Media Reform Green Paper response: BAI Communications

bai communications

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1 Introduction

1.1 Evolving Australia's free-to-air television services

Australia's national and commercial free-to-air (FTA) television broadcasters currently deliver 27 channels between them, providing audiences a vast array of locally relevant news, drama, entertainment, and sport. These services play an integral role in the cultural and social fabric of Australia by providing audiences with a rich and diverse variety of Australian voices and stories, news, current affairs, and journalism from a plurality of perspectives, together with access to sporting events and other events of importance to the national identity. The ongoing sustainability and success of a vibrant FTA television industry is essential for the many thousands of direct and indirect jobs held in the broadcasting and screen production sectors.

Digital Terrestrial Television (DTT) is the predominant means of delivering FTA television to Australian consumers, and that means a vibrant and sustainable FTA television industry is inextricably linked to the appropriate evolution of the DTT platform. The DTT platform provides a reliable, ubiquitous service to over 99% of Australians free of charge and has been responsible for ensuring that a universal, equitable television service is available to almost all Australians. This is a unique and extraordinary achievement when compared with other countries, particularly given the size and geographic distribution of the population. This has been made possible by sustained and continued investment in broadcasting infrastructure across the country. The 'one to many' nature of DTT has proven to be an extremely efficient means of content delivery compared with other technology options and remains very capable of supporting the FTA industry to deliver services to Australians into the future. DTT also gives broadcasters unmediated access to audiences that can tune in without needing to the content via a third party-controlled user interface.

The DTT platform is essential for the many Australians who are less likely to be able to readily access alternatives. Older Australians, those who are less affluent and people in regional and remote areas are less likely to access IP delivered online offerings, such as the metropolitan FTA broadcasters' Broadcast Video on Demand (BVOD) offerings, live streaming services or competing services such as Netflix. These online services depend on the audience having a reliable high-speed internet connection, so are not free to the consumer at the point of delivery. As regional broadcasters' content is largely sourced from the metropolitan broadcasters via affiliation agreements, they have no online offering at all.

Consequently, there is, and will be into the foreseeable future, a significant proportion of Australians for whom going online will not be a substitute for FTA television delivered over the DTT platform. Any reduction in availability of FTA television over DTT for these viewers would therefore exacerbate Australia's digital divide.

BAI is pleased to provide a response to the government as it seeks to define an appropriate technology and regulatory framework for the industry moving forward. As a significant provider of DTT transmission services, and with deep broadcasting technology and spectrum planning expertise, we hold a keen interest in the future of the FTA industry and the underlying platforms that support it.

While the future state of the industry, including structural and content decisions, will largely be a matter for the government and broadcasters to agree, we have endeavoured in this response to illuminate how the government can think about achieving key public policy objectives, including:

- Releasing the scarce public resource of spectrum to support evolving alternative uses
- Reinvesting some of the proceeds from spectrum reallocation to assist the FTA broadcast industry to remain competitive, given the critical role that it plays in informing and entertaining Australians
- Preserving technology optionality for the industry to compete effectively with the many subscription video on demand (SVOD) and other internet-based services that contest audience attention, now and into the future.

Beyond spectrum planning decisions, this will require the industry to address broadcasting technology choices for the DTT platform, including transmission and compression standards that could be adopted. Within this framework we consider potential costs, transition models, multiplex configurations, and additional work required to validate these decisions.

1.2 BAI's submission and recommendations

1.2.1 Submission overview

BAI's submission articulates the potential future state of the terrestrial platform, commencing with an overview of future RF channel planning scenarios that seek to maximise the capacity of the terrestrial platform while also releasing spectrum for mobile communications. It then explores the available range of transmission and compression standards that can be used, and the benefits and trade-offs of these choices. Finally, BAI provides an indicative view of the costs that would be incurred in moving to a chosen future state.

Below, BAI has provided recommended next steps for consideration. We welcome the opportunity to engage further with the government and broadcasters to explore these concepts.

1.2.2 RF channel planning recommendations (Section 2.2.4)

Validate the RF planning for selected options

We have outlined in our paper an RF planning model that allows the release of 84 MHz of spectrum in a scenario where there are four multiplexes (individually 'mux', collectively 'muxes') in metropolitan (metro) markets and four muxes in regional markets, and a model that allows the release of 77 MHz in a scenario where there are four muxes in regional markets while five muxes are retained in metro markets. The attraction of these models over the three muxes in metro and three muxes in regional as proposed by the Green Paper is that, in conjunction with consideration of technology upgrades to the platform (as discussed in Section 1.2.3 below), there is a balance achieved between an improved viewer experience (by retaining capacity for a greater breadth of content or higher picture quality) and the efficient use of spectrum.

These options would make greater use of single frequency networks (SFNs) than the three metro mux / three regional mux scenario outlined in the Green Paper, necessitating a DVB-T2 upgrade to take advantage of the broadcast standard's larger guard intervals. The work completed by BAI has focused on assessing the likely risk of co-channel interference, and, while the initial assessment is positive, more detailed planning and assessment is required to validate the models' appropriateness in meeting the government and broadcasters' objectives. Detailed planning has not yet been completed on changes that may be required to input feed arrangements, which may result in incremental investment and ongoing costs. This should be completed to allow a full assessment of the options.

Gain clarity on the intended use of the 600 MHz spectrum for mobile communications in the Asia-Pacific region to validate required spectrum releases and interference concerns

Clarity should be sought on the proposed allocation and configuration of the 600 MHz band for 5G in the Asia-Pacific region, as this will inform what amount of spectrum release will allow the use of this band to be maximised in Australia.

1.2.3 Transmission and compression standard recommendations (Section 2.3.4)

Preserving the option to adopt DVB-T2 and HEVC in the future will ensure FTA broadcasting can remain competitive with internet-based services

Due to improved access to higher speed internet for many Australians in the last few years, consumers are increasingly seeing higher quality content on their SVOD services, with high definition (HD) now a basic expectation of many viewers and with 4K/ultra high definition (UHD) content now widely available on the most popular SVOD platforms.

