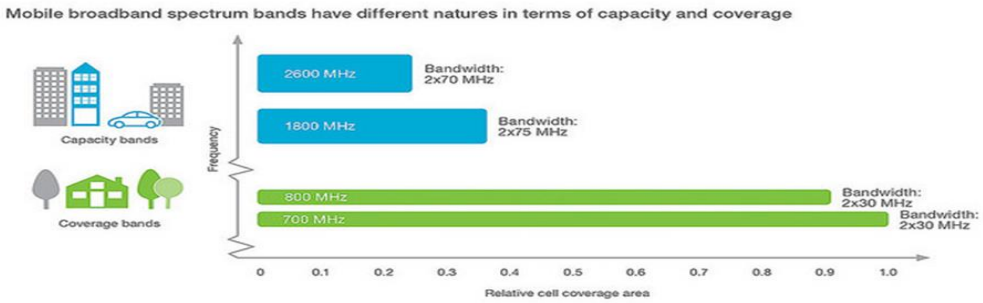
[26] Both LTE and LTE-A with multiple-antenna configurations may offer an aggregate downlink speed per base station exceeding 150 Mb/s within 20 MHz of used spectrum



Source: Eurobarometer (2014)

The additional spectrum for WBB in the 700MHz band has specific properties which are particularly well suited to: i) coverage, i.e. providing high-speed rural broadband (in terms of geographical reach and quality of the signal), and thus ensuring ubiquitous connectivity for personal communications and also for IoT including connected cars and ii) in improving indoor penetration, i.e. the signal inside buildings in urban areas. The enhanced broadband coverage would make high speed WBB more widely available to EU citizens, thereby enabling them to access more and better services, including in particular audiovisual content, on their handsets. The 700 MHz band is hence an essential spectrum asset for achieving the Union's broadband coverage and connectivity targets, thereby establishing the necessary foundations for a fully functioning DSM.

Figure 10 – Capacity and coverage characteristics of different spectrum bands[27]

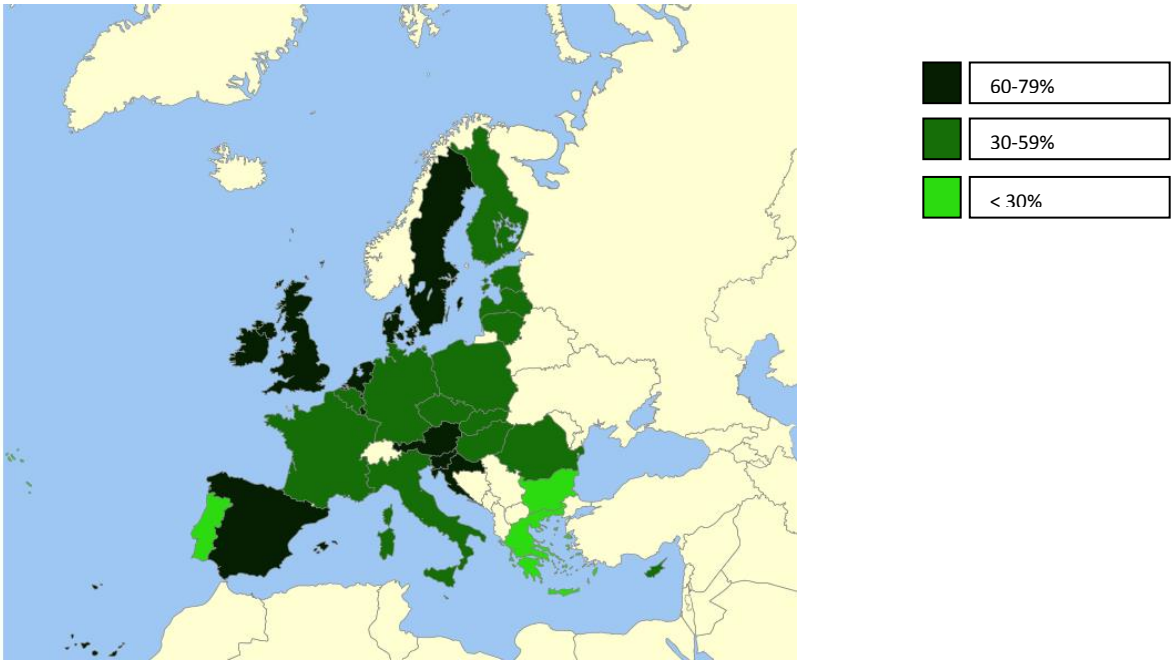


Source: Ericsson Connectivity Report, 2014

In urban areas indoor coverage would increase, allowing consumers to continue to benefit from their on-the-go services as they move in and out of buildings and other indoor locations such as tunnels, conference centres, stations etc. This will have a positive impact on the up-take of mobile subscriptions giving on-the-go access to the Internet. Figure 9 illustrates the current uptake of such mobile subscriptions in the EU.

Figure 11 – Percentage of EU households with a mobile subscription giving access to the Internet

[27] The relative cell coverage is expressed in radius of coverage of each mobile network cell



Source: Eurobarometer (2014)

Mobile operators confirmed in interviews with the study team that their expected return on investment is higher in the 700 MHz band due to the higher cost of building sites in other [higher] bands. Such positive characteristics could be fully exploited if the timely granting of licenses in the 700 MHz band is accompanied by coverage obligations to increase investments and achieve broadband targets and the overarching DSM connectivity objectives. Such coverage targets would ensure that the capabilities of the spectrum are effectively utilised and that citizens will benefit from faster mobile data services and extra capacity in rural areas and improved indoor coverage in urban areas, as well as extended coverage of rail and roads.

The Commission estimates, based on the prices paid for spectrum in 'equivalent' bands (i.e. 800 MHz and 900 MHz), that mobile operators will pay over EUR 11 billion for the 700 MHz spectrum if made available. This is the most common method of benchmarking spectrum value for a specific band in the EU, since auctions are now almost the exclusive means of assigning WBB spectrum. This estimate seems reliable when compared with the actual prices paid in France and Germany as well as with the estimated benefit of the 700 MHz for Ireland contained in a study by Frontier Economics (*Figure 19*).

The additional WBB capabilities would also have wider economic and social benefits as mobile broadband is, and will continue to be, an essential catalyst for the European economy (including SMEs) in existing and entirely new industries such as public services, health, connected cars and smart meters and grids. Connectivity will enable new revenue streams and business models, drive efficiencies and improve the delivery of on-line services to EU citizens and therefore also facilitate social inclusion. In addition, Europe will both contribute to and benefit from the economies of scale of a near-global harmonisation of this band.

Given that deployment of 5G technology is expected to begin by 2020, dedicated IoT networks could access the 700MHz band duplex gap (the spectrum unused between uplink and downlink traffic) as they do not need a lot of bandwidth but require good coverage conditions. This spectrum will hence facilitate the development of innovative services, whether they rely on ubiquitous coverage, such as connected cars or higher WBB speeds, such as e-health and audiovisual services.

Gartner estimates that IoT will support services, such as those ranked below, with total annual spending of about EUR 55 billion in the EU28 countries in 2016[28].

Figure 12 – Top ten connected applications in 2020

Connected cars
Clinical remote monitoring
Assisted Living
Home and building security
Pay-as-you-drive Car insurance
Car usage (new business models)
Smart meters
Traffic management
Building automation
Electric Vehicle Charging

Source: GSMA Connected Living Programme[29]

In terms of impact in the EU, more details on the top two applications can be given as examples:

- Connected cars revenue in EU28 will reach around 25 billion EUR in 2020[30] mainly driven by driver assistance and safety applications. Deployment and uptake of connected cars services is clearly dependent on the availability of ubiquitous connectivity and could benefit from the introduction of 5G IoT components for connected cars by 2020[31].
- mHealth could save 99 billion EUR in healthcare costs in the EU and add 93 billion EUR to the EU GDP in 2017[32] alongside an improvement in patient welfare;

EU companies would also benefit from pervasive wireless broadband services with a positive impact on growth and competitiveness. Other potential benefits for society would be the use of the 700MHz band for specific mobile broadband services such as Public Protection and Disaster Relief (PPDR).

Existing licensed DTT broadcasting services (public and private) would have less spectrum in the UHF band available for their operations. DTT services will have to be accommodated in the sub-700MHz and use more efficient spectrum technologies in order to maintain the same quantity and quality of available channels. This migration will generate costs for broadcasting network operators as they will have to reconfigure their networks to use only the sub-700MHz band. The repurposing of the 700MHz band will require significant changes to the broadcasting networks (planning, transmitters, antennas for distribution, encoders, multiplexing) in order to accommodate broadcasting services in the sub-700MHz band.

DTT network operators will be required to restack their channels or upgrade to more efficient spectrum technologies. This might imply a reduction in the number of TV channels in some Member States, especially with restacking, and/or that some services might not be available on both the old and the new system (see Annex 10.5.7). Restacking will cost between 180 and 245 million euro EU-wide while upgrading to DVB-T2 will cost between 450 and 890 million EU-wide depending on whether broadcasters upgrade to MPEG4 or HEVC compression technologies. In addition DTT viewers will have to update their TV sets or set-top-box to receive the DTT channels after transition. This means consumers will have to invest in a new TV set or set-top-box.

[28] Based on world estimate from Gartner, with EU28 estimate based on EU28 share of world GDP
[29] http://www.gsma.com/newsroom/press-release/gsma-announces-the-business-impact-of-connected-devices-could-be-worth-us4-5-trillion-in-2020/
[30] World estimate from Strategy&, EU28 estimate based on EU28 share of world GDP
[31] 5G vision: https://5g-ppp.eu/wp-content/uploads/2015/02/5G-Vision-Brochure-v1.pdf
[32] Price Waterhouse Coopers

Manufacturers of consumer equipment might experience a faster replacement of consumer equipment than would be the case in the absence of an EU measure because DTT viewers will need DVB-T2 compliant equipment (television or set-top-box) by 2020[33]. The Commission study estimates that consumer costs will amount to between EUR 616 million (for primary households only) and EUR 1.3 billion (for all DTT households) to upgrade to DVB-T2 MPEG4 set-top-box and EUR 1.6 to 3.3 billion respectively to upgrade to DVB-T2 HEVC set-top-box by 2020. This corresponds, per household concerned, to EUR 40 for a DVB-T2 MPEG4 set-top-box and EUR 100 for a DVB-T2 HEVC set-top-box. 68% of these costs will arise in France, Italy and Spain where consumers will need new equipment if they want to continue receiving DTT services. On the other hand these countries have relatively low LTE coverage and WBB take-up and will hence benefit from the better quality WBB offers based on the additional 700 MHz spectrum, particularly in rural areas.

The majority of undertakings in the cultural and creative industries[34] are SMEs. In particular PMSE users are the undertakings likely to be affected by a significant reduction of available 'white spaces' for their operations in the 700 MHz band. The Commission study estimates that PMSE costs for a transition by 2020 will amount to 200 million euro based on 30% of current audio PMSE users operating in the 700 MHz band. At the same time, it should be noted that wireless microphones can access spectrum in other tuning ranges outside the 700 MHz band and efficiency can also be improved by making more use of digital technology. The Commission anticipated spectrum needs for audio PMSE (see Annex 10.3) and ensured a baseline of frequency bands suitable for average daily use in an Implementing Decision[35] on harmonised technical conditions of radio spectrum use by wireless audio PMSE equipment in the Union (see also the related impact assessment[36]). This decision provides harmonised core bands amounting to 29 MHz and an obligation of outcome for Member States to find an additional 30 MHz of spectrum for PMSE. The proposed implementing decision on the 700 MHz band will give Member States the possibility of using the duplex gap and guard bands of the 700 MHz band for PMSE, thus making available 25 MHz of the 30 MHz identified in the PMSE decision and harmonising its technical conditions of use. The proposed implementing decision does not mandate PMSE use as this is not uniform across and within Member States and is thus best left to national authorities to decide. The Commission will also request an Opinion from the RSPG concerning a Union Strategy for PMSE services[37].

Other cultural and creative industries specialized in audio-visual content production will not be affected as the DTT platform would continue to be amongst the platforms to distribute their content and since they would benefit from a better high-speed WBB which would be better suited to distribute their content to a wider group of citizens.

For regulatory authorities, costs and benefits will depend on the applicable national regulatory framework – i.e. the possibilities of license withdrawal, renewal or extension in other frequency bands and/or other administrative costs. Some of the current licences in the 700 MHz band will have to be amended in order to enable transition to mobile broadband services, depending on their date of expiry (*Figure 27*). This will entail procedural steps in terms of due process pursuant to the principles set by

[33] For cable receivers, additional immunity requirements on the basis of current standardization activities will be set in place when introducing mobile services in the 700MHz. This will ensure that cable TV receivers (DVB-C) will be protected against interference.
[34] Germany has already announced compensatory measures, see Annex 10.5.6.
[34] Independent producers are often SMEs but incumbent broadcasters are large organisations
[35] Commission Implementing Decision 2014/641/EU
[36] https://ec.europa.eu/digital-agenda/en/news/commission-implementing-decision-01092014-spectrum-use-wireless-audio-pmse
[37] As part of the follow-up to this initiative, and on the basis of the Opinion requested from the RSPG, the Commission will consider the need to identify additional frequencies to be made available for audio PMSE, and if necessary launch a strategy to put this into effect; which may include a number of frequencies located in the UHF band.

the electronic communications regulatory framework, including Directive 2002/20/EC and in particular Article 14 thereof on amendment of rights and obligations. Pursuant to that Article, Member States shall ensure that the rights, conditions and procedures concerning rights of use may only be amended in objectively justified cases and in a proportionate manner, taking into consideration, where appropriate, the specific conditions applicable to transferable rights of use for radio frequencies. To do so, notice shall be given in an appropriate manner of the intention to make such amendments and interested parties, including users and consumers, shall be allowed a sufficient period of time to express their views on the proposed amendments, which shall be no less than four weeks except in exceptional circumstances.

The costs of cross-border interference and coordination between WBB and DTT would be reduced as these agreements would be concluded by 2017, in line with a milestone that would be set in the legislative measure to prepare the way for using WBB by 2020. In addition cross-border interference *vis à vis* third countries would benefit from a common EU position as opposed to single Member States on their own in terms of external border coordination. Member States submitted a RSPG Opinion[38] that supports EU action in the form of a Decision of the European Parliament and the Council and a complementing Commission Implementing Decision describing the technical conditions for the use of the 700MHz band.

The scale of these impacts may vary considerably across Member States depending on the country topology, DTT portfolio as well as network parameters. This diversity represents a challenge to the coordinated release of the 700MHz band. Given the varied importance of DTT as a television delivery platform as well as its network topology in different Member States, the Commission study on the Socio-economic impact of repurposing the 700MHz band organised Member States into groups representing a certain topology for the assessment of transition costs (*Figure 38*).

Restacking cannot accommodate about 20% of the current channels, so the assumption is that broadcasters will opt for upgrading to more efficient technologies which also enables them to better compete with other platforms. The total minimum and maximum costs for the three groups of affected stakeholders (broadcasters, audio PMSE and DTT users) are listed for both MPEG4 and HEVC upgrades with minimum and maximum values depending on the cost assumption for each transmitter (*Figure 40*) in Annex 10.5.7).

Figure 13 – Estimated total costs of clearing the 700 MHz band with upgrade to DVB-T2/HEVC and DVB-T2/MPEG4 in EU 28 (€ million)

	DVB-T2/HEVC		DVB-T2/MPEG4	
Date	Min	Max	Min	Max
2020	2258	2461	1423	1704
2021	1866	2069	1284	1565
2022	1562	1765	1168	1449

Source: LS telcom & VVA

6.2.2. Reservation of the sub-700 MHz frequency band for DTT and PMSE

The protection of the DTT platform in the sub-700MHz band would safeguard and sustain the current European audiovisual model in countries relying on the DTT platform for such purposes by providing regulatory certainty as to the availability and location of spectrum for broadcasting services. This would accelerate network investment to update broadcasting technologies while promoting research and innovation on new means of audiovisual content distribution. The upgrade to more spectrum

[38] http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG15-595_final-RSPG_opinion_UHF.pdf

efficient technologies estimated in the section above will densify broadcasting networks in the sub-700 MHz band resulting in less 'white spaces' available for wireless audio PMSE. These users will encounter more difficulties in accessing spectrum; an exact estimate of the costs generated by this is not possible as it depends on which equipment is being used on which frequency and the intensity of use at a specific time and location (this varies widely for PMSE). As detailed in Annex 10.3, Commission Decision 2014/641/EU obliges Member States to make available at least 59 MHz for PMSE (in different ranges, also outside the UHF band). This constitutes a baseline across Europe. In case of higher national demand a Member State could also reserve spectrum for PMSE in the sub-700 MHz band, subject to national rules.

Given the cross-border nature of radio spectrum, reserving the sub-700MHz band for DTT services means that Member States less dependent on the DTT platform will be prevented from using this spectrum for the roll-out of next generation WBB networks that can create the conditions for the provision of IoT and other innovative services, including social and public service innovation.

Non-linear TV is increasing fast. Indeed, more and more audiovisual content is being consumed through platforms other than linear television[39]; streaming video is growing strongly, primarily driven by over-the-top (OTT) providers like YouTube and Netflix. This is confirmed by the increasing number of commercial agreements between non-linear streaming content providers and telecom operators which contribute to accelerating the distribution of OTT streaming services (*Figure 28*).

Despite the growth of mobile viewing, linear TV generally remains the predominant means of viewing audiovisual content with over 80% of viewing time in the EU Big 5[40] still dedicated to linear TV (*Figure 25*). EU citizens choose to watch linear television in spite of the increasing alternatives; pre-scheduled content thus appears to have inherent value for them. At the same time demand for linear TV is declining in some Member States[41].

