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[p. 347] **Radio Spectrum Battles: Television Broadcast vs Wireless Broadband and the Future of PSB**

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Abstract

A principal incentive behind the move to digital television has been the release of radio spectrum in the attractive UHF band which can be used for other, notably wireless, services. This so-called digital dividend and related spectrum battles have heightened in recent years as evidenced by the negotiations in the World Radiocommunication Conferences. Frequencies are a core input to many industries and thus radio spectrum management has acquired high economic and political significance. Historically in Europe, the terrestrial platform has been critical for the delivery of PSB. But increasingly since 2007, digital terrestrial network operators have come under enormous pressure to relinquish frequencies in response to the looming spectrum crunch of the wireless broadband sector and the projected phenomenal demand for its services. The article argues that limiting spectrum access for the DTT platform should not be synonymous with a corresponding weakening of PSB. The often dry and technical debate on radio spectrum management cannot obscure what is really at stake. The values that PSB stands for need to be adapted to and guaranteed in a likely post-broadcast **[p. 348]** environment. The political, economic, social and cultural principles of PSB remain valid irrespective of the underlying delivery platform used. The debate on a platform-neutral PSB is currently not as prominent as the debate on the spectrum demands of the wireless broadband industry. At best, the two debates (future of DTT/ WBB spectrum and future of PSB) are conducted in silos. Radio spectrum management should not be used as an(other) excuse to weaken PSB. Debate and action based on a digital commons space and communication rights can provide the way forward.

Keywords: radio spectrum, public service broadcasting, policy, Europe, terrestrial television, wireless broadband

Introduction

A principal incentive behind the introduction of digital terrestrial television has been the release of radio spectrum in the attractive UHF band[1] and its subsequent use for other, notably wireless, services. This so-called digital dividend and related spectrum battles have heightened in recent years as evidenced by the negotiations in the World Radiocommunication Conferences. Radio frequencies are a core input to many, in what interests us, communication services and thus radio spectrum management has acquired high economic and political significance. Historically in Europe as a whole, the terrestrial platform has been critical for the delivery of Public Service Broadcasting (PSB). However, increasingly since 2007, digital terrestrial network operators have come under enormous pressure to relinquish more frequencies in response to the looming spectrum crunch of the wireless broadband (WBB) sector in the face of the projected phenomenal demand for its services.

The article explains that, given its centrality to the delivery of PSB in many countries in Europe, the discussion about the future of Digital Terrestrial Television (DTT) becomes in essence a discussion about the future of PSB. It argues that a weakening of the DTT platform by limiting spectrum access should not be synonymous with a corresponding weakening of PSB. The often dry and technical debate on radio spectrum management cannot obscure what is really at stake: how to adapt and secure PSB values in the emerging media environment, irrespective of which transmission platform(s) will succeed. The assumption is that the political, economic, social and cultural principles of PSB remain valid regardless of the underlying delivery mechanism. The debate on a platform-neutral PSB is currently not as prominent as the debate on the spectrum demands of the WBB industry. At best, the two debates (future of DTT/ WBB spectrum and future of PSB) are conducted in silos. The division of competences within the EU whereby the EU holds responsibility for infrastructure and economic issues whilst the member states retain responsibility for cultural matters does not help (Michalis 2007). Equally, variations in DTT penetration and its importance for the delivery of PSB as well as variations in the strength of PSB institutions within the EU are not conducive to a comprehensive

debate. Still, it is argued here that radio spectrum management should not be used as an(other) excuse to weaken PSB.

In what follows, the article first discusses radio spectrum management and explains its rising economic and political significance. The next section assesses the spectrum crunch narrative put forward by the WBB industry to justify its demands for more spectrum, and discusses developments and divisions in related international negotiations as well as their impact on actual national policies through the reassignment of spectrum from DTT to the WBB sector. **[p. 349]** Next, the article examines the main questions raised by the legacy spectrum users over the spectrum crunch claims of the WBB industry. There follows a discussion about the possible future of PSB centred on platform-neutral values, a digital commons space and communication rights. The article ends with a summary of the key arguments.