For FTA services to remain competitive with these platforms into the future, the industry should not foreclose the option of adopting newer broadcasting and encoding technologies. Specifically, future-proofing the platform to meet the dual objectives of improved viewer experience and efficient spectrum usage is likely best achieved by a rollout of the HEVC compression standard, along with an evolution to the DVB-T2 transmission standard. As we have illustrated in this response, these technologies will allow FTA services to increase picture quality or the number of services while at the same time reducing the spectrum required, so meeting the government's objective of reallocating some spectrum and releasing a digital dividend. BAI therefore advocates for the option to adopt these technologies in the future to be preserved.

Understand the current receiver population

Whatever path the industry chooses, accurate receiver data is not readily available to inform transition decisions. As a key first step, the department (which played a similarly effective role in the switchover from analogue to digital television) should commission research to understand the current receiver population in Australian homes and a forecast population over the next five years. This will allow confidence in making decisions to transition from legacy standards.

Set a receiver standard

Should there be a decision to upgrade the terrestrial platform based on a DVB-T2 upgrade and/or move to a more modern compression codec (e.g., MPEG4, HEVC), it is imperative that a receiver standard is set and mandated for the Australian market. This will ensure that all new televisions sold in the market will be compatible with the future platform standard and will help alleviate some of the compatibility issues concerning Service Information (SI) and managing dynamic multiplexing on the platform. The benefit of this policy measure will be a quicker and cheaper transition to the new state.

1.2.4 Investment of the digital dividend to further the ongoing sustainability of regional broadcasting

The Green Paper recognises that the commercial regional broadcasters, without their own BVOD platforms, face potentially greater challenges than their metropolitan counterparts. It also recognises that although the terrestrial platform is a highly efficient means of delivering linear television, the ABC, SBS, and the regional commercial broadcasters face relatively higher transmission costs per viewer, due to the geographic spread of the audience.

BAI welcomes the proposal that a portion of the proceeds from the auction of reallocated spectrum be set aside to support a stronger media sector and public service outcomes, including support for the Australian production sector, funding for news and journalism, and contribution to broadcasters' technology transition costs.

Given the significant social benefit that results from the availability of FTA television via the DTT platform in remote and regional Australia, BAI believes that consideration should also be given to using part of the spectrum proceeds to fund the upgrade of the platform to a more efficient standard (thereby enabling maximum spectrum release), and to subsidise DTT transmission in remote and regional areas.

There are, of course, many examples of government funding being available to fund regional services and infrastructure, including the government subsidy of the VAST platform (largely in areas not reached by DTT), the Mobile Black Spot programs to improve mobile reception in regional Australia, the Regional Connectivity Program to subsidise improved broadband connectivity, and the many similar state government programs and initiatives. BAI submits that measures to subsidise regional DTT transmission that ensure ongoing sustainability of these services are at least as important as those measures.

1.3 About BAI Communications

BAI Communications designs, builds, and operates cellular, Wi-Fi, broadcast, radio and IP networks around the world. We are engineering experts and technology innovators with proven experience in delivering the next wave of connectivity solutions through long-term partnerships with broadcasters, transit operators, governments, and mobile network operators. As a leading communications infrastructure provider, BAI's neutral host solutions connect people, enrich communities and advance economies. Our global operations span Australia, Canada, United Kingdom, Hong Kong and the US, where we have a majority stake in Transit Wireless.

In Australia, we own and operate one of the most extensive terrestrial transmission networks in the world, delivering 59 million broadcasting hours to ~99% of the population. In times of crisis, national broadcasters rely on us to maintain the connection with Australians – flood, fire, cyclone or other natural disaster – and emergency services rely on us to help keep them informed. We have proudly delivered managed broadcast transmission services to the ABC and SBS for over 20 years, and in 2019 become the managed broadcast transmission service provider to Southern Cross Austereo (SCA). We also provide access to broadcast infrastructure to all other broadcasters in the Australian market and are contracted to provide managed transmission services to Network Ten.

2 Future state of the terrestrial platform

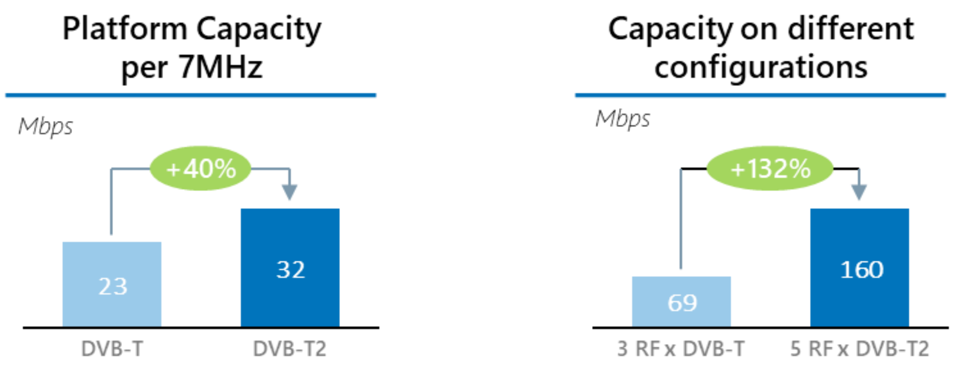
2.1 Introduction

BAI believes that several factors should influence the future state of the terrestrial platform. Firstly, the range and picture quality of content that the broadcasters want to show over the platform both now and into the future is a primary consideration. Secondly, a view should be taken on the degree of flexibility required in the platform to continue to evolve or cater for new content, as well as the competitive environment that the platform will be operating in and the corresponding consumer expectations. For example, if consumers are watching UHD content over Netflix, will they be satisfied watching standard definition (SD) content over the terrestrial platform? Our submission seeks to unpack the technology principles that underpin the decisions facing the government and the broadcasters.

Conceptually, a terrestrial television platform is made up of several transmitters each carrying a mux of broadcasters' content that are licensed to broadcast in specific RF channels (under licences issued by ACMA to broadcasters). The technology used by the transmitters and the quantum of spectrum employed ultimately drives the capacity of the platform to broadcast content.

The total capacity (or data throughput) of a transmitter and the platform overall can be expressed in megabits per second (Mbps), the same way we think about our household internet connection and is determined by two factors: the number of RF channels employed (7 MHz per RF channel) and the broadcast standard used to transmit. In Australia, we currently use the DVB-T standard, while DVB-T2 is the next evolution of this standard that provides 40% more capacity. Figure 1 illustrates the difference in capacity between DVB-T and DVB-T2 on a single 7MHz channel and illustrates the bookends of capacity using the technologies across three to five RF channels.

