2011 - Peer-Reviewed Conference Paper

Citation:

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Opportunities for White Space Usage in Australia

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Abstract† - We discuss the scope and nature of opportunities for white space devices to operate in the UHF band in Australia after the digital dividend. We identify opportunities for white space usage in the reduced UHF band to be used for television services as well as in nearby guard bands. We extend the discussion to the longer-term by examining scenarios in which broadcasting services could use the synergistic effects of white space devices to either voluntarily migrate out of the UHF band or secure their occupation of this important spectrum beachhead.

INTRODUCTION

White spaces are channels that have been allocated for terrestrial television broadcasting but which have not been assigned to the provision of television services in a particular licence area. These unused channels have traditionally served a variety of purposes, arising from (i) the need for guard spaces between analog TV services in the same licence area, (ii) the need for geographic separation between TV services that are in different licence areas but are broadcasting on the same channel, and (iii) usage opportunities in areas where channels are not allocated to broadcasters due to supply constraints (small number of authorised or deployed services) or demand weakness (e.g. low population density or alternative transmission technologies).

In an age of acute spectrum scarcity, allocated but unused ‘beachfront’ spectrum always presents an efficiency puzzle to regulatory agencies [1]. Although the white spaces serve a legitimate and useful purpose in the planning and delivery of high quality terrestrial television services, new technologies have emerged that promise significant (if not exponential) increases in the productive and allocative-efficient usage of white spaces while minimising the potential for interference to the reception of terrestrial television services. A device, which opportunistically uses these available channels, is commonly referred to as a ‘white-space device’.

As we stress in a recent contribution, [2], white space devices (WSD) have so far adopted two types of profiles: (i) low power and short range ‘symbiotic’ WSDs, such as wireless microphones and biomedical telemetry monitors, which broadcasters have long tolerated, and (ii) ‘invasive species’, such as emerging higher power WSD based on advanced technologies that are proposed to exploit white spaces on a much larger scale and in a more dynamic fashion, typically to provide broadband wireless access services.

In this article, we examine the threats and opportunities in Australia for symbiotic and invasive WSD as the UHF spectrum allocated to broadcasting shrinks from 300 MHz (520-820 MHz) to 174 MHz (520-694 MHz) and as the share of this spectrum held by telecommunications companies expands? We first present the regulatory context for white space usage in Australia. We then present current plans for UHF reallocation, and discuss the nature of the opportunities and challenges confronting invasive and symbiotic WSD at different stages of the re allocation process.

REGULATING WHITE SPACE USAGE

Whereas in the US pre-2008 white space arrangements rested on tolerance for symbiotic WSD and regulatory enforcement for invasive species, a different evolution took place in Australia[3]. Here, secondary usage rights for symbiotic WSD have long been authorised by class licences (such as the LIPD class licence for low interference potential devices). The Australian regulator has typically (but not always) used its class licensing powers to establish open access regimes that are similar to the ‘unlicensed’ approach used in other countries. The long term nature of available white spaces – a consequence of the essentially static use of the broadcasting bands for television services – meant that usage rights for symbiotic WSD were relatively easy to

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define, well understood by industry and straightforward to implement. As a result, usage rights for symbiotic WSD in Australia are well specified and have proved less controversial than in some other countries.

A decade after the introduction of digital terrestrial television services, 2010 was a watershed year for the use of the UHF band in Australia. The progressive switch off of analog terrestrial television services started on 1 July 2010 with the move to digital only services in a regional area. In June, the Australian Government announced that there would be a “digital dividend” of 126 MHz of high value spectrum in the UHF band. The digital dividend encompassed the entire 700 MHz band – from 694 MHz to 820 MHz – and would become available for next generation networks after the completion of digital switchover in 2013 and the subsequent “restacking” that is required to accommodate digital terrestrial television services in the lower part of the UHF band from 520 MHz to 694 MHz. This reduced UHF band will be of high interest to – and represents a significant opportunity for – proponents of invasive WSD.

WHITE SPACES ARRANGEMENTS IN AUSTRALIA

Australia has long established arrangements that have enabled the co-existence of broadcast services (authorised by apparatus licences) and symbiotic WSD (authorised by class licences) in the UHF spectrum from 520-820 MHz used for terrestrial television services. However, now that the size and location of the digital dividend has been determined, the need for new regulatory arrangements in Australia is rapidly approaching.

