New Business Strategies and Marketing Opportunities Exploiting TV White Spaces

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Abstract: - Radio spectrum when used appropriately is an important catalyst for the flourishing of economic activities through broadband wireless services provision. The radio spectrum suitable for the propagation of wireless signals is a limited resource and hence requires optimal allocation as collectively dictated by regulatory, technical and market domains. The current global move to switch from analogue to digital terrestrial television has opened up an opportunity for the re-allocation of this valuable resource. In one way, spectrum bands once used for analogue TV broadcasting will be completely cleared – leaving a space for deploying new licensed wireless services, and in another way, digital terrestrial television technology geographically interleaves spectrum bands to avoid interference between neighbouring stations – leaving a space for deploying new unlicensed wireless services. In this context, this paper elaborates on new business strategies and marketing opportunities, which arise, by exploiting geographically interleaved spectrum, also known as TV White Spaces (TVWS).

Key-Words: - TVWS, Digital Dividend, Spectrum trading, marketing opportunities, business strategies

1 Introduction

Information and Communication Technologies (ICTs) have drastically changed the world in which we live. With increased interconnections in economic activities, knowledge sharing, entertainment, socializing etc, billions of people around the world today are utilizing ICTs to function in real-time across the world without delay and with blurred distinction between physical and digital experiences. These experiences are further magnified by access to mobile broadband networks where the limitations of wire-line access are overcome by giving people the ability to communicate anytime and anywhere. From the European Union's (EU) perspective, the Lisbon Treaty envisions providing significant improvements in mobile broadband, multimedia and Internet access to European citizens. To this end, the European Commission is putting forth efforts to make a pan-European mobile broadband network become a reality through harmonizing the spectrum usage of the 27 EU Member States, especially by creating an innovation space in the "Digital Dividend", after the re-allocation of broadcast spectrum.

The broadcast spectrum is a low frequency spectrum in the VHF and UHF portion of the radio spectrum; a portion that has traditionally been used exclusively by television broadcasters for analogue transmission. The spectrum section offers attractive features like high building penetration, wide coverage, and moreover, the wavelength of UHF bands signals is sufficiently short such that resonant antennas with sufficiently small footprint can be used which are acceptable for many portable use cases and handheld devices. However, regulatory rules do not allow the use of unlicensed devices in the TV bands, with the exception of remote control devices, medical telemetry devices and wireless microphones. Currently, there is a global move to convert TV stations from analogue to digital transmission. This is called the digital switch-over (DSO) or in some cases the analogue switch-off (ASO) referring to the time when digital transmission effectively starts, or when analogue transmission effectively stops operation respectively.

Although the DSO process is underway in EU countries, the ASO process will differ from country to country depending on the market configuration. It is predictable that the European Commission's call for the completion of the ASO process by 2012 will be difficult to achieve for some Member-States. On the other hand, however, it is expected that the experiences of countries that have completed the ASO process or undertaken extensive planning will provide useful lessons for countries only beginning the planning process.

Due to the spectrum efficiency of Digital Television (DTV), some of the spectrum bands used for analog TV will be cleared and made available for other usage. Moreover, DTV spectrum allocation is such that there are a number of TV frequency bands which are left unused within a given geographical location so as to avoid causing interference to co-channel or adjacent channel DTV transmitters; the spectrum bands are geographically interleaved. The cleared bands and the unused geographical interleaved spectrum bands provide an opportunity for deploying new wireless services. These opportunities create what is called the "Digital Dividend". For the European Commission, the "Digital Dividend" (i.e. cleared spectrum and geographical interleaved spectrum) [1] constitutes a great opportunity to achieve important goals of the EU Lisbon strategy [2], especially in the area of providing mobile broadband Internet access.

Market analysis indicates that the "Digital Dividend" in Europe is a unique opportunity to realize economic/social benefits across EU countries. This is a key to maintaining Europe's competitiveness – especially given "Digital Dividend" advances in other regions. Secondary markets initiatives in Europe generally lag the rest of the developed world – there has been very little progress in the development of comprehensive frameworks for secondary trading at European level.