Radio Spectrum Management: the limits to market-based thinking and the need for regulatory intervention in the DTT/WBB battle

Radio spectrum appears to be a technical and dry policy area, even if critical to a wide range of media and communication services (e.g. public service, commercial, terrestrial and satellite television; radio; cellular mobile; wireless internet) but also other activities (defence, medical, scientific etc.). The radio spectrum is part of the electromagnetic spectrum. It is a natural but finite resource. The useable frequency range is between 3 Hz and 3,000 GHz (Laflin and Dajka 2007). Not all frequencies have the same characteristics which means that not all are suitable for a particular activity. For instance, the higher the frequency, the larger its bandwidth capacity (the more information it can carry) but the shorter its range and the distance it travels.

Frequencies do not stop at national borders and are susceptible to interference. For this basic reason radio spectrum has required regulation, nationally and internationally. Internationally, the International Telecommunication Union allocates frequencies to specific uses (e.g. satellite and terrestrial television, wireless broadband) and, for spectrum management purposes, it has divided the world into three geographical regions. Region 1, of interest to this article, comprises Europe, Africa and the Middle East. Region 2 is the Americas whilst, lastly, Region 3 comprises the rest of the world, Asia and Australasia. Then nationally, based on these international decisions, governments and regulators proceed with the assignment of

frequencies to specific users (e.g., television broadcasters, cellular mobile companies).

In the past, during the monopolistic media and communication orders, radio spectrum management was straightforward in the sense that governments had to satisfy three main users, typically all under state control: public/state broadcasters, telephone administrations and the military. These would get frequencies against no or a very small fee and the assumption was that they could keep them for life. Under the traditional command-and-control approach, governments would decide who could use the spectrum and how.

Since the late 1950s, radio spectrum management has steadily and growingly attracted the attention of economists emphasising its untapped economic potential. It all famously started with British born economist Ronald Coase who in 1959, studying the the Federal Communications Commission in the USA, argued that the aim of policy should not be to deal with market failure but rather to define property rights in relation to radio spectrum and other natural resources (Coase 1959). His unconventional ideas took three decades to be put in practice. Three factors pointing to the unattainability of the old consensus were crucial. Firstly, the gradual opening up of media and communication markets has resulted in more users needing spectrum (for instance, more broadcasters) whilst similarly, secondly, the advent of new technologies (notably cellular mobile and more recently broadband wireless) has further increased demand. The significant larger number of activities requiring spectrum and the concomitant increase of potential users have rendered spectrum **[p. 350]** management both more challenging and complicated. Lastly, the traditional 'government knows best' assignment method was criticised for being slow, bureaucratic, non-transparent and, to make matters worse, as providing no incentives for efficiency or technical innovation with regard to spectrum use. The response to these developments and shortcomings has been the growing introduction of less prescriptive market-based spectrum management methods, principally auctions, whereby the key decisions (who is going to get the frequencies and what their use will be) rests no longer with governments but with the market players themselves. The marketization of spectrum has the added advantage of raising precious revenue for cash-strapped governments.[2] Indeed, the auctions for mobile phone licences in the USA in the mid-1990s and some of the first 3G auctions in Europe in 2000 at the

height of the Internet bubble raised spectacular sums of money for governments thereby providing proof that the new economic thinking was working.[3]

However, as Sims et al. argue, the belief in the market as the best mechanism to manage spectrum was fundamentally shaken in the second half of 2000s in the face of the exponential growth of the WBB industry and the associated huge spectrum requirements, notably in bands already occupied by digital terrestrial broadcasters. In their words: '[i]t was a tacit admission either that liberalisation alone could not deliver, or that it was inherently a slow process, unfit for its biggest challenge so far.' (Sims et al. 2016: 6). It was clear that the competing demands on spectrum between the WBB industry and the incumbent DTT operators were not going to be settled by the market but required regulatory intervention and thus an at least partial return to the traditional radio spectrum management method.

In sum, within a short period of time, spectrum management has acquired high political and economic significance. In policy terms, as the case of DTT – WBB demonstrates, we are at a crossroads as the limits to spectrum liberalisation have become obvious and governments have taken it upon themselves to find a solution. It is maintained here that this recourse to the traditional spectrum management method where governments decide has the potential to facilitate the debate on the future of PSB as opposed to the scenario where the decisions would be left solely to the market, a scenario that arguably entailed a higher threat to public service policy goals.

From Spectrum Scarcity in Broadcasting to Spectrum Crunch in Mobile: (inter)national developments

Radio spectrum has always been central to broadcasting. In the early days, radio spectrum scarcity justified monopolies in television markets (Humphreys 1996). Technological advances, market liberalisation and neoliberal ideas stressing the value of spectrum as an economic resource have all contributed to end the initial era of spectrum scarcity in broadcasting.