Key parameters for the restack of digital terrestrial television services were revealed in July 2010 when the Minister formally directed the regulator to take a number of government policy objectives into account as it realised the digital dividend [4]. For white space proponents, the most important of those parameters is the requirement for the regulator to preferentially use VHF Band III (174-230 MHz) for digital terrestrial television services in metropolitan areas (that is, in the capital cities of each Australian state and territory). The use of VHF Band III for main transmitter sites will not entirely prevent the need to use channels in the UHF band (520-694 MHz) for terrestrial television services in metropolitan areas. However, the preferential use of VHF Band III will significantly diminish the requirement for channels in the reduced UHF band in metropolitan areas.

The significance of the use of VHF Band III to provide digital terrestrial television services to metropolitan Australia is best seen by considering the white space capacity that is available in the United States – a country of similar geographic size to Australia but with a much larger population -310m and 21.5m respectively in July 2010 [5]. The results of a semi-empirical analysis presented to IEEE DySPAN in Singapore in April 2010 indicate that white space availability is relatively poor in metropolitan areas in the United States because of the extensive use of channels in the UHF band to provide digital terrestrial television services to populated areas [6]. Nonetheless, the authors concluded that the benefit to urban and suburban areas in the United States from the deployment of white space devices and networks in the UHF band (470-698 MHz) could be of the same order as the benefits expected from the allocation of 62 MHz in the 700 MHz band as part of the US digital dividend.

THE GUARD BANDS

High level band planning arrangements for the spectrum identified as the Australia digital dividend (698-820 MHz) are also of interest to white space proponents. The regulator set out its preferred approach to configuring the digital dividend spectrum in a discussion paper that it released in October 2010 [7]. That approach would result in a 9 MHz guard band from 694-703 MHz to prevent interference between high power broadcasting services below 694 MHz and the mobile telecommunications networks most likely to be deployed above 703 MHz. This 9 MHz guard band will clearly be of interest to WSD proponents.

Because of its availability in all geographic areas – the 694-703 MHz guard band will likely be of interest to WSD proponents. However, although perhaps counter-intuitive, it would seem prudent for symbiotic and invasive WSD to minimise their reliance on the use of 694-703 MHz in Australia. On the one hand, use of the guard band will be heavily constrained near the band edges to protect broadcasting services below 694 MHz and mobile telecommunications networks above 703 MHz. On the other hand, 9 MHz of (most likely) open access spectrum in the UHF band can be expected to attract a large number of devices providing a wide range of applications and services. Additionally, the likely high availability of white spaces in metropolitan Australia means that significantly more spectrum (and thus more capacity) will be available to both symbiotic and invasive WSD than the 9 MHz that will be ubiquitously available but on a more contested basis.

DIGITAL DIVIDEND 1.0: SWITCHOVER AND RESTACK

The process of switching-off analog signals commenced in regional Australia in 2010 and is to be completed by the end of 2013. The transition process includes digital switchover (where analog services are switched off) and then digital restack (where digital services are consolidated into channels between 520-694 MHz). Further on, there is also potential for complete clearance of broadcasting services from the UHF band – a longer term option that we have described elsewhere as Digital Dividend 2.0 and canvas briefly later in this article).

The current band plan consists of the familiar interweaved layout of analog and digital channels in the UHF Band, separated by white spaces. Wholesale analog switch-off by the
end of 2013 means that only digital channels will remain, separated by very large (temporary) white spaces. Throughout this four year period (2010-2013), the government and the regulator will be focussed on establishing arrangements for the services that will be the primary users of the broader UHF band from 2014 (broadcasting and, most likely, telecommunications).

Prior to auctioning and issuing new licences for the digital dividend, the band will need to be re-planned. This will involve clearing the 700 MHz band (694-820 MHz) and restacking (consolidating) all digital terrestrial television services in the reduced 520-694 MHz band. By that stage, if no other factors were taken into account, the potential availability of white spaces would seem to fall significantly, and particularly by comparison with the previous stage (band clearing). However, given the preference discussed earlier for main transmitter sites in metropolitan areas to use VHF Band III and the much higher performance of digital terrestrial television (which performs robustly in interference environments that disrupt analog services), the potential availability of white spaces in Australia would seem to be much higher than the availability of white spaces in the United States. It would clearly be useful for WSD proponents to be aware of the most likely white space outcomes in Australia and to engage constructively with industry and the regulator about the approach taken to restack planning.