Figure 1: Range of DTT platform capacity according to technology choice



As shown above, the range of capacity in using three to five RF channels is 69-160 Mbps for the terrestrial platform[1].

The amount of content that can be broadcast over the platform is a factor of the capacity as demonstrated above, the picture quality, and the compression standard used by broadcasters in the distribution of their content. In Australia, MPEG2 is the most basic compression standard for the terrestrial platform, while MPEG4 (50% more efficient than MPEG2) is also widely used. HEVC (50% more efficient than MPEG4) is the next evolution of compression and, while not yet used on the DTT platform here, is widely adopted for online video delivery in Australia and around the world Including for example the German DTT platform.

[1] BAI's data rate assumptions have been sourced from the European Broadcasting Union (EBU): tr036 (ebu.ch)

As an example, a program broadcast in UHD will consume more bandwidth than a program broadcast in SD (assuming the same compression standard is used) and an HD program using a modern codec such as HEVC will consume less capacity than one compressed in MPEG2.

2.2 RF channel planning models

2.2.1 Overview

To deliver terrestrial television, RF channels are used across the VHF and UHF spectrum. The Australian DTT platform uses 7 MHz wide channels, of which five channels are used per market to broadcast across most of Australia today. In the current spectrum plan, there is an additional sixth channel that has been reserved to assist with future technology evolution.

The current spectrum plan for DTT uses one six-channel block of VHF spectrum and four six-channel blocks of UHF spectrum, so, in total, the platform employs 42 MHz of VHF and 168 MHz of UHF spectrum. The UHF spectrum is located between 526-694 MHz and is suitable for use in mobile communications, but the VHF spectrum located at 174-230 MHz is not suitable for mobile communications services. The use of VHF spectrum for main transmission facilities in the metro markets means that the surrounding areas must use UHF spectrum to avoid co-channel interference. At an appropriate distance, the VHF channels are then re-used in regional areas located further away from the metro markets.

2.2.2 Future options

BAI has assessed the principles outlined in the Green Paper and other potential RF planning outcomes to understand the future state the platform could take and how much spectrum could be released and used for mobile communications under different scenarios.

BAI has conducted initial channel planning work to assess the amount of spectrum that could be released under different outcomes, looking at all markets within a 200 km radius of the three largest metropolitan markets (Sydney, Melbourne and Brisbane), which notably includes the overlap markets (e.g., the Central Coast in NSW and the Gold Coast and Sunshine Coast in QLD).

In assessing the amount of spectrum that could be released, BAI has used, as its guiding principle, a desire to ultimately release as much as possible of the proposed 84 MHz outlined in the Green Paper and to retain as many channels as possible to support the DTT platform in doing so. To achieve this aim, our planning relies - in parts - on the technical specifications of DVB-T2 to achieve the outcome and makes greater use of SFNs. This will require further validation, as discussed in the next section. The use of VHF spectrum in metro markets for high power transmissions means that we can envisage RF planning outcomes that result in more muxes being used in metro than in regional if that is the desire of the government and broadcasters.

Table 1 below shows the potential combinations of transmissions across the metro and regional markets, and the maximum spectrum that we have assessed could be released under each scenario. These scenarios and the spectrum released have been validated at a preliminary level by industry; however, will require detailed planning to be completed prior to implementation.

Table 1: RF channel planning summary spectrum release

Number of metro muxes	3	4	4	5	5
Number of regional muxes	3	3	4	4	5
Spectrum released	84 MHz			77 MHz	28 MHz
Estimated marketable spectrum	14 x 5 MHz blocks			12 x 5 MHz blocks	4 x 5 MHz blocks
Note: Estimated marketable spectrum is indicative and subject to future co-existence assessments. Spectrum released under the 5/5 scenario (28 MHz) would likely require spectrum to be released as Time Division Duplex (TDD) rather than Frequency Division Duplex (FDD)					

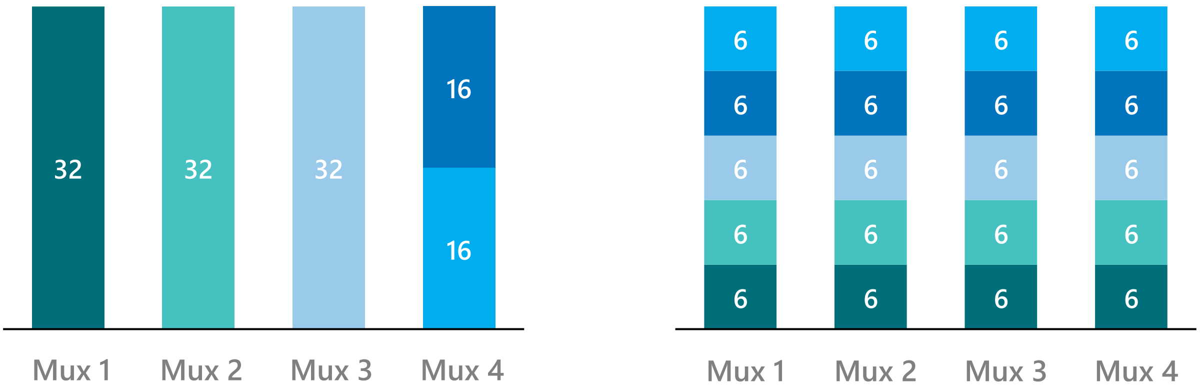
In assessing these models, the following statements can be made:

- Any selected channel plan that releases more than the sixth channel (which is already mostly vacant around Australia) will release a significant amount of spectrum for mobile communications use.
- Under a five metro/four regional mux model, the spectrum capable of being released is 77 MHz nationally, and it is 84 MHz in regional markets that are sufficiently distant from metro markets to avoid interference to broadcast reception.
- All scenarios except for a five metro/five regional mux model result in enough 5 MHz blocks being released so that each major mobile network operator could acquire 2 x 10 MHz paired spectrum if this were a desired outcome (notwithstanding that there may be some differences in the cost to implement).

