Submission to the

Department of Broadband, Communications and Digital Economy

on the

Digital Dividend

By

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January 2010

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Dear Sir/Madam

Thank you for the opportunity to respond to the Green Paper on the Digital Dividend (January 2010), and I have presented answers to a very large proportion of the discussions.

In providing this submission it became apparent through discussing with engineering associates over the past 45 years that there was a fundamental flaw in Australia moving away from the global standard of 8 MHz channel boundaries back to 7 MHz channel boundaries, and this is topic discussed in the Appendix of this submission.

By resurrecting the nominal 8 MHz channel boundaries and re-applying these boundaries through the VHF bands, the channel spacing falls into a logical order – unlike the mess that is there now.

Repeating the same 8 MHz channel technique through the UHF bands slightly reduced the number of UHF channels but this submission demonstrates that this is not a problem. Further, by spacing the channels at 8 MHz this inadvertently created a 120 MHz band in the upper UHF area that somewhat coincided with the 7 MHz spacing, but the 8 MHz channel spacing was spot-on when it came to re-structuring this 120 MHz band into six 20 MHz bands for bi-directional Broadband CAN applications in remote geographic locations.

This 702 MHz to 822 MHz band in the UHF can now have a dual purpose – based on the geographic location and the demographics and I recommend this restructuring to the experts in your department.

In responding to radio spectrum demands in the Green Paper, it became apparent to me the Federal Government apparently uses about 25% of the spectrum, that the NBN is not being used to nearly its fill capacity, that AARNet is rather synergetic to the NBN, that the state government networks would also have a considerable amount of synergy; but all entities are operating separately. By pulling all these network infrastructures into the NBN as the national wholesale provider then a significant amount of the spectrum demand would be eliminated through synergetically moving radio links into shared optical fibre cables, which should in turn free up a considerable amount of the spectrum used by the federal government.

Please do not hesitate to contact me for further information.

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Table of Contents

Answers to Questions

Question 3.1

Should digital dividend spectrum be used to provide mobile telephony and broadband services?

Spectral Behaviour of Radio Waves

The Green Paper touches on the almost missing topic that the transmission properties of the electromagnetic spectrum behave very differently at different frequencies. It is not just a matter of allocating a particular part of the spectrum to mobile services or television or other communication facility, but understanding how the electromagnetic wave promulgates, and then allocating that area of the spectrum so that it performs in an optimum manner.

Because the size (length) of the antennae dipole is roughly equal to 0.5 times the wavelength and the wavelength is inversely proportional to the frequency, this means that the higher the frequency, the shorter the antennae.

Further, as the radio carrier frequencies are raised, they tend not to hug the earth’s curvature as like under say 3 MHz, and by 30 MHz these radio waves will bounce of the ionosphere around the globe. Above say 40 MHz, radio waves much more loosely hug the earth’s curvature, but these frequencies start to penetrate the ionosphere and tend to bounce off mountains, buildings etc instead of being absorbed on impact. By 700 MHz the ionosphere is easily penetrated (or the wave is absorbed in the ionosphere), and a substantial amount of the radiated energy is reflected from mountains, buildings etc. Above say 700 MHz radio waves act more like light beams (although they still tend to curve a bit around the world) but by about 2 GHz and above radio waves act very much like visible light – but with a ‘spray’!

With this very brief discussion on understanding basically that radio waves act differently over the spectrum, it shows that simply allocating spectrum on a user needs basis is very unwise, unless the spectrum is matched for the use and geographic location, combined with sound economic plan.

Commercial mobile telephony relies on having an antenna short enough that it remains within the handset and consequently, this means that all mobile telephone technologies (including mobile Internet technologies) should work above nominally 800 MHz.

Horizontal and Vertical Polarised Transmissions

Although the spectrum is heavily discussed in general terms, the Green Paper fails to discuss, realise or comprehend the merits of vertical and horizontal polarisation of the television signals, as this effectively doubles the amount of available channels (or doubles the potential of ‘digital dividend’) over the same geographic area, and/or minimises channel interference.

Historically, horizontal polarisation was utilised for the metro areas and vertical polarisation was used for the country areas. With the axis of standard television antennae facing each other but positioned 90 deg to each other, the transmitted signal will be attenuated by about 25 to 45 times (about 30 dB), effectively nulling that signal. This means that television transmitters can be positioned in relatively near proximities to each other (inside say 100 km) and the EM fields will be orthogonal to each other and with the receiving antennae being 90 deg, and usually aimed in another direction, the chance of signals causing appreciable clashing is very low.

Broadband CAN to fixed premises – Yes, Mobile CAN – No.

Question 3.2

How much spectrum would be required to provide these services?

Australian VHF Spaghetti

If we look at VHF Bands I, II, and III and see what is currently going on then the table below gives a fairly good answer:

Channel	Designated	Band	Lower	Upper	Width
0	VHF	I	45	52	7
			52	56	4
1	VHF	I	56	63	7
2	VHF	I	63	70	7
			70	**77**	**7**
			77	**85**	**8**
3	*VHF*	*II*	*85*	*93*	*8*
4	*VHF*	*II*	*93*	*101*	*8*
5	*VHF*	*II*	*101*	*108*	*7*
			108	**115**	**7**
			115	**122**	**7**
			122	**129**	**7**
			129	**137**	**8**
5A	VHF	III	137	144	7
			144	**151**	**7**
			151	**158**	**7**
			158	**166**	**8**
			166	**174**	**8**
6	VHF	III	174	181	7
7	VHF	III	181	188	7
8	VHF	III	188	195	7
9	VHF	III	195	202	7
9A	VHF	III	202	209	7
10	VHF	III	209	216	7
11	VHF	III	216	223	7
12	VHF	III	223	230	7

Table 1: Australian VHF Spectrum with nominal 7 MHz Channels

This little table above shows that some of the channels did not get continuously separated by 7 MHz as stipulated by the rather inept telecommunications bill in the mid 1950s, (which was caused because of a monumental Ministerial blunder in the 1950s referred to in the Appendix “**Why 7 MHz Channels?**”) but some spectrum around these channels was ‘shuffled’ to make it all look like it comfortably fits into the desired ranges to give channel 5A and channel 9A. A further complication is that the FM radio band fits right in 88 – 108 MHz where channels 3, 4, 5 sit at 85 – 108 MHz, effectively voiding the application of these three channels.

Australia’s 7 MHz Channel Blunder

The International Telecommunication Union (ITU), is the recognised international body that sets recommendations for all countries to follow, and with very sound economic reasoning that if every country went off and ‘did its own thing’ then each country would have to manufacture specialised electronics for television and telecommunications and technology advances in one country will not be transferred into other countries because they would be working to their own standards.

The ITU recommended that all the television channels be standardised to 8 MHz, but the USA under considerable commercial pressures to maximise profiteering quickly settled on a 6 MHz bandwidth to maximise the number of commercial channels, and the USA public have paid the price together with their appalling free-to-air TV reception quality, and consequent heavy take-up of pay-to-view Cable TV.

Concerning Australia in the mid 1950s, commercial pressures also 'influenced' the Federal Government to dither off the ITU 8 MHz TV bandwidth recommendation and consequently Australia inexplicably chose a 7 MHz TV Channel bandwidth instead of the internationally recognised and widely adopted 8 MHz bandwidth (except for the USA/Japan, which due to even heavier commercial pressures settled on 6 MHz). Since the mid fifties, Australia has remained in a television technology backwater with all commercial TVs in Australia needing a range of specialised circuitry that is uncommon to the rest of the globe.

Detail on how and why this Federal Ministerial monumental blunder took place is detailed in the associated Appendix under "**Australia's 7 MHz Channel Blunder?**"

Fixing the 7 MHz Channel Blunder

As stated in the Green Paper (page 9) "***The primary objective of this aspect of the work of the ITU is to ensure interference-free operations of radio-communication systems through implementation of the Radio Regulations and Regional Agreements,*** ". Even though Australia may be relatively geographically isolated, in economic and technology terms Australia is very closely tied globally, and therefore **it makes no sense to continue with the fiasco of using 7 MHz television channels when the ITU has recommended 8 MHz television channels.** The move to step into the digital television spectrum is an ideal time to drop the 7 MHz spectrum divisions and move to global standard 8 MHz spectrum divisions for television channel bandwidths.

One of the obvious benefits in globally standardising to 8 MHz television channels is that the manufacturing of televisions become globally standard (except for the USA as usual) and that the various manufacturing maintenance spares are both cheaper and the more common, and this facilitates re-badging for even better profitability for the manufacturers and even cheaper competitively produced TVs for the consumers.

By standardising on the slightly wider television channel bandwidth at 8 MHz, the proportion of skirt frequencies is slightly smaller, so the overall bandwidth is actually more effectively used than if the television bandwidth remains at 7 MHz. Looking at the inter-band skirts in this context (where neither channel can use this frequency range), the number of skirts is reduced by about 14% or alternatively, the total useful bandwidth has a dividend of about 14% when using 8 MHz channels, compared to using 7 MHz channels.

Bandwidth bears a direct relationship with definition, so the higher the bandwidth: the better the definition. High definition TV (HDTV) requires a maximum of bandwidth, and with the onset of three-dimensional television (3DTV) images, the need for bandwidth will be even more than it is now.

Broadband Customer Access Network (CAN) requirements are based on bi-directional 100 Mb/s and to reliably get this data rate, then an analogue (spectrum) bandwidth of 20 MHz is necessary in each direction – which is effectively 40 MHz.

My professional experience in telecommunications engineering technologies made it rather clear to me that when early television came out in the mid 1950s, UHF bands were not commercially viable as the technologies of printed circuit boards, stripline, modern filter theory, and transistors were in their infancy. With the development of these technologies over the past 50 years the UHF bands became a commercial reality – but in the mid 1950s the limited number of channels in the VHF range was a real concern, radio promulgation in the VHF bands was being learned (and Australia was under very strong UK and European influence and engineering direction; and under strong USA commercial pressures).