**Opportunities & Challenges**

Conditional on the exact design of the re-planning and restacking process, the digital dividend in Australia should present at least two important opportunities for a class licensed open access regime for WSD: (i) the likely high availability of white spaces in the restacked 520-694 MHz segment of the UHF Band; and (ii) up to 22 MHz of guard band spectrum, including a 9 MHz guard band from 694-703 MHz, a 10 MHz guard band from 748-758 MHz and a 3 MHz guard band from 803-806 MHz. The opportunities provide WSD proponents with significant incentives to engage in the consultation processes that the Australian regulator commenced in 2010 – with the release of a discussion paper in October 2010 and a one day conference at the National Maritime Museum in Sydney in November 2010. WSD proponents now have a window of opportunity to seek regulatory outcomes that (i) maximise the availability of white spaces in 520-694 MHz – and particularly in metropolitan Australia where demand for white space devices can be expected to be highest, (ii) secure class licensed open access rights to these white spaces that will optimally enable their extensive colonisation by invasive WSD without jeopardising digital terrestrial television services, and (iii) best exploit the opportunities presented by guard bands to maximise the performance of WSD – at both the device and network level.

Given the long term trend of increasing competition for spectrum and contestability about its highest value use, WSD proponents should not be surprised at the emergence of challenges to their interest to intensively use white spaces for non-broadcasting services. We expect that there will be challenges from broadcasters as well as from operators of telecommunications networks. An obvious challenge will be to address the long standing of concern of broadcasters that WSD will interfere with the reception of digital terrestrial televisions. Another challenge that WSD proponents should consider is the likely interest of broadcasters in accessing unallocated channels in the UHF band for emerging spectrum intensive broadcasting services such as 3D television. If the latter challenge does eventuate, then broadcasters may seek to completely prevent invasive WSD from colonising the reduced UHF band (520-694 MHz). Alternatively, broadcasters could seek to limit the intensity of use of white spaces by invasive WSD (while limiting device numbers would seem impractical, the sophisticated nature of invasive WSD may well allow operational constraints to be imposed at both the device and network level). The rationale for a strategy of this kind would be to minimise consumer disruption if white space availability in a particular area is reduced because of the allocation of a vacant channel to a new digital terrestrial television service.

Operators of telecommunications networks – both fixed and wireless and in established frequency ranges as well as the digital dividend spectrum – may become the unlikely allies of the broadcasters if concerns of this nature are pursued with the regulator. Much will depend on how established operators view invasive WSD: if invasive WSD are seen to be complementary to traditional business models and their associated network infrastructure, established operators are likely to argue for regulatory arrangements compatible with invasive WSD. However, if established operators see invasive WSD as a disruptive threat to their businesses – perhaps if WSD proponents adopt business models akin to that pursued by Meraki when it first released the Mini in 20072 – then they would most likely oppose the development of regulatory arrangements favourable to the intensive use of white spaces by invasive WSD.

**Digital Dividend 2.0**

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2 Meraki is a provider of low-cost, centrally-managed, large scale WLAN services e.g. for multiple sites business applications or for ‘main street’ internet services (e.g. city hotspots). The Meraki Mini is an IEEE 802.11 b/g based mesh repeater allowing users to build a wireless mesh network and control it via web-hosted interface. The hardware was developed with an open-access platform (Linux) and the software provided with quasi open access licensing agreements (e.g. freedom to re-write the device’s main code). Meraki has since moved away from its open access roots, imposing restrictive software licensing agreements in 2008.
Although the focus of many WSD proponents is understandably on the digital dividends that are being or have already been achieved around the world, we propose that the strategy of WSD proponents could usefully be informed by a longer term (10-15 year) perspective. While the situation for DTV (and thus WSD, both symbiotic and invasive) seems likely to stabilise after digital restack and the reallocation of the digital dividend, there is emerging interest in the potential for further reallocation of UHF spectrum from broadcasting to other services – which we describe as a ‘digital dividend 2.0’.

For example, in August 2009, the European Commission identified two options for making more spectrum available for wireless broadband or other non-broadcasting purposes in the European Union. One option was to reallocate the segment 694-790 MHz – a dividend 2.0 which would be more consistent with digital dividend now being achieved in Australia and across the Asia Pacific. The second option was to completely clear DTV from the UHF band to realise a digital dividend from 470-790 MHz. While the report indicates that neither of these options is realistic in the short term, it identifies that they may well be achievable in the medium (beyond 2015) to long (beyond 2020) term.