Around 125 million European households in 2014 received television channels via the DTT platform. About half of these only have DTT technology[42] with no additional services from other platforms. Promoting freedom of choice and expression, cultural diversity and media pluralism is not intrinsically linked to the terrestrial TV platform but in some Member States DTT is currently the only platform supporting these general policy objectives whereas in others these are fulfilled through obligations imposed on cable and satellite platforms. Despite the competitive role of alternative platforms in the distribution of audiovisual content, the number of DTT households is forecast to remain stable until 2020 in the European Member States (IHS Technology, 2015).

6.3. Option 3 – Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020 and coordinated designation of the sub-700MHz band for flexible use for audiovisual and wireless broadband services [in downlink-only mode], according to national demand.

6.3.1. Coordinated designation and authorisation of the 700MHz band for wireless broadband by 2020

The socio-economic impact of the designation and authorization of the 700MHz band is the same as the one assessed in Option 2.

[39] Linear TV is intended here as the mass distribution of scheduled programs
[40] EU 'Big 5' are France, Germany, Italy, Spain and United Kingdom
[41] http://www.telecompaper.com/news/linear-tv-falls-to-39-of-total-video-viewing-time--1100112 organised a survey through their Dutch consumer panel which is likely to have some inherent bias towards younger, more Internet friendly consumers and which shows 61% of viewing time goes to non-linear content
[42] IHS Technology

6.3.2. Flexibility approach to the sub-700MHz band

In Option 3, the 'flexibility approach' allows for the co-existence of DTT and WBB services in downlink-only mode, which sufficiently mitigates interference with DTT thus allowing remaining DTT services in a country and along its borders to operate effectively. Cross-border coordination ensures that DTT broadcasting services in border territories will not be disrupted by WBB services in neighbouring countries

Option 3 enables Member States to decide on the use of the sub-700MHz band. They could maintain the current DTT services or deploy (some) downlink-only WBB services, according to their national circumstances. A combination of WBB services in downlink-only mode and/or DTT services will be provided in the sub-700MHz band depending on the economic viability and social acceptance in each Member State. For Member States that decide to lighten if not lift current technology or service restrictions on the use of the sub-700MHz band they will be asked to align to harmonized technical parameters of use of the sub-700MHz band, detailed in a Commission Implementing Decision[43], to avoid divergent approaches at national level and, therefore, the risk of interference. By allowing Member States the flexibility to decide the best designation of the sub-700MHz band the positive economic impacts are maximised and the negative social impacts are minimised.

This Option will not only give priority to DTT services and thus ensure a continuing future for terrestrial television delivery where needed but will also potentially enable mobile operators to increase their downlink capacity to respond to consumer demand where the spectrum is available (by acquiring new spectrum or leasing it from current right-holders). Downlink and uplink speeds and traffic are asymmetric with a greater need for downlink than uplink capacity mainly due to increasing video and app-based mobile use (*Figure 22*-24). Audio PMSE users will encounter more difficulties in accessing 'white spaces' due to the densification of DTT networks. A cost benefit analysis of this flexibility cannot be calculated as it will depend on the individual Member States' decisions. Member States take the view in the RSPG opinion that there is a need to have technically appropriate and sufficient spectrum for PMSE and consider that depending on developments and requirements of such services, there could be a need to identify additional spectrum. The RSPG recommends that the PMSE industry develops more advanced and spectrum efficient technologies.

The Lamy Report and the RSPG support this Option as it would provide both flexibility and certainty. The flexibility allows Member States to introduce different WBB services in the sub-700MHz if compatible with broadcasting needs. Certainty (in terms of frequency resources for DTT) will be provided in Member States that would rather use the sub-700MHz band for broadcasting services and audio PMSE in white spaces. In promoting DTT and WBB co-existence, this Option would also pave the way for converged and innovative broadband-broadcasting services in the longer term when such technology matures.

In addition, this Option foresees an obligatory market evaluation by 2025. The Commission, in cooperation with the Member States, will carry out an assessment on the developments relating to the use of the sub-700MHz band taking into account social, economic, cultural and technological aspects; the outcome would determine whether any regulatory changes are needed. The Lamy Report advocates a more efficient and flexible approach to radio-spectrum management so that, as far as possible, market forces and technological innovation determine the optimal use of spectrum, with a view to optimising economic benefits. This evaluation was broadly supported by respondents to the Lamy Report public consultation (Annex 10.2.3).

[43] Following the harmonisation of the 700MHz band, the Commission will trigger the process to adopt a future Commission Implementing Decision specifying the technical framework to allow a flexible use of the sub-700MHz band. Such an Implementing Decision would still require a mandate to CEPT, pursuant to the Radio Spectrum Decision (2002/676/EC).

6.4. Option 4 – Coordinated designation and authorisation of the whole UHF broadcasting band for wireless broadband services by 2020.

Option 4 would provide mobile operators with the entire UHF band to roll-out next generation networks (LTE technology) to provide new and innovative services. Harmonised coverage obligations as envisaged in Option 2 would be extended to the additional sub-700MHz band thus providing extensive coverage and indoor penetration for wireless broadband. The target of 1200 MHz for WBB set by the RSPP would be exceeded contrary to the Commission's 2014 conclusion that "there is currently no need for additional spectrum harmonisation, beyond the 1200 MHz target, in the range 400 MHz-6 GHz for licensed wireless broadband"[44]. The Commission launched a public consultation in September 2015 to look into the needs for Internet speed and quality beyond 2020[45]. Option 4 would include the harmonisation of the technical conditions allowing the provision of WBB services across the Union and thus create a single EU-wide market for network roll-out and equipment. Even though this Option makes available the entire UHF band, for the purpose of estimating costs and benefits, the Commission still considers the 700 MHz band as a separate portion to the sub-700MHz because:

- the technical parameters of the band plan and of devices are not available;
- there is no global harmonization of the sub-700MHz;
- the additional needs for WBB are currently being evaluated by the Commission

Therefore, it is not currently possible to quantify the benefits of releasing the sub-700MHz for WBB.

Allowing both downlink and uplink wireless broadband services in the sub-700MHz band is not compatible with current DTT services. DTT services will not be protected in Option 4, so de-facto they will be unable to operate in the UHF band as of 2020. The release of the whole UHF band to wireless broadband would be likely to have significant impacts on the structure of the broadcasting market in some Member States. DTT could operate in the VHF band (e.g. in Finland)[46] but this band only offers 56 MHz of spectrum, it is already used for digital radio[47] in many Member States and TV antennas are not currently adapted to transmit on this band.

The audiovisual content (including pay-tv channels only distributed on this platform) would be distributed across the available alternative platforms. This might include innovative distribution channels such as LTE broadcasting or OTT (internet) distribution. These could stimulate cultural diversity by providing opportunities for new forms of cultural expression such as interactive content platforms (Youtube, Vimeo, etc.) but there may be a risk of a diminished offer and content prioritisation as operators tend to promote content on a purely commercial basis (Annex 10.5.3). The imposition of legal compulsory must carry obligations, requiring innovative platforms to provide content, could mitigate this risk and best-efforts on internet distribution and other measures to ensure quality of service would provide optimal conditions to facilitate their emergence.

Option 4 does not entail any network transition costs since broadcasting towers will still be used for radio and mobile network operators will mainly reuse their existing infrastructure to deploy services on the additional spectrum. Broadcasting network operators (in some countries separate from the TV distribution) will experience lower returns as their infrastructure will be used only to transmit radio signals. Also, the costs of cross-border interference and coordination between WBB and DTT would only arise *vis-à-vis* third countries as per the GE06 agreement. Option 4 implies large costs for audio

[44] Commission Report COM(2014)536 on the Radio Spectrum Inventory
[45] https://ec.europa.eu/eusurvey/runner/InternetConnectivitySurvey
[46] According to information collected in the RSPG Report on "Spectrum for Wireless Broadband and Broadcasting in the Frequency Range 400 MHz to 6 GHz" (RSPG13-522, pp.24), 4 Member States use the VHF broadcasting band III for DTT while the band is used mostly for Digital Audio Broadcasting.
[47] WorldDAB indicated that Digital Audio Broadcasting services are on air in Band III (174-230 MHz) in Belgium, Denmark, France, Germany, Ireland, Italy, Netherlands, Poland, Spain, Sweden, and the UK.

PMSE users. The Commission study estimates that PMSE costs for a transition by 2020 will amount to 667 million euro. PMSE users may be able to use the duplex gaps between uplink and downlink WBB but it is uncertain how much spectrum would be available and whether that would allow for their average daily operations in the UHF band and how Member States would tackle spectrum requirements for extraordinary events.

Finally, Option 4 will generate costs related to the loss of the DTT sector as a whole and the strong pressure on audio PMSE users. It is not possible to estimate these costs but they would include the loss or drastic change of business plan of current DTT broadcasters as well as the related job losses.

Citizens would experience better coverage and better quality of innovative services provided by mobile operators. On the other hand they will see their TV choice reduced by one platform. Those currently using DTT as their only TV platform (some DTT households already view television via another platform in addition to DTT) will have to migrate to alternative platforms: satellite, cable, IPTV or to innovative distribution models. Migrating to an alternative platform (satellite or cable) might imply costs up to 9 billion euro depending on the platform (when available) and the equipment (Annex 10.5.8).

Depending on the Member State and specific location of the viewer, a number of issues might arise with alternative platforms for the provision of audio-visual services:

- Satellite networks use higher frequency spectrum than DTT and allow high data rates which eliminates the trade-off between numbers of channels, and higher audio and video quality than DTT. Its coverage is 100% but viewers might experience reception issues in densely populated urban areas (because of obstacles preventing the dish to receive the signal) and in the very northern part of Europe (i.e. northern parts of Finland and Sweden). Although a number of free-to-air satellite channels are available, some households may prefer to subscribe to pay-tv services;
- The cable platform is not available in all EU countries and does not typically cover remote areas;
- Some questions remain about the resilience of wireless broadband infrastructure and its capacity to ensure a high-quality viewing experience. According to Ofcom's paper on the Future of Free to View TV (2014), significant challenges need to be overcome in order for WBB networks to be able to offer consumers a viewing experience comparable with DTT networks;
- Mobile networks do not currently offer the same levels of coverage, network reliability and robustness as DTT, even if their potential in this regard is steadily growing.

This Option was not envisaged in the Lamy Report. The RSPG Opinion did consider it and noted that the introduction of uplink would require ITU Region1-wide agreement to synchronise different implementations and transition periods in these countries. The RSPG Opinion concluded that it would be too challenging to agree on all the technical elements necessary to set up both cross-border bilateral and multilateral agreements with EU and non-EU countries and therefore did not prefer this Option.

7. Comparison of options

For the comparison of the efficiency of options in Figure 11 we assumed that broadcasting transition costs were related to more efficient technologies (DVB-T2 with MPEG4 or HEVC) because restacking cannot accommodate the entire current DTT offer in terms of channels and quality. Figure 11 also provides the costs for PMSE users and consumer equipment cost is assumed to be related to primary DTT households as other DTT households would already be viewing content from an alternative TV platform.

The Commission considers that Option 3 best fulfills the policy objectives. On one hand, a full-scale repurposing as envisaged in Option 4 is not currently considered appropriate as DTT still has an important role in many Member States. On the other hand, in light of the evolving trends of consumer viewing of audiovisual content, Option 3 provides the supplemental downlink flexibility and thus an opportunity for innovative platform development. This 'flexibility option' safeguards the interest of both DTT and WBB services in the sub-700MHz band – it would enable the creation of an innovation ecosystem for both of them. The positive economic impacts would be maximized and the negative social impacts minimized. Even though the cost of transition is lower for later dates, the timely availability of the 700MHz band for WBB will benefit SMEs by promoting investment in connectivity to enable a range of new and innovative services and business models and will address the interference problems likely to arise as Member States decide to assign this spectrum to WBB. The 2020 timing is appropriate as it would enable IoT applications in the context of 5G deployment expected to commence in 2020.

Option 3 offers optimal legal conditions for traditional broadcasting services to co-exist with wireless broadband services in downlink-only mode provided that continued access to spectrum for terrestrial broadcasting as a primary user is guaranteed on the basis of national demand.

This option aims to improve the conditions for the establishment and functioning of the DSM. In line with the Radio Spectrum Decision (676/2002/EC) and the RSPP (243/2012/EU) objectives, this policy option proposes a sustainable and balanced solution to achieve the DAE goals on broadband access and audiovisual policy (i.e. cultural diversity and creative content) in the UHF band. Releasing the 700 MHz band for wireless broadband (with additional carrier aggregation along with the 800MHz[48] and 900MHz[49] band) offers unique capabilities to provide sufficient coverage in rural areas and offer in-building penetration in urban areas.

Option 3 is the best option in terms of subsidiarity and proportionality. The subsidiarity principle is respected because the initiative's objectives could not be achieved by Member States individually (as detailed in section 2) while at the same time allowing national circumstances (in the sub-700MHz band) to be taken into account. The flexible use of the sub-700MHz band is proportionate since it addresses the problem and achieves the objectives in the most efficient way. Clearing the whole sub-700MHz band for WBB, as envisaged in Option 4, would go beyond what is currently necessary to satisfy the demand for sub-1GHz spectrum needed to meet mobile traffic demand.

At the same time, Option 3 provides regulatory certainty for DTT in the sub-700MHz band for those Member States that wish to maintain their current sub-700MHz DTT capacity.

A timely and coordinated clearance of the 700MHz band in the EU will reap the full economic benefits of mobile broadband connectivity in the EU by maximizing economies of scale and reducing operating costs. It is essential that the 700MHz band is made available for WBB within a relatively short and synchronised time window to ensure the right incentives for rapid network roll-outs.

The preferred option, in line with the Lamy report recommendation, is that by 2020 spectrum needs to be assigned to mobile networks. This does not happen overnight - in some Member States complex reallocation procedures will have to be put in place. Past experience with 3G and 4G in the 800 MHz band has shown that this might take more than 24 months.

The Commission has identified that the following operational objectives of the preferred option are:

[48] Decision 2010/267/EU on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union

[49] Decision 2009/766/EC on the harmonisation of the 900 MHz and 1 800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community amended by Decision 2011/251/EU

- Allocate 60MHz[50] of additional harmonised spectrum in the 700MHz band towards the 1200 MHz target;
- Contribute to the achievement of DAE broadband targets by 2020 through encouraging Member States to include coverage obligations in 700MHz licenses;
- Ensure cross-border frequency coordination agreements within the Union as well as with non-Union countries by 2017.

In summary, Option 3 will:

- Provide additional EU harmonised spectrum to meet growing mobile traffic demand by 2020;
- Contribute to DSM connectivity objectives and DAE broadband targets;
- Reduce fragmentation of UHF band use and prevent interference between WBB and DTT services;
- Facilitate market transformation towards more efficient technologies;
- Adapt to new forms of audiovisual consumption while sustaining the current free-to-view model;
- Allow Member States to choose whether to use (part of) the sub-700MHz for uses other than DTT and audio PMSE, under certain conditions.

Article 6 of Decision 243/2012/EU establishing a multiannual radio spectrum policy programme (RSPP) provides that Member States may, where appropriate and in conformity with Union law (in particular with Union State aid law), ensure that the direct cost of migration or reallocation of spectrum usage is adequately compensated in accordance with national law. Some Member States have already asked for guidance on cost compensation compatibility with EU State aid law (i.e. in the RSPG Opinion). On the basis on their national law, Member States may consider the adoption of appropriate, necessary, proportionate and technologically neutral cost compensation measures to mitigate the impact on consumers (households), PMSE users[51] as well as to ensure the continuity of broadcasting services. When considering such measures, in particular for broadcasters with running DTT licenses, Member States must comply with the principle of technological neutrality and take into account the relevant decision practice of the Commission in the area of State aid[52] as well as the related case law of the EU Courts[53]. In some instances, measures adopted to compensate for the

[50] N.B.: 60 MHz is the maximum amount that can be made available in the band 694-790 MHz due to technical reasons, including compatibility with a worldwide channelling arrangement that generates high economies of scale.