Re-Aligning the VHF Spectrum to 8 MHz channels

If the television channels had not been tampered with and left at 8 MHz then the channel allocation probably would have been like the table below:

Channel	Designated	Band	Lower	Upper	Width
0	VHF	I	45	53	8
1	VHF	I	53	61	8
2	VHF	I	61	69	8
			69	77	8
			77	85	8
3	***VHF***	***II***	***85***	***93***	***8***
4	***VHF***	***II***	***93***	***101***	***8***
5	***VHF***	***II***	***101***	***109***	***8***
			109	117	8
			117	125	8
			125	133	8
			133	141	8
			141	149	8
			149	157	8
			157	165	8
			165	173	8
6	VHF	III	173	181	8
7	VHF	III	181	189	8
8	VHF	III	189	197	8
9	VHF	III	197	205	8
10	VHF	III	205	213	8
11	VHF	III	213	221	8
12	VHF	III	221	229	8

Table 2: Proposed Australian VHF Spectrum with 8 MHz Channels

When Table 1 and Table 2 are compared, there is very little difference except for two extra channels 5A and 9A and in hindsight I really doubt that the two extra channels served any useful purpose at all. With the introduction of the UHF channels, these extra VHF channels have now proven to be unnecessary, as was the reason to reduce the bandwidth to 7 MHz from 8 MHz in the first case.

Re-Aligning UHF Channels to 8 MHz

Very fortunately, the UHF Bands IV and V are contiguous between 526 MHz and 820 MHz, with 7 MHz spacing as below:

Channel	Band	Lower F	Upper F	Channel	Band	Lower F	Upper F
28	IV	526	533	49	V	673	680
29	IV	533	540	50	V	680	687
30	IV	540	547	51	V	687	694
31	IV	547	554	52	V	694	701
32	IV	554	561	53	V	701	708
33	IV	561	568	54	V	708	715
34	IV	568	575	55	V	715	722
35	IV	575	582	56	V	722	729
36	V	582	589	57	V	729	736

37	V	589	596	58	V	736	743
38	V	596	603	59	V	743	750
39	V	603	610	60	V	750	757
40	V	610	617	61	V	757	764
41	V	617	624	62	V	764	771
42	V	624	631	63	V	771	778
43	V	631	638	64	V	778	785
44	V	638	645	65	V	785	792
45	V	645	652	66	V	792	799
46	V	652	659	67	V	799	806
47	V	659	666	68	V	806	813
48	V	666	673	69	V	813	820

Table 3: Australian UHF Spectrum with 7 MHz Channels

Correcting the UHF Channel Bandwidths to 8 MHz

By moving to the global standard of 8 MHz instead of the isolated 7 MHz and then restructuring the UHF band to be based on 8 MHz channels, this reduces the number of available UHF television channels from 42 back to 37 (a reduction of about 14%), and also decreases the percentage of wasted skirt (inter-channel) bands by about 14%.

By then nominating the upper UHF 702 – 822 MHz band for Broadband fixed premises services communications (CAN) this provides a contiguous block of 120 MHz in the upper UHF which is particularly suited for longer distance bi-directional Broadband to/from fixed premises (and this frequency band would particularly suit non-urban areas like regional, rural and remote).

With the smallest of lateral (engineering) thinking, these channels could be restored to 8 MHz over nominally the same bandwidth and the table would then look like:

Channel	Band	Lower F	Upper F	Channel	Band	Lower F	Upper F
28	IV	526	534	47	V	678	686
29	IV	534	542	48	V	686	694
30	IV	542	550	49	V	694	702
31	IV	550	558	50	V	702	710
32	IV	558	566	51	V	710	718
33	IV	566	574	52	V	718	726
34	IV	574	582	53	V	726	734
35	IV	582	590	54	V	734	742
36	V	590	598	55	V	742	750
37	V	598	606	56	V	750	758
38	V	606	614	57	V	758	766
39	V	614	622	58	V	766	774
40	V	622	630	59	V	774	782
41	V	630	638	60	V	782	790
42	V	638	646	61	V	790	798
43	V	646	654	62	V	798	806
44	V	654	662	63	V	806	814
45	V	662	670	64	V	814	822
46	V	670	678				

Table 4: Proposed Australian UHF Spectrum with 8 MHz Channels

So, the number of UHF channels would be reduced from 42 back to 37 and cover literally the same radio spectrum. Realising that mobile telecommunications needs the physically smallest of antennae to be practical, it makes sense that if for extended mobile communications capability the channels were peeled off from the upper-most frequency range then roughly from 702 MHz to 822 MHz (120 MHz as shown greyed in the above table) could be realised for Broadband CAN telecommunications and still this would leave 22 (8 MHz) channels in the UHF range for television broadcasting and datacasting.

What Spectrum Could Be Available

To qualify the situation, if there is UHF digital dividend spectrum above nominally 700 MHz available to be used by mobile / broadband technologies then this area of the spectrum could be used – but it should be in a large contiguous block, nominally 702 MHz to 822 MHz.

The beauty of this 120 MHz contiguous block of bandwidth – now based on 8 MHz channels for TV usage, is that it now can be directly converted into Broadband Wireless (radio) Internet that uses a 2 * 20 MHz channel arrangement. The proposed solution is to use the following channel structuring:

Usage	Frequency Low	Frequency High
Transmit 1	702 MHz	722 MHz
Transmit 2	722 MHz	742 MHz
Transmit 3	742 MHz	762 MHz
Receive 1	762 MHz	782 MHz
Receive 2	782 MHz	802 MHz
Receive 3	802 MHz	822 MHz

Table 5: Australian Upper UHF Spectrum with proposed 20 MHz Channels

This engineering approach keeps the guard band (the frequency band between the two directions) at a constant maximum to minimise crosstalk and interference, and it makes the engineering design for the equipment particularly easy, because the band pass filters do not have to be all that sharp, so the engineering of the filters can be relaxed. Also, because the directional separation is a constant frequency, the engineering is particularly modular and that really drives the engineering and production costs right down while maximising on overall system performance.

Economically, the cost of producing equipment to match this guideline would be significantly cheaper than having the transmit and receive channels directly adjacent to each other. This innovation makes the use of the spectrum highly profitable, and/or the end user costs can be substantially lower, meaning that the equipment-usage would more than offset for the lower cost. Commercially, people in non-metropolitan areas connected with this type of Broadband radio would then be able to do Internet based business transactions on a close par to those in metropolitan areas, and others that have FTTP CAN connections to the Backhaul Internet infrastructure.

Question 3.3

When would this spectrum be required?

Who Needs the UHF Spectrum and Why

Australia has a relatively large landmass, about 90% that of the USA, and a population about 10% that of the USA, and Australia is 2.2 times the landmass of Eastern Europe [1] (see the map below), or about the same size of all of Europe; yet the population in Australia is a small fraction that of Europe's population [2]. In further consideration of Europe, this collection of countries already work co-jointly through the European Economic Union (EEU), and considering that the EEU is a considerably large land mass with a well developed infrastructure, then following the standards used in the EEU makes a lot of economic sense, particularly when most of Europe uses these same standards, with some very slight variations.

Canada is a slightly larger landmass than Australia, and a population of about 33 million, making Canada (9.27 people per square mile) highly comparable with Australia (6.4 people per square mile) [3]. The USA is inextricably tied to Canada as Canada's southern border (about 2500 km is with the USA and Alaska (about 500 km on the western Canadian border). Because of this tight landmass tie and the comparably high population density in the USA compared to Canada, Canada is unfortunately locked into the USA radio spectrum as part of North America.

This tie-down of Canada by the USA is particularly unfortunate as the USA economy (as bankrupt as it really is) dominates the telecommunications technical standards in the Americas, and because these standards were developed by competitive companies, and not in a highly co-operative (community-minded) approach, these standards are generally focussed on maximising the return on investment (RIO) and not maximising the operational capability; and this fundamental flaw (of financial greed) has generally culminated in standards that generally don't quite have the necessary bandwidth capabilities for the purposes they were originally intended (eg; telephony, television etc.).

As a consequence of the USA domination of the Americas telecommunication standards, this dilemma puts the Americas (including Canada) out of comparison with Australia and puts South-East Asia as a much closer landmass that has a highly developed society into tight comparison and association with Australia – even though the population densities in South East Asia far exceed that of Australia – and even when comparing the urban population densities. For example Singapore, and much of Sydney (circularly centred on Parramatta) have a roughly similar area, but the population density in Singapore far exceeds that of Sydney (or Melbourne for that matter, considering that Sydney and Melbourne have roughly identical population densities)!

All this discussion points to the fact that this upper UHF spectrum should not be put up for auction or allocated to portions of the competitive market, but it should be used solely by the NBN to provide Broadband CAN in rural and remote areas that cannot be connected by FTTP.

Question 3.4

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Why Competitive Spectrum Use is Unnecessary

The dilemma in Australia is that the population density is substantially lower than any other developed nation, so the desperate need for mobile bandwidth in regional, rural and remote areas is to a very large degree – totally unwarranted – unless Australia continues down the "must operate in a competitive infrastructure regime", and this mantra has proven time and time again to be extremely inefficient and highly wasteful of very scarce resources.

If we were to take the "must operate in a competitive infrastructure regime" mantra a bit further, then historically (from the Davidson Report [5] in 1982 which introduced the USO (Universal Services Obligation) strategy into the telecommunications (specifically telephone services)), then it should have been very obvious that the USO strategy was severely flawed from its inception.

The lessons that were taught and proven via the USO strategy clearly showed that any enforced competitive regime heavily relies on the economic situation where the population density can openly support several competing infrastructure businesses and the massive inefficiencies that comes with competitive infrastructures. The obvious flaw in the USO strategy relates to the low population density and very high cost of telecommunications infrastructure combined with a rather low available revenue from the targeted population, and the very inefficient use of resources in particular: the at least duplication of telecommunications services by competitive infrastructure businesses where even one infrastructure is not operating profitably.

By moving the television broadcasting and datacasting (broadcasting) services out of the VHF range and into the lower contiguous UHF block, then these services can be more localised at lower powers and operate with much less inter-channel interference in adjacent cell areas.

The VHF range can almost be resumed apart from the FM band 88 – 108 MHz, and the band 108 – 230 MHz can then be used for rural /remote communications (homestead to mobile vehicle), without affecting the demand for the UHF bands.

By allocating the spectrum from the top (702 – 822 MHz) in 20 MHz channels for use as Broadband point-to-point communications in the CAN, then this spectrum would be used sparingly as FTTP will provide most Broadband services to all premises without having to resort to UHF CAN technologies like WiMax.

Any competitive telecommunications wholesale infrastructure has an intrinsic waste that is at the best 50% economically efficient as a non-competitive telecommunications wholesale infrastructure servicing all resellers. In a recent submission [9] to the DBCDE, I detailed the massive expenditure of having competitive Cable TV CANs in Australian metropolitan areas, and this submission clearly showed that this Second Best economic solution was about 225% more expensive (less economic) than the non-competitive wholesale infrastructure solution.