There is an attraction to the four metro/four regional and five metro/four regional mux scenarios as in conjunction with consideration of technology upgrades to the platform, there is a balance achieved between an improved viewer experience (by retaining capacity for a greater breadth of content or higher picture quality) and the efficient use of spectrum. These alternative scenarios do rely on a larger network reconfiguration, with an increased reliance on SFNs. The increased use of SFNs is expected to require a move to DVB-T2 to achieve the spectrum release, as this standard provides larger guard intervals than DVB-T, allowing greater transmitter spacing without intra-SFN interference. Further analysis is required to confirm this preliminary work.

Importantly, from an RF planning perspective, in the case where there is the sharing of muxes, these scenarios are neutral as to which broadcasters share each mux, so any combination of broadcasters could consolidate their use of muxes, and equally a scenario is possible where all broadcasters share capacity across all muxes. Figure 2 below shows the two bookends of how five broadcasters could share four muxes. In the first example, three broadcasters retain full use of a single DVB-T2 mux (32 Mbps capacity), while two broadcasters would share the use of a single mux. In the second example, all five broadcasters share access to the four muxes equally, with each broadcaster getting access to ~26 Mbps.

Figure 2: Illustrative example of how five broadcasters could share capacity across four muxes



BAI would be pleased to provide supporting analysis on how these channel planning scenarios can be deployed to achieve these outcomes and would welcome the opportunity to discuss them further.

2.2.3 Key considerations

Spectrum release

The Green Paper suggests that an RF plan that releases 84 MHz is a desired outcome, with the main advantage being that this release would allow the Australian market (as a part of the broader Asia-Pacific region) to mirror the spectrum plan of the United States of America (US), where this spectrum has been released. However, the 3GPP based technology channel plan for the 600 MHz band in the Asia-Pacific has not yet been determined, and it is not necessarily the case that the Australian market would follow the US precedent. When the 700 MHz band was cleared in achieving the first 'Digital Dividend', the Asia-Pacific region elected to use a different spectrum configuration to the US market. As such, while an 84 MHz release in line with the US would provide the flexibility to replicate that model, other models may be more appropriate for the local context and may reduce the importance of achieving the full 84 MHz release.

Mobile communications / broadcast interference

As with the original Digital Dividend, the co-existence of broadcast services with mobile communications services will need to be investigated, to ensure that the services do not cause interference to each other.

The 3GPP based technology channel plan for the 600 MHz band in the Asia-Pacific region has not yet been determined. If the USA channel plan approach is undertaken with a FDD with 'reverse' duplex approach, it could be expected that a dense network of mobile sites – not co-sited with broadcast services – would have a significant adverse impact on television reception.

It is recommended that both theoretical and practical studies be conducted to ascertain the potential for mutual interference between the broadcast and telecommunications services.

Increased use of SFNs

To achieve all or close to the 84 MHz of released spectrum, while maintaining as many RF channels as possible, our planning assumes a greater use of SFNs. There are two implications that follow. Some broadcaster services that are currently off-air fed (that is, they receive their signal from a site that is also broadcasting live to households) will need to switch to direct link-fed inputs, requiring a capital investment and an uplift in ongoing operational expenses to support the network. Likewise, the use of SFNs is likely to necessitate the use of DVB-T2 as the broadcast standard, as technical specifications are more advantageous than DVB-T for operation in single frequency mode, with a much larger guard interval being practical, resulting in a lower risk of interference.

Shared multiplexing

Any reduction below five RF channels on the platform will necessitate the sharing of muxes by at least two, and up to five, broadcasters. This will create challenges in terms of ensuring that playout and distribution to site can be effectively co-ordinated. As an example, it is likely that the broadcasters sharing a mux will need to be played out of the same playout centre and will also need to use a common hardware and software configuration set up for encoding and multiplexing. Although complex to navigate, the resolution of all these issues appears feasible (since this is a model employed internationally) but may require additional investment to support the transition to the future-state of the platform.

Additionally, there are technical challenges inherent in the current broadcast receiver standards that create a risk in transition should it be done with DVB-T. These technical challenges are discussed in Section 2.3 'Broadcast and compression standards'.

2.2.4 Recommended next steps

Validate the RF planning for selected options

The four metro/four mux regional mux scenario that releases 84 MHz, and the five metro/four regional mux scenario that releases 77 MHz, make use of more SFNs than would be required with a three metro/three regional mux scenario as envisaged in the Green Paper. These options do have a risk of co-channel interference, which means a DVB-T2 deployment would be beneficial to take advantage of its greater range of available guard intervals. There would also potentially be increased costs to deliver content to some sites. The work completed by BAI to date has focused on assessing the likely risk of co-channel interference, and, while the initial assessment is positive, more detailed planning and assessment is required to validate the models' appropriateness in meeting the government and broadcaster's objectives. Detailed planning has not yet been completed for changes that may be required to input feed arrangements, which may result in incremental investment and ongoing costs. This should be completed to allow a full assessment of the options.

Gain clarity on the intended use of the 600 MHz spectrum for mobile communications in the Asia-Pacific region to validate required spectrum releases and interference concerns

Clarity should be sought on the proposed allocation and configuration of the 600 MHz band for 5G in the Asia-Pacific region.

2.3 Broadcast and compression standards

2.3.1 Overview

Consideration of the most appropriate broadcast and compression standards is important both in terms of technical performance (driving network performance and overall capacity) and compatibility with the installed base of televisions. This arises as both transmitters sending the program signals and TVs receiving the program signals must comply with the same transmission standard for broadcast content delivery over the terrestrial network in order to operate.