Technological developments (notably the advent of cellular mobile, digital television and wireless broadband) and the large number of market players following the liberalisation of electronic communications markets have increased demand for spectrum, in particular for the most favourable frequencies which are all, however, already occupied. The most sought after frequencies, so-called "sweet spot", are the upper part of the Very High Frequency (VHF) band and the entire UHF band (Laflin

and Dajka 2007: 8). Various industries make competing claims upon them and spectrum management decisions have high economic and political stakes since they can open or close market opportunities.

[p. 351] In recent years, one of the most contentious radio spectrum debates in the International Telecommunication Union (ITU) Region 1 (Europe, Africa and the Middle East) has concerned the future of the UHF band and in particular the allocation of frequencies between the WBB industry which asks for more spectrum and the digital terrestrial broadcasters who, in Europe, occupy most of the band. The popularisation of smartphones and subsequently other Internet-enabled mobile devices (e.g. tablets) has fed into projections that demand for wireless data (notably video which requires a lot of bandwidth) stands to skyrocket and that, consequently, the industry is in dire need for substantially more spectrum. The belief that the WBB sector can advance economic growth and improve competitiveness, significantly more than broadcasting services (for Britain see Harvey and Ala-Fossi 2016: 8-9), makes the WBB spectrum demands hard to refute, especially given the recession ensuing the 2008 financial crisis. However, the terrestrial platform is historically associated in Europe with PSB. The debate therefore becomes more complicated as the future of the UHF band is inextricably linked to the future of PSB, as we shall see.

There are three main ways to address increasing demand for spectrum: change of use, spectrum expansion and substitutes. Change of use, for instance freeing up frequencies from broadcasting and reallocating them for use by WBB services, is possible but is an expensive and time-consuming process that requires careful planning. Another solution to accommodate growing demand for frequencies is to expand spectrum either extensively by using higher frequencies (some debates around 5G) or intensively by squeezing more capacity out of a smaller number of frequencies (e.g. the move from analogue to digital television). Finally, a third solution is to use substitutes and, for example, rely on wired distribution thereby releasing the previously occupied frequencies for another purpose. Switching off terrestrial television completely in favour of satellite, cable and IP distribution of television signals would be a case in point here.

The quest for more frequencies to accommodate the projected exponential growth of WBB has relied on all three solutions. In policy terms, these solutions require international and national decisions. The international policy level has been crucial in the WBB spectrum crunch debate. The ITU can identify and allocate more

spectrum to specific services/ industries by revising its intergovernmental treaty (the Radio Regulations) at its World Radiocommunication Conference (WRC) which takes place every three to four years.

In 2006, in preparation for the WRC-2007, the ITU estimated that between 1280 and 1720 MHz of spectrum was needed to be allocated to the WBB sector by 2020 for 3G and 4G mobile communications, a target which the respective industry standing to benefit applauded enthusiastically (Decision 2012, para. 22). The WRC-2007 dealt with the so-called first digital dividend, that is the spectrum that could be released following the completion of the switchover from analogue to digital terrestrial TV given that the latter requires less spectrum. The freeing up of frequencies, especially in the valuable UHF band, could contribute towards satisfying the increasing demand for spectrum by the fast-expanding wireless industry. However, given differing national circumstances, the WRC-2007 could not agree on the same band for all its three Regions. Thus, whereas for Region 2 (Americas) and Region 3 (Asia-Pacific) the first digital dividend would be on the 700 MHz band, in Region 1 (Europe, Africa and the Middle East) the first digital dividend would be on the 800MHz band (Delaere and Cullell-March 2014). This lack of harmonisation across the Regions reflected the heavy reliance on the UHF band for the delivery of terrestrial television in several European countries.

[p. 352] But there were divisions within Region 1, reflecting existing investment and penetration rates of DTT and WBB. Overall, Africa and the Middle East enjoyed more freedom in relation to UHF decisions and at the same time they had greater need to assign (more) spectrum to WBB to facilitate access to the Internet through wireless devices and thus be able to reap associated economic and social benefits. Ironically, having trailed behind Europe in the roll-out of terrestrial analogue television and the subsequent switching process from analogue to digital TV meant that they were not held back by the legacy of earlier policy decisions and infrastructure investments. Africa and the Middle East could turn their perceived earlier ‘technological lagging behind’ manifested in the low availability and penetration of terrestrial television to their advantage now: they would be able to potentially release frequencies to WBB faster and at a fraction of the cost and inconvenience experienced in Europe and, equally important, their later move to digital terrestrial television meant that they could benefit from subsequent more spectral efficient technologies and thus release more spectrum (Stirling 2012).