In the Cable TV / Broadband Internet CAN case, the coax cable binds the electromagnetic transmission path, so parallel cables can carry identical frequency spectrums and carry totally different content.

Unfortunately with radio this media is 'unbound' and spectrum usage has to be geographically isolated, or alternate spectrum has to be used for similar applications and this introduces yet another level of Second Best economic scenario [11] that introduces incredible (spectral) waste that is incorporated in the competitive regime.

So, not only is competitive radio spectrum extremely cost inefficient because of the nature of competition itself (with its multi-managements and multi-infrastructures, advertising, marketing and billing, legal costs and short-cut maintenance procedures), but the use of the spectrum is extremely wasteful because competitors have to use separate parts of the scarce spectrum, and Statistical Queuing Theory clearly shows us that multiple networks will always run at a lower occupancy rate than a single large network – meaning that with the spectrum cut up amongst more than one wholesale provider, the overall network occupancy will be much less than if the mobile radio spectrum were connected through one operator. This is clearly another very poor Second Best economic outcome [11] for Australia.

(Beware of reading about the Second Best economic outcomes from USA based publications and Websites as these economists have severely twisted the concepts to make the Second Best economic situation look good in a competitive environment!)

While engineers in Australia are looking to find spectrum to provide to competitive mobile phone carriers that use radio CAN (which us an unbounded media), competitive business minded economists are blindly auctioning off the last of the available radio spectrum to competitive bidders! The problem is that because of the pseudo random movement of people with mobile phones – these competitive carriers will never really cause their competitive networks to be fully utilised (occupied), and this is another case where the Second Best economic scenario causes the spectrum to be fully allocated to competitors, while the users

When Australia's mobile radio spectrum is finally placed under on wholesale provider, then the cost of that infrastructure will also be minimised, making the overhead structurally far less expensive, and that in turn provides the wholesale telecommunications infrastructure for all resellers to maximise their profits without highly uncoordinated infrastructure investment (which in itself is another highly wasteful competitive attribute alluded to above).

Question 3.5

How might the roll-out of the NBN impact on the provision of fixed wireless broadband services?

Current Non-Metropolitan CAN Technologies

Unlike the technology of radio or television broadcasting (where the transmitter usually radiates an evenly distributed signal in all directions) in the case of fixed wireless Broadband services, either the transceivers are intentionally close, or the electromagnetic beam is intentionally narrow such that there is very little external physical interference caused or received.

Currently many Broadband premises customers are using satellite (using parabolic reflector antennae at their premises to operate with a pencil-like electromagnetic beam to communicate with the satellite) as their CAN connection. The reason these customers are doing using satellite is because the pair copper that connects their phone services is far too long (>2 km) to connect ADSL broadband to the nearest local DSLAM (which would most probably be located in the local exchange or SCAX hut).

Many customers are far too distant from their local exchange for pair copper (say >12 km) and connect with HCRC (High Capacity Radio Systems), which also use pencil like electromagnetic beams to cover upwards of 50 km in two hops – because 30 km is about the practical limit for point-to-point radio in the low GHz range, due to the earths curvature. The problem with HCRC is that the digital bandwidth is 2 Mb/s, and while this is good for telephony to multiple services (because HCRC is a CAN technology that connects several customers via a common radio beam), the shared 2 Mb/s bandwidth does not come even close to providing any reasonable Broadband connection.

With the introduction of FTTP (Fibre to the Premises), which has a practical distance limit of more than 60 km, pair copper/ADSL technology will be obsolete, so these customers inside say 12 km of a local exchange site (SCAX hut for example) will be connected with FTTP as the NBN Co rolls its services out in the non-metro areas to replace copper. Customers upwards of 50 km could also be connected with FTTP removing the need for HCRC technologies to need to use any part of the radio spectrum, and almost totally removing the need for satellites to be used for broadband provision to rural and remote broadband customers (removing the need for satellites to use spectrum over Australia).

Fixed wireless Broadband service have their place where the terrain is too rough or too long to install FTTP, and that firmly puts fixed wireless Broadband services as the very last choice for Broadband CAN connections – not the very first choice.

Question 3.6

How much spectrum would be required to provide these services?

UHF CAN Spectrum for Rural and Remote

In light of the above answer that virtually all fixed access services can and should be provided by FTTP then only a small amount and probably towards the top of the UHF range, where the antennae are unsuitable (physically too big) for mobile communications, but high enough such that a significant Broadband bandwidth can be transmitted with relatively cheap electronics.

The answer provided in 3.2 provided a table that clearly showed a 120 MHz bandwidth in the upper UHF range would provide quite sufficient spectrum so that point-to-point CAN technologies (like WiMax) could be engineered to utilise six 20 MHz bands to create three separate point-to-point connections over the same geographic territory. With the directivity of Yagi antennae being typically narrower than 20 degrees, then any one base station could theoretically point up to 18 different directions – spaced by 20 degrees, and with the three bands in operation then a total of 54 Broadband customers could be connected at one Radio Base Station.

Considering that the population density in Rural and Remote areas is much very low except for sparsely located homesteads and towns, a typical Radio Base Station would at the most be loaded with say four UHF Broadband CAN point-to-point radio systems. This means the loading of these Base Stations will be very low, and in most cases, the inner inland eastern Backhaul Backbone that I proposed in 2009 [6, 7, 8] would provide the connectivity such that most of the inland towns would have FTTP connectivity, and only some of the more remote homesteads would require the UHF Broadband spectrum to connect their CAN.

VHF Spectrum for Homesteads

An alternative and innovative approach is that the newly freed up VHF spectrum (174 MHz to 230 MHz) – about 56 MHz could well be used for base station to premises fixed services over relatively long distances using Yagi antennae, as the construction of these antennae is rather cheap, (and the isotopic gain can be in the order of 30 dB) the electronics is significantly inexpensive compared to working in the GHz range, and the geographic range of transceivers could exceed 60 km, making them a very cheap alternative for FTTP.

This approach totally frees up the UHF band for other uses, like a “homestead UHF base-station” for local mobile communications to operate within say 5 to 15 km of the homestead, giving the homestead people the flexibility to use mobile phones in and around the homestead, Broadband Internet and fixed access telephony (VoIP) off the parent link.

Question 3.7

How many networks will need to be accommodated to provide a competitive communications industry?

Kicking the Competitive Dead Horse

Economically it makes no sense to have more than one wholesale network beyond the capital cities (ie outside the ‘metro’ areas) and with this economic rationality, the amount of spectrum used can be radically minimised (optimised) to one, so that the need for duplicating spectrum is virtually eliminated while providing an excellent coverage for all mobile users.

Since the Davidson Report [5] introduced commercial pressures in 1982 to make the telecommunications infrastructure move away from being an efficient infrastructure service into being a commercial user-pays business concern in Australia; Telecom Australia and later Telstra all but removed its infrastructure rebuilding business from everywhere but the major capital cities, because they knew that only the major metro areas returned profits and the rest (non-metro) was a cost-centre situation.

The Davidson Inquiry / Report realised this major flaw of attempting to commercialise the telecomms infrastructure, so instead of reporting that telecomms commercialisation was totally impractical in Australia because of the relatively low population densities and comparatively long transmission distances, this Report compounded a ridiculous situation and instigated the Universal Services Obligation (USO) to pay off the incumbent telecomms operator and provide comparative (though not competitive) services outside the metro areas!

The Federal Government now provides an annual compensation to make the non-metro ‘look as though it was ‘comparative’ (and somehow therefore ‘competitive’) – and the price of the

USO is hotly argued, meaning that the compensation is not nearly adequate to compensate Telstra as the incumbent, and the competing carriers are deliberately shirking their financial responsibilities in co-funding the USO to Telstra and in the interim these competing carriers remain ‘looking competitive’!

Taking the notion of having one non-metropolitan wholesale carrier makes a lot of economic sense as this network infrastructure is very expensive, and it takes years to rollout. With the understanding that the NBN Co will be providing Australia-wide wholesale telecommunications services to a number of private resellers, then any number of private resellers can have their customers using the wholesale services at any location – without the need for network services infrastructure duplication.

So when economic sense prevails, the NBN Co wholesale infrastructure economic model will provide the single wholesale mobile infrastructure footprint with just one network for all non-metropolitan locations, then surely that has to be the best economic solution for Australians! In this situation the amount of spectrum required by the NBN will be less than what the competitive telecomms carriers are currently using until the broadband requirements are again increased to account for higher speed wireless/radio customer access networks

Question 3.8

When would this spectrum be required?

First Install the NBN Backbone Backhaul

Currently Telstra has Broadband / mobile spectrum in non-metro areas, and I believe that it is nowhere near being used to anywhere near its full potential because the population density is far too small to make this a commercially profitable venture (without charging their customers rather heavy user fees).

Most competing carriers to a large degree also use the Telstra mobile coverage in many non-metropolitan areas (ie regional, rural and remote) to minimise their operating costs through purchasing wholesale service agreements through Telstra. This in turn makes the Telstra venture of installing remote mobile base stations less of a cost centre on their business (but still it is a cost centre and a business they would rather out of).