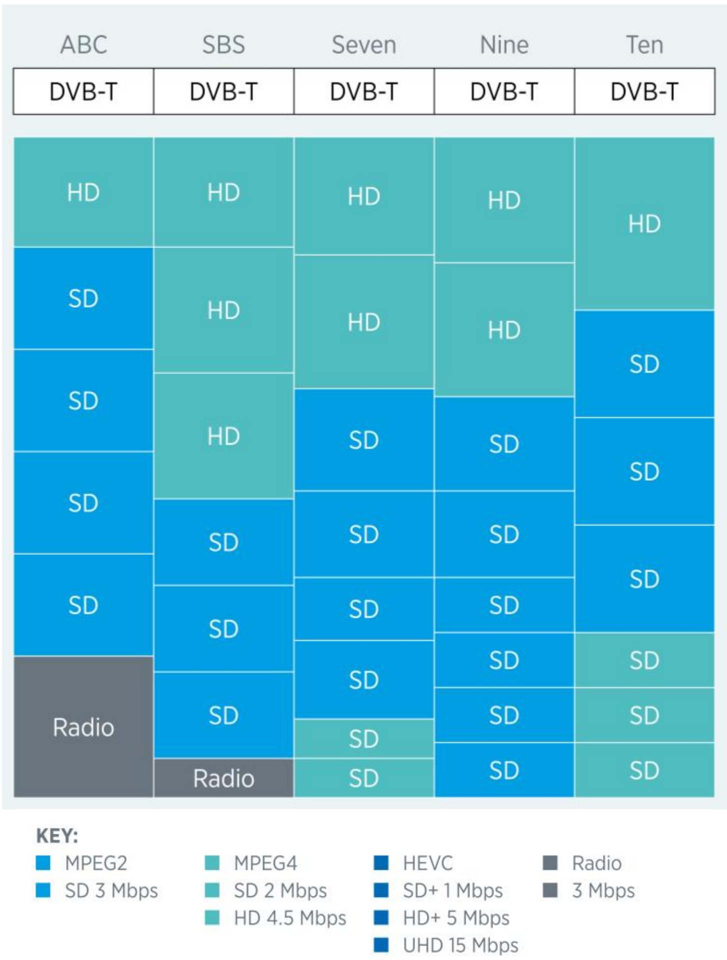
DVB-T is the broadcast standard currently used by the DTV platform and DVB-T2 is the next generation of the standard. DVB-T allows a total of 23Mbps of content to be broadcast per 7MHz channel while DVB-T2 allows 32Mbps; so, all things being equal, DVB-T2 can carry ~40% more content than DVB-T. While televisions compatible with the newer DVB-T2 standard have been sold in Australia for some years, the exact penetration of these compatible televisions is unknown. Anecdotally, however, during the DVB-T2/HEVC trial that BAI conducted in partnership with the broadcasters in 2018, all TVs purchased 'off the shelf' could receive DVB-T2 and HEVC, so it would be a reasonable assumption to make that almost all TVs sold today would be compatible with the DVB-T2 standard.

It should be noted that all DVB-T2 receivers have 'backwards compatibility' and can also receive DVB-T signals. This is one of the primary reasons for not pursuing the use of the ATSC 3.0 standard (an alternative to the DVB standards, used in the US) as in this case adaptor boxes would be required as no ATSC 3.0 televisions are currently backwards compatible with DVB-T.

Compression codecs are used to reduce the Mbps required to broadcast television content over the terrestrial platform (and are used in all video players in general) – therefore, TVs must be compatible with specific codecs to decode and show the program. Different codecs have different levels of compression: MPEG2 is the oldest and relatively least efficient, while MPEG4 and HEVC are newer variants (by way of example, a program compressed on HEVC would use 25% of the bandwidth of the same content compressed over MPEG2).

Although MPEG2 is the originally mandated standard in Australia, all broadcasters in Australia are currently using a mixture of MPEG2 and MPEG4 compression for their different program streams – particularly for HD and some SD content. There is believed to be a high penetration of MPEG4 capable TVs in the Australian market and a growing population of HEVC enabled sets. Figure 3 below shows an example from the Sydney metro market of the mix of content broadcast under different compression standards.

Figure 3: Current programming mix by picture quality and compression standard in Sydney metro market



There is no technical limitation to broadcasters using different compression standards within the same mux. In fact, there are some spectral / operational efficiencies in choosing to use two. For progressive scanned formats such as HD+ and UHD, HEVC is much more efficient than MPEG4 (i.e. requires less Mbps to deliver). However, if a broadcaster chose to provide some SD content as part of a DVB-T2 delivered mux they may choose to encode using MPEG4 as this codec is better for interlace content, which is standard for SD content.

Should the broadcasters and government elect to mandate either DVB-T2 as a broadcast standard or HEVC as a compression standard, it would be logical to mandate them both because of the need to ensure receiver compatibility. The process to transition the installed television base to the new standard would be very similar if one or both are pursued, so it would be worthwhile gaining the full capacity benefit of adopting DVB-T2 and HEVC in conjunction with each other.

2.3.2 Future options

A decision will be required around the breadth and quality of content that will be broadcast on the platform. Underpinning that choice will be a technology choice that enables this desired future state.

The ultimate technology standard future state of the platform is important, as it drives significant difference in capacity. To highlight an example, a single DVB-T/MPEG4 mux could carry up to five HD programs (at 1080i resolution), while a DVB-T2/HEVC mux could carry up to six HD programs (at 1080p resolution – a higher quality than 1080i). Delivering a single UHD/4K program would be impossible under a DVB-T/MPEG4 single mux scenario, but up to two could be accommodated under DVB-T2/HEVC. The effects of this are obviously multiplied depending upon the number of RF channels (or muxes) that are used on the platform.

Relating this to the Australian terrestrial platform, it is useful to examine some potential future states by depicting relative capacity requirements of the different technology choices (noting, that there are many combinations of SD/HD and UHD picture quality mixes possible). This analysis is conducted based around the following bitrate assumptions. Note, we have excluded some options from our analysis due to practicality (e.g. the MPEG2 standard does not allow for UHD pictures and UHD using MPEG4 is simply too large to efficiently transmit) and as one moves between certain encoding standards there is a natural move to a higher standard (progressive scan) of SD or HD than currently used:

Table 2: Capacity requirements for different picture quality and technology choices

	SD	HD	UHD
MPEG2	3 Mbps	n/a	n/a
MPEG4	2 Mbps	4.5 Mbps	n/a
HEVC	1 Mbps	5 Mbps	15 Mbps
	Notes: - *We have excluded HD from MPEG2 as it is not in use today* - *We have excluded UHD from MPEG2 and MPEG4 as it is not feasible technically* - *HD in HEVC would be encoded at 1080p, at 1080i for MPEG2 and MPEG4*		

Using these assumptions, the following illustrative statements can be made:

- Under a DVB-T/MPEG4 model, four RF channels (i.e. four muxes) would be required to accommodate the content broadcast today at the same picture quality.
- Under a DVB-T/MPEG4 model, if the broadcasters wish to broadcast all content in HD, then the five RF channels (i.e. five muxes) currently in use would be insufficient.
- Under a DVB-T2/HEVC model, if the broadcasters wish to broadcast all content in HD (and no UHD content), this could be accommodated in five RF channels (i.e. five muxes). Under HEVC, HD would be in progressive scan versus interlaced.