The "Digital Dividend" could be valuably employed by Cognitive Radio (CR) technologies. CR technology [3] is a key enabler for both real-time spectrum markets [4] and dynamic sharing of licensed spectrum with unlicensed devices. It performs spectrum acquisition, either through purchasing (in cleared spectrum) or sensing (in vacant bands (e.g. geographically interleaved spectrum), over a range of frequency bands, dynamically acquires unused spectrum, and then operates in this spectrum at times and/or locations when/where it is able to transmit in a non-interfering basis, while achieving its service's Quality of Service (QoS). Currently Cognitive Radio systems are being intensively researched for proper access to the TV White Spaces (TVWS) which become available on a geographical basis after the digital switchover [5].

In 2009, the Radio Spectrum Policy Group (RSPG) published the final draft of their report on 'Cognitive Technologies' [6], which makes explicit comments on the possibility of supporting trading mechanisms for CR technologies. This report describes the vertical and the horizontal models for the licensed sharing of spectrum. The vertical model, which is most likely of more relevance, envisages the licensed user (i.e. the DTT broadcaster, allowing secondary usage of its spectrum at locations and times that it is not used). The horizontal model, on the other hand, is of less relevance to horizontal sharing because it pools all the spectrum held by a group of licenses such they can then access that spectrum according to their given demand profiles.

Globally, the active secondary trading of spectrum is still more a concept than a reality. There are a number of milestones that may mark the inception of secondary spectrum trading in the global context. Notably, New Zealand commenced spectrum trading in 1987, Guatemala in 1996, Australia commenced in 1997 and both the Federal Communications Commission (FCC) [7] and Ofcom [8] adopted spectrum trading regulations in 2004. However, there has been little activity in the economic/business and regulatory development of an active secondary trading environment for micro trades of the kind that we might envisage in the TVWS context. The development of secondary

trading systems in Europe is delayed when compared with the rest of the developed countries. For this case, research activities [5] envision filling this gap by investigating mechanisms for secondary spectrum trading and proposing relevant means to enable the existence of a secondary spectrum regime in the European context.

For the successful development of dynamic spectrum trading mechanisms and marketable wireless service provision models in TVWS, the intersection of the influences from regulatory, technology, and market potential aspects, is first need to be analyzed. To this end, this paper aims at analyzing the digital switchover roadmap in Europe and surveying the trends in the TVWS market in order to indentify new business strategies and marketing opportunities in the field of Information and Communications Technologies (ICTs). Following this introductory section this paper analyses digital switchover roadmap in Europe in section 2 and surveys the trends in the TVWS market in section 3. Finally, section 4 concludes this paper.

2 Digital Switchover from analogue to digital terrestrial television

The digital switchover process is underway. Around the world, countries have launched their Digital Terrestrial Television (DTT) services and begun planning to switch off their analogue networks. But analogue switch-off is not an easy process. Ending the transmission of analogue services may have terrible consequences if viewers are not adequately prepared and governments want to ensure that proper safeguards are taken. For this reason careful planning and the involvement of the entire broadcast industry is required.

The process of analogue switch-off will differ in countries depending upon the market configuration. Countries with many households relying on the terrestrial platform need to take different measures than countries with few terrestrially dependent households. The experiences of countries that have completed analogue switch-off or undertaken extensive planning can provide useful lessons for countries only beginning the planning process. Understanding which approaches work best, as well as pitfalls that should be avoided, can help ensure a successful process. The transition to digital terrestrial television at present is largely a preoccupation of the advanced economies of the world and the major markets are the USA, Japan and Europe – and, within Western Europe, the UK, Spain, Germany, Italy and France.

The switch-over from analogue to digital terrestrial TV in Europe will free up highly valuable radio frequencies due do the greater efficiency of digital broadcasting transmission. The “Digital Dividend” spectrum will become available throughout Europe within a relatively short space of time, as all Member States should complete the switch-off of analogue TV by 2012 at the latest. It is essential that this window of opportunity is used to ensure an appropriate level of coordination in the European Union to reap the full social and economic benefits possible from access to this spectrum, and to provide a clear EU roadmap for Member States moving ahead at different speeds as a result of differing national circumstances.