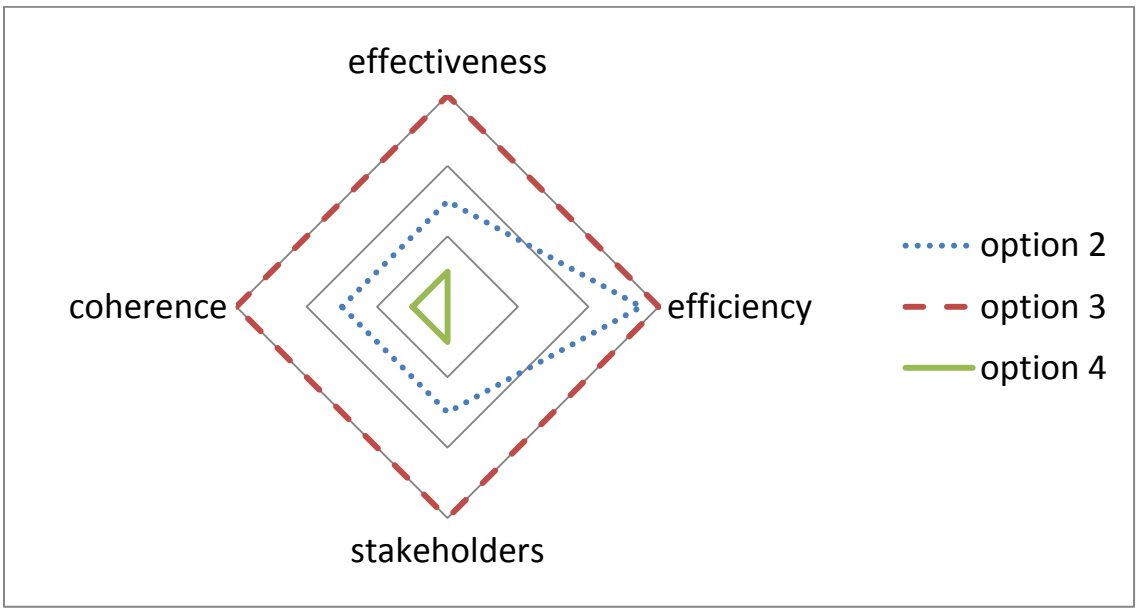
[51] The Commission approved state aid in several decisions. See, among others, N622/03 Digitalisierungsfonds – Austria, OJ C 228, 17.9.2005; C25/04 Introduction of digital terrestrial television (DVB-T) in Berlin-Brandenburg – Germany, OJ L 200, 22.7.2006; C24/04 Digital terrestrial television in Sweden, OJ L 112, 30.4.2007; C52/05 Digital decoders in Italy, OJ L 147, 8.6.2007; N270/06 Subsidies to digital decoders with API – Italy, OJ C 80, 13.4.2007; N107/07 Subsidies to IdTV – Italy, OJ C 246, 20.10.2007; C34/06 Introduction of digital terrestrial television (DVB-T) in North Rhine-Westphalia, OJ L 236, 3.9.2008; SA.28685 Captación de Televisión Digital en Cantabria – Spain, OJ C 119, 24.4.2012; N671b/2009 – Digital switch-over in Slovakia, OJ C 39, 8.2.2011.

[52] State aid C 25/2004, DVB-T Berlin Brandenburg; State aid C 52/2005, Digital decoders; planned Commission decision for January 2016 on State aid SA.32619 notified by the Kingdom of Spain for the compensation of damages for the liberation of digital dividend.

[53] Case ECJ, C-222/04 of 10 January 2006, *Cassa di Risparmio di Firenze*, para. 131; Case ECJ, C-126/01 of 20 November 2003, *GEMO SA*, para. 28; Case ECJ, C-53/00 of 22 November 2001, *Ferring SA*, paras. 19 ff; Case ECJ, C-143/99 of 8 November 2001, *Adria-Wien Pipeline*, para 38; Case ECJ, C-310/99, *Italy v. Commission*, para 251; Case ECJ, T-109/01 of 14 January 2004, *Fleuren Compost BV v. Commission*, para. 54; Case ECJ, C-251/97 of 5 October 1999, *France v. Commission*, para. 40. Case GC, T-177/07 of 15 June 2010, *Mediaset v. Commission*, case ECJ, C-403/10 P of 28 July 2011, *Mediaset v. Commission*. GC Case T-21/06 of 6 October 2009, *Germany v. Commisssion* concerning DVB-T – Berlin/Brandebourg, GC Cases T-461/13 Spain v. Commission, T-462/13 *Basque Country and Itelazpi v. Commission*, T-463/13 and T-464/13 *Galicia v. Commission and Retegal v. Commission*, T-465/13 *Catalonia and CTTI v. Commission*, T-487/13 *Navarra v. Commission* and finally T-541/13 *Abertis Telecom and Retevisión v. Commission.*

withdrawal of rights, where such compensation does not exceed the prejudice generated by the withdrawal, could be in certain circumstances consistent with Union State aid law.

Figure 14 – Comparison of options across all dimensions considered



The scope of the legal approach would be different for the 700MHz and sub-700MHz bands. The EU strategy for UHF band should therefore comprise four major elements:

i. harmonised technical conditions for WBB in the 694-790 ('700') MHz band via a Commission Implementing Decision. This Implementing Decision will contain the channelling arrangements for 2x30 MHz of spectrum for wireless broadband (global alignment for economies of scale), guard bands for protect services in neighbouring frequency bands, and four options for using the so-called centre gap (25 MHz) for either PMSE, supplemental WBB downlink, Public Protection and Disaster Relief or Machine to Machine Communications, depending on national demand. Any of these services would contribute to achieving a priority mentioned in the RSPP.

In addition, a Decision of the European Parliament and the Council will

ii. establish a binding, common deadline to ensure the assignment and effective use of 700MHz for WBB services across the Union as well as measures for coordinating this transition while promoting coverage obligations;

iii. introduce a flexible approach whereby Member States can choose a shared use of the sub-700MHz band for TV broadcasting and WBB services (downlink-only) according to national circumstances, provided there is no interference with DTT-using Member States and priority is given to audiovisual services distribution;

iv. mandate an evaluation of the proposed UHF legal measure no later than 1 January 2025 that will enable the Commission and Member States to re-assess developments and adjust the EU strategy, if necessary.

This solution would give legal certainty for providers of audiovisual services to mass audiences while enabling co-existence of wireless broadband technologies (downlink-only) where possible.

Figure 15 - Comparison of options: effectiveness, efficiency, stakeholder views and coherence

Option	Effectiveness versus objectives *(- negative; 0 neutral; +positive)*	Efficiency (million €)	Stakeholders' views *(- negative; 0 neutral; +positive)*	Coherence *(- negative; 0 neutral; +positive)*
Option 1 - Base line; no EU action	**(-)** No additional spectrum band harmonised at EU-level to meet mobile traffic demand Does not contribute to DAE broadband targets and DSM connectivity objectives Increased UHF band fragmentation : potential interference between WBB and DTT and lack of economies of scale Does not facilitate market transformation towards more efficient technologies	0	**(-)** Vast majority of respondents to Lamy Report Public Consultation support a coordinated approach to repurpose the 700 MHz Member States support a coordinated approach to repurpose the 700 MHz	**(-)** Will not help to fulfil RSPP Art. 9 goal to 'identify 1200 MHz of spectrum for wireless broadband by 2020'. Will not fulfil DAE target 30 Mbps broadband coverage by 2020
Option 2 – Coordinated repurpose of the 700 MHz band for WBB and reservation of the sub-700 for DTT and audio PMSE	**(+) 700MHz** Additional EU harmonised spectrum to meet mobile traffic demand by 2020 Contributes to DAE broadband targets and DSM connectivity objectives Reduces fragmentation of UHF band use and prevents WBB and DTT interference Facilitates market transformation towards more efficient technologies Reduced availability of 'white spaces' for audio PMSE use	Mobile 11400 Broadcasters: -659 (HEVC) -888 (MPEG4) PMSE -200 Consumer equipment: -616 (MPEG4) -1602 (HEVC) TOT: 8939 (HEVC) 9696 (MPEG4)	**(+) 700MHz** Vast majority of respondents support a coordinated approach to repurpose the 700 MHz band but with no consensus on a single date (see Annex 10.2.3). Some national broadcasters prefer to leave the timeframe to national discretion. Member States support a coordinated approach to repurpose the 700 MHz band as reported in RSPG Opinion and RSC.	**(+) 700MHz** Will contribute to RSPP Art. 9 'identify 1200 MHz of spectrum for wireless broadband by 2020'. Will fulfil DAE target of 30 Mbps broadband coverage by 2020 Decision 2014/641/EU guaranteed a baseline of available spectrum for audio PMSE equipment

	(0) sub-700MHz Prevents Member States from using the sub-700MHz for uses other than DTT and audio PMSE Safeguards and sustains current audiovisual model		**(0) sub-700MHz** Supported by broadcasters and content production industries in the Lamy Report public consultation Rejected by mobile network operators in the Lamy Report Public Consultation	**(-) sub-700MHz** Will prevent some MS from starting to introduce innovative wireless services
Option 3 – Coordinated release of the 700 MHz band and coordinated designation of the sub-700 for flexible use for audiovisual and WBB services	**(+) 700MHz** Additional spectrum band harmonised at EU-level to meet mobile traffic demand Contributes to DAE broadband targets and DSM connectivity objectives Reduces fragmentation of UHF band use and prevents interference between WBB and DTT Facilitate market transformation towards more efficient technologies Reduced availability of 'white spaces' for audio PMSE use	Mobile 11400 Broadcasters: -659 (HEVC) -888 (MPEG4) PMSE -200 Consumer equipment: -616 (MPEG4) -1602 (HEVC) TOT: 8939 (HEVC) 9696 (MPEG4)	**(+) 700MHz** Vast majority of respondents support a coordinated approach to repurpose the 700 MHz with no consensus on a single date (see Annex 10.2.3). Member States support a coordinated approach to repurpose the 700 MHz as reported in RSPG Opinion and RSC.	**(+) 700MHz** Will contribute to RSPP Art. 9 'identify 1200 MHz of spectrum for wireless broadband by 2020'. Will fulfil DAE target 30 Mbps broadband coverage by 2020 Decision 2014/641/EU guaranteed a baseline of available spectrum for audio PMSE equipment
	(+) sub-700MHz Allows Member States to choose whether to use the sub-700MHz for uses other than DTT and audio PMSE Safeguards and sustains current audiovisual model, including neighbouring countries' DTT	Value of supplemental downlink capacity	**(+) sub-700MHz** The flexible use of the sub-700MHz is subject to diverging opinions of respondents The flexible approach is envisaged in the Lamy Report and supported by mobile and broadcasting vendors, other stakeholders remain cautious until it is more clearly defined Member States support the flexible use of the sub-700MHz (RSPG Opinion)	**(+) sub-700MHz** Proportional measure that accommodates the different current situations in Member States Coherent with EU Audiovisual Media Services Directive

Option 4 – Coordinated repurpose of the UHF band (700 MHz band and sub-700) for WBB	**(+) 700MHz** Additional spectrum band harmonised at EU-level to meet mobile traffic demand Contributes to DAE broadband targets and DSM connectivity objectives Reduces fragmentation of UHF band use and prevents interference between WBB and DTT Facilitate market transformation towards more efficient technologies Reduced availability of 'white spaces' for audio PMSE use	Mobile 11400	**(+) 700MHz** Vast majority of respondents support a coordinated approach to repurpose the 700 MHz Member States support a coordinated approach to repurpose the 700 MHz band.	**(+) 700MHz** Will contribute to RSPP Art. 9 goal to 'identify 1200 MHz of spectrum for wireless broadband by 2020'. Will fulfil DAE target 30 Mbps broadband coverage by 2020 Decision 2014/641/EU guaranteed a baseline of available spectrum for audio PMSE equipment
	(0) sub-700MHz Further EU harmonised spectrum to meet mobile traffic demand by 2020 Does not safeguard and sustain current audiovisual model Reduced availability of 'white spaces' for audio PMSE use	Additional value to mobile operators PMSE -667 Broadcast distribution: 0 Consumer equipment: -9000 Reduced return on broadcast infrastructure End of DTT sector	**(0) sub-700MHz** Supported by mobile network operators Rejected by broadcasters and content production industries Option discarded by the Member States (RSPG Opinion)	**(0) sub-700MHz** Overachieves RSPP objective of 1200 MHz Does not safeguard and sustain current audiovisual model Decision 2014/641/EU guaranteed a baseline of available spectrum for audio PMSE equipment

8. Monitoring and evaluation

From the experience of a similar initiative, i.e. the release of the 800 MHz band, the Commission has identified some aspects that can be improved: a longer deadline, intermediate milestones and a better degree of assurance as to what will happen with the rest of the UHF band. The Commission has identified the following milestones that need to be reached to ensure a coordinated release of the 700 MHz band. These measures should provide an additional EU route that will facilitate MS to meet the final transition deadline:

- Adopt a national transition plan no later than mid-2017 to promote a timely and synchronised time window for700MHz band release
- Finish cross-border frequency coordination agreements within the Union as well as with non-Union countries no later than December 2017[54]
- Allow the effective use of the 700MHz band (694-790MHz) for electronic communications services by 30 June 2020
- Establish regulatory certainty and flexibility in spectrum use of the sub-700 MHz band to match Member State diversity in DTT penetration
- Evaluation to assess market developments regarding the usage of the sub-700MHz band (470-694MHz) no later than 2025 and adapt the regulatory framework as appropriate.

The table below outlines the indicators of progress that will be monitored by the Commission Services to evaluate whether the objectives of this initiative are being met. The indicators will be monitored through various sources including the Commission's missions in Member States and permanent dialogues with National Authorities.

Figure 16 - Monitoring indicators by policy objective

Policy objective	Monitoring indicators
Avoid interference between WBB and DTT via a coordinated release of the 700MHz band for WBB	Number of Member States that have adopted and communicated a transition roadmap by 30 June 2017
	Number of Member States that have concluded their cross-border frequency coordination agreements by 31 December 2017
	Number of compliant national transition roadmaps which must, if relevant, include: i) national frequency planning; ii) follow-up on the authorization of DTT licenses; iii) measures to facilitate the timely availability of interoperable television broadcasting network equipment and receivers iv) any national compensation measures
Promote DSM connectivity/coverage through wider use of sub-1 GHz spectrum	Number of 700MHz licenses to be issued nationally to mobile operators that include coverage obligations
Secure the public interest and consumer benefits on the UHF band while facilitating market	Number of sub-700MHz licenses issued to provide wireless broadband services that follow the

[54] According to the RSPG opinion on 'Long-term strategy on the future use of UHF band in the European Union', all necessary cross-border coordination agreements, including transitional agreements, need to be finalized by the end of 2017 at the latest.

transformation	technical parameters needed to protect DTT in cross-border territories.
	RSPG focus discussions on the technological progress of video technologies, audio PMSE Strategy that will reserve core assets (spectrum bands) in the UHF and steer the debate to prepare the market review in 2025
	European Commission, in cooperation with Member States, will report to Council and the Parliament on the usage of the sub-700MHz band in the Union

Option 2 and the preferred Option 3 include an evaluation no later than 1 January 2025, This will allow a reappraisal of the benefits of further policy adjustments in the sub-700MHz band if market and technological developments warrant. The 2025 evaluation will help the Commission to assess the performance of the EU intervention and whether it delivers, at a minimum cost, the desired EU goals described in section 4.

This evaluation will provide a key opportunity to engaged stakeholders to continue providing feedback on EU interventions and an independent judgment of the situation based on the evidence available[55]. According to stakeholders that participated to the Lamy Report public consultation, the scope of the evaluation should include at least:

i. consumption trends and patterns of audiovisual content;
ii. technology and market developments including platform competition and efficiency, growth and demand for WBB;
iii. regulatory requirements to guarantee access to critical resources and public service needs including coverage obligations.

[55] All respondents to the Lamy Report Public Consultation agreed on the need to undertake a market Review (see Annex 10.2.3).

9. BIBLIOGRAPHY

Aetha Consulting. (2012). *Case studies for the award of 700 MHz / 800 MHz band: Germany.*

Aetha Consulting. (2014). *Future use of the 470-694 MHz band.*

Ala-Fossi, M., & Bonet, M. (2015). Clearing skies? The sudden rise of new European spectrum policy and future challenges for DTT in Finland and Spain. *FACE Conference.* Helsinki.

Analysys Mason. (2013). *Analysis of technology trends, future needs and demand for spectrum in line with Art.9 of the RSPP : final report.*

Analysys Mason, DotEcon and Hogan & Hartson. (2009). *Exploiting the digital dividend - a European approach.*

Bazelon, C., & McHenry, G. (2013). Spectrum value. *Telecommunications Policy 37*, 737-747.

CEPT Report 53(A). (November 2014). *to the European Commission in response to the Mandat"To develop harmonised technical conditions for the 694-790 MHz ('700 MHz') frequency band in the EU for the provision of wireless broadband and other uses in support of EU spectrum policy objectives".*

Chauhan, S. (s.d.). Environmental and health hazards of mobile devices and wireless communication. *Mobile Computer Systems (CSE 6392)*.

CISCO. (2015). *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019.*

Collins, R. (2014). *Television, cohesion and the EU. The Palgrave Handbook of European Media Policy.* (C. P. Karen Donders, Éd.) Palgrave.

Crusafon, C. (2015). *The European Audiovisual Space: How European Media Policy has set the pace of its development European Cinema and Television. Cultural Policy and Everyday Life.* (I. B. Eva Novrup Redvall, Éd.) Palgrave.

Delgado. (2015). Reallocating 700 MHz band: should we do it? *Info*, col 17, pp: 9-21.

d'Haenens, L., & Bink, S. (2001). Digital Convergence The Development of a New Media Market in Europe. Dans L. d'Haenens, & F. Saeys (Éds.), *Western Broadcasting at the Dawn of the 21st Century* (pp. 124-145). Ney York Berlin: Mouton de Gruyter.

Digitag & Analysys Mason. (2014). *Roadmap for the evolution of DTT - a bright future for TV.*

Digital Europe. (2014). *White paper on supplemental downlink in the UHF band.* Brussels.

Donders, K. (2012). *Public Service Media and Policy in Europe.* Palgrave Macmillan.

Ericsson. (2014). *Ericsson Mobility Report.*

ESPON. (Version 23/03/2012). *European Perspective.*

Eurobarometer. (2012). *MEDIA USE IN THE EUROPEAN UNION.* European Commission.

Eurobarometer. (2014). *E-COMMUNICATIONS AND TELECOM SINGLE MARKET HOUSEHOLD SURVEY.* Eurobarometer.

European Broadcasting Union. (2014, June). Assessment of the available options for the distribution of broadcast services.

European Broadcasting Union. (2014, March). Can DVB-T2 cope with spectrum shortage? *Tech-i*(19).

European Broadcasting Union. (2014, October). Technical Report 3348 Frequency and network planning aspects of DVB-T2.

European Commission. (2014). *Report to the Council and the Pariliament on the implementation of the Radio Spectrum Policy Program.* European Commission.