Any further reallocation of UHF spectrum away from broadcasters and into other uses would clearly have major implications for WSD proponents – not least because it may call into question the viability of enabling intensive use of white spaces by invasive WSD. Any regulatory framework that allowed the use of invasive WSD must be considered very carefully, as we discuss in [2]. The second implication is that highly functional invasive WSD that have operated flawlessly in a broadcasting environment for many years may no longer be tolerated after further reallocation of the UHF band in a digital dividend 2.0 scenario. The availability of spectrum for wireless telecommunications networks access is expanded by relocating broadcasting services, to high capacity geostationary satellites operating in the Ka band (20-30 GHz) or to the ubiquitous fibre to the premises national broadband network that is being established by the Australian Government.

Crucially, this implies that the long term viability of invasive WSD may well depend on their ability to operate effectively in spectrum used by telecommunications networks as well as in the broadcasting environment in which they are currently evolving. We suggest that WSD proponents take pre-adaptive steps to ensure that the design and development of invasive WSD takes into account the likely need for those devices to be able to survive the transition from a broadcasting environment (characterised by a small number of high power sites and stable licence areas) to a telecommunications environment (characterised by a large number of lower power sites and on-going growth in base station deployments). Accordingly, we claim that the prospects for long term success of invasive WSD will be enhanced if WSD proponents develop devices, network architectures and application models that are complementary to established operators and business models rather than disruptive.

Interestingly, there are at least two reasons why the longer term interests of terrestrial broadcasters may also align with the development of invasive WSD that are complementary to the business models and network architectures of telecommunications operators. The first is the medium term potential for terrestrial broadcasters to establish tradable property rights to the channels that they use to provide digital television services to their licence areas (spectrum licences in the Australian regulatory framework). In this scenario, a financial incentive would be created for broadcasters that chose to trade their UHF spectrum for higher value uses (such as telecommunications) and move to another delivery technology. Alternatively, intensive use of the reduced UHF band using advanced technologies may be of such high value that the threshold is never reached where the benefits of a Digital Dividend 2.0 outweigh the costs of completely clearing terrestrial digital television services from the UHF band. In this scenario, broadcasters and invasive WSD would combine to create a diverse ecosystem that was robustly impervious to demands for more spectrum for traditional telecommunications infrastructure – because that ecosystem was able to satisfy demand for wireless access that could never be met by the monoculture of exclusive broadcasting use.

We suggest that an optimal approach would be for regulators and industry to identify the technical and operating characteristics that would allow invasive WSD to successfully transition from broadcasting environments where there are a small number of high powered transmitters and where technology changes little over time, to telecommunications environments where there are large numbers of low powered transmitters and rapid technological change over time. Ideally, invasive WSD would be able to adaptively collaborate with telecommunications networks using advanced technologies (even if such adaptability could ultimately mitigate against the need for a digital dividend 2.0).

Conclusions

2010 was a watershed year for broadcasters, telecommunications companies and WSD proponents in Australia. The Federal Government announced in June that the Australian digital dividend would be a contiguous 126 MHz from 694 to 820 MHz. Digital switchover commenced in regional Australia in July and is to be completed by the end of 2013. The regulator commenced a consultation process about reallocating the digital dividend ahead of the auction of licences for spectrum from the digital dividend spectrum in 2012 (with new networks able to commence operations once the restack of digital television services into the reduced UHF band of 520-694 MHz is complete). Importantly, as planning
for the restack is now underway, the Minister has directed the regulator that VHF Band III (174-230 MHz) should be used for main transmitter services in metropolitan Australia – which should have a major and positive impact on the availability of white spaces in Australia.

We identified the opportunities and the challenges for WSD proponents in Australia that are the results of these developments. There is now a window of opportunity for WSD proponents to optimise the availability of white spaces in Australia and establish regulatory arrangements that will allow intensive use of those white spaces by symbiotic WSD. We argue that the success of symbiotic WSD will be enhanced if WSD proponents take into account the likelihood of consideration a digital dividend 2.0 in the 10-15 year time frame. We conclude that the potentially conflicting objectives of broadcasters, telecommunications companies and WSD proponents may be able to be reconciled by the development of invasive WSD that are complementary – both technically and commercially – with established telecommunications operators and business models (rather than disruptive for these models). Most optimistically, we identify that intensive use of UHF spectrum by invasive WSD may well be to the long term benefit of both broadcasters and telecommunications operators.

Finally, we recognise that the imminent debate in Australia about white space and white space devices would usefully be informed by an analysis of the likely availability of white space given the parameters established for the restack of digital terrestrial television services. To that end, WSD proponents would be well inspired to seriously consider undertaking an analysis of possible outcomes and preferred options for white space availability in Australia that draws on the approach developed by [6] to identify white space capacity in the United States.

REFERENCES