The proposal to repurpose the 700 MHz band for WBB shortly before the WRC-2012 at the insistence of African and Middle Eastern countries came as a surprise to Europe. These countries (notably the UAE, Egypt and Nigeria) argued that: for them, the 700 MHz band would be essentially the first digital dividend, and not the second as in Europe, given that the 800-MHz band was used by other services such as national defence; the allocation of the 700 MHz band to mobile would harmonise its use across all ITU Regions allowing the industry to benefit from economies of scale; and lastly, given the favourable propagation characteristics of the band, it would contribute to closing the digital divide (El-Moghazi et al. 2014: 6).

In the end, the WRC-2012 decided that the second portion of the UHF band, the 700 MHz band, should be shared by both broadcasting and mobile services (co-primary status) in Region 1 as of 2015. In contrast, in the rest of the world, the 700 MHz band was to be assigned exclusively to wireless broadband.

Meanwhile, Europe was still dealing with the first dividend. In its first radio spectrum policy programme adopted in 2012, the EU required all its members to reallocate the 800 MHz to WBB services by 2013 and set the target of 1200 MHz of spectrum for WBB by 2015 (Decision 2012). This reallocation took more time than originally anticipated. The WRC-2007 allocated the 800 MHz band on a co-primary basis to broadcasting and mobile broadband, providing flexibility to individual countries to use the band for either activity. This resulted in variations and delays within the EU as some countries decided to assign the 800 MHz band for non-mobile uses, including digital television, whilst other countries, starting with Germany where traditionally the terrestrial platform has not been significant for the transmission of television, opted to auction the spectrum and allow its use for 4G.

Furthermore in 2013, in response to the WRC-2012 decision concerning the 700 MHz band, Commission Vice-President Neelie Kroes asked Paschal Lamy (former EU Trade Commissioner and WTO Director General) to chair a High Level group bringing together representatives from the broadcasting, media and mobile sectors tasked with finding an agreed position on the future use of the UHF band. It was not possible for the Group to reach consensus and the report presented to the Commission contained effectively the personal views of Lamy based on the discussions of the Group. Lamy recommended the so-called 20-30-25 formula, namely the 700 MHz should be repurposed **[p. 353]** by 2020 (give or take 2 years),

that the DTT platform should be guaranteed until 2030, and that finally a state-of-play review should take place in 2025.

The subsequent WRC-2015 endorsed the use of the 700 MHz band for wireless broadband for Region 1 too, thereby harmonising this band throughout the world with significant industry and economic benefits in terms of scale and reduced cost of consumer devices (GSMA 2015). It also ruled the exclusive use of the sub-700 MHz band, the last and only remaining UHF spectrum, for broadcasting in Region 1.

In response, in February 2016, the European Commission**,** endorsed the Lamy formula and presented a proposal for a common deadline for the repurposing of the 700 MHz band for mobile services under harmonised technical conditions whilst securing the sub-700 MHz band for DTT and thus providing regulatory certainty in the markets where DTT has a significant presence but at the same time allowing flexibility so that that can also be used for downlink-only wireless broadband electronic communications services (from the network to the user's receiving equipment) in order to cater for national variations in DTT reliance (EC, 2016a). In addition to the WRC-2015 outcome, the Commission linked its proposal to the Digital Single Market strategy and, of course, the growing demand for wireless broadband and the estimate that by 2020 mobile internet traffic would have grown eightfold.

The 700 MHz band is a 'sweet spot' for WBB operators because it can provide high transmission speeds together with wide coverage servicing rural areas and improving coverage indoors in urban areas, and it can also promote investment in innovation around 5G and the Internet of Things. Furthermore, satisfying the spectrum needs of the WBB industry is seen as crucial in the efforts to make Europe a global leader in 5G with all the accompanying economic benefits. Coordinated European action played a crucial role in Europe's leadership in 2G (GSM) in the 1990s, a position that Europe relinquished in subsequent generations but is now hoping to regain in the 5G race. Releasing and repurposing spectrum for WBB early is therefore vital. Indeed, France and Germany have already assigned the 700 MHz band to WBB whilst at least four other (Denmark, Finland, Sweden and Britain) will complete the process in the next few years. Divergent national approaches are already visible even though the Commission explains that common action is needed.