European Parliament . (2013). *The Challenges of Connected TV .*

European Parliament. (1982 February). *Hahn Report. Report on radio and television in the European Community.*

European Union. (2012, May 14). Decision 2012/243/EU of the European Parliament and of the Council establishing a multiannual radio spectrum policy programme.

European Union. (2015). *Digital Agenda for Europe*. Récupéré sur http://ec.europa.eu/digital-agenda/

European Union. (2015). *Wireless Europe*. Récupéré sur http://ec.europa.eu/digital-agenda/en/wireless-europe

European Union. (s.d.). EU public consultation on the Lamy Report.
Fierce Wireless Europe. (2015, July 10). *France kicks off 700-MHz spectrum auction*. Consulté le October 19, 2015, sur Fierce Wireless: http://www.fiercewireless.com/europe/story/france-kicks-700-mhz-spectrum-auction/2015-07-10
Fierce Wireless Europe. (2015, June 19). *German spectrum auction raises more than €5B*. Consulté le October 19, 2015, sur Fierce Wireless Europe: http://www.fiercewireless.com/europe/story/german-spectrum-auction-raises-more-5b/2015-06-19
Fishbein, B. (2002). Waste in the wireless world: the challenge of cell phones, the toxic content of cell phones and other electronic devices. INFORM Inc.
Frontier Economics. (2015). *A cost benefit analysis of the change in use of the 700 MHz radio frequency band in Ireland.* London.
Gartner. (2015, 11 10). Gartner Says 6.4 Billion Connected "Things" Will Be in Use in 2016, Up 30 Percent From 2015. *Newsroom*. Stamford, Connecticut, USA.
GSMA. (2012, 02 27). *GSMA*. Consulté le 10 08, 2015, sur GSMA Announces the Business Impact of Connected Devices could be Worth US$4.5 Trillion in 2020: http://www.gsma.com/newsroom/press-release/gsma-announces-the-business-impact-of-connected-devices-could-be-worth-us4-5-trillion-in-2020/
Harvey, S. (2015, 09 04). *Digital Dreams and opens skies: universal service and the BBC.* . Consulté le 10 26, 2015, sur Open Democracy.: https://www.opendemocracy.net/ourbeeb/sylvia-harvey/digital-dreams-and-open-skies-universal-service-and-bbc
Kea. (2010). *Promoting Investment in the Cultural and Creative.* ECCE Innovation – Nantes Métropole.
Lamy, P. (2014). *Results of the work of the High Level Group on the future use of the UHF band (470-790 MHz).*
Mansell, R. (2014). *Here comes the revolution – the European Digital Agenda. The Palgrave Handbook of European Media Policy.* (C. P. Karen Donders, Éd.) Palgrave.
Meabe, U., Gil, X., & Caiwai, I. (2015, June). On the coverage and cots of HPHT versus LPLT networks for rooftop, portable and mobile broadcast services delivery. *IEEE Transactions on Broadcasting., 61*(2).
(2009). *MEASURING THE ECONOMIC CONTRIBUTION.* UNESCO.
Mehta, A., & Musey, A. (2014). 'Overestimating Wireless Demand: Policy and Investment Implications of Upward Bias in Mobile Data Forecasts.
Mobile Broadcast Spectrum: A vital resource for the US Economy. (2015). CTI - The Wireless Association.
Nielsen. (2015). *Total audience report Q1 2015.*
NPD DisplaySearch. (2014, 06 11). *DisplaySearch*. Consulté le 10 08, 2015, sur Replacement TV Purchase Decisions Driven by Picture and Sound Quality Despite Introduction of New Features: http://www.displaysearch.com/cps/rde/xchg/displaysearch/hs.xsl/140611_replacement_tv_purchase_decisions_driven_by_picture_and_sound_quality.asp
OECD. (2013). *Communications Outlook.* OECD Publishing.
OECD. (2015). *Digital Economy Outlook.*
Pauwels, C., & Donders, K. (2011). *From Television without Frontiers to the Digital Big Bang. The EU's continuous efforts to create a Future-proof Internal Media Market. The Handbook of Global Media and Communication Policy.* . (M. R. Robin Mansell, Éd.)
PEW Research Center. (2015). *State of News Media.*
Plum & Farncombe. (2014, December). *Challenges and opportunities of broadcast-broadband convergence and its impact on spectrum and network use.*
Radio Spectrum Policy Group. (19 February 2015, June 13). *RSPG Opinion on a long-term strategy on the future use of the UHF band (470-790 MHz) in the European Union.*
Radio Spectrum Policy Group. (7 June 2013, June 7). *RSPG Report on proposed spectrum coordination approach for broadcasting in the case of a reallocation of the 700 MHz band.*

SKY Corporate. (s.d.). *Sky+ HD Box Environment Factsheet.*

Tadayoni, R., & Henten, A. (2013). *Has Digitization delivered? Fact and fiction in digital TV broadcasting. Handbook on the Digital Creative Economy.* (C. H. Ruth Towse, Éd.) Edward Elgar Publishing.

Telecom Paper. (2015, September 2). *Linear TV falls to 39% of total video viewing time* . Consulté le September 2015, sur Telecom Paper: http://www.telecompaper.com/news/linear-tv-falls-to-39-of-total-video-viewing-time--1100112

Valcke, P., & Ausloos, J. (s.d.). *Audiovisual Media Services 3.0: (Re) defining the scope of the European broadcasting law in a Converging and Connected media environment.* (C. P. Karen Donders, Éd.) 2014: Palgrave.

Valdani Vicari Associates. (2013). *Assessment of socio-economic aspects of spectrum harmonisation regarding wireless microphones and cordless video-cameras (PMSE equipment.*

Viola, C., Watson, J., & Sims, M. (2015). *The Prospects for LTE Broadcast.* Policy Tracker.

Waterman, D., Sherman, R., & Wook, S. (2013). The economics of online television: Industry development and aggregation, and TV everywhere. *Telecommunications Policy 37*, 725-736.

WIK-Consult. (2012). *Inventory and review of spectrum use: Assessment of the EU potential for improving spectrum efficiency.*

WikConsult and Aegis. (2013). *Impact of traffic off-loading and related technological trends on the demand for wireless broadband spectrum.*

10. ANNEXES

10.1. Annex: Procedural information

10.1.1. Identification

This Staff Working Paper was prepared by the unit B4 'Spectrum' of Directorate B 'Electronic Communications Networks and Services' of Directorate General 'Communications Networks, Content and Technology'. The RWP reference of this initiative is 2015/CNECT/017.

10.1.2. Organisation and timing

Other services of the Commission with a policy interest in the subject have been associated in the development of this analysis. The Impact Assessment Steering Group was drawn from the existing Spectrum Inter-Service Group. The Impact Assessment Steering Group met for the first time on 10 March 2015 to discuss the problem definition and the possible policy options as well as its preliminary impacts. During the first meeting B4 presented the tender specifications for the study on "Socio-economic impact of repurposing the 700MHz band for wireless broadband services in the EU".

A second Impact Assessment Steering Group meeting took place on 17 July during which the Commission services discussed the proposed options based on the results of the Lamy Report public consultation. Participants were also informed on the tender on the socio-economic impact of repurposing the 700MHz for wireless broadband that should support the IA.

A third Impact Assessment Steering Group took place on 23 September 2015 to discuss a draft of the impact assessment. Comments were received by 28 September 2015.

A fourth Impact Assessment Steering Group took place on 9th October 2015 to discuss a considerably revised version of the document.

Other units in DG CONNECT, as well as DG COMP, DG GROW, DG ENER, DG MOVE, HOME, JUST, EAC and Secretariat General provided their input and comments during the process.

10.1.3. Regulatory Scrutiny Board

This staff working document was discussed at the regulatory scrutiny board meeting of 25 November 2015.After the positive opinion of the Board, their recommendations have been addressed as follows.

RSB recommendation	**How is it addressed?**
C.1. Enhance the baseline scenario	A mapping of status-quo including the situation of different MSs has been added in section 2.1 (Figure 4), further reference to the starting point of MSs has been included in section 2.2. The baseline scenario has been enhanced in section 6.1 when explaining how the problem would evolve in option 1. Reference has been made to the international context including an updated reference to the outcome of WRC-15. Further explanation to the 2013 telecom package, 800 MHz Decision and the ongoing telecom review has also been included in section 2.1

		A better explanation to the benefits of economies of scale on a more illustrative and anecdotal way has been added in sections 2.1 and 6.2.1.
C.2. Strengthen the analysis of impacts	1. baseline	The problem definition has been updated with the most recent information available, in particular concerning France and Germany which have already auctioned the 700 MHz to mobile operators for WBB use and with regards to the current diversity in terms of DTT penetration and available alternative TV platforms. Option 1 has been clarified to explain what we think is likely to happen including the elements that we cannot predict.
	2. coordinated approach	Section 2.2.on how would the problem evolve without coordination has been fine-tuned and section 6.1. 'no EU action' has emphasized the negative impacts of such a lack of coordination.
	3. consumers	The impact on consumers has been made clearer in section 6.2.1. This section now includes two additional figures i) figure 7 on 4G coverage in Europe and ii) figure 9 on percentage of EU households with a mobile subscription giving access to the Internet have been inserted. Additional reference to consumers has been made in section 6.4
	4. PMSE	Section 6.2.1 now includes a reference to the proposed implementing decision on the 700 MHz that will allow MS to use part of the band for PMSE. Annex of SME Test dedicated to PMSE manufacturers and users has been modified accordingly.
	5.Environmental	Section 6 clearly states that there is no environmental impact linked to the replacement of DTT but to the electricity consumed by TV sets or set of boxes. This statement is based on available studies that conclude that most of the carbon footprint comes from customer use of the equipment rather than manufacturing,
	6. DTT licenses	A narrative on possible compensatory measures (possibly as a result of breaking the running DTT licenses) has been added in section 7.
D. Clarification of elements included in the Implementing Decision and Council Decision		Sections 3 and 7 clearly state and define the scope of the two legal instruments to be used to implement the EU intervention logic on the UHF broadcasting band.

10.1.4. Evidence

The options considered in this impact assessment were designed by taking into account the following main inputs:

(i) the Lamy report,

(ii) the contributions to the Pascal Lamy report public consultation,

(iii) the RSPG opinion on a long-term strategy on the future use of the UHF band,

(iv) a study on the 'Economic and Social Impact of Repurposing the700MHz band for Wireless Broadband Services in the European Union',

(v) a study on 'Challenges and opportunities of broadcast-broadband convergence and its impact on spectrum and network use'.

The sources are clearly indicated in the bibliography and range from academic papers to industry figures and estimates.

10.1.5. External expertise

The European Commission sought external expertise on the technical field as well as on the socio-economic impacts of possible uses of the UHF band.

The European Commission issued on 11 March 2013 a Mandate to the CEPT to develop harmonised technical conditions for the 694 -790 MHZ ('700 MHZ') frequency band in the EU for the provision of wireless broadband electronic communications services and other uses om support of EU spectrum policy priorities. The final report is expected in March 2016.

Beside the technical external expertise the Commission contracted a study on the 'Economic and social impact of repurposing the 700 MHz band for wireless broadband services in the European Union' (SMART 2015/010). The study was conducted by Valdani Vicari Associates (VVA) and LS telcom. Details of the study findings are provided in the technical sections, Annex 10.4 and 10.5 below.

10.2. Annex: Stakeholder consultation

10.2.1. High Level Group

The High Level Group (HLG) on the future use of the UHF band (470-790 MHz) was convened at the end of 2013 by the Vice President of the European Commission and Commissioner for the Digital Agenda Neelie Kroes. It comprised nineteen executive-level representatives from the mobile and broadcasting sectors, including the PMSE sector, under Pascal Lamy Chairmanship. The overarching objective laid down in the mandate of the Group was to deliver strategic advice to the Commission for the development of a European strategy on the future use of the UHF band including possibilities for sharing parts of the band.

The Group was asked to look at how Europe will access and use audiovisual content and data in the medium to long term and come up with options that respond to 4 separate challenges:

- What will next generation (terrestrial) provision/reception of audiovisual content (including linear TV) look like?
- How do we secure the public interest and consumer benefits while facilitating market transformation?
- What are the strategic elements of spectrum use in the UHF band in light of the first challenge? What would the regulatory role of the EU be in coordinating developments?
- What are the financial implications for a next-generation terrestrial platform for broadcasting and internet use?

10.2.2. The Lamy Report

The Lamy Report made two main recommendations:

1. The "2020-2030-2025" formula: the 700 MHz band should be vacated from DTT use by 2020 (+/- 2 years) and made available ('repurposed') for wireless broadband thus offering additional spectrum to mobile operators. The transition, if and when the band is repurposed, is a major challenge at national and EU level. The formula also foresees regulatory certainty for DTT in the spectrum below the 700 MHz band until 2030. The report recommends an evaluation by 2025 to re-assess developments and adjust the EU strategy, if necessary.
2. The "flexibility option" proposes downlink-only wireless broadband use of UHF broadcasting spectrum in the remaining portion below the 700 MHz band (in the band 470-694 MHz). Broadcasting use would always have priority, yet specific channels or locations not used for terrestrial broadcasting or PMSE could become available for downlink-only applications depending on national circumstances.

The report focused on a coordinated EU position in future World Radiocommunication Conferences to support the European framework. In particular, it proposed that the EU did not support the co-primary allocation of the 470-694 MHz band – which would remain the only spectrum available to DTT –to mobile services at the next WRC in 2015 (WRC-15). The Commission, with broad consensus from the Member States, and other countries worldwide (e.g. Russia, South American, African and Asian countries) did not support such action. Although, the proposal was not approved in Region 1, Finland and Slovenia supported the identification of the sub-700MHz band for mobile services.

The full Lamy Report is available by following this link:
http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=8423

10.2.3. Lamy Report Public Consultation on 700MHz spectrum band

The Commission submitted for public consultation a *questionnaire* in order to collect the views of stakeholders of options for the future use of the UHF TV Broadcasting Band: the Lamy

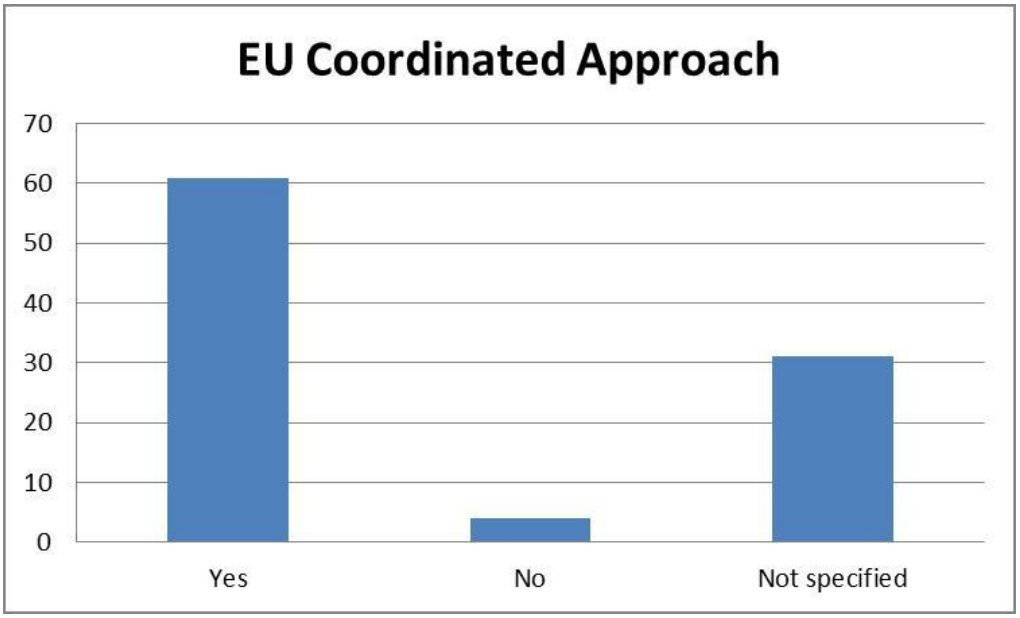
Report. The questionnaire asked contributors inter alia to provide views on the Lamy Report. The closing date for comments was 12 April 2015; however contributions received up until the 16 April 2015 were included. The Commission received a total of 356 contributions to the public consultation; 260 citizens and 96 stakeholders representing different industries provided input. Three contributions came from experts, representing universities, research institutes or professional societies.

The results of the consultation suggest that an EU coordinated approach, a common roadmap as well as a cost-efficient transition are needed for a successful release of the 700MHz band in the European Union (the upper part of the UHF band). The respondents gave their suggestions on how to use the 700 MHz band (694-790 MHz), on the regulatory certainty for current users of spectrum, the flexibility and harmonisation of use of sub-700MHz for TV (470-694 MHz), as well as the European approach at the 2015 World Radiocommunication Conference (WRC-15).

EU Coordination

Out of 96 organisations, 61 organisations see merits in an EU coordinated approach to clear the 700MHz band for wireless broadband usage, representing 64% of the respondents, while only 4 organisations (4%) see no merits in such an approach. 31 Organisations (32% of the respondents) have not specified whether or not they see merits in an EU coordinated approach.