Ultimately, the amount of content and picture quality that it is broadcast in is a matter for the broadcasters to determine, as this is critical to determining the future-state required, or what future flexibility may be required if the desired future state is not yet known.

2.3.3 Key considerations in selecting standards

What content will be broadcast on the platform into the future and at what quality?

As detailed in the options analysis above, crucial to determining what is the best path for the platform is understanding what content will be broadcast over the platform and at what quality. The validation of this future state will involve discussion between the broadcasters and government to collectively understand platform evolution. If the desire is for a platform capable of providing a varied range of content, at a picture quality comparable to alternative IP-based platforms, then an evolution to DVB-T2/HEVC appears logical.

What does the current installed base of televisions support and what are they forecast to be?

Once a desired future state is understood, equally important will be the need to ascertain what the current receiver population looks like and what it can support, as this will be critical in understanding transition costs and timing. Importantly, this work must consider what the likely state of the installed base will be like at the time of transition, not just at today's levels. BAI discusses the potential transition models in section 2.4 of this submission.

What technical challenges will need to be managed in the shift to the future-state?

The introduction of shared multiplexing creates complexity in how the platform is managed and how information about what is being broadcast is delivered (and understood) by the installed base of televisions. Without the proper configuration there is a risk that either additional mux space will need to be taken up with duplicative information or televisions may freeze up and not be able to be restarted. It should be noted that under a DVB-T2 upgrade process, all DVB-T2 enabled televisions in line with the receiver standard would be capable of receiving shared mux content across the DVB-T and DVB-T2 platforms.

2.3.4 Recommended next steps

Preserving the option to adopt DVB-T2 and HEVC in the future will ensure FTA broadcasting can remain competitive with internet-based services

With improved access to higher speed internet for many Australians in the last few years, consumers are increasingly seeing higher quality content on their SVOD services, with HD now a basic expectation of many viewers and with 4K/UHD content now widely available on the most popular SVOD platforms.

For FTA services to remain competitive with these platforms now and into the future, the industry should not foreclose the option of adopting newer broadcasting and encoding technologies to ensure that even if some spectrum is released for alternative use, that the DTT platform retains sufficient capacity to be competitive and sustainable over the long term.

BAI believes that future-proofing the platform is likely best achieved through a rollout of the HEVC compression standard, along with an evolution to the DVB-T2 transmission standard. These technologies will allow FTA services to increase picture quality or the number of services while at the same time reducing the spectrum required, therefore meeting the government's objective of reallocating some spectrum and releasing a digital dividend. BAI thus advocates for preserving the option to adopt these technologies in the future.

Understand the current receiver population

Regardless of the path the industry chooses, accurate receiver data is not readily available to inform transition decisions. As a key first step, the department (which played a similarly effective role in the switchover from analogue to digital television) should commission research to understand the current receiver population in Australian homes and a forecast population over the next 5-7 years. This will allow confidence in making decisions to transition from legacy standards and will assist in designing a transition plan that creates minimal disruption to consumers.

Set a receiver standard

Should there be a decision to upgrade the terrestrial platform and to mandate either a DVB-T2 upgrade and/or a move to a modern compression codec (e.g. MPEG4, HEVC), it is imperative that a receiver standard is set and mandated for the Australian market to ensure all new televisions sold are compatible with the future platform standard. This will also help alleviate some of the compatibility issues around SI and managing dynamic multiplexing on the platform. The benefit of this measure will be a more cost effective and time efficient transition to the new state.

2.4 Transition models and timelines

2.4.1 Overview

If the decision is made to move to a new broadcast standard, compression standard, or both (noting BAI's earlier comments that it would be logical, if mandating an upgrade of one, to also mandate an upgrade of the other), then the question becomes how to operate the terrestrial platform most effectively while in the transition state. Some of the primary factors to consider are:

- To what extent should Australians who have not yet upgraded their equipment be able to continue to access the same or substantially the same amount of content?
- What consumer incentives should be created through the content broadcast to encourage adoption of the new technology standards?
- How quickly should the change be implemented? What is the appropriate timescale that allows for the release of spectrum to enable mobile communications versus the readiness of the installed television consumer base to switchover? For instance, should a transition take place today to DVB-T/MPEG4 would involve similar consumer disruption to a shift to DVB-T2/HEVC over the medium term, as the opportunity will exist to define receiver standards and bring the installed base up to a point where transition is easier.
- What level of risk of Australians being 'left behind' is acceptable to assume in completing a transition to a new platform? To what extent can IP platforms be considered a safety net?