Similar to the repurposing of the 800 MHz band, the cost of clearing the 700 MHz band will fall onto terrestrial television network operators, terrestrial broadcasters and viewers. In particular the latter would incur costs yet again as they

would need to upgrade their reception equipment in advance of the normal equipment renewal cycle all in the name of spectrum efficiency without any benefits this time. In fact, in some cases, the services available following the squeeze of the DTT platform to the sub-700 MHz band will diminish as this band will not be always able to support all current services as will be the case in Italy and Spain, two countries that witnessed the launch of many new mostly local channels with the introduction of digital television. Still, the economic rationale behind the repurpose of the 700 MHz appears extremely strong (data from EC 2016b). Against a total cost of €1.3 to 4.5 billion, the Commission, based on the proceedings from previous spectrum auctions, expects the repurposing of the 700 MHz band to generate around €11 billion. The Commission's data thus suggest that the costs associated with the clearance of the 700 MHz band from its current DTT use dwarf the overall revenues by €9.7 to 6.5 billion, an extremely enticing incentive in the current austerity times.

[p. 354] **Questioning the Spectrum Crisis**

The WBB industry has identified various bands that could be reassigned to it. Understandably, the incumbent spectrum users which include terrestrial broadcasters, governments, and satellite operators dispute the projected substantial spectrum demands put forward (Womersley 2015: 20). Although nobody doubts the increase in demand for mobile broadband capacity, what is questioned is the accuracy of the traffic projections and associated spectrum requirements by the WBB industry (does the WBB industry really need so much more spectrum?).

Some commentators question the very concept of spectrum crisis. For instance, in her book on the US telecommunications and internet markets, Crawford is critical of the "spectrum crisis" argument, forcibly pushed by wireless operators. She documents how, by 2011, the two main wireless operators AT&T and Verizon had succeeded in "[framing] both the policy problem (more spectrum capacity!) and its solution (take spectrum away from the broadcasters and give it to broadband!)" (Crawford 2013: 243). In refuting the "spectrum crisis" argument, Crawford maintains that the two US companies possessed plenty of spectrum already and what was needed was investment in additional towers and wires (connecting towers to fibre) in order to improve wireless transmission. But, she explains, such capital expenditure would reduce the companies' return on capital and investors do not like that.

Beutler goes as far as to suggest that the demands for more spectrum by the WBB industry have less to do with mobile traffic projections and rather they are more an excuse to limit competition:

> 'the major incentive to get hold of the entire UHF band is not shortage of spectrum but rather the attempt of mobile network operators to get rid of a powerful competitor (ie. the broadcasters) in their effort to gain ground in the hard-fought market segment of audiovisual content provision.' (2015: 26)

Looking more closely at the traffic projections, at least five factors raise reasonable doubts about the spectrum needs of the WBB industry. The first has to do with the very wide estimates of the growth of mobile data. Studies, most of them backed by the WBB industry, push some to question the validity of the projections. Interestingly, Cisco, which has been publishing annually an influential study on traffic projections and growth trends for a decade, has revised its traffic growth forecasts downwards twice now (see VNI 2014 for downward revisions in the 2013 report and similarly the 2013 for revisions in the 2012 report). Mehta and Mussey (2015: 315) assessed the reliability of mobile demand projections and concluded that in the past seven Cisco forecasts 'overestimates were nearly twice as frequent as underestimates (19 vs. 10)' whilst, moreover, overestimates were 'on average of greater magnitude than underestimates (103 vs. 81 [petabytes]/month).' They found that industry forecasts produced the highest mobile traffic growth projections, not surprisingly since network providers or equipment manufacturers, such as Cisco, stand to benefit directly from such high projections. They noted that independent research firms with 'a less direct relationship to the benefits of additional spectrum allocation' to broadband wireless produced lower projections but noted that such firms may still have 'institutional relationships and biases that potentially hinder complete objectivity' (p. 318). And yet, the **[p. 355]** various industry and research projections are endorsed without verification by national and international regulatory bodies (e.g. FCC in the USA and the ITU) which then base policy decisions on the allocation of spectrum resources on them.