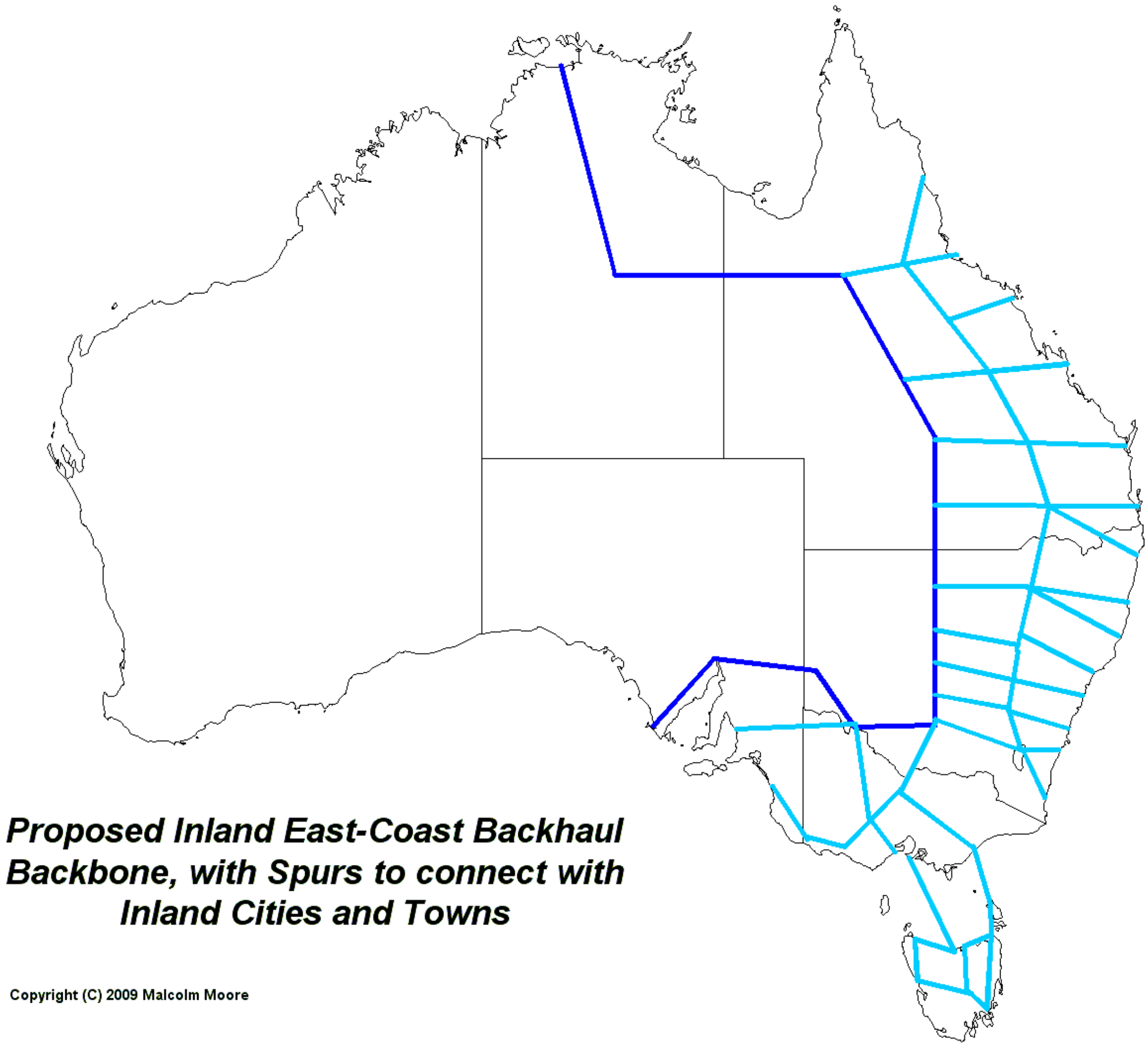
Optus has a scant coverage in many non-metropolitan areas and this is in itself a spectrum duplication that could well be done without.

To complicate matters worse, there is very little optical fibre backbone outside the metro areas apart from a few optical fibre ‘ropes’ between major capital cities. Without substantial optical fibre-based systems to connect with radio-based Customer Access Networks (CAN) the radio spectrum in discussion in the Green Paper will have no consequential connection to any Backhaul telecommunications network infrastructure.

Eastern inland Australia is a major issue as there is virtually no high capacity optical fibre in NSW west of about Griffith, Parkes, Dubbo, Narrabri: and in Queensland, west of about Roma, Toowoomba, Emerald, Charters Towers.

In some recent earlier submissions to the DBCDE [6, 7, 8] I showed a map of Australia that included an eastern inland backbone with spurs to the east coast. Although the associated Expert Committee and Select Committee reports totally neglected to make any reference to my submissions, the NBN Co has taken on to implement some of the imperative optical fibre backbone between Darwin and Brisbane as described in those submissions.

The picture below shows the intuitive map of the north-south inland backbone (royal blue) with spurs and cross-links (cyan blue) towards the east coast. Currently almost none of this backhaul exists, and without it the value of the digital dividend beyond the metro areas is virtually useless.



If the NBN Co were to buyout the Telstra and Optus non-metropolitan Broadband / Radio / Telephony etc. infrastructure and provide this back as a wholesale infrastructure to both Telstra and Optus, (and other competing carriers) then this synergetic innovation would be a win-win-win situation for the conservation of the Dividend Spectrum, the minimisation of excessive unprofitable infrastructure beyond metro areas and the maximisation of the use of this infrastructure. Economically this strategy is far more responsible than forcing a non-commercial situation (ie Davidson Report) to make existing infrastructure even more inefficient through introducing competitive infrastructures that will never pay their way (see Appendix 2).

Assuming that it will take about two years to negotiate the selling of (or giving away) the non-metro telecomms network (which is primarily owned by Telstra) – to the NBN, and the installation of a reasonable inland fibre optic backbone backhaul through the inland of eastern Australia (as depicted in the map above), then the timetable for introducing UHF bandwidth for radio point-to-point Broadband CAN in rural and remote areas to be concurrent would be about 2012 – 2013.

That is, this point-to-point Broadband CAN equipment should be scheduled to be installed and commissioned in place in 2012 – 2013, which means the Gann chart to work out the timeline for managing this project needs to be worked from the finish date of say June 2012. From my extensive engineering and Project management experience, the clock is already ticking and there will be very little gap time from now; meaning that the UHF spectrum for point-to-point Broadband CAN communications needs to be resolved virtually immediately.

Question 3.9

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Is Anybody Actually Listening?

A recent Broadband submission [6, 7, 8, 9] from me to the Select Committee on Broadband 2009, carried a swathe of arguments that never got as far as the final report! In short, the submission showed that on a commercial basis there is no way that telecommunications infrastructure can be operated beyond the major capital cities (the metropolitan areas – in telecomese). These arguments have already been provided to the Select Committee and they are referenced in this submission for your attention.

In the Sydney Morning Herald – Weekend Edition, 23-Jan-2010, News page 11: The NSW Legislative Assembly is calling for Submissions on “Transforming Life Outside Cities: The Potential of Broadband Services”. It seems to me that the questions being asked in their Call for Submissions very closely aligns to the questions being asked in by the DBCDE Call for Submissions regarding the Digital Dividend, and therefore a substantial amount of both Federal and State revenue can be saved if you two bodies worked in close cooperation with each other instead of separately.

Question 3.10

What are the spectrum implications associated with the NBN?

Competitive Spectrum is Extremely Wasteful

As I have stated elsewhere in this submission, with a non-competing wholesale network (ie NBN), the radio spectrum requirements by competing infrastructure businesses is virtually eliminated, and the statistical network efficiency (which means business efficiency) is maximised.

The implications that flow on from this is that Optus, Telstra and other competitive infrastructure service providers that have fixed and/or mobile radio CAN network infrastructure beyond the metropolitan areas will be ‘doing it tough’ because these network infrastructures will not be making any profit (just ‘looking good’ in terms of geographical network coverage). It therefore makes very good business sense for these competitive businesses to ‘sell’ or give over their non-metropolitan radio CAN infrastructures to the NBN and rent the wholesale service back from the NBN.

Because of economy of scale and because the NBN is not a competitive retail provider, the NBN will be in a prime position to provide the fixed and mobile radio CAN wholesale services at a lower operational rate than any of the incumbent competitive operators can provide. Further, the cost of the radio spectrum can be ‘sold back to the NBN for a nominal fee’ and the NBN can then move with its economy of scale and minimise the spectral usage (and overhead costs because of that) and maximise the spectral network service quality while minimising the use of the overall spectrum.

Question 3.11

What other implications might the NBN have for the allocation of digital dividend spectrum?

Economy of Scale is far more Economic than Competition

In October 2007 I produced a submission to the Regional Telecomms Review Board [12] and in the Appendix A of that submission I produced a set of tables that showed the nominal telecommunications costs on a pro-rata basis, based on a 100 figure for 1999-2000. While this technology timeline barely touched on radio transmission, it did however show that over the last seven years, the operational costs for a similar network connectivity would fall to 26.54 by 2007; or in other words the costs for telecomms network connectivity would be then in the order of 26% of what they were in 2000.

This chart therefore clearly shows that the competitive regime is extremely inefficient, because in that time the end user costs had not dropped in line to be 74% less than they were in 2000, but according to Senator Coonan at that time, the end-user costs had come down by a mere 26% over that same period, so therefore the remaining 48% of potential savings has been lost through increased competitive inefficiencies.

Other implications that the NBN might have in the allocation of the (UHF) digital dividend spectrum are that because the NBN is not to be a competitive body – but an infrastructure body. The mobile radio spectrum will then be managed by the NBN to minimise all geographically duplicated mobile infrastructures, which in turn will radically minimise the spectrum usage into one mobile wholesale network and through, that the mobile spectrum will not be made deliberately scarce through competitive pressures.

As far as the allocation of the upper UHF band (702 MHz – 822 MHz) is concerned, the NBN would be the sole wholesale user of this spectrum allocation and consequently its use would be limited to geographic areas where FTTP is impractical or too expensive. Through the economies of scale principles the NBN will be in a position to provide and maintain communications services through this radio media at a lower operational cost than any other equivalent directly purchased transmission system, and consequently even private companies wanting to be connected with radio links using this spectrum would find it by far the most cost effective solution to use the wholesale services of the NBN and a retail reseller – even if the reseller is part of their own (mining) company.

Question 3.12

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

Is Anybody Actually Listening?

A recent Broadband submission [6, 7, 8, 9] from me to the Select Committee on Broadband 2009, carried a swathe of arguments that never got as far as the final report! In short, the submission showed that on a commercial basis there is no way that telecommunications infrastructure can be operated beyond the major capital cities (the metropolitan areas – in telecomese). These arguments have already been provided to the Select Committee and they are referenced in this submission for your attention.

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Federal and State revenue can be saved if you two bodies worked in close cooperation with each other instead of separately.

Question 3.13

Should digital dividend spectrum be used to provide mobile television services?

Population Density Commands Spectrum Application

With the digital spectrum restructured on 8 MHz channel bandwidths instead of 7 MHz this should be let global standards be applicable inside Australia and provide adequate bandwidth for digital TV to function properly.

The intrinsic problem is antennae size and even with the 702 MHz - 822 MHz upper UHF band being used in the rural and remote for Broadband CAN connectivity (using 20 MHz channels), there is no problem with this same 120 MHz wide band being used in metropolitan areas for mobile television broadcasting – using 8 MHz channels as stipulated in Table 4 of this submission.

If mobile TV were to be used in regional geographic areas where CAN applications were concurrent, then it would be necessary to position the mobile TV broadcasting channels within the range of 526 MHz to 702 MHz – to keep out of the upper UHF spectrum. At any non-metropolitan location the number of 8 MHz wide TV channels available in the lower UHF would be 22, and that number of channels should be far more than adequate for any district with a nominal radius of say 50 to 70 km, especially in non-metropolitan regions.