Figure 17 – Stakeholders in favour of an EU coordinated approach



Source: Commission Public Consultation, 2015

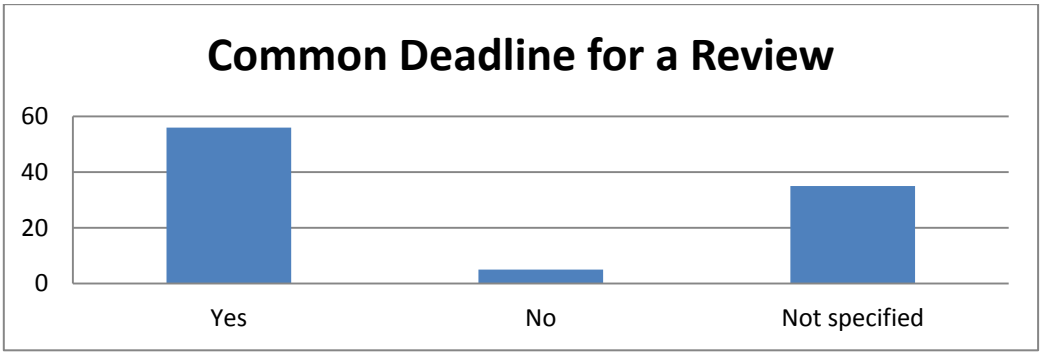
The respondents argue that EU coordination reduces fragmentation on the internal market and contributes to the harmonisation of the network coverage obligations and establishment of common standards for receivers. It also contributes to the development of a spectrum strategy for complementary users such as Program Making and Special Events.

According to the stakeholders, the EU coordination entails the cross-border coordination of bi-lateral and multi-lateral frequency rights, as well as negotiations with third countries. The vast majority of mobile operators and equipment manufacturers additionally finds EU coordination crucial for co-existence of the digital terrestrial television and wireless broadband in cross-border territories. Various stakeholders from the cultural and creative industries indicate that the scope of regulatory coordination should ensure continuity of digital terrestrial television below the 700 MHz band.

A great majority of the respondents are in favour of establishing a common deadline to clear the 700 MHz band and support the date range in the Lamy Report of 2020 (+/- 2 years). Mobile operators favour the release in 2020 or earlier. On the other hand, cultural and creative industries as well as broadcasting network operators and some consumer associations tend to support a deadline of 2022 (2020 +2). Stakeholders in the manufacturing and electronic industries suggest that the deadline of 2020 is reasonable as the general rule.

Most stakeholders are in favour of a common EU deadline for conducting a review for broadcasting and wireless broadband services market developments shortly thereafter, possibly around 2025.

Figure 18 – Stakeholders in favour of a common deadline for a market review



Source: Commission Public Consultation, 2015

Funding and Financial Resources

Regarding funding arrangements, cultural and creative industries in particular ask for clear EU guidance on the availability of funding and financial resources needed to cover the costs of transition and clearance of the 700 MHz band that is currently used by broadcasting and other cultural-related services such as Program Making and Special Events. This guidance is required to ensure that Member States progress in a timely and coordinated manner towards the release of the 700 MHz band. Electronic manufacturers moreover urge the EU to promote industry collaboration to reduce delay and to fully reap the benefits from economies of scale.

Spectrum-efficient Technologies

There is general support to promote spectrum-efficient technologies for Digital Terrestrial Television equipment (i.e. Digital Video Broadcasting-Terrestrial 2 (DVB-T2) and High Efficiency Video Coding (HEVC)), and to take measures at the EU level to facilitate usage of the latest technologies. However, most of the respondents reject mandatory measures to use a specific technology. According to the respondents, such an approach will go against technological neutrality and the industry should be able to choose the most adequate and suitable technology.

Flexible Downlink-only Use

The flexible use of the sub-700MHz is subject to diverging opinions of respondents. Some stakeholders did not support the flexible downlink-only use of the spectrum below 700 MHz for wireless broadband services because of concerns on the potential technical compatibility or not with digital terrestrial television (DTT) while others reject it for being too restrictive and ask for the inclusion of uplink too (bidirectional wireless broadband services) which enables provision of full internet access services.

The EU at the World Radiocommunication Conferences

There is broad support for a common European approach to the sub-700MHz band at the World Radiocommunication Conference 2015 (WRC-15).

(1) Link to Summary Report

(2) Link to Citizens' Contributions

(3) Link to Organisations' Contributions

10.3. Annex: Who is affected by the initiative and how – SME Test

Who is affected	How
Member States	The EP and Council decision will establish regulatory certainty and flexibility in spectrum use of the sub-700MHz band to match Member State diversity in DTT penetration by 30 June 2020. To promote a short and synchronised time window of 700MHz release, the EP and Council decision will require Member States to: • Adopt national transition plan by 30 June 2017 • Finish cross-border frequency coordination agreements within the Union as well as with non-Union countries by 31 December 2017 The Implementing Decision will require Member States to: • Designate and authorise the 700MHz band for electronic communications services • Harmonise the technical conditions of use of the 700 MHz band for electronic communications services • Designate and make available the 703-733MHz and 758-788MHz frequency bands for networks other than high-power broadcasting networks. They shall do so on a non-exclusive basis for terrestrial systems capable of providing electronic communications services.
Broadcast network operators	In compliance with the EP and Council Decision, broadcast network operators will have to reconfigure their networks to move to the lower part of the UHF band (i.e. sub-700MHz) in order to clear the 700MHz in 2020. In order to meet the deadline, DTT network operators will be required to convert systems to most efficient spectrum technologies if they wish to maintain current choice and transmission quality of programmes or improve it (eg. through transition to Ultra High Definition programing). The upgrading of DTT networks can be done in three ways: i. through a compression of technology, most Member States use the so-called MPEG-2 standard for DTT signal compression, but a move to a more advanced compression technology such as the widely-available MPEG-4 H.264/AVC (MPEG-4) standard would almost double the capacity, and value, of UHF broadcasting band ii. modulation of radio technology DTT in the EU uses the Digital Video Broadcasting – Terrestrial (DVB-T) standard. Improvements to the techniques used by DVB-T are brought by the DVB-T2 standard. This standard increases the capacity of DTT channels (multiplex) compared to DVB-T;

	iii. network topology, most DTT networks in the EU are mostly multi-frequency networks (MFNs) so each given DTT channel (multiplex of 8MHz frequency channel) uses different frequencies in different geographic locations to avoid self-interference. Restacking or the increased use of single-frequency networks (SFNs), where all frequency channels are used at all sites, could reduce the need for spectrum.
Mobile Network Operators	The EP and Council Decision will enable the provision of wireless broadband services in the 700MHz once this band is cleared by 2020. MNO will roll-out high speed wireless networks and provide extra capacity in rural areas and improved indoor coverage in the urban areas. In compliance with the Commission Implementing Decision, MNO will provide electronic communication services on a non-exclusive basis in the 700MHz band, particularly in 703-733MHz and 758-788MHz.
Consumers and Users	Upgrade TV sets which might create end-user equipment costs. These costs are calculated on the basis of the life cycle of current equipment, cost of new equipment and, the number of times the equipment is used daily.
Equipment manufacturers	The harmonization of the 700MHz band for systems capable of providing electronic communication services and other uses in the Union, will enable equipment manufacturers to benefit from the economies of scale
PMSE users	The Implementing Decision will make it harder for PMSE users to find enough spectrum for their needs in the 'white spaces' of the UHF band. Program Making and Special Events operate in radio spectrum white spaces across the UHF. They will have to operate in the sub-700MHz band. The size and the exact frequencies of the 'white spaces' differ between different geographical locations. 'White spaces' are used by wireless audio PMSE applications, on the condition that they do not cause interference to the authorised broadcasting services and that they are not themselves protected from interference from other users. They will need multiple equipment or equipment that can tune into a wider range of frequencies. Small users need less spectrum for their operations and this will likely remain available via the ‘white spaces’ in the remaining part of the UHF band (i.e. the sub-700MHz band) while large professional wireless audio PMSE users claim they need about 100 MHz of spectrum in the UHF band due to its technical characteristics. Wireless audio PMSE users are concerned about the increasing risk of interference they are subject to due to these changes in the use of UHF spectrum. If and when unacceptable levels of harmful interference were to become frequent, wireless audio PMSE users would have to find alternative solutions.

	PMSE users are not protected from harmful interference in the 700 MHz band and there is no guarantee for a minimum amount of available, usable spectrum. PMSE use can be licence-free, subject to general authorisations or licence-based. PMSE use of spectrum does not generally require payment or in case of licences e.g. when coordinated by a regulator, it implies minimal fees.
PMSE manufacturers	Manufacturers, which are mainly SMEs in this sector, need to adapt each model to the specific frequencies made available in the different Member States. Since this is a niche market, these specialised manufacturers have limited resources and R&D on digital equipment and other innovations would be encouraged if there were a single market.

SME Test dedicated to PMSE manufacturers and users operating in the 700MHz band

(1) Consultation with SMEs representatives	Consultation with the SMEs took place during the Lamy Report Public Consultation that ended on the 12th of April 2015. Although the Commission Implementing Decision 2014/641/EU on PMSE was already published in the Official Journal of the European Union on September 2014, the public consultation took place before the Decision was implemented in all Member States. 36 contributions were submitted by stakeholders from the creative and cultural industries that are made up of broadcasters, content producers, arts and creative organizations and PMSE users. SMEs were also consulted through regular bilateral meetings with specific companies.
(2) Preliminary assessment of business likely to be affected	As described in section (6.2.1. and 6.4) content producers would not be negatively affected by the preferred option 3 of this IA. Their core business model consists of pushing content through various platforms and, in Option 3 DTT would continue to be available to deliver audiovisual content. On the contrary, the release of the 700MHz band could be detrimental for PMSE services which would need to be reallocated in other bands. There is already evidence that the pressure on the UHF band availability has led national regulators to find alternative but uncoordinated solutions to the needs of the wireless audio PMSE users. Further, some of the solutions are of a temporary nature. Such uncertainty means users are reticent to invest in equipment operating in this band and manufactures reticent to producing it since it could become unusable within some years. It would be expected, however, that some radio-microphone users, being aware of the potential future loss of the 700 MHz band, would have, where possible, purchased and be using equipment that would be sub-700 MHz.

<table>
<tr><td></td><td>The impact on PMSE applications will affect both users (arts, music, conferences…) and manufacturers of the relevant equipment.

There are approximately 2.2 million audio PMSE in use in the EU and 30% of devices are currently operating in the 700 MHz band.</td></tr>
<tr><td>(3) Measurement of the Impact on SMEs</td><td>The impacts due to the on-going changes in spectrum use in the UHF band were estimated over the following assumptions:

• 2.2 million audio PMSE in use in the EU
• 30% of devices are currently operating in the 700 MHz band.
• Natural replacement cycle of 8 years
• Radiomicrophone system varies from 100 to 5000 Euro, but on average is around 650 Euro.

These inputs lead to a total replacement cost for EU28 countries as shown in the table below. Both a positive and negative acceleration factor have been implied to take account of user restriction, or use encouragement to replace equipment knowing that it will become unusable over the coming years. The table below illustrates the PMSE costs associated with different deadlines for the release of the 700 MHz band.

<table><tr><th></th><th>2020</th><th>2021</th><th>2022</th></tr><tr><td>-20% acc.</td><td>230 mill €</td><td>207 mill €</td><td>187 mill €</td></tr><tr><td>Neutral</td><td>200 mill €</td><td>175 mill €</td><td>153 mill €</td></tr><tr><td>+20% acc.</td><td>173 mill €</td><td>147 mill €</td><td>125 mill €</td></tr></table></td></tr>
<tr><td>(4) Assess alternative options and mitigating measures</td><td>Although the preferred Option of the Impact Assessment shows that the PMSE sector could be particularly affected, the spectrum needs for this sector were anticipated by the European Commission in 2014 when
Implementing Decision 2014/641/EU on harmonized technical conditions of spectrum use PMSE equipment was adopted.
This Decision not only designates and makes available frequency bands for wireless audio PMSE but also improves coexistence between microphones and mobile networks across the EU. This measure provided harmonised 'core bands' in the 800 MHz and 1800 MHz 'duplex gaps' to stimulate economies of scale for 'basic' equipment, facilitate the use of small users, foster the cross-border and EU-wide employability of equipment, and focus manufacturers' R&D efforts. This measure also gives certainty on an amount of spectrum available through the harmonised bands and the additional 30 MHz to be made available if there is demand.

The value of this EU measure approved in 2014 lies in its</td></tr>
</table>

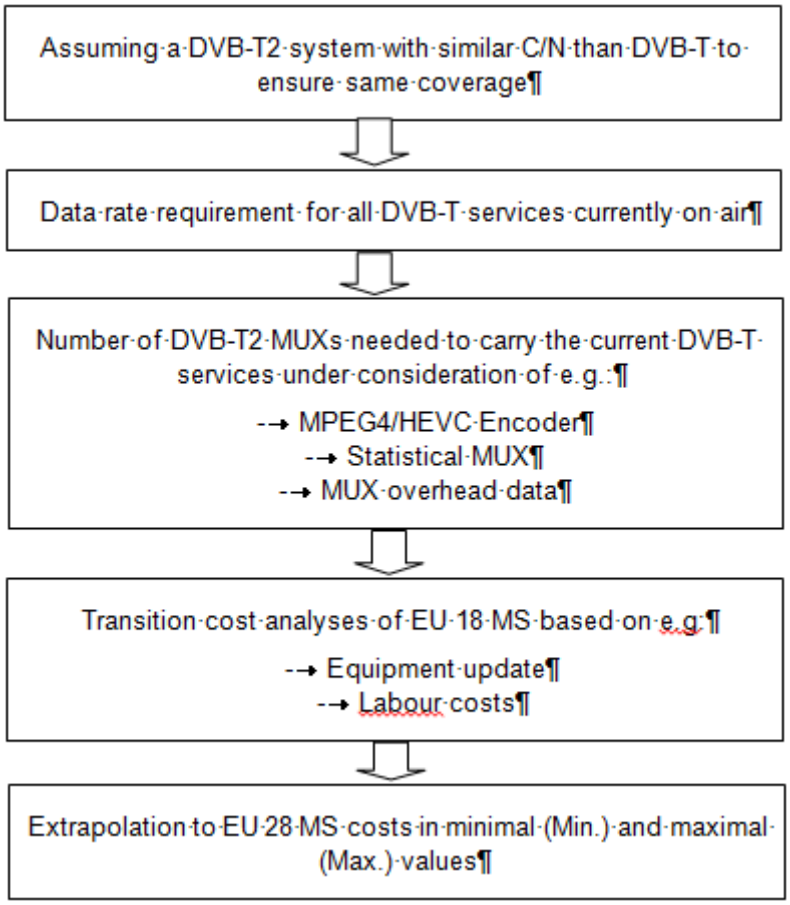
	tiered approach which aims to address the different objectives while fully taking into account subsidiarity and proportionality as well as efficiency of spectrum use. It was estimated to reduce the costs due to the UHF spectrum changes by 76 million euros. In addition, as explained in section 6.2.1. the proposed Implementing Decision on the 700 MHz band will give Member States the possibility of using the duplex gap and guard bands of the 700 MHz band for PMSE, thus making available 25 MHz of the 30 MHz identified in the 2014 PMSE Implementing Decision. Finally, in order to mitigate the effects on PMSE services, the Commission will request an RSPG Opinion concerning a Union Strategy for PMSE services.

10.4. Annex: Analytical models used in preparing the impact assessment.

10.4.1. Costs

The LS telcom & VVA study's general approach was to make first a very detailed cost analysis for 5 selected countries: Finland (FI), Slovakia (SK), Spain (ES), Germany (DE) and Greece (EL). This outcome was used to benchmark the methodology used to determine the costs based on 18 EU member states where the necessary data was provided. Finally the total costs were extrapolated for all EU Member states. These countries show a wide diversity of parameters regarding country size, network topology, population density and terrestrial TV penetration. Another extrapolation based on the country size (cost/sqkm) validated this approach as the results were quite similar.

The methodology itself was to define the necessary number of DVB-T2 multiplexes and the derived transition costs, which is also shown in a graphical manner below based on certain assumptions regarding labour and equipment costs and the expected technology gain.

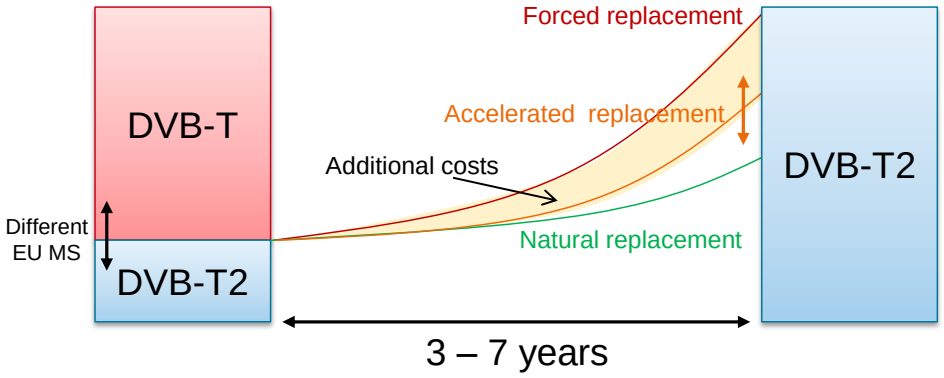


The costs for broadcast network operators are estimated on the basis of three potential scenarios:

i. restacking as a means of re-organising the frequencies in use at a given site – network operators will no longer use frequencies in the 700 MHz band and start using other assignments at that site that are sub-700 MHz;
ii. replace the present DTT system and move to second generation video broadcasting (DVB-T2) along with the source of coding standard HEVC (minimum costs)
iii. or replace the present DTT system and move to second generation video broadcasting (DVB-T2) along with the source of coding standard MPEG4 (maximum cost).

All costs are given in a Min. to Max. range. This is based on an assumed range of transition efforts spend per transmitter which comprises labour as well as equipment costs. This finally results in certain range of entire costs.