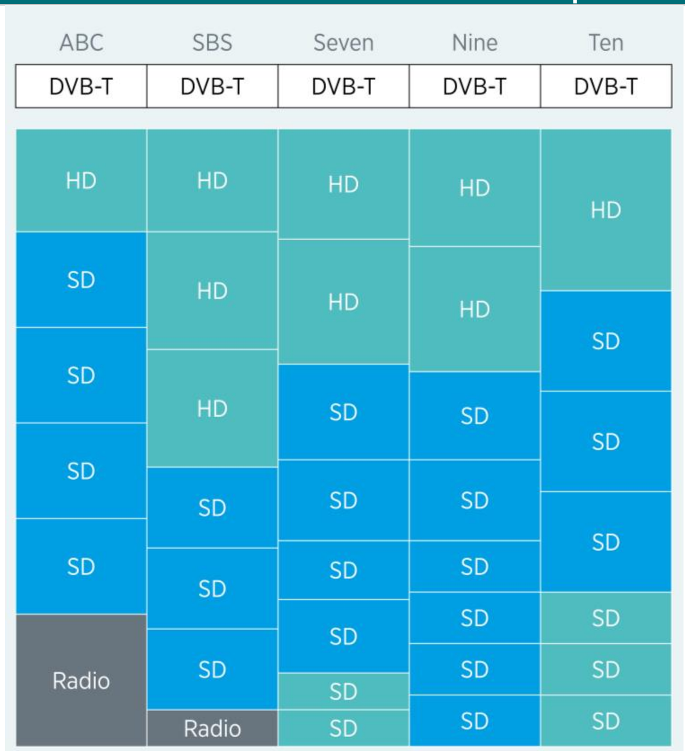
For example, when the Australian market switched over from analogue to digital transmission, there was a complete simulcast of all channels until switchover, meaning that all consumers retained access to all existing analogue channels, even if they had not yet upgraded their television. Incentives to shift over are also important. In the case of the digital switchover, the release of multi-channels and the availability of more content drove significant consumer adoption. The pace at which switchover was desired was also weighted to ensuring that Australians were predominantly ready to go. Finally, there was a strong desire from broadcasters and government to ensure that no Australian was left without television, so a Household Assistance Program was provided to roll out set-top boxes that allowed analogue televisions to receive digital signals, coupled with a broad-scale communications program. Answers to these questions are important to driving transition choices.

2.4.2 Future options

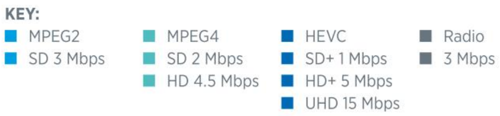
If the desired future-state involves a transition to DVB-T2 (and HEVC), there will be several key decisions to be made around the type of transition, informed by the answers to the questions BAI posed in the 'Overview' section. Practically, the decision will need to be made around how many muxes will be devoted to the new platform and whether to establish a transition service using the sixth mux. This will need to be done with a view to striking a balance between providing sufficient content to consumers who have not yet transitioned to the new platform with enough differentiated content (either in programming or picture quality) to entice households to make the switch. There are many potential combinations possible and in Figure 4 below there are some illustrative examples of how the broadcast industry and the government may seek to transition to a new platform.

Figure 4: Illustrative models of how the DTT platform could transition to DVB-T2/HEVC

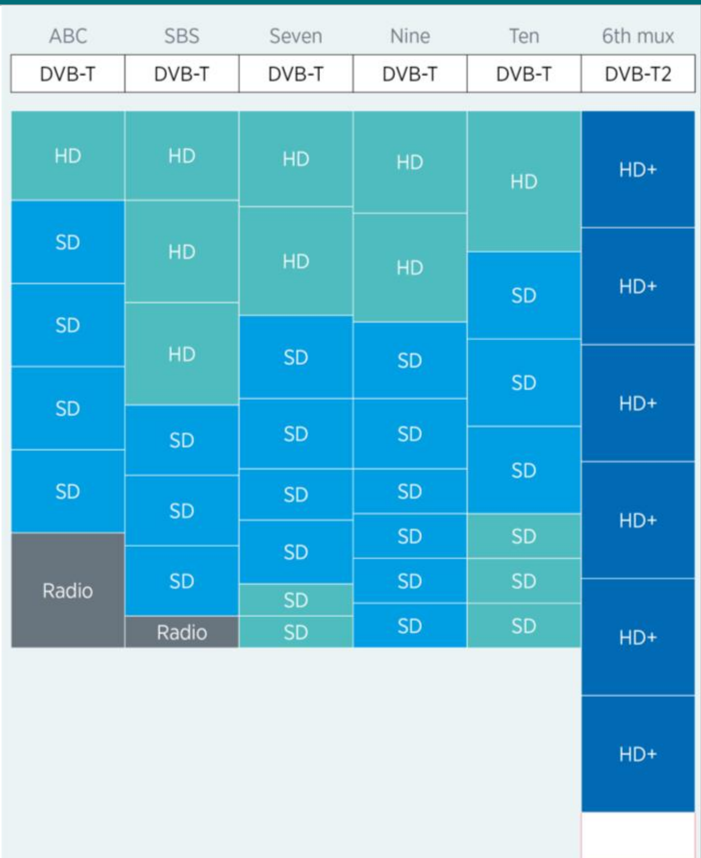
Current platform configuration



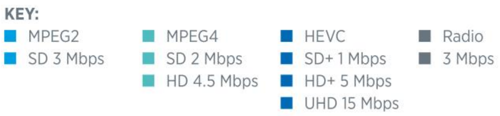
- Current configuration of metro muxes
- 27 unique programs
- 34 television streams
- 17 radio streams



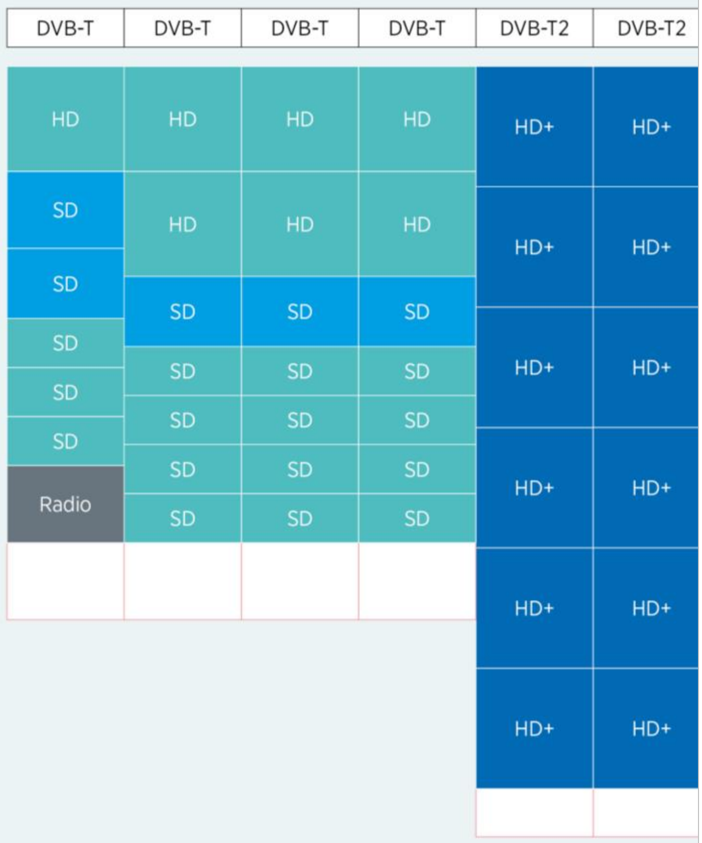
Scenario 1: One DVB-T2 mux



- Scenario 1 has no disruption to current programming or picture quality, but low levels of new content
- Current DVB-T platform continues on remaining five muxes – no loss of content
- Additional DVB-T2 mux deployed on the 6th channel and shared between broadcasters
- Limited additional content able to be broadcast – if any UHD channels, then not all broadcasters could be on the 6th mux assuming HD+ as a minimum standard