In metropolitan regions, the need for using the upper 120 MHz in the UHF for Broadband Internet is totally unwarranted as all these areas will have more than adequate FTTP CAN infrastructure to provide these Broadband services, and this then allows a further 15 TV channels that are 8 MHz wide, totalling 37 TV channels in the metropolitan areas.

Considering that mobile TV reception is along the similar lines to that of mobile phone transmission, then in this specific case, the upper UHF should be reserved in the metropolitan areas so that low power transmitters can promulgate the broadcasting using just the upper 15 TV channels in the range 702 MHz to 822 MHz.

There is another form of transmission that may have been overlooked and that is datacasting of business data (for example the ASX trade data) on a virtually continuous live feed. The data rate does not have to be all that fast and 256 kb/s is more than adequate. This data would be via subscription, and therefore it would be broadcast on a multicast arrangement where the reception key would be locked in via Internet (probably on a rolling key encryption process).

In a very similar vein to Voice Frequency Telegraph (VFT) technology used in analogue telephony backhaul infrastructure, and the multiplexing of stereo audio in 2 Mb/s digital transmission; several (for example 16) datacasting channels could be concurrently transmitted over a single 8 MHz wide TV channel – each having a 0.5 MHz nominal bandwidth. By using any TV channel in the lower 22 range of the UHF spectrum, this service would then be nationally available and minimise the need for a high usage of the Internet, and a high usage of FTTP facilities to provide universally available business data to any location that is capable of receiving UHF TV in Australia.

Question 3.14

How much spectrum would be required to provide these services? Please provide estimates for each delivery model (i.e. unicasting, multicasting and broadcasting).

Taking the Broadcasting load off FTTP

As stated immediately above, if one 8 MHz channel were to be used for datacasting (be it unicasting, multicasting or broadcasting), then the 8 MHz channel should be able to convey nominally 16 data channels (each being nominally 0.5 MHz wide). The engineering problem will be that of Group Delay Equalisation at the band edges of the TV channel, but if this were slightly over pre-equalised (Tchebyshev approximation) before transmission, then the problem of Group Delay should be minimal and all 16 channels should be fully functional.

The one 8 MHz channel would be the medium for every geographic location, so only one of the 22 lower UHF TV channels would be reserved for datacasting. The decision if the streams are to be used as unicasting, multicasting or broadcasting is entirely up to the manager of the sub-channel itself, and the protocol that is used to allow the data at the receiving end to be allowed past the decoder.

Question 3.15

When would this spectrum be required?

The NBN Backhaul is Delaying Everything

There is no point in putting in any datacasting channel equipment until the Telstra and Optus non-metropolitan infrastructure has be handed over to the NBN and the NBN has put in place the eastern inland backhaul backbone so that non-metropolitan population can connect to the Internet. For further information refer to the answer for Question 3.8.

Question 3.16

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

How to Decentralise Australia

There have been several attempts to decentralise Australia from its capital cities and every time this has been raised and funded, the good intentions have fallen flat because the transport infrastructure (Road, Rail, Telecommunications) is totally insufficient. Canberra is there because it is in between Sydney and Melbourne and it has the major telecommunications golden boomerang of optical fibre right through it, and there are several other cities along the same route (Goulburn, Wagga Wagga, Albury-Wodonga, Wangaratta, Bendigo) that would not exist if the telecommunications path did not pass right through them.

Having been brought up in the country and having brought up children in suburban Sydney, I know that the quality of life in the country far exceeds that of the metropolitan suburbs, but when it comes to employment, being in a non-metropolitan area severely restricts the opportunities because virtually all office based work is metropolitan based.

Part of this culture is that many executive managers have only worked in major city offices and they know that to survive to the top it is essential to have continual face-to-face meetings to shore up opinion and strategise each and every (personal) advancement. This winner take all mentality is how big business works and nothing will change that except if meetings can be done on a less personal basis using video conferencing on a virtually continual basis, and even then power groups form through drinks after work.

Apart from the top executives being locked up in a few offices in the major capital cities, the rest of the work force does not have to be anywhere near the executive offices, and with improved telecommunications it has been shown that international call centres (for example India) can be cheap and nasty solutions. Almost all day-to-day office work need not be done in any capital city, and the land prices in country towns is significantly cheaper.

Putting this together we as a community would do very well to decentralise our general office staff into the medium country towns and use optical fibre telecommunications to be the transport conduit – at least that way the children will have a far richer education, child minding would be minimised and focussed on the family, and daily transport would be a 10 minute trip at the most.

Question 3.17

Should digital dividend spectrum be used to allow expansion or enhancement of existing broadcasting services? What would it deliver?

The Imperative of Standardising

If the entire UHF spectrum were reallocated as I have suggested to 8 MHz channels then literally all the problems about not having sufficient bandwidth would be managed

Question 3.18

How much spectrum would be required to provide these services?

Standardising on 8 MHz Channels is Imperative

Let’s start at 8 MHz channels instead of 7 MHz channels as explained in Table 4 of this submission.

Question 3.19

When would this spectrum be required?

The NBN Backhaul is Delaying Everything

There is no point in putting in any regional HDTV channel equipment until the Telstra and Optus non-metropolitan infrastructure has be handed over to the NBN and the NBN has put in place the eastern inland backhaul backbone so that non-metropolitan population can connect to the Internet. For further information refer to the answer for Question 3.8.

Question 3.20

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

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There have been several attempts to decentralise Australia from its capital cities and every time this has been raised and funded, the good intentions have fallen flat because the transport infrastructure (Road, Rail, Telecommunications) is totally insufficient. Canberra is there because it is in between Sydney and Melbourne and it has the major telecommunications golden boomerang of optical fibre right through it, and there are several other cities along the same route (Goulburn, Wagga Wagga, Albury-Wodonga, Wangaratta, Bendigo) that would not exist if the telecommunications path did not pass right through them.

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Apart from the top executives being locked up in a few offices in the major capital cities, the rest of the work force does not have to be anywhere near the executive offices, and with improved telecommunications it has been shown that international call centres (for example India) can be cheap and nasty solutions. Almost all day-to-day office work need not be done in any capital city, and the land prices in country towns is significantly cheaper.

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Question 3.21

Should digital dividend spectrum be used to implement DVB-T/MPEG-2 to DVB-T2/MPEG4 or DVB-T/MPEG-4 conversion strategies? If so, which strategies?

The HDTV Encoding Tradeoff

As new encoding technologies come out they will reduce the need for bandwidth, but they will also introduce a degree of time delay, which will make them unacceptable, and a compromise will be agreed on.

At this stage we have a moshpit of 7 MHz TV channels and nothing fits comfortably, so moving to 8 MHz channel spacing is not all that radical (at least it runs along global standards), and then we will be looking to HDTV and possibly 3D TV where bandwidth encoding will be important, and at least we will have standard 8 MHz channels, so the encoding as it happens will fit without the need for local engineering to make the ugly sisters foot jamb into the crystal slipper that belonged to Cinderella!

Question 3.22

Would additional spectrum be required? If so, how much?

Advanced Coding Reduces Spectrum Requirements

With the channel spacing set on 8 MHz and with digital TV tuning over the UHF band from 526 MHz to 822 MHz covering 37 channels; and with the understanding that the implementation of various advanced technologies to compress the bandwidth requirements for HDTV will alleviate the need to ‘harvest extra spectrum’; then no extra spectrum will be required – providing that the geographic locations of these technologies do not interfere with the current broadcast coverage.

Just like any other TV broadcast arrangement, some TV channels will use different modulation specifications to accommodate HDTV, 3DTV etc. The TV receivers have already become modular, and it will become standard practice to replace a component part (like a tuner module) to be able to receive these different format modulation and decoding patterns. Alternatively a special tuner will be a component part that will most likely connect with a High Definition Modular Interface (HDMI) connector to the main screen component.

Question 3.23

When would this spectrum be required?

The NBN Backhaul is Delaying Everything

There is no point in putting in any Regional HDTV channel equipment until the Telstra and Optus non-metropolitan infrastructure has be handed over to the NBN and the NBN has put in place the eastern inland backhaul backbone so that non-metropolitan population can connect to the Internet. For further information refer to the answer for Question 3.8.

Question 3.24

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

How to Decentralise Australia

Refer to the answer in Question 3.20

Question 3.25

Should spectrum from the digital dividend remain designated as broadcasting services bands spectrum to provide capacity for additional broadcasting services?

Population Density Commands Spectrum Application

This has already been answered in 3.13

Question 3.26

How much spectrum would be required for this purpose?

Metropolitan Spectrum extends to 822 MHz

Given that there are nominally five TV broadcasting businesses in Australia, and considering that each of these businesses will want to broadcast up to say four channels concurrently, then this means that a total of 20 channels will be in use. Considering that with 8 MHz spacing the total number of channels available in the UHF band will be 37 in the metro and regional areas, this leaves 17 channels for other uses.

Considering that two 8 MHz ‘TV’ channels may be used for datacasting then this leaves 15 channels available in the metro and regional areas for community based TV broadcasting.

In the rural and remote areas, the situation will be slightly different because the upper UHF (702 MHz – 822 MHz) will be required for point-to-point CAN communications in some locations (until that is replaced by FTTP), so this leaves a total of 22 TV channels that are 8 MHz wide.

In the understanding that government/commercial broadcasters have a ‘limited revenue’ in non-metro areas, these commercial broadcasters will not fund a total of four channels each, in fact I doubt they would fund more than two channels each. With five government/commercial broadcasters each broadcasting two TV channels this is a total of 10 TV channels, and including two channels for datacasting then this totals a maximum of 12 channels to be used out of an available 22 channels.

Even if these broadcasters increased their coverage to three channels per broadcaster, this only brings up the usage to 17 channels, leaving another five available for community TV broadcasting in every broadcasting region. In most cases the maximum number of TV channels being broadcast in rural and remote areas would be about 12, leaving about 10 free TV spectrum channels for community TV broadcasting at every regional area.

Question 3.27

When would this spectrum be required?

The NBN Backhaul is Delaying Everything

There is no point in putting in any Regional HDTV with special encoding until the Telstra and Optus non-metropolitan infrastructure has be handed over to the NBN and the NBN has put in place the eastern inland backhaul backbone so that non-metropolitan population can connect to the Internet. For further information refer to the answer for Question 3.8.

That aside, the metro areas could move on HDTV with special encoding once the coding standards have been successfully trialled and proven to work, and the international industry is in step with Australia.