The consumer costs are based on the analysis framework illustrated in the diagram below. This example shows the situation for a move from DVB-T to DVB-T2, but the same analysis method has also been used for a move to HEVC or for the replacement of PMSE equipment.



Taking the example above, the method is as follows:

- Determine the existing penetration of DVB-T2 receivers in 2015 in EU Member States (the study team assumed a penetration of 50% of DVB-T2 receivers for countries where there are DVB-T2 services and 20% for countries where there is DVBT and 0% of HEVC receivers as these are not yet available);
- Determine the extent to which the natural replacement (of television receivers) will cause an increase in DVB-T2 receiver penetration, assuming that all receivers purchased from today onwards are DVB-T2 compatible (the study team assumed a replacement period of 7 years);
- Consider that there may be an accelerated replacement of receivers if consumers are aware that they require a DVB-T2 receiver by a given date, or because new services become available on DVB-T2 before that date.
- Determine the number of receivers that would need a forced replacement, that is to say, those receivers which, by the end of the period in question, would not have been replaced through natural or accelerated replacement and thus would represent the cost of migrating all remaining consumer equipment to.

The costing model delivered by the study team was run with DTT penetration data from Eurobarometer (2013) and data for DTT primary households and DTT total households from IHS Technology (2015) and refers to the forced replacement of set-top-boxes that would not have already been replaced by 2020.The study also applies faster and slower replacement cycles to consider the amount of set-top-boxes to be replaced in different scenarios and the relevant cost figures. For the purpose of cost comparisons in this document the neutral scenario was considered.

10.4.2. Benefits of the 700 MHz band

The Commission estimated how much the 60 MHz of spectrum (2*30 MHz) available in the 700 MHz could be licensed for based on the prices paid for the 800 MHz and 900 MHz bands in auctions that took place in the period June 2010 to May 2014.

The 700 MHz could be worth about 11 billion euros to European mobile operators based on the average price per MHz per population paid for the 800 and 900 MHz bands on the conditions of the existing licenses, for example in terms of coverage obligations. If mobile operators are willing to pay this price to acquire the 700 MHz spectrum, this should be equal to or less than their valuation for this spectrum, i.e. the benefit (revenues-costs) that they expect to make from this asset. If Member States were to set more ambitious coverage obligations, mobile operators would be likely to offer less money for these licenses but the overall value would nonetheless be the same as consumers would benefit from the increased coverage.

Figure 19 – Estimate value to mobile operators of the 700 MHz band based on 800 and 900 MHz band auctions, 2010-2014

800 MHz FDD [60 MHz]	EU average		Estimate for 700 MHz band EUR million (60MHz and 508 million population)
Final price of the band [EUR million]	688.69		
Final price [EUR million / MHz]	11.54		
Final price [EUR/MHz/pop]	0.41		12,597.31
900 MHz FDD [70 MHz]			
Final price of the band [EUR million]	156.52		
Final price [EUR million / MHz]	6.16		
Final price [EUR/MHz/pop]	0.33		10,121.64
		band average	11,359.48
Correlation with IE estimate			91
Extrapolation to EU28 based on population			10,049.57

Auctions took place in Germany and France in 2015. In the former the auction was concluded in June 2015. Since this was a multi-band auction it is not possible to identify the price paid for the 700 MHz band only. Based on the total price paid for all the bands (very likely an underestimation for the 700 MHz), the 60 MHz of the 700MHz were valued at 1.07 billion euro. In France, the reserve price for the 700 MHz band has been set at nearly 2.5 billion euro with Arcep estimating that the final bid could raise over 3 billion euro. The figure of 11 billion for the EU28 thus seems like a reasonable baseline estimate for the value that will be raised by 700 MHz auctions.

10.5. Technical Annex

10.5.1. Glossary and Acronyms

CEPT : European Conference of Postal and Telecommunications Administrations, an organisation in which 48 European countries cooperate to regulate posts, radio spectrum and communications networks

DTT : Digital Terrestrial Television

DVB-T2: Latest Standard for Digital Video Broadcasting Terrestrial

DVB-C: Digital Video Broadcasting Cable

EBU : European Broadcasting Union

ECC: Electronic Communications Committee

GE06 : ITU Geneva 2006 agreement

HEVC: High Efficiency Video Coding with double the data compression ratio compared to MPEG-4 at the same level of video quality

HPHT : High power high tower

IPTV : TV carried via IP protocol (via broadband)

IoT: Internet of Things

ITU : International Telecommunications Union

LPLT : Low Power Low Tower

MPEG4: Method of defining compression of audio and visual digital data. MPEG4 is an evolving standard of MPEG1, MPEG2 and MPEG 3.

MUX: DTT multiplex is a bundle of TV services that have been digitised, compressed and combined into a data-stream for transmission to the consumer over a single spectrum channel.

OTT : Over the top services provided over broadband

PMSE : programme making and special events

PPDR : Public Protection and Disaster Relief

Restacking: A means of re-organising the frequencies in use at a given transmitter site

RSC : Radio Spectrum Committee, a Committee which assists the Commission, which procedures and functioning is recorded in Articles 3 and 4 of the Radio Spectrum Decision (676/2002/EC)

RSPG : Radio Spectrum Policy Group, a group of Member States' delegates (not independent regulatory authorities) representing their country's positon on spectrum related matters

RSPP : Radio Spectrum Policy Programme

UHF band : Ultra high frequency band, intended in this document as the frequency range 470-790 MHz

VHF : Spectrum band 30-300 MHz

WBB : wireless broadband

WRC : World Radiocommunication Conference

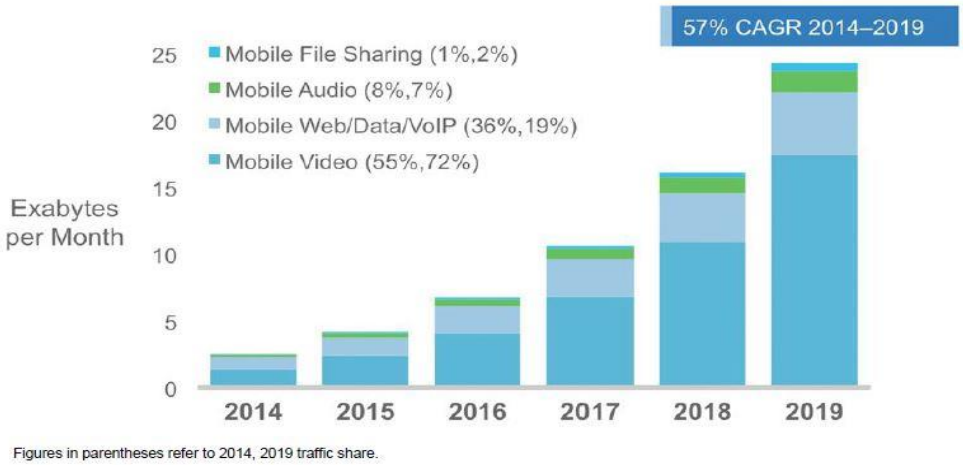
10.5.2. Mobile sector

Although in 2013 Cisco lowered its previous projections, they still estimate mobile data traffic growth rate (CAGR) at 45% in 2014 and 48% in 2015 in Western Europe.[56]

Figure 20 - Mobile Data and Internet Traffic, 2014-2019

Mobile Data and Internet Traffic, 2014–2019							
	2014	2015	2016	2017	2018	2019	CAGR 2014–2019
By Geography (PB per Month)							
Asia Pacific	977	1,622	2,616	4,114	6,245	9,459	57%
North America	563	849	1,287	1,897	2,704	3,798	47%
Central and Eastern Europe	242	464	832	1,409	2,231	3,488	72%
Middle East and Africa	199	383	690	1,194	1,927	3,051	73%
Western Europe	341	504	760	1,137	1,653	2,392	48%
Latin America	201	354	581	915	1,380	2,032	59%
Total (PB per Month)							
Mobile data and Internet	2,524	4,176	6,765	10,666	16,140	24,221	57%

Figure 21 – Mobile data traffic per application type, 2014-2019



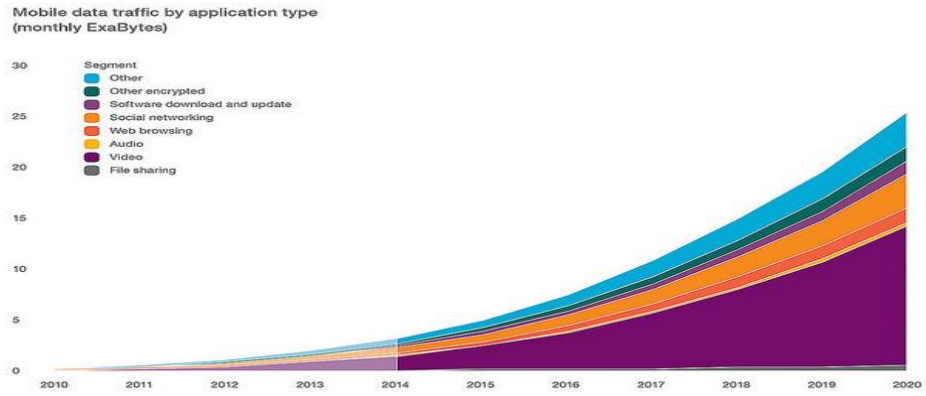
Figures in parentheses refer to 2014, 2019 traffic share.

Source: Cisco VNI Mobile, 2015

According to the Ericsson Mobility Report 2014[57], video streaming is expected to grow exponentially: around 55% of global mobile data traffic will come from video streaming by 2020 (Cisco forecasts 72% by 2019). Many factors fuel the demand of the mobile video such as the quality of the smart device, including the screen size and resolution as well as the production quality, the viewer's expectations and network performance.

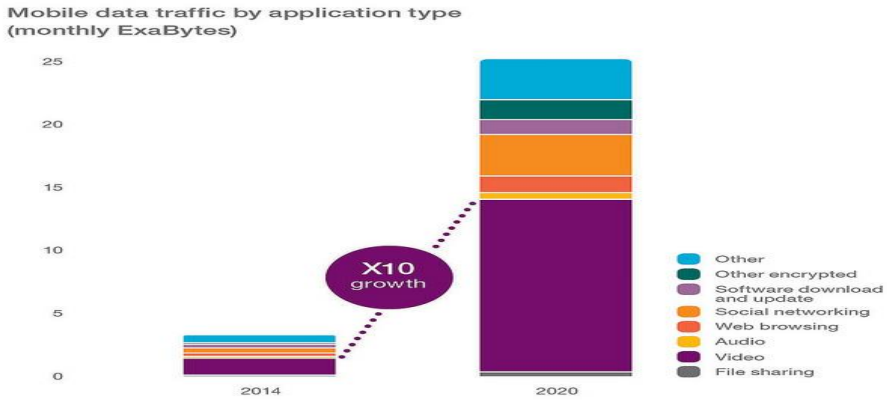
[56] CISCO (2015)
[57] Ericsson (2014)

Figure 22 – Mobile data traffic per application type, 2010-2020



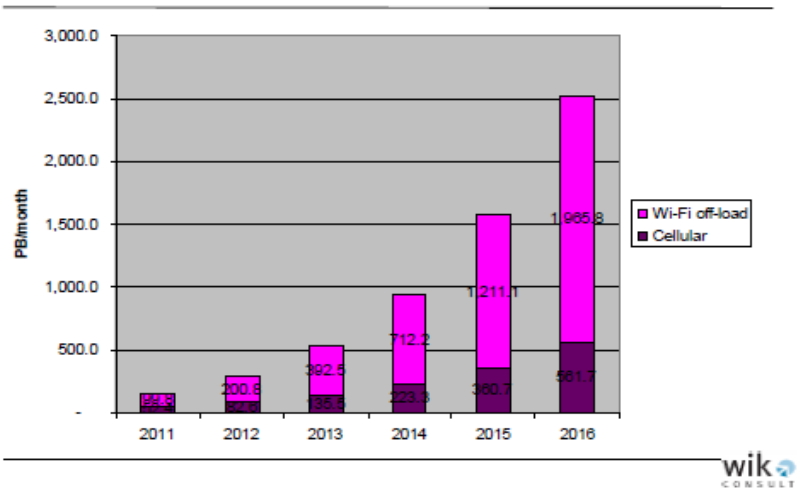
Source: Ericsson Mobility Report, 2014.

Figure 23 – Mobile data traffic per application type, change between 2014 and 2020



Source: Ericsson Mobility Report, 2014

Figure 24 – Observed and predicted mobile traffic off-load



Source: Wik Consult, 2012

10.5.3. The European Audiovisual Model and the audiovisual sector

The audiovisual sector is one of the most important in the culture related domain. Certainly, the audiovisual industry belongs to the cultural and creative sector which makes a significant contribution to the EU economy, creating around 3.3% of the EU GDP and employing 6.7 million people[58].

The audiovisual sector is mainly cultural and thus an essential national area of competence. At the same time, both Union[59] and Member States level rules have a common rationale comprising the following categories:

1. The financing model of the audiovisual sector in Europe consists of a mixed model based on private and public funds. The commitment of the EU and Member States' public institutions towards the audiovisual industry is based on the importance of Public Service Broadcasting.

   i. The Amsterdam Protocol acknowledges that the system of public broadcasting in the Member States is directly related to the democratic, social and cultural needs of each society and to the need to preserve media pluralism .The Protocol guarantees Member States' right to fund public service broadcasting[60] insofar as such funding is granted for the fulfilment of a public service remit as conferred, defined and organised by each Member State, and insofar as such funding does not unduly affect trade and competition in the EU.

   ii. Public service broadcasting, although having a clear economic relevance, is not comparable to a public service in any other economic sector. There is no other service that at the same time has access to such a wide sector of the population, provides it with so much information and content, and by doing so conveys and influences both individual and public opinion.

   iii. As underlined by the Council Resolution concerning public service broadcasting[61]: "Broad public access, without discrimination and on the basis of equal opportunities, to various channels and services is a necessary precondition for fulfilling the special obligation of public service broadcasting" and more "public service broadcasting must be able to continue to provide a wide range of programming in accordance with its remit as defined by the Member States in order to address society as a whole; in this context it is legitimate for public service broadcasting to seek to reach wide audiences."

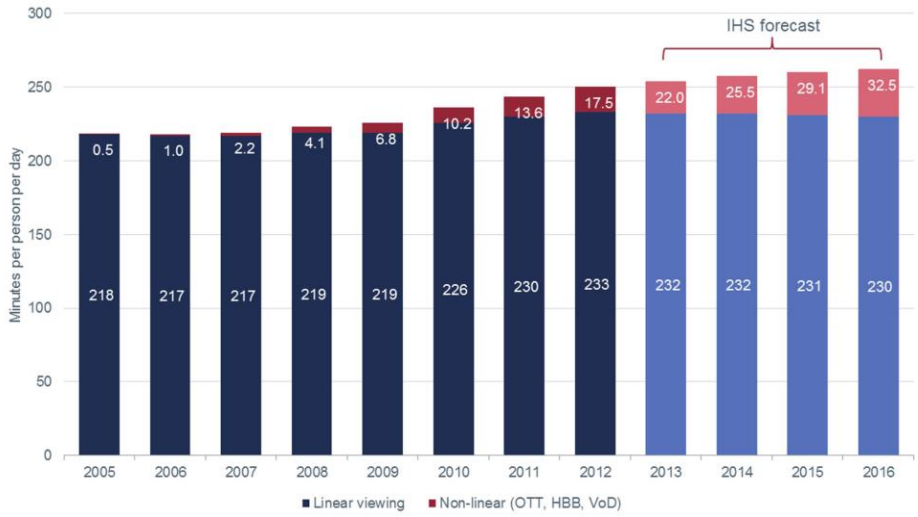
2. Rules ensuring cultural diversity (promotion of European of works) in the Audiovisual Media Services Directive.
   i. The AVMS Directive requires broadcasters to reserve a majority proportion of their transmission time, excluding the time allotted to news, sports events, games, advertising, teletext services and teleshopping, for European works (Article 16). In some Member States private broadcasters are requested to invest a portion of their revenues to finance audiovisual productions (e.g. art 5.3 Spanish Audiovisual Law).
   ii. Article 17 requires broadcasters to reserve a minimum share (at least 10%) of their transmission time, excluding the time allotted to news, sports events, games, advertising, teletext services and teleshopping, for European works created by their independent producers. Alternatively, Member States may

[58] https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/external_swp.pdf
[59] Audiovisual Media Service Directive
[60] The national financing systems are compliant with EU-law as long as they comply with the criteria Communication from the Commission on the application of State aid rules to public service broadcasting of 2 July 2009. Basically, funding is subject to (1) a clear definition in law of the scope of activity/public interest (2) no overcompensation/ control of overcompensation and supervision of the public service mission (3) transparent evaluation of the overall impact of publicly-funded new media services.
[61] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:41999X0205&from=EN

require broadcasters to allocate at least 10% of their programme budget to independent productions. An adequate proportion of works by independent producers should be recent, i.e. less than five years old.