The opening of the “Digital Dividend” spectrum for different services creates an opportunity particularly for wireless broadband network operators to gain valuable radio spectrum. This would allow for more effective competition in the provision of broadband services. As of late 2009, ten countries had completed the process of turning off analog terrestrial broadcasting. Many other countries had plans to do so or were in the process of a staged conversion. The first country to make a wholesale switch to digital over-the-air (terrestrial) broadcasting was Luxembourg, in 2006, followed by the Netherlands later in 2006, Finland, Andorra, Sweden and Switzerland in 2007, Belgium and Germany in 2008, and the Denmark and Norway in 2009.

The Member States that launched DTT early mainly broadcast using MPEG-2 compression technology, while Member States that have recently launched, or are yet to launch (such as Ireland, Latvia, Lithuania, Romania, and Slovenia) plan to use MPEG-4 compression technology from the outset. Austria, Denmark, Finland, Germany, Italy, Luxembourg, Portugal, Sweden and the UK all consider future migration to the MPEG-4 standard to be highly likely. In particular, Sweden and Denmark intend to simulcast using both the MPEG-2 and MPEG-4 standards in the foreseeable future.

The average simulcast period for analogue and digital terrestrial TV in Member States is about 5.5 years. Smaller Member States with extensive cable infrastructure/take-up, such as the Netherlands and Luxembourg, switched off their analogue TV signals nationally overnight. Germany, as a larger nation with extensive cable infrastructure, adopted a regional digital switchover plan and had a simulcast period of almost six years. In contrast, in the UK, where terrestrial TV is one of the main TV platforms, simulcast is expected to occur for a total of 14 years prior to ASO.

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Member States have varying approaches to their DSO plans. The pace at which they are being executed appears to depend on geography, the television platform landscape, policy objectives and political will, as well as the level of technological advancement. In general, Western European Member States have started, and are likely to complete, their DSO before Eastern European Member States. Indeed, five (Finland, Germany, Luxembourg, the Netherlands and Sweden) have already switched off their analogue transmissions.

The European Commission's call for the completion of analogue switch-off by 2012 may be difficult to achieve for some Member-States. Based on currently available evidence, it can be generally assumed that the digital switchover process will take between 14 years (as in the United Kingdom) and 3 years (as in the Netherlands) from the time of the first launch of DTT services to the switch-off of the last analogue services. Factors that will influence the process include the number of viewers relying on the terrestrial television platform, spectrum availability, and the penetration of DTT services.

Countries that have already launched DTT services and begun to switch-off their analogue terrestrial platform will likely complete digital switchover by 2012. However, countries that have not yet launched their DTT platforms risk being unable to complete analogue switch-off by 2012.

At this stage, all Member-States, apart from Poland, appear to have confirmed their intention to complete analogue switch-off by 2012. Already, the process have been completed by 5 Member-States (Finland, Germany, Luxembourg, the Netherlands, Sweden) while a further 8 Member-States (Austria, Belgium, Czech Republic, Estonia, France, Italy, Spain, the United Kingdom) have begun switching off analogue services in one or more areas. It is expected that these countries will be able to complete analogue switch-off by 2012, if not earlier. Member States that have not yet launched DTT services will have more difficulty in reaching a sufficiently high level of penetration to allow for analogue switch-off by 2012.

3 Economic potential and social values of TV White Spaces

Due to the spectrum efficiency of DTT, some of the spectrum bands used for analog TV will be cleared and made available for other usage. Moreover, DTV spectrum allocation is such that there are a number of TV frequency bands which are left unused within a given geographical location so as to avoid causing interference to co-channel or adjacent channel DTV transmitters; the spectrum bands are geographically interleaved. The cleared bands and the unused geographical interleaved spectrum bands provide an opportunity for deploying new wireless services [9], [10], [11], [12], [13].