Question 3.28

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

How to Decentralise Australia

Refer to the answer in Question 3.20

Question 3.29

Is access to digital dividend spectrum required for government purposes? If so, for what purposes?

Keeping Government Business Secure

The problem with radio transmission is that it is ‘unbounded’ – meaning that radio waves radiate like the waves caused by a stone thrown in a pond. The alternative is ‘bounded’ transmission and this is through media that totally encloses the electromagnetic waves, and that inherently brings with it a very high degree of security. Examples of bounded electromagnetic waves include waveguides, coaxial cable, optical fibre and twisted pair (only if it is screened and/or part of a cable).

If as discussed in the Green Paper, the government has a high proportion (25% spectrum) of radio communications between locations, then in my opinion the government needs to look very long and hard at what network structure it really has and what it can do to make that network primarily through bounded media, not unbounded media.

Recent news (December 2009) about USA based Drones in Afghanistan being monitored by free off-the-Internet software clearly shows that all radio communications of any private nature must be encrypted and as the Australian Defence Force (ADF) has its troops remote from headquarters, then radio communications is imperative – but from there on the communications must be bounded wherever possible – and that means using the optical fibre network in Australia wherever and whenever possible.

Using the NBN to clear the Spectrum

As the NBN morphs out of Telstra and Optus to become the telecommunications backbone of Australia, there is yet another large optical fibre network that in my opinion should be morphed into the NBN. The Australian Academic Research Network (AARNet) is a very large predominantly optical fibre network that has significantly grown in the background over the last decade and nationally interconnects virtually all university campuses, to most TAFE campuses and many secondary schools. AARNet also has very significant international high-speed optical fibre network connections to several other countries in a global infrastructure.

Much of this AARNet infrastructure also passes through Telstra and Optus telecomms facilities, just as the NBN will and therefore it makes good business sense to me that AARNet should be merged into the NBN. This merging will make the NBN truly functional, as much of the NBN will be connected to schools, TAFEs and Universities in any case. As most of

AARNet is already optical fibre, the synergy with the NBN should maximise the use of optical fibre and minimise any further use of radio links – reducing load on the spectrum.

In terms of national security, government connections using satellite are easily compromised and these should be minimised as far as possible. The considerable radio and optical fibre network that is federal government owned and rented should also be merged into the NBN incorporating AARNet and this combined network would facilitate a much raised security infrastructure and minimise any further use of radio links – reducing load on the spectrum.

As for the government itself, if the federal and state governments merged their telecomms network infrastructures into the NBN then this would remove a layer of duplication and create an economy of scale that would make large scale optical fibre routing highly economic, while concurrently producing several hundred optical fibre routes that could easily replace point-to-point radio situations; providing far more secure communications and considerably freeing up the spectrum that is currently occupied by government bodies.

Question 3.30

How much spectrum would be required for these purposes?

Giving is Better than Taking

The answer provided to Question 3.29 showed that by using the NBN as Australia's telecommunications backbone and by merging government owned and rented network infrastructure into the NBN then some of the spectrum that is currently being used by the government will no longer be required – because the communications will now pass through bound media (optical fibre).

This answer also showed that through economies of scale that AARNet could also be economically merged into the NBN as should all state telecomms network infrastructures, and this could significantly reduce the call for spectrum use while providing a far more secure and reliable network infrastructure.

Question 3.31

When would this spectrum be required?

Merging AARNet into the NBN is Imperative

Initially, Telstra and Optus non-metropolitan infrastructure has to be handed over to the NBN and the NBN has put in place the eastern inland backhaul backbone so that non-metropolitan population can connect to the Internet. Concurrently, AARNet needs to be merged into the NBN and the AARNet single point of contact (SPOC) needs to be established to manage the retailing of the telecomms services into all universities, TAFEs and all schools

That aside, the federal government could immediately move to merge its network infrastructure into the NBN, and establish a federal government SPOC retail reseller to manage the government telecomms services. Likewise, the state governments could immediately move to sell their telecomms infrastructures to the NBN, and set up a retail reselling arrangement where they purchase the wholesale services from the NBN and manage the retailing into their own departments.

Question 3.32

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

The Competitive Regime is Economically Inefficient

The answers given in 3.29, 30, and 31 explain the benefits of this use, and demonstrate the raised security value along with far cheaper service costs because the very expensive overheads of competition are removed.

Question 3.33

How much spectrum are these devices likely to require in the future?

Less Is More

The answers given in 3.29, 30, 31 explain that by using the economies of scale through merging AARNet and the state telecomms infrastructures into the NBN, together with merging the federal government infrastructures into the NBN then because of the spare capacity in optical fibre infrastructures, then radio links will not be required in many cases, so the demands on spectrum usage will be less, and that provides more spectrum availability.

Question 3.34

Will there be room in the broadcasting services bands, after digital switchover and restacking, to meet their future spectrum requirements?

The VHF Spectrum Dividend

What has not been mentioned in the Green Paper was that the VHF range (45 MHz to 230 MHz) is almost all freed up (except for the FM band 88-108 MHz shown in maroon in Tables 1 and 2), so this is another 165 MHz that is available for alternate usage as another dividend of moving the television and datacasting up to the lower end of the UHF band.

This VHF part of the spectrum is not much use for mobile communications because the antennae are generally too large, but there is a range of industrial applications like base to vehicle communications that would have a use for this spectrum, particularly in rural and remote locations.

The VHF band 109 – 230 MHz could have particular use as homestead base station to mobile vehicles in rural and remote areas and this part of the spectrum seems not to be considered as part of the flow-on from the original digital dividend. If this radiation pattern were vertically polarised then this would provide a direct use for whip antennae on county-based Utes over several tens of km.

Alternatively part of this large VHF band could be put aside for Wireless Audio Devices. In a similar vein to Datacasting in the UHF band, wireless audio devices could be allocated an 8 MHz channel and this channel could be divided into several smaller sub-channels of say 250 kHz (0.25 MHz) wide for FM transmissions at low level, so that in any 8 MHz channel, this could hold say 32 wireless audio channels, and be limited to a range of say 100 metres.

Question 3.35

Should separate UHF spectrum be reserved Australia-wide for use by these devices from the digital dividend spectrum? If so, how much?

No response

Question 3.36

When would this spectrum be required?

No response

Question 3.37

What would be the benefits of this use? Arguments should focus on the value this use of spectrum presents for the Australian community and economy.

No response

Question 4.1

What issues will arise through viewers being required to rescan? Can receivers be developed that are able to automatically rescan?

Finding New TV Channels

The Green Paper correctly assumes that re-scanning a TV receiver is not all that difficult a process, and in this light, this can very easily be promulgated by a few news media stories, and the commercial channels have already jumped on the bandwagon to tell their prospective viewers (customers) because this is in their financial interest.

On the innovative TV front, there is nothing wrong with having a setting on a TV so that say every month it automatically re-scans the available spectrum for TV channels, and if it finds anything new it should be able to inform the viewer of the new channel(s). The only problem is that some people will have their TV channels set in a particular structure, so the option should be there for the viewer to structure the new channel into their viewing preferences.

Really, programmed auto scanning for TV channels is not a topic for the Green Paper to discuss but for innovative TV developers to use in the competitive market to outsell their competitors.

Question 4.2

In the small number of cases potentially affected, what is the likely cost for viewers associated with replacing their existing UHF antennas? It would be helpful if the cost per antenna and the likely total cost for all affected viewers could be identified.

Commercial Grade Coax Problems

The Green Paper incorrectly assumes that replacing a standard TV Antenna with a new UHF Antenna will fix the reception problem, but there is a secondary problem in that the lead-in cable that is commercially available is of commercial grade not industrial grade, and consequently the attenuation per unit length (metre) is appreciably more than the loss through an industrial standard cable, and this attenuation loss increases with age.

In understanding the ageing problem a little better, a typical VHF commercial grade lead-in has a useful life of about 10 to 20 years, where an industrial grade lead-in has a useful life of about 30 to 40 years.

What has to be also understood is that the attenuation is proportional to the log of the frequency, meaning that as the frequency extends from the VHF range into the UHF range, the attenuation in the lead-in cable can be so great that a mast-head amplifier is required to amplify the signal be at least 15 dB to keep the signal above the noise floor in this transmission system, especially if the TV cable includes splitters to feed to more than two rooms. Commercial grade coax cable lead-ins have a rather poor outer conductor as act more like leaky pipes than clean highways for the UHF.

There is however a silver lining in dropping the VHF band and concentrating on the UHF band for TV. As shown above most current TV antennae consist of a composite array to receive both VHF and UHF, and these antennae naturally have a relatively high Voltage

Standing Wave Ratio (VSWR), which means that these antennae internally reflect a considerable amount of the received signal – much like sea waves crashing into solid rock cliffs, and a reflected wave runs back into the sea. Most composite UHF/VHF antennae are a two-part construction, joined at the common feeding point by a balun (balance to unbalance transformer and probably a high pass / low pass filter.

By removing the VHF connection at the filter and feeding the balun directly off the Yagi dipole the VSWR will be minimised (increasing the reception level by more than about 3 dB). By replacing the commercial grade coax lead-in with industrial grade coax, the attenuation will be reduced by about 3 dB per 10 metres (and typically the lead-in length is about 20 metres), so the overall gain by properly replacing the coax would be about 6 dB, and the UHF antenna will operate more effectively because the VHF connection will no longer detract from it, so the reception signal level will be increased by about 9 dB on what it was before, which in almost all cases will make a dramatic improvement in the received signal level – without replacing any antennae!

With very little engineering effort, the VHF part of the composite antenna can be detached, and a new industrial grade coax cable lead-in can be installed to replace the existing commercial grade coax lead-in. This maintenance practice would nominally take about 30 minutes to an hour, and the coax cable would cost about say $1.50/metre; so considering that a typical roof mounted antenna has say 20 m of coax attached, then the overall cost should be in the order of $70 (labour) + $30 (coax) = $100 per household in round figures.

No Reason for Government Subsidies

Because most of the cause for replacement of Coax (and sometimes associated antennae) is due to ageing and wear, there is no reason for any Government Department to subsidise the maintenance of television receiving apparatus. In the case where new Digital TV channels are brought in to an area, most viewers already have suitable multi-Band antennae, and isolating off the VHF connections will in almost all cases dramatically improve the VHF response (as described above) so again there is no reason for Government funding or subsidies to any part of the community.