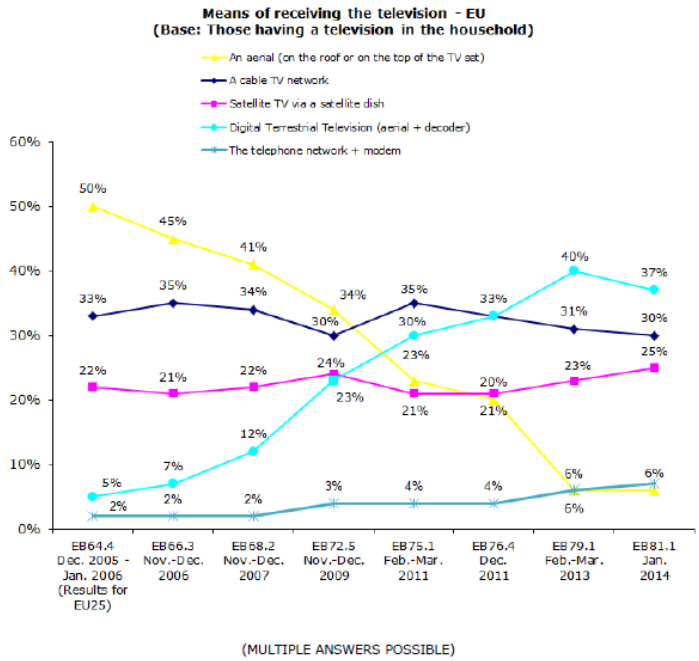
3. Broad access to events of societal importance. As underlined by the Council Resolution concerning public service broadcasting[62]: "Broad public access, without discrimination and on the basis of equal opportunities, to various channels and services is a necessary precondition for fulfilling the special obligation of public service broadcasting"

Figure 25 –The relevance of linear television in the EU 'Big 5'[63]



Source: IHS – Screen Digest: Cross-platform television viewing time

Figure 26 - Means of receiving television in the EU



Source: Eurobarometer, 2014

[62] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:41999X0205&from=EN

[63] EU 'Big 5' are France, Germany, Italy, Spain and United Kingdom.

Figure 27 – TV viewing habits per age group in the EU

QE3.1 Could you tell me to what extent you…?

Watch television on a TV set

	Everyday\ Almost everyday	Two or three times a week + About once a week	Two or three times a month + Less often	Never	No access to this medium (SPONTANEOUS)	Don't know	At least once a week
EU27	86%	11%	2%	1%	0%	0%	97%
Age							
15-24	77%	17%	4%	2%	0%	0%	94%
25-39	82%	13%	3%	2%	0%	0%	95%
40-54	86%	11%	2%	1%	0%	0%	97%
55 +	92%	6%	1%	1%	0%	0%	98%
Education (End of)							
15-	92%	5%	2%	1%	0%	0%	97%
16-19	88%	9%	2%	1%	0%	0%	97%
20+	83%	12%	3%	2%	0%	0%	95%
Still studying	71%	22%	5%	2%	0%	0%	93%
Occupation scale							
Self-employed	82%	13%	3%	2%	0%	0%	95%
Managers	82%	13%	3%	2%	0%	0%	95%
Other white collars	82%	14%	2%	2%	0%	0%	96%
Manual workers	85%	12%	2%	1%	0%	0%	97%
House persons	90%	7%	2%	1%	0%	0%	97%
Unemployed	89%	7%	2%	2%	0%	0%	96%
Retired	94%	5%	0%	1%	0%	0%	99%
Students	71%	22%	5%	2%	0%	0%	93%

QE3.2 Could you tell me to what extent you…?

Watch television via the Internet

	Everyday\ Almost everyday	Two or three times a week + About once a week	Two or three times a month + Less often	Never	No access to this medium (SPONTANEOUS)	Don't know	At least once a week
EU27	7%	10%	14%	63%	6%	0%	17%
Age							
15-24	14%	19%	19%	45%	3%	0%	33%
25-39	10%	15%	18%	54%	3%	0%	25%
40-54	5%	9%	15%	67%	4%	0%	14%
55 +	3%	4%	6%	74%	12%	1%	7%
Education (End of)							
15-	2%	3%	3%	77%	14%	1%	5%
16-19	6%	9%	12%	67%	6%	0%	15%
20+	9%	14%	20%	54%	3%	0%	23%
Still studying	15%	22%	19%	42%	2%	0%	37%
Occupation scale							
Self-employed	10%	11%	17%	59%	3%	0%	21%
Managers	10%	16%	22%	50%	2%	0%	26%
Other white collars	9%	14%	18%	57%	2%	0%	23%
Manual workers	7%	11%	14%	64%	4%	0%	18%
House persons	4%	6%	7%	73%	10%	0%	10%
Unemployed	7%	10%	12%	64%	7%	0%	17%
Retired	2%	3%	5%	75%	14%	1%	5%
Students	15%	22%	19%	42%	2%	0%	37%

Source: Eurobarometer, 2012

The American provider of on-demand Internet streaming media, Netflix, is currently available in many EU countries: Denmark, France, Germany, The Netherlands, Norway, Sweden, Finland, Switzerland, Austria, Belgium, Luxembourg, Ireland and United Kingdom.

Figure 28 - Overview of Netflix deals with EU Telecom Operators

EU Member State	Telecom Operators
Austria	T-Mobile Austria is offering its LTE customers a free six-month Netflix subscription from 23 February 2015.
Belgium	Proximus (existing customers): six months free Netflix subscription Valid for customers with a subscription to at least two products (of which one should be Internet Maxi).
France	Bouygues Telecom Netflix through its TV set-top boxes from November 2014.and Orange
Germany	Deutsche Telekom's Entertain IPTV platform; Vodafone Germany offers a free six-month subscription for Netflix with certain plans
Ireland	Vodafone deal: Six months of free access to Netflix for all new customers of
The Netherlands	Vodafone deal: Six months of free access to Netflix for all new customers
United Kingdom	Vodafone deal: Six months of free access to Netflix for all new customers

Source: European Commission services

Aetha estimated Consumer Premises Equipment (CPE) costs (CPE costs may be underestimated due to the potential requirement of new aerial systems).

Figure 29 – CPE cost by category

Cost category	Cost in EUR
Satellite dish	50EUR
Set-top Box (per TV devices) for cable and satellite	70EUR
Installation	Varies in EU countries (average 100 EUR)

Source: Aetha, 2014

Cost category	Cost in EUR
Installation and purchase satellite equipment (dish, set-top-box)	200EUR
Set-top box cable	40EUR

Source: LS telcom & VVA, 2015

10.5.4. Digital Television

Digital television (DTV) is the transmission of audio and video by a digitally processed and multiplexed signal. Several regions of the world are in different stages of adaptation from analogue to digital TV and are implementing different broadcasting standards. Europe adopted the Digital Video Broadcasting (DVB) standard; its extension, DVB-T2 offers higher bit rate (more data can be carried over the same frequency per second) and makes the system suited for carrying HDTV signals on the terrestrial TV channel.

Figure 30 – Countries with DVB, DVB-T2 and other broadcasting standards

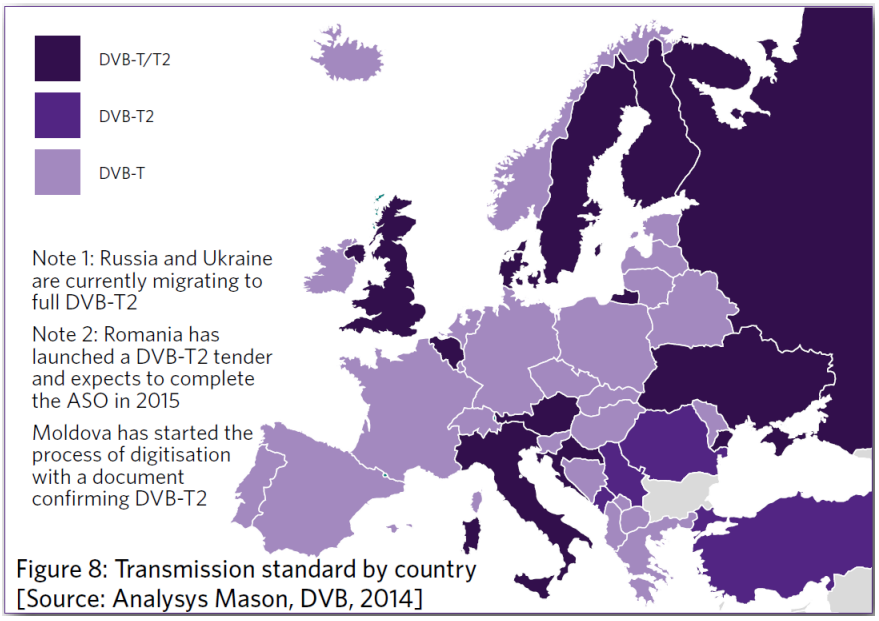


Figure 8: Transmission standard by country
[Source: Analysys Mason, DVB, 2014]

A video coding format is used to store and transmit digital video content. Several video coding formats exist including MPEG-2, MPEG-4 and HEVC. Coding techniques reduce redundancy in video data, i.e. limit the amount of information needed to reproduce the content on a TV screen thus allowing more content to be transmitted over a certain signal.

HEVC is the successor of MPEG-4. HEVC is said to double the data compression ratio compared to MPEG-4 at the same level of video quality. It can alternatively be used to provide substantially improved video quality at the same bit rate.

10.5.5. DTT spectrum use in EU Member States

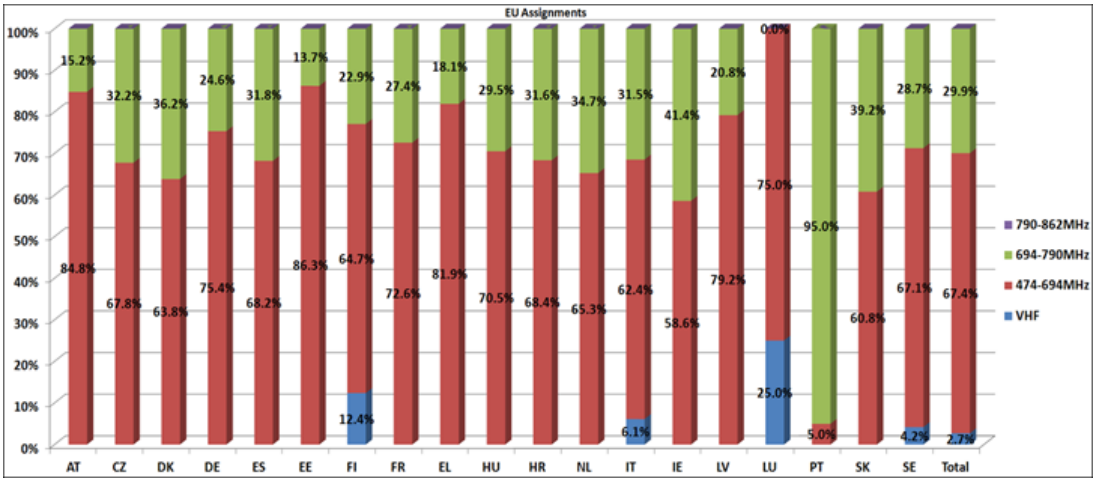
The 800 MHz band comprises a range of 9 channels, the 700 MHz band 12 channels and the UHF band (including 800 and 700 MHz) 49 channels. Decision 2010/267/EU established the 800 MHz frequency band as a digital dividend in the European Union and Member States had to allocate this band (790 to 862 MHz) for other services. The Radio Spectrum Policy Programme (RSPP) mandated the opening up of the 800 MHz band throughout the EU by 1 January 2013. This Decision had significant consequences for the national planning of Member States as many of them had to reallocate the DTT services to lower frequencies different than the ones initially planned. 11 Member States awarded the spectrum by 1 January 2013, while almost all the others sought a derogation with regard to the deadline[64]. This delay i) was detrimental to the roll-out of 4G mobile networks and uptake of smartphones adapted to the 800MHz band in Europe ii) caused a number of cross-border interference issues.

[64] Report of the Commission to Council and Parliament on the implementation the RSPP (European Commission, 2014)
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0228&rid=1

If the 700 MHz channels were also to be vacated, the changes would lead to a repurposing of 21 channels in total, which is about 43% of the channels previously intended for terrestrial digital TV.

The figure below shows the assignments (i.e. operational broadcasting services) that operate in the VHF and UHF bands for the 19 countries for which LS Telcom obtained data.

Figure 31 – Distribution of DTT assignments in the VHF and UHF bands (percentage)



Source: LS telcom & VVA (2015)

Figure 32 - Expiry dates of existing broadcasting licenses in the UHF band in EU28

Expiry timeframe	Number of countries	Percentage of countries
2013-2015	5	15,2%
2016-2019	8	24,2%
2020-2023	16	48,4%
2024-2027	9	27,3%
Expire at some point after 2027	3	9,1%
No answer	2	6,1%
2016-2026	24	72,8%
License renewed annually	1	3%
Expires 2032	1	3%
No license expiration	6	18,2%

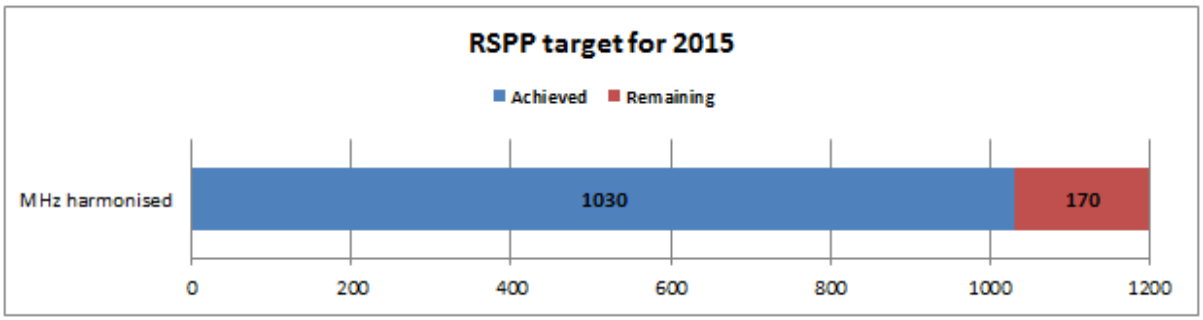
Source: RSPG Report on wireless broadband spectrum (RSPG13/552)

10.5.6. Current spectrum harmonisation and usage of sub-1 GHz in the EU

EU harmonized spectrum for WBB

Figure 33 – EU harmonised bands for wireless broadband with respect to 1200 MHz objective identified in the RSPP

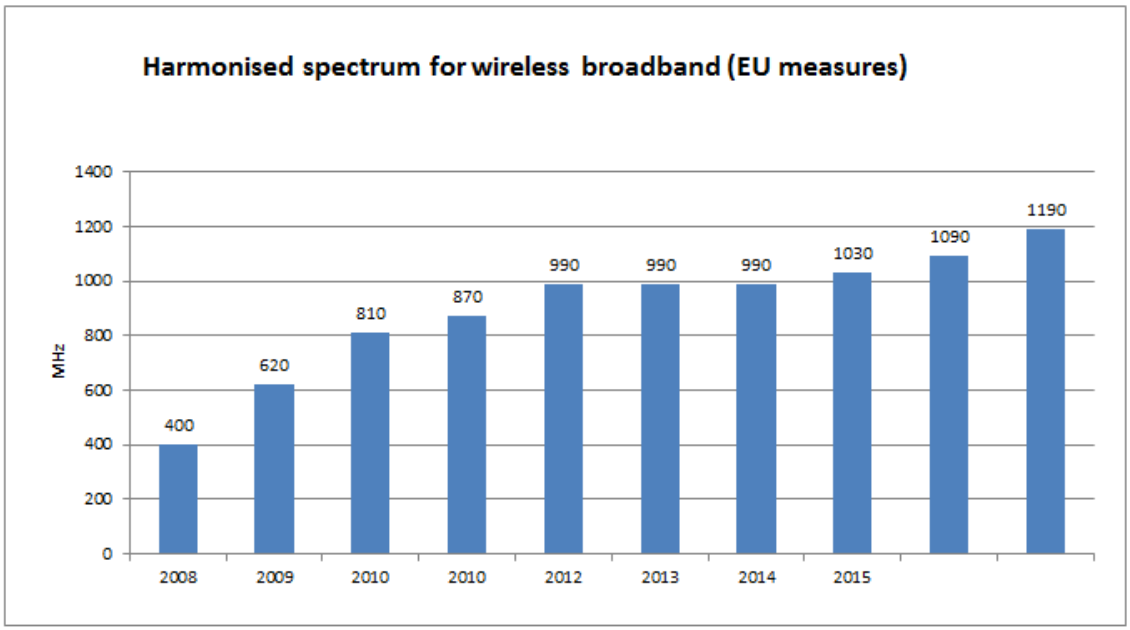
The setting of a target was requested by the European Parliament to steer Member States' efforts to allocate spectrum for wireless band



Suitable spectrum for WBB has been identified. The figure below maps the EU harmonised spectrum for WBB as well as simulates the effect of the harmonisation of the 700 MHz and the 2.3 GHz band (both currently under consideration for an EU harmonisation measure for WBB use) which would contribute to the 1200 MHz target.