The economic potential and consequent social value in Europe, arising from a wise management of the "Digital Dividend" (cleared spectrum + TVWS), has been the object of many studies in last 3 years. The major findings of most of the studies are correlated and identify the following potential uses of the "Digital Dividend":

- Digital Terrestrial Television (DTT)
- Mobile TV
- Commercial wireless broadband services (fixed and mobile)
- Wireless broadband services for public protection and disaster relief (PPDR)
- Services ancillary to broadcasting and program making (SAB/SAP)
- Cognitive Radio technologies

Due to the differences and peculiarities of each Member State, the potential growth and demand on each of the aforementioned potential "Digital Dividend" uses may vary significantly. However, studying a representative sample from a wider categorization of all Member States, illustrated that the UHF band used for terrestrial broadcasting is estimated to generate €750bn to €850bn in Net Present Value (NPV) for the European Economy. Additionally, the excellent propagation and coverage characteristics of this band are, without doubt, of great interest for the major stakeholders and will require a common approach and harmonization of the actions, especially on behalf of neighboring countries.

In this respect, the conservative trend in Europe is to allocate a part of the UHF spectrum (ranging from 72 to 92 MHz at a first stage) to mobile operators, which is estimated to generate between €63bn to €232bn NPV, measuring the benefits for a 20 year period. A further expansion will probably be reconsidered at a second stage, after reevaluation of the market as a whole, taking into consideration updated data on demand, market growth and technological innovations.

At a broader view, the market can be analyzed under different scenarios (e.g. pessimistic, conservative and optimistic) in which, the main key drivers are the DTT and Wireless Broadband Service growth/demand and the relation between them. These parameters are then interpreted into economic figures considering, either a very specific

UHF spectrum allocation for each service (e.g. 790 MHz – 862 MHz sub-band for mobile operators) or different ranges of spectrum allocation for the each service, in order to identify the optimal distribution of the band to the different potential uses of the "Digital Dividend".

In order to quantify the forecasting of the growth and demand of the Wireless Broadband Service and finally interpret them into direct and indirect economic benefits and externalities, the models are using measurable key activities such as Video (streaming and downloading measured in minutes/month), Browsing (pages/month), Music (tracks per month), Email (emails/month), Mobile TV (minutes/month) and Other Business Applications, all referring to a representative "file size per use".

Direct benefits are those arising from the direct consumption of mobile broadband services and are split into the cost/benefits due to the producers and those due to the consumers. For producers of mobile broadband services, direct benefits primarily accrue as a result of a reduction in network costs. If these cost savings were retained by the operators or their shareholders, this would add to the producer Surplus. However, since the specific market is considered to be highly competitive, it can be safely assumed that almost 100% of cost-savings are ultimately passed on in price changes. Reduced prices for mobile broadband will facilitate increased consumer usage of the service and the incremental benefit to consumers or consumer surplus is this additional usage, combined with lower prices for existing usage.

Indirect benefits result from indirect effects that the market for these services have on other product markets and, as a result, can further increase total consumer and producer surplus. For example, some of the incremental revenues from a mobile broadband service could be generated by advertisements or incensement of e-commerce and not only by the subscribers. However, especially for the advertising revenues, they do not represent an economic benefit but a financial flow or an expense by the advertiser as part of its marketing strategy which results in higher sales and profits for the producers in other parallel markets.

Externalities are wider economic benefits to society as a whole which are not generally taken into account by the consumer or the producer when selling the product or service. These would include increased productivity of workers, since the business applications will be available easier and in more efficient ways, additional job generation, boosting of related industries, etc. Moreover, as a further social add on, can be considered the improvement of Quality of Service, as well as the enhancement of the safety and security related applications, which promote a better quality of life to the citizens.

4 Conclusion

Currently, there is a global move to convert TV stations operating from analogue to digital transmission. Due to the spectrum efficiency of DTV, some of the spectrum bands used for analog TV will be cleared and made available for other usage. This paper analyses the switch-over from analogue to digital terrestrial TV in Europe, which will free up highly valuable radio frequencies due do the greater efficiency of digital broadcasting transmission. The "Digital Dividend" has great potential for the provision of a wide range of services, as the radio signals in this range travel far and equipment can be easily used indoors. It represents a unique opportunity for Europe to meet the growing demand for radio spectrum, particularly to provide wireless broadband to rural areas, thereby bridging the digital divide, and to facilitate the creation of new wireless services such as the next generation of mobile broadband, as well as to support the development of terrestrial broadcasting. It can therefore contribute significantly to the Lisbon goals of competitiveness, economic growth and new marketing opportunities satisfying some of the important social, cultural and economic needs of European citizens.

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