Television receivers have a commercially limited life and therefore all viewers must be accountable for their actions and realise that the Government has provided a wide time window into when TV channels will be re-stacked, and that the VHF Bands will no longer be used for future TV Broadcasting. The Government has also given a wide time window informing viewers that Analogue TV transmissions will cease and that the lower UHF Bands will be used for all future TV broadcasting (including digital TV broadcasting). With this understanding, there is no reason for any form of Government funding or subsidy to any part of any part of any community to replace their TV sets, their TV antennae and their coaxial cable lead-ins.

Considering the immense financial and material waste caused by the disastrously poorly managed “Energy Efficient Homes Package”, [10] and understanding the very close parallels drawn on by employing unqualified and inexperienced ‘tradesmen’ to install and repair TV antennae (as it was done with installing fibreglass batts in ceiling cavities); any Government sponsored subsidy will surely lead to yet another disastrous situation where the pricing will be over-inflated, the work standards will not reach the poorest Quality standards, virtually no traceable recording of receiving levels will be provided to prove the necessity of the work, and the workmanship will be shoddy.

Dropping the VHF TV Band

In practical terms, the overall bandwidth for television / datacasting would totally drop the VHF bands, so because all antennae are fundamentally based on half wavelength, then comparatively the much larger large size of antennae to pick up the Channel 0, 1, 2 frequencies would be eliminated.

It is vitally important to realise that the amount of ghosting (as seen with analogue transmissions), is particularly relevant in the lower VHF range and this is because the receiving antennae used in most cases is essentially a very simple Yagi design with one director and one reflector. This type of antennae has a particularly poor directivity (with the front-to-back ratio being only a few dB) so these antennae are very vulnerable to receiving reflected transmissions with a slight delay causing ghosts on the reception.

Places like Western Sydney (with the Blue Mountain range as a close backdrop) made these simple Yagi antennae rather ineffective and in that case many residences had a “Phased Array” antenna that has a flat mesh as a screen behind an array of paralleled dipoles. These antennae were far more effective, and far more expensive to install and maintain.

Commercial TV Reception Antennae Construction

To get a better understanding of these commercial antennae, the picture below shows a typical residential antenna engineered for Australia’s capital city suburbs.

This antenna is a composite VHF / UHF antenna with the UHF component being the much shorter dipoles (basically on the left hand side), which is a Yagi construction with eight director dipoles (counting from the left), a composite active dipole (with the black box in the middle of it) and a four-element V shaped passive reflector behind this active dipole. The VHF component of this TV antenna is in two parts. The longest dipole on the right is the reflector for the VHF Band I and in front of that reflector are four dipoles forming a log-periodic antenna (note the feeder crossovers under the supporting beam). Band III in the VHF range has much shorter dipoles sitting as yet another log-periodic array, using the common node points as the VHF Band I component. While this may be brilliant engineering, I have no doubt that the VSWR is heavily compromised – particularly in the VHF range.

With the VHF spectrum removed from the television bands, such an antenna as above would no longer be necessary and a far more simple and effective UHF Yagi design will give superior results in virtually every case! The current 8 directors could be increased to 18 directors giving a much better gain (compared to an isotropic reference) and the beam width will be significantly narrower.

Further in this brief discussion, the upper VHF area for channels area in particular 173 MHz – 230 MHz would not be required, but in saying this, it is also vitally important to realise that commercial television antennae used a much better Yagi antennae structure with typically 3 to 5 directors in front of the dipole to give this frequency range a much better front-to-back ratio and this is why this frequency range holding channels 6 through to 12 has a much better reception characteristic than the low VHF range. The UHF bands continue this practice of using Yagi antennae for directivity because of the simplicity of construction and generally good results.

Question 4.4

What is required in the restacking process for broadcasters? Are there potential spectrum use implications? How much time is required for broadcasters to plan and implement transmissions at new frequencies?

The UHF Antennae Dividend

When we move into the UHF spectrum and narrow the band from 526 – 820 MHz – which is 0.559 octaves down to say 526 – 702 MHz – which is 0.335 octaves, then we have another dividend in that the residential television / datacasting antennae can be engineered as a Yagi or a Log-Periodic structure with a nominal centre of 608 MHz, and a Q (Quality Factor) of about 3.45, which when compared to a UHF antennae to cover the earlier range of 526 – 820 MHz would be centred on say 658 MHz and have a Q of 2.24.

While this 54% improvement in Q might not appear all that much, the directivity (angle of reception) of the antennae is considerably narrowed and the isotropic gain of the equivalent antennae is marginally increased, while the front-to back attenuation is significantly increased; and all these characteristics combine to make a clearer reception (or alternatively a lower transmitting power that would radically reduce the inter-area channel interference).

The spectrum dividend is created by now having dramatically narrowed directivity, which will provide a reception that is much less prone to ghosting (and even though digital transmission does not show ghosts in most cases, the cleaner signal will prevent the digital code error correction from working overtime, and that means considerably less signal dropouts and more reliability with data based transmissions like Internet and datacasting).

The problem is for residences that are geographically located where they are broadly co-linear with two transmitting masts where the same frequency and polarisation is not used; the residences then receive both transmissions. There could be major issues in a number of geographic cases and I am sure that part of the role of the Spectrum Management Authority (SMA) is to position transmitters and stipulate the bandwidth and peak emitted power (PeP) that may be transmitted so as to avoid reception interference.

To further reduce the inter-area channel interference, the H/E fields can be transmitted on the horizontal or vertical plane, so adjacent transmission areas can have their electromagnetic fields effectively being cancelled (or nulled) out simply by setting the transmitting antennae either vertical or horizontal on the transmission mast. By having the adjacent area operating with the H/E fields rotated by 90 deg, (ie vertical polarisation versus horizontal polarisation) then the receiving antennae will null the offending transmissions in the order of 20 to 30 dB, ***before this signal gets into the receiver***; greatly reducing the probability for interfering signals to affect the desired signal.

Considering that the number of 8 MHz television transmitters per unit area has never exceeded about eight, and even with digital television, if this figure were to increase then allowing 22 channels in the constricted UHF band (526 – 702 MHz) then is an allowance of 160% (2.6 times) over the current usage, and that is somewhat unlikely.

Question 4.5

How much is it likely to cost broadcasters to move digital television services to alternative frequencies, both in terms of the purchasing of new transmission equipment or the retuning of existing equipment? It would be helpful if best and worst-case scenarios could be presented.

Changing a TV Transmission Frequency

The Best Case Scenario is that the TV Broadcaster is already on the frequency and nothing changes – so this cost is zero.

The Average Case Scenario is that the TV Broadcaster is off frequency, and that the transmitting aerial, power stages and associated direct receiving equipment have to be re-tuned, and in some cases, because the direct receiving equipment is both modular and inflexible, then some modules in these specialised receivers will have to be replaced.

In the Worse Case Scenario, the TV Broadcaster's frequency will be so far away from the allocated transmitting frequency that the Antennae will need to be replaced and retuned, the Transmitter will have to have replacement tuned sections and the direct receiving equipment is both modular and inflexible, then some modules in these specialised receivers will have to be replaced.

In most cases (Best and Average Case Scenarios), the change of frequency will be marginal and the re-tuning will take in the order of several hours – most likely during the low viewing period between 12 midnight and 6 am, so commercially this will not affect the viewing customers (unless they also do not re-scan their TVs to lock in on the new frequencies). In any case it would be up to the TV Broadcaster to put out several promotional information sessions in the weeks preceding to let their viewers know that their transmitting frequency is going to change and what to do to keep their viewers! These promotional information sessions have got to be seen as good local publicity of their own businesses, and consequently such promotions are not an invitation for tax concessions.

In the Worst Case Scenarios, the TV antennae on the mast may need replacement – but this has to be taken into account with normal wear and tear with ageing and as such even though these antennae are replaced, they can be on-sold to another TV Broadcaster, or located elsewhere in their own network so the cost really is heavily mitigated (minimised).

Similarly with changed frequencies, the TV transmitter tuning will probably not cover the range to the changed frequency and so replacement cavity resonators will be mandatory, and although these are not cheap, they will have use elsewhere, so they can in all probability be either on-sold or used in another TV transmitter at another location.

Question 4.6
How would low-interference potential devices be best accommodated in the UHF bands in light of the proposed digital dividend and the restacking of digital broadcasting services?

No response

Question 4.7
Do these devices use specific frequencies within the UHF bands? Which frequencies do they use?

No response

Question 4.8
What costs would be involved for users to move frequencies?

The Answer to Question 4.5 covers this topic.

Question 4.9
Should one or more discrete frequency bands be set aside within the UHF bands for use by low-interference potential devices?

No response

Conclusion
It seems to me that the channel bandwidths were compromised way back in the 1950s to be 7 MHz and not the global standard of 8 MHz and now is a very good time to get all TV channels re-aligned to 8 MHz; and all sub channels made to sit in that framework having 4 MHz, 2 MHz, 1 MHz, 0.5 MHz, 0.25 MHz bandwidths.

The restructuring of the UHF bands to start at 526 MHz and extend to 822 MHz has good value as this provides 37 TV channels having the capability to be 8 MHz wide (which I understand to be global standards, not Australian standards).

The upper 120 MHz of the UHF (702 MHz – 822 MHz) has use in metro areas because of much higher population densities, but in rural and remote areas this frequency band could be used for point-to-point Broadband CAN connections where FTTP is totally impracticable, and in those areas, the extra TV channels would not be commercially viable – so this is a win-win situation based on geographic demography.

Merging AARNet, state telecommunications infrastructures and federal telecommunications infrastructures into the NBN will have a very big economy of scale factor that in Australia with our very low population density will significantly improve the reliability and Quality of telecommunications services and provide the services at a much lower end-user cost. This merging will also have a negative impact on the demands for electromagnetic spectrum as many of the existing telecomms infrastructures using radio will be able to be moved into bound media of optical fibre and provide another level of national security.

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Appendix

Australia's 7 MHz Channel Blunder

Emerging TV and VHF Technologies

In the mid 1950's when the Australian Government moved to introduce Television, the established engineering protocol was to follow what was then the CCITT (now the ITU) as the international standards centre of excellence. Internationally, the CCITT had settled on 8 MHz for the channel bandwidth so that the Phase Alternated Line (PAL) colour sub-carrier could be positioned far enough away from the luminescence signal so that the bandwidth of the luminescence signal would be minimally compromised and the clarity of the luminescence would provide a very good picture quality in most cases. (But we are talking Black and White television transmission here for Australia.)