The second factor has to do with current consumption patterns. Not only is there no consensus about how much data will travel on mobile networks but, if current practices are any indication for the future, despite the increasing penetration of Internet-enabled mobile devices and additional spectrum granted to the mobile industry most of the data will not travel through cellular mobile networks but continue

to be offloaded onto Wi-Fi networks.[4] As mobile users 'are increasingly using Wi-Fi connections for calls and texts as well as data … they have ever less need for a mobile connection, no matter how blazingly fast it may be.' (Anon. 2016). Indeed, according to Cisco's latest annual publication on traffic projections, Wi-Fi offloading has been growing over the years, despite continuing investment in faster mobile networks and increased coverage. Cisco notes that in 2015 for the first time more than half of mobile data traffic was offloaded onto the fixed network through Wi-Fi and this trend shows no signs of slowing down (Cisco 2016: 1). Cisco (2016: 21) expects offloading to increase to 55% in 2020. Paradoxically, Cisco observes that 'Wi-Fi offload is higher on [faster] 4G networks than on lower-speed networks' and it expects that it will rise from 56% at the end of 2015 to 58% by 2020. In short, faster mobile networks have not diminished the rising offloading trend and will not render fixed networks obsolete. Instead of platform convergence where mobile and IP will take over, what we see is platform co-existence and complementarity. Lamy (2014: 4) was right to note that the broadcast-broadband convergence is not going to materialize 'for a long time.'

The third factor that questions the spectrum needs of the WBB sector is the growing interest in wholesale networks. This refers to mobile operators sharing infrastructure, a practice that is more commonplace with newer generations of mobile technology. Network sharing makes economic and environmental sense but it means at the same time fewer separate networks and in turn less pressure on spectrum. Indeed, Cave and Webb (2015) as well as Sims et al. (2016 Part IV) identify a policy shift towards spectrum sharing, not least in response to the shortcomings of the market-based assignment mechanisms (principally auctions and trading).

The fourth and related factor is the trend towards market consolidation. In recent years, the number of mobile operators in Europe has decreased as a result of mergers in various countries, including Ireland, Germany and Austria. In January 2016 in Britain, the regulators approved the £12.5bn merger between the largest fixed operator BT with the largest mobile operator EE thus allowing the former to enter the mobile market and provide quad-offers (CMA, 2016). The increased consolidation in the European mobile markets and the concomitant reduction in the number of operators arguably reduce demands on spectrum by the WBB industry without sacrificing its growth.

Finally, the mobile industry in Europe acquired significant parts of the radio spectrum in anticipation of its investment in 3G and 4G. It is unclear how much of the already allocated spectrum the industry is using and as such what the incremental benefits of releasing yet more spectrum to the WBB industry would be (Ratkaj 2013): what could the industry deliver with the additional spectrum it asks for that cannot be delivered on the significant amounts of spectrum already granted and that will be so extraordinary so as to justify the disruption and threat to the economic, social and cultural **[p. 356]** benefits of DTT that such a reassignment of frequencies entails? Furthermore, despite the uncertainties surrounding the next generation of mobile technology (5G), it appears that spectrum outside the UHF band (for instance, above 3 GHz) could be useful and, more importantly, could be provided with considerably less disruption and without threatening the benefits the DTT generates (Anon. 2016).

The value of DTT in Europe and the future of PSB: digital commons, communication rights and the importance of distribution

The breakthrough in digital compression technology in 1990 in the USA, ushered in the race for fully digital television. The transition to digital television has been country specific shaped by national characteristics as well as policy and infrastructure legacies (Starks 2013). DTT has been the most controversial and lengthy platform transition, strongly linked to the future of PSB. The migration process has been costly for terrestrial broadcast network operators, broadcasters and consumers. Besides the benefits of digital television (more channels, new formats notably high definition and interactive television, and higher quality sound and picture), one core incentive behind the push for DTT has been the spectrum efficiencies it can deliver and the consequent release of frequencies to be reallocated for use by WBB services believed to contribute to greater economic growth, frequencies which can be auctioned and raise revenue for governments (Galperin 2004).

In Europe, the UHF band has been reserved historically for terrestrial television and is critical for the delivery of DTT. In fact, in contrast to the WBB sector that can rely on non-UHF frequencies (for instance, on higher bands) to support their services, the UHF band is the only band that is suitable for broadcasting.