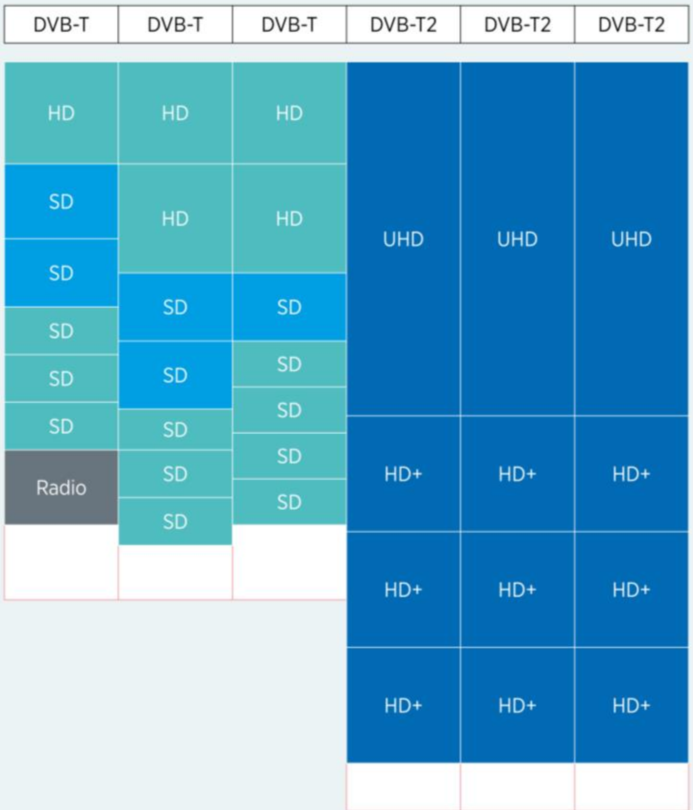
Scenario 2: Two DVB-T2 muxes



- Scenario 2 has minimal disruption to existing programming and broad availability of HD+ content
- Current DVB-T platform continues on four muxes – all content apart from main channel SD migrates to MPEG4
- Additional DVB-T2 mux deployed on one existing mux and the 6th channel and shared between broadcasters
- Broadcasters able to provide more HD+ content (at least two channels) on DVB-T2 to attract viewers to the platform

KEY:
- MPEG2: SD 3 Mbps
- MPEG4: SD 2 Mbps, HD 4.5 Mbps
- HEVC: SD+ 1 Mbps, HD+ 5 Mbps, UHD 15 Mbps
- Radio: 3 Mbps

Scenario 3: Three DVB-T2 muxes



- Scenario 3 has disruption to existing programming, but allows broad deployment of UHD to entice viewer switchover
- Current DVB-T platform continues on three muxes – all content apart from main channel SD migrates to MPEG4, broadcasters have three channels only
- Additional DVB-T2 mux deployed on two existing muxes and the 6th channel and shared between broadcasters
- Up to three broadcasters able to provide more UHD content on DVB-T2 to attract viewers to the platform

KEY:
- MPEG2: SD 3 Mbps
- MPEG4: SD 2 Mbps, HD 4.5 Mbps
- HEVC: SD+ 1 Mbps, HD+ 5 Mbps, UHD 15 Mbps
- Radio: 3 Mbps

Using these scenarios, the following statements can be made:

- If at least two muxes are DVB-T2 enabled, then all broadcasters could have at least two channels in HD+.
- In using three DVB-T2 enabled muxes, all commercial broadcasters would be capable of showing one UHD channel simultaneously; however, this would require reduced picture quality on the existing DVB-T platform to retain all existing programming.
- If only using five muxes in total, there would be significant compromises to the range and/or quality of the content available on the DVB-T platform to allow a wide range of UHD content to be provided on the DVB-T2 channels.

Should there be a desire to implement a DVB-T/MPEG4 future-state as the Green Paper proposes, there would not need to be any transition process as outlined above, it would simply come down to when the government and broadcasters were comfortable to commence broadcasting solely in MPEG4. It is worth noting, however, that a switch to DVB-T/MPEG 4 would not be without disruption to the consumer; while there would be less issues around television compatibility, such a switch would necessitate a reduction in either the number or quality of the channels broadcast today. In addition, there would be a significant piece of work to move to the sharing of muxes to ensure that the broadcasters can ensure a robust and reliable service.

2.4.3 Key considerations for managing transition

Operating the transition muxes

In a future-state environment, the transition mux/es will need to be operated on a shared basis. Coordination will be required between the broadcasters so that the content can be encoded and multiplexed together compatibly and then efficiently delivered to site. There are also likely to be additional bandwidth requirements for content distribution, due to the increased capacity of the muxes if operating under DVB-T2 and if the sixth mux is in operation. The costs and planning around this will need to be reviewed in detail prior to moving ahead.

Cost of transition

BAI has undertaken an initial estimate of the cost to upgrade the platform from a transmission chain viewpoint. There are likely to be additional costs in the transition, for example upgraded encoding and multiplexing equipment. The key factors that determine the cost of transition from the transmission side are what future-state RF plan has been agreed, whether or not changes are deployed to all terrestrial sites (e.g. would self-help sites be included/excluded) and if the sixth mux is used to assist transition. Table 3 looks at scenarios using a four metro mux/three regional mux (*4/3 Plan*), four metro mux/four regional mux (*4/4 Plan*) and five metro/four regional mux (*5/4 Plan*) RF planning outcome. In addition, it estimates