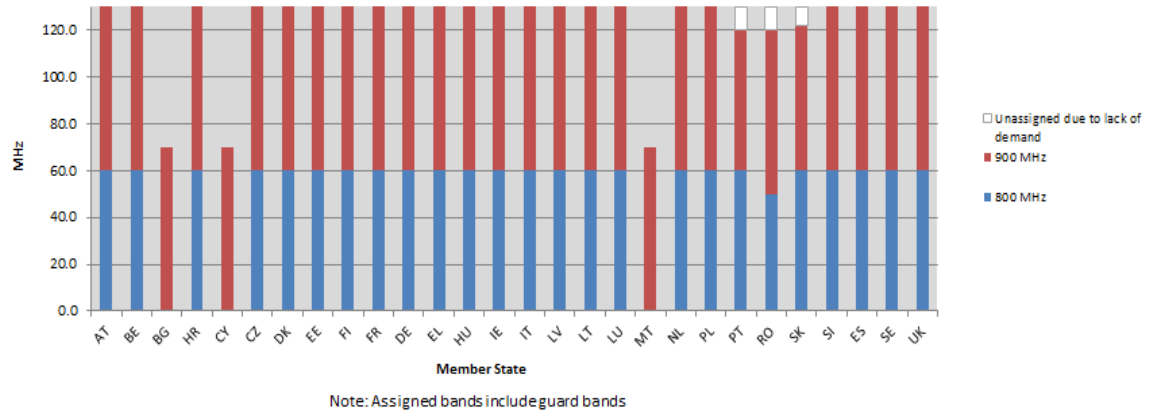
Figure 34 – Simulation of EU harmonised bands for wireless broadband with 700 MHz and 2.3 GHz harmonisation measures

Reference	2008/411/EC	2009/766/EC	2010/194/EU	2010/267/EU	2012/688/EU	-		2015/750/EU		
Band	3,4-3,8 GHz	900 & 1800 MI	2,6 GHz	800 MHz	2 GHz	-		1.5 GHz	700 MHz	2.3 GHz
Year	2008	2009	2010	2010	2012	2013	2014	2015		
MHz	400	220	190	60	120	0	0	40	60	100
Aggregated spectrum	400	620	810	870	990	990	990	1030	1090	1190



Source: European Commission services

Figure 35 – Current assignments in harmonised EU bands below 1GHz (October 2015)



Source: European Commission services, 2015

Status of EU Member States' plans to repurpose the 700 MHz band

Germany (auction completed)
Germany's held in April 2015 a big spectrum auction for the 700 MHz, 900 MHz, 1500MHz and 1800 MHz bands. Rights of use of the 700 MHz band were equally distributed between the three major mobile operators, and the spectrum will become available for effective use for the whole territory of Germany by Q2/2019 (starting in 2018). Germany imposed coverage obligations of 50 Mb/s per cell sector with view to achieving 10Mb/s per mobile user for 98 % of the population of Germany in line with its national broadband strategy (50 Mb/s for all by 2018, independent of technology). Germany is organising a move from DVB-T to DVB-T2 and compensatory measures are foreseen for PMSE but are also likely for DTT given that 50% of the auction revenues from the 700 MHz band are allocated to the Bundesländer (federal states) which have the competence for managing broadcasting frequencies.

France (auction completed)
France completed the auction of the 700 MHz band in November 2015. The effective availability of the 700 MHz band for mobile broadband is planned to take place progressively across the whole country between 2016 and 2019. France imposed coverage obligations on mobile operators which foresee three different levels to be complied with between 2022 and 2030. In particular, metropolitan population must be covered at 98% by 2027, main roads at 100% by 2030 and villages included in the so-called "mobile coverage extension national programme" at 100% by 2027.

Finland (authorisation planned)
The political decision was taken in January 2013 to transfer the 700 MHz band to wireless broadband, when the minister requested the necessary legislative amendments to make this possible. The formal decision will take effect following WRC-15 with a target deadline for repurposing the 700 MHz band set for the beginning of 2017. A part of the sub700 MHz band and the VHF band remain available for broadcasting.

Sweden (authorisation planned)
Sweden took the decision on 27 February 2014 to release the 700 MHz band for mobile broadband and mobile telephony. This decision states that on 31 March 2017, all broadcasting in the band 694-790 MHz will cease and the band is available for broadband for the following day. The lower UHF band and the VHF band remain available for broadcasting. The NRA is developing the conditions for access to the 700 MHz band and authorisation is planned for Q4/2016.

United Kingdom (authorisation planned)
The UK regulator Ofcom launched on 28 May 2014 a public consultation about changing the use of the 700 MHz band to wireless broadband, which indicates 2022 as the deadline for the

changeover while an earlier date is possible (from 2020). The consultation closed on 29 August 2014. The UK has indicated that the lower UHF band is required for broadcasting for the foreseeable future.

Denmark (authorisation planned)
At the request of the Danish government, the Danish regulator and the Ministry of Culture has been studying the possible transfer of the 700 MHz band to broadband by 2020. The ensuing report, issued in June 2014, suggests that a transition would be beneficial, but requires using the most modern broadcasting standards. A new plan 'Digital Growth" released by the Danish Government in December 2014 includes as its first point the use of the 700 MHz for mobile broadband from 2020 onwards.

Ireland (authorisation likely)
The Irish regulator completed in June 2015 a cost-benefit analysis (CBA) for the repurposing of the 700 MHz band and issued the preliminary view that the 700 MHz band can and should be repurposed as this would represent its most efficient use. The CBA concluded that a net benefit of €91 million is to be expected for Ireland if the 700 MHz band is repurposed for WBB in 2018.

The Netherlands (authorisation likely)
In 2014, the Dutch government announced its intention to repurpose the 700 MHz band for WBB. A recent public consultation ended in June 2015.

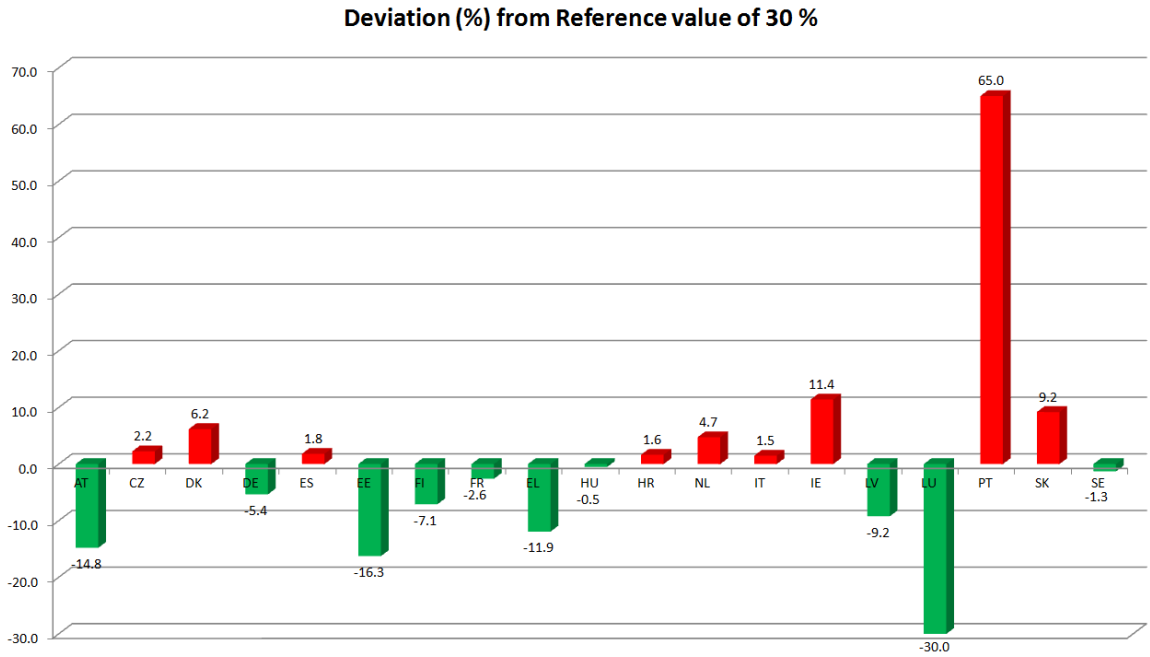
Status of other countries' (outside the Union) plans to repurpose the 700 MHz band
The 700 MHz band is allocated or commited to allocate in 42 countries worldwide according to the same technical conditions (compatible channelling arrangments and power levels) to be adopted at Union level (the so-called APT band plan) in Argentina, Australia, Brazil, Chile, Ecuador, Fiji, Japan, Mexico, New Zealand, Panama, South Korea, Taiwan. Currently, there are 11 networks active, in particular in Australia, New Zealand and Taiwan. Globally, only the USA and Canada (and Bolivia) have diverging channelling arrangments for the band – in both countries the 700 MHz band is already used for WBB.

10.5.7. Transition costs for the release of the 700 MHz band

An indicator for the level of impact in repurposing of the 700 MHz band is the ratio of 700 MHz assignments in operation vis à vis the total DTT operational assignments. The theoretical reference value is 30% (12 channels in the 700 MHz band over the total 40 channels in the 474 – 790 MHz range.

The average of the 19 countries for which data is available leads to a very similar value of 30,2%. Countries with a larger ratio than the reference value are more affected by repurposing of the 700 MHz band (red colour) and countries with a lower ratio are less affected (green colour).

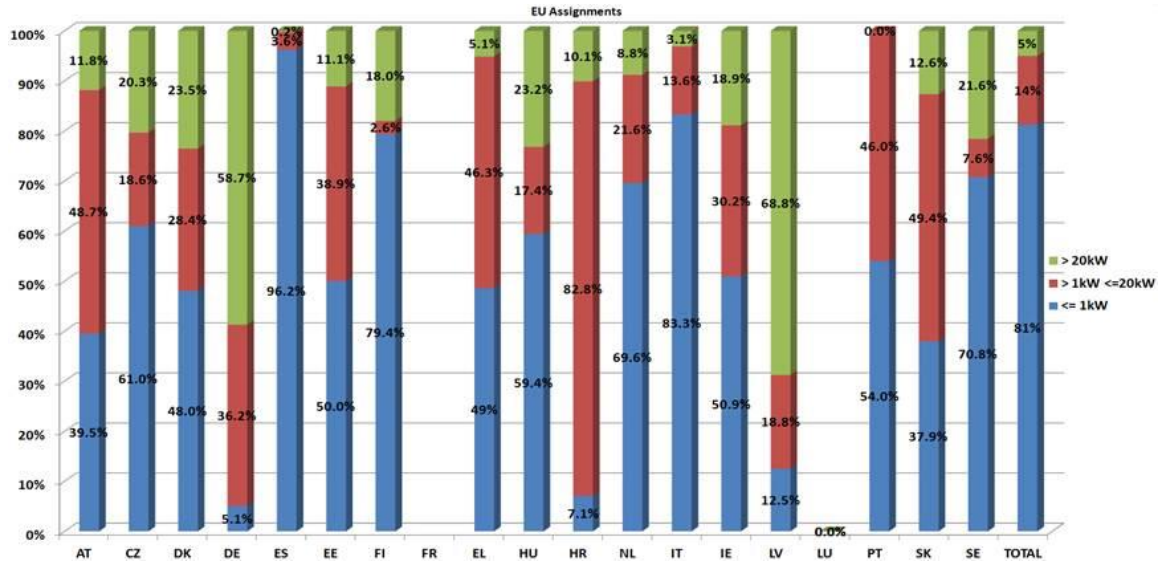
Figure 36 – Level of impact in repurposing 700 MHz band related to an average of 30%



Source: LS telcom & VVA (2015)

An additional indicator for the level of impact in repurposing is given by the transmitter power structure of the DTT network in operation as usually it is more difficult to find new channels for high power sites than for transmitters radiating with low power.

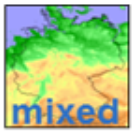
Figure 37 – 700 MHz transmitter power structure of 18 EU countries



Source: LS telcom & VVA (2015)

The selection of representative countries was based on three criteria depicted in the figure below: the type of terrain, the number of multiplexers and the percentage of assignments in the 700 MHz band.

Figure 38 – Selected countries and relevant criteria

	Terrain	No of MUX	700 MHz quota (%) (No)
Germany (DE)		3	25% (138)
Finland (FI)		9	23% (189)
Slovak Rep. (SK)		4	39% (87)
Greece (EL)		6	18% (214)
Spain (ES)		8	32% (2991)

Source: LS telcom & VVA (2015)

These representative countries were used to investigate the possibility of replacing the present DTT assignments in the 700 MHz band by available GE06 frequency resources below channel 49, i.e. restacking the current assignments by using only the sub-700 MHz band. A range of costs was estimated based on the expected effort per transmitter/site, which could differ. To retune a transmitter from a channel in the 700 MHz band to a channel in a sub 700 MHz band the effort expected can vary (some transmitters are easier to retune than others e.g. you need just a laptop and plug to the transmitter, the effort may also depend on the power category of transmitter, etc.):

- Min value – minimum effort for retuning
- Max value – maximum effort for retuning

Based on the restacking analyses of the 5 representative EU countries, the study team concluded that it is not possible to restack all the current assignments. Therefore further coordination effort of the regulatory authorities would be necessary to investigate if and how many additional new channels could be add to the GE06 plan. This process is currently undergoing.

The estimated restacking costs, developed on the available data of 18 EU countries and based on a different cost per power category, were benchmarked with the outcome of the results of the detailed analyses of the 5 countries and extrapolated to total costs for 28 EU Member States.

Figure 39 – EU28 restacking costs

Country	Total costs [€ million]	
	Min.	Max.
EU 28 MS	182	245

Source: LS telcom & VVA (2015)

Compared to available information regarding real restacking costs incurred for the repurposing of the 800 MHz band in Portugal, these estimated cost are correlating very well particularly for countries with similar network topology to Portugal.

An alternative scenario is that the present DTT system would be upgraded to DVB-T2 with the video coding standard MPEG4 or HEVC. In this scenario the costs were calculated assuming that the current number and quality of programs would be maintained. The costs are calculated for the necessary number of multiplexes using DVB-T2/MPEG4 or DVB-T2/HEVC (fewer are necessary with the HEVC coding standard).

Figure 40 – EU28 transition costs to upgrade to DVB-T2 (MPEG4 or HEVC)

	Broadcast Operators				Audio PMSE	Users			
Timeframe	DVB-T2/HEVC		DVB-T2/MPEG4			DVB-T2/HEVC		DVB-T2/MPEG4	
	Min	Max	Min	Max		primary	total	primary	total
2020	456	659	607	888	200	1602	3326	616	1253
2021	456	659	607	888	175	1235	2566	502	1020
2022	456	659	607	888	153	953	1979	408	831

Source: LS telcom & VVA (2015), IHS Technology (2015), European Commission (2015)

The cost of migrating to DVB-T2 are made up from a combination of equipment costs, which we would expect to fall over the time period, and engineering/staff costs, which we would expect to rise. Given the rough balance between these two different cost elements, we do not believe that the costs for these transitions would vary significantly from year-to-year.

10.5.8. Consumer costs for the release of the 700 MHz band

To calculate the cost of the replacement of user equipment, the following assumptions have been considered:

- An existing penetration of DVB-T2 receivers of 20% in DVB-T2 countries and 0% in DVBT countries in the current year (2015) and an existing penetration of HEVC receivers of 0%;

- A natural replacement cycle of receivers of 7 years will increase DVB-T2 receiver penetration starting 2015 and HEVC starting 2018, assuming that all receivers purchased from today onwards are DVB-T2 compatible;

- The cost of a replacement receiver has been taken to be that of a set-top box only since regardless of the television used, a new set-top box would be sufficient to provide consumers with the new service. The value used for 2015 are:

  – €40 falling 5% per year for a DVB-T2 set-top box;

  – €100 falling 10% per year for an HEVC set-top box;

In Options 2 and 3, the number of receivers that would need a forced replacement, that is to say, those receivers which, by the end of the period in question, would not have been replaced through natural or accelerated replacement would thus represent the cost of migrating all remaining consumer equipment to DVB-T2 or HEVC.

There are various values for the penetration of DTT in Member States. The values used by the study team have been taken from the 2013 Commission's Special Eurobarometer 396[65]. The Commission has run the estimation model with the IHS Screen Digest data for primary and total DTT penetration. The results for all 28 EU Member States for the three sets of DTT penetration figures are shown in the tables below.

Figure 41 – Cost of forced replacement of DVB-T2 MPEG4 compatible receivers, 2020-2022

Year	2020	2021	2022
Cost (€ million), Eurobarometer Penetration Figures			
-20% acceleration	1322	1112	936
Neutral	1122	913	744
20% acceleration	947	745	586
Cost (€ million), IHS DTT primary penetration			
-20% acceleration	945	795	669
Neutral	802	653	532
20% acceleration	677	533	419
Cost (€ million), IHS DTT total penetration			
-20% acceleration	1942	1634	1375
Neutral	1649	1342	1093
20% acceleration	1392	1096	862

Source: LS telcom & VVA (2015), IHS Technology (2015), European Commission (2015)

[65] http://ec.europa.eu/digital-agenda/en/news/special-eurobarometer-396-e-communications-household-survey

Figure 42 – Cost of forced replacement of DVB-T2 HEVC compatible receivers, 2020-2022

Year	2020	2021	2022
Cost (€ million), Eurobarometer Penetration Figures			
-20% acceleration	2452	1954	1558
Neutral	2222	1714	1322
20% acceleration	2007	1497	1116
Cost (€ million), IHS primary receiver			
-20% acceleration	1767	1408	1123
Neutral	1602	1235	953
20% acceleration	1447	1079	805
Cost (€ million), IHS total DTT penetration			
-20% acceleration	3670	2925	2332
Neutral	3326	2566	1979
20% acceleration	3004	2240	1671

Source: LS telcom & VVA (2015), IHS Technology (2015), European Commission (2015)

In Option 4, consumers would need to switch to another platform. For the purpose of cost calculation it was assumed that they would switch to cable (if available) or satellite. In this case the equipment costs are set at €40 for a cable set-top box and €200 for a satellite receiver kit (both falling 5% per year), the satellite figure includes €100 for installation.

Figure 43 – Cost of forced switch to cable or satellite receivers, 2020-2022

Year	2020	2021	2022
Cost (€ million), Eurobarometer Penetration Figures			
Neutral	1122-12588	913-11959	744-11361
Cost (€ million), IHS DTT primary penetration			
Neutral	802-9072	653-8619	532-8188

Source: LS telcom & VVA (2015), IHS Technology (2015), European Commission (2015)