Despite differing penetration rates, the DTT platform is considered important in most European countries. Almost half of all households (250 million people) rely on DTT whilst the EBU (2014a) estimates that live TV viewing will continue to be

important and still account for over 80% of TV consumption in 2020. In some Southern European countries (such as Greece, Italy and Spain), the DTT platform is dominant. Even in countries where the DTT platform has been facing strong competition from cable, satellite and IPTV (like France and Britain), DTT remains the only platform that offers universality. In Britain, for example, according to the latest available data, in 2014, 41% of households received television via DTT only whilst DTT was the dominant tv viewing platform at just under 45% compared to the second higher, the satellite platform with a 40.5% share, a percentage that has not increased since 2010 (Ofcom 2016: para. 3:10). This indicates that television consumption platforms and patterns are more resilient than market forecasts would lead us believe.

The DTT platform is often the pillar of PSB delivery and key in supporting crucial public policy goals (for instance, Ofcom 2014). It offers innovation and competition to other (typically subscription-based) television platforms. Moreover, as a key platform for many major broadcasters, DTT supports considerable investment in original content and thus promotes European cultural diversity. The DTT platform is a cost effective and reliable means of delivery that offers unparalleled reach and original quality programming (including news), all important in encouraging active citizenship and enhancing common experiences and social cohesion. With no gatekeepers and no encryption, it is the only platform in most European countries that can deliver **[p. 357]** these substantial economic, political, cultural and social benefits to citizens free at the point of access. Another important advantage of the terrestrial platform is that it is national and hence allows governments to retain strong regulatory powers over broadcasting services as opposed, for instance, to satellite and IP distribution which can be based and controlled from outside a country's borders. These core benefits are closely interdependent so that a change in one (for example, weakening the DTT platform) will impact upon others (associated economic, political, cultural and social benefits).

At the moment, there is no other platform in sight that can credibly support broadcasting and has the same reach as DTT.[5] Mobile broadcast and IP technologies cannot, at least in the foreseeable future, meet the same levels of quality, universality and cost-effectiveness that the DTT in the UHF band offers (EBU 2014b, Goggin 2012, Plum Consulting and Farncombe 2014). Besides technical questions, various operational and policy issues remain unresolved. For instance, data caps in pricing schemes would not allow the consumption of television content (unless it is offloaded

on WiFi networks as is currently the practice) or would make such consumption prohibitively expensive; the extent to which mobile broadcast technologies can support simultaneous viewing is unclear; and consumer devices that can support mobile broadcast are not widespread (EBU 2014c: 45).

It is not just that the new distribution platforms (cable, satellite, IP, mobile) have intermediaries and, unlike terrestrial broadcasting, carry the risk of rent-seeking gatekeepers, it is also the case that the new distribution platforms are typically commercial and interested in creating and exploiting artificial scarcities for financial benefit. As Martin explains, the digital ubiquity newer technological platforms, like mobile and IP, promise on the one hand offers the potential of expanding the reach of PSB and enabling participation but on the other hand it entails greater reliance on corporate players, 'private control over public resources and communications,' deeper surveillance of citizens/ users, and ultimately the further entanglement of PSB in the agendas of a few transnational technological giants and the structures of informational capitalism (2016: 7, 16). Multiplatform presence involves significant distribution costs whilst it seems that there will continue to be a need for regulatory intervention that will ensure the presence, easy findability and affordability of public service content. This brings us to the concept of a commons.

The weakening of the DTT platform can become a symptom and a cause of the broader trend of reducing the public sector and of the intensifying enclosure of the (digital) commons (Murdock 2005). For Murdock, PSB can be the pivot of digital commons space, 'a linked space defined by its shared refusal of commercial enclosure and its commitment to free and universal access, reciprocity, and collaborative activity' (2005, p. 227). Moe (2011) finds Murdock's idea of a commons space valuable for guiding communication policy in conceptualising public service beyond broadcasting even though this space could encompass services and content from a variety of other actors too, including libraries, museums and civil society.