What also had to be taken into account was that the vertical and horizontal synchronisation pulses were comparatively large in the analogue signal and to accommodate this in the modulation scheme, a 'vestigial' (partial) sideband was used so that the overall amplitude modulated transmission signal was not a SSB (single side band) as SSB transmission arrangement requires a very stable carrier, but a small carrier with some of the AM spectrum below the carrier frequency, and the carrier frequency could 'lock-in' the receiver. Each broadcast channel has a 'skirt' where the transmission is effectively unusable (much like a hedge between city properties), and this 'skirt' takes some of the allocated spectrum.

Ministerial Incompetence

According to very good authority (Alan Neville Thiele - who was later the Chief Engineer for the ABC for a considerable number of years and extremely highly respected), the Federal Government of the day was to sign off on an 8 MHz channel frequency and spectrum usage as per the CCITT recommendations, but apparently just before the paper was to be signed off the Minister was ill advised by a person with commercial interests that the Government could get an extra (say) 14% of channels over the same spectrum if they decreased the TV channel bandwidth from 8 MHz to 7 MHz.

With classical Ministerial ineptitude the Bill was passed and signed off within a few hours much to the despair of the television and telecommunications engineering fraternity in Australia and internationally. The Australian Federal Parliament in its grandstanding stupidity had just signed Australia into the television backwater, and it took several years for many brilliant Australians to dig us somewhere out of this unholy mess.

In that instant, no commonly produced television sets made anywhere else in the developed world would work in Australia, so instead of using economics to advance Australia, we had to re-engineer everything from the specifications upwards to accommodate a narrower channel bandwidth: transmission modulation electronics, transmitter constructions, transmitter antennae construction, television receiver turrets, the television's intermediate frequency bandwidth structure, the demodulation for sound, and later the whole exercise had to be repeated for television incorporating colour.

ABC Engineering Brilliance

Very fortunately we had Neville Thiele, where he and his team came up with an equalisation innovation that deliberately over-equalised the transmitted luminescence signal (including over-equalised group delay); subsequently the TVs intermediate frequency stage filters (which are quite complex) could be mass-manufactured to much lower tolerances than before and give excellent results.

Had it not been for this brilliance, the whole TV industry in Australia would have had to accept defeat and plead for the then Minister to alter his grandstand position in the Bill and revert to the European 8 MHz standard.

Commercial Pressures

Concurrently, the USA engineers were way off the mark with their NTSC system (jokingly called ***Never Twice Same Colour*** because of its appallingly poor visual performance)! With a continually varying (radio) transmission path (between the transmitter's antenna and the receivers antenna) the group delay also continually varied causing the colour sub-carrier to vary in phase relative to the luminescence signal – so the picture was "never twice the same colour".

The CCITT recommended (European system) was based on 8 MHz bandwidth and included a 64 usec delay line in the receiver and in the transmitter the colour sub-carrier was phase alternated every horizontal line. When the 64 usec delayed colour phase and the immediate colour phase were compared in the television, their phase differences were self-cancelled and the colour faded slightly if the phase error was particularly bad. Commercially the PAL system was slightly more expensive, but the performance was exceptionally good, with the colour being very stable, far outperforming the NTSC system.

In a similar vein Cable TV is a far more stable transmission medium as a coax cable bearer compared to highly reflective radio waves (which cause shadows in analogue TV reception). Having a commercially pathetic 'free to air' TV system in the USA was probably the main reason why the USA population in desperation flocked to cable TV, and paid for the captive privilege to view what would be free, if commercial pressures had not severely compromised the free to air standards by insisting on NTSC instead of moving to the CCITT recommended PAL transmission with an 8 MHz bandwidth.

It seems that the USA NTSC system had its TV transmission channels based on 6 MHz, primarily due to commercial pressures to minimise the channel width in order to maximise the number of channels (in a very similar fashion to the total stuff up caused in Australia by commercial pressures here). ***This USA-based debacle again speaks volumes for commercial pressures to be totally removed from the process to allocate channel space.***

Conclusion

It is a damning situation that is exemplified by the absolute incompetence of the Australian Federal Government and its Ministers to also take advice from a commercial identity (in much the same vein as that in the USA) to – in the early case – fractionally reduce the bandwidth of the TV channel from 8 MHz to 7 MHz without consulting with professional engineers (who are not in it for their bonuses and or dividends)!

We can only hope that the Government Ministers / Senators/ Opposition take serious note of the two extraordinary debacles shown here that were caused through commercial pressures to maximise profiteering. ***All Government bodies; be they elected or part of the APS, have a moral duty to put the people first and the profiteering last.***

Why Spectrum Auctions Don't Work

Some years ago the USA government was (again) desperate for funds – primarily because the taxation system in the USA has been so heavily rorted by their own multi-national corporate businesses. These businesses have also colluded large numbers of stooge economists [4] and university lecturers that have unwittingly taught liaise fare economics, where the government of the day takes a very back-seat position and lets business have a free rein through 'free market forces'! Almost all of the USA government bodies are virtually powerless and cash-strapped because almost all the 'control' comes from big business and not the government.

In this desperation, somebody in the USA government came up with the idea of auctioning off the electromagnetic spectrum to create federal funds. The prices paid for the spectrum were immense and the USA government came out of the financial situation with some less immediate debit, but the competitive businesses had to recoup these financial losses and the only way forward was to considerably raise the end user costs!

So in the short term – the USA government recouped some of the revenue it so desperately needed (revenue that it would have received generally if its taxation system was in order), but in the medium term the telecommunications costs significantly rose, and this in the longer term directly pushed up inflation, which in my opinion, made the spectrum auctions useless, particularly because the end user costs rose, and consumer usage took the hit.

Shortly after the spectrum sales in the USA, in Australia, somebody with political connections and probably aligned with the SMA saw the short-term windfall gain made by the USA government in auctioning the electromagnetic spectrum, and pushed the button for auctioning off the electromagnetic spectrum relating the Australia, and in my opinion the auction sales were a disaster for cost-effective telecommunications in Australia.

Ancient history taught us all that the major cities grew along the trade corridors, and nothing is different today – even with Internet, the time taken to deliver the commodities (and the route taken settle the trade decisions)! Isaac Newton also taught us that the attraction between two objects is proportional to the inverse square of the (time related) distances, and with this knowledge put together it becomes obvious why higher population densities inherently have heavier trade / business, and this explains why shopping malls have a higher trade level than shopping strips like in country towns or corner shops in some suburbs.

In understanding that the Davidson Inquiry [5] clearly realised that telecommunications beyond Australia's metropolitan capital cities are a cost centre (ie not profitable) situation, so this associated Report then included the Universal Services Obligation (USO) to 'make the cost centre look comparable' (but not competitive) to its somewhat profitable metropolitan cousin – which has a much higher population density.

This Report in 1982 clearly showed that the prime cause of the non-metropolitan network being unprofitable was the Newtonian relatively long distances between major (trading) centres; so introducing the USO to make the networks look comparable was a dismal folly to comply with the instructions to the Inquiry to make the telecomms network infrastructure look as though it could profitably support the competitive regime, so that the telecomms sector could be floated on the ASX – like that in the New York Stock Market.

In direct comparison, the USA has a slightly larger landmass as Australia [1] but the USA population is about 10 times that of Australia. Understanding that Australia has five somewhat profitable (in telecommunications terms) metropolitan cities, then the USA would have at least 50 (in telecommunications terms) profitable metropolitan cities, or looking at this in the Newtonian viewpoint; the distances between the USA cities would be one tenth that of the distances in Australia, and the square of 10 is 100, meaning that the commercialisation prospects in the USA are optimistically 100 times that of Australia. Considering that a large proportion of the Australian population is in the south eastern corner of Australia, and the inter-city distances are say five times that in the USA, the commercialisation prospects in the USA are pessimistically 25 times that of Australia.

Put in a common light, the commercial viability of telecommunications in the USA is at least 25 times that in Australia and the Davidson Report spelt this problem out (but nobody took notice), and that is now why the National Broadband Network (NBN) has been raised to put the necessary telecomms infrastructure beyond the metropolitan areas. Unfortunately our current Telecomms Minister's advisors just don't get it that this telecomms infrastructure will never be profitable and consequently it should only be operated as not-for-profit Government Business Enterprise (GBE), never be floated as a business and never be placed on the ASX.

When it comes to auctioning off the electromagnetic spectrum in Australia, again the Telecomms Minister's advisors just don't get it that this spectrum is infrastructure that is to be provided as a "use-it-or-lose-it" scarce resource, which is simply not for sale, rent or transfer.

The reality is that the end user costs for telecommunications facilities in Australia already is very expensive and that a large proportion of those expenses come from equipment purchases (ongoing maintenance is considerably cheaper). The added problem is that the auctioned spectrum is extremely expensive (almost as expensive as the equipment itself) and without that licence to use a part of the spectrum, a competitive telecomms business cannot operate.

Alternatively, if the NBN were to be 'granted spectrum usage' on a wholesale basis then it could provide the radio-based wholesale telecommunications services to non-metropolitan areas at much lower than 'commercial wholesale rates' and that would then leave plenty of financial room for competitive resellers to make a profit (and even float on the ASX) without actually owning any infrastructure!

It therefore follows that auctioning off spectrum in Australia has at the best been inept lunacy that was totally doomed to failure, and whomever in Australia signed off on this get rich scheme should (in my opinion) be held accountable; summarily sacked and gaoled for at least five years.

Acronyms

AARNet	Australian Academic Research Network
ADF	Australian Defence Force
ADSL	Asynchronous (directional data speed) Digital Subscribers Line
CCITT	Consultative Committee on International Telegraphs and Telecommunications
DSLAM	Digital Services Line Access Multiplexer
EEU	European Economic Union
FTTP	Fibre to the Premises
GBE	Government Business Enterprise
H/E	Magnetic vector / Electric vector
HCRC	High Capacity Radio Concentrator
HDMI	High Definition Modular Interface
ITU	International Telecommunications Union
kHz	kilo hertz
km	kilo metres
MHz	mega hertz
NBN	National Broadband Network
NTSC	National Television Standards Committee
PAL	Phase Alternated Line
PeP	Peak Emitted Power
Q	Quality Factor
SCAX	Subscribers Country Automatic exchange
SMA	Spectrum Management Authority
SPOC	Single Point Of Contact
SSB	Single Sideband (radio transmission)
TAFE	Technical And Further Education
TV	Television
UHF	Ultra High Frequency
USA	United States of America
USO	Universal Service Obligation
VHF	Very High Frequency
VSWR	Voltage Standing Wave Ratio

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