The above discussion illustrates the key argument of this article. The starting point is that distribution and content are interrelated. Distribution – how we find and get content – matters as much as the content we access (Michalis 2014). What is at stake at present is not the future of a distribution platform as such but rather what this platform stands for. The weakening of the terrestrial television platform by limiting its access to frequencies entails serious implications for innovation and competition in the field of distribution but also, **[p. 358]** crucially, for the terms of access to public

service content and very likely for public content creation too. What is at stake is the future of PSB, its values which are preconditions for the delivery of core public policy objectives in a democratic society: public content free at the point of consumption, independence, universality of access and appeal, quality content, all facilitating social inclusion and political participation in society (BRU 1985). The case for PSB remains valid and powerful (e.g. Brevini 2013). A recent report on the future for public service television in Britain underlines the continuing relevance of these values of 'independence, universality, citizenship, quality and diversity' and argues that these need to be embedded into the regulation, funding, and I would add distribution, of PSB in the changing media landscape (Future of TV 2016, 155). Interestingly, the BBC Strategy Paper in October 2015 defines PSB referring to '[a]ccess to culture, media and information' as 'a basic human right' (BBC 2015: 9). In other words, the justification for the BBC/ PSB is no longer about public value but it is about fundamental rights; PSB is an entitlement.

A DTT switch-off is unlikely until at least 2030. The challenge till then is to try to replicate, and even enhance, the existing strong economic, social, political and cultural benefits currently associated with the DTT platform, discussed above, to the evolving digital media environment. Murdock's idea of a digital commons space and the (re)emergence of a rights-based discourse[6] provide useful directions for policy debate and action. A citizens-centred digital commons, as opposed to a commercially enclosed one, can promote communication rights facets of which include access to information, equal distribution of commutative resources and power, the promotion of trust and understanding in contemporary societies. Both notions (digital commons – communication rights) emphasise the central role of PSB organisations but at the same time acknowledge the contribution other actors can make, including museums, galleries but also local communities. In addition, both concepts allow us to go beyond a simple reconceptualisation of PSB in the post-broadcast multi-platform environment to address contemporary policy issues such as persistent restrictive structural characteristics of the media market, notably concentration of ownership, and newer concerns such as the emergence of new gatekeepers in the delivery of public service content (e.g. powerful platforms). This last point draws attention to the need to include the *distribution* of content (how we find it and how it is delivered) to the debate on PSB as distribution carries significant public interest implications.

Conclusion

This article started with a discussion of the intensifying pressures in Europe to release more UHF spectrum from DTT in order to accommodate the expected phenomenal growth of the WBB sector. This so-called digital dividend debate has heightened in recent years as evidenced by the negotiations in the World Radiocommunication Conferences, especially from 2007 onwards. These developments manifest the critical economic and political significance of the radio spectrum. The article moved on to critically assess the spectrum crunch narrative put forward by the WBB industry to justify its demands for more spectrum and looked into the arguments put forward by legacy users and other commentators.

It has been argued that the seemingly technical and dry area of radio spectrum management should not obscure the vital economic, social, political and cultural and issues that are at stake and are supported by PSB. The DTT platform **[p. 359]** in Europe is often the pillar of PSB delivery and associated public policy goals. The future of a single platform (DTT) should not be aligned with the future of PSB values so that the weakening of one automatically signals the weakening of the other. Rather the debate on the future of the DTT platform can be turned into an opportunity and used to strengthen calls for a technology-neutral definition of PSB and its continuing, if not reinforced, significance in the emerging multiplatform environment. The article discussed some serious doubts about the all IP future scenario and its feasibility but even if we agree that the future lies with IP networks, the key question remains: how can we replicate and even strengthen the existing economic, political, social and cultural benefits that we have at present in the DTT world? Policy debate and action based on a non-commercial citizenship-focused digital commons space as a precondition for the support of communication rights can provide a way forward. This is a difficult but not impossible task that will shape the society we live in.

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Endnotes:

[1] Ultra-High Frequency (UHF) band (470-790 MHz).
[2] Not all spectrum auctions have been successful in financial terms.
[3] In Britain, in 2000, the Treasury raised €39bn (£22.5bn) whilst the proceeds from the German 3G auctions later that year were €50.5bn (£30.3 bn).
[4] The Wi-Fi industry uses unlicensed spectrum primarily in the 2.4 GHz band.
[5] There are exceptions like Belgium and the Netherlands which historically have had an extensive cable infrastructure.
[6] For an historical and geographical overview see Padovani and Calabrese 2014. For a recent account see Aslama Horowitz and Nieminen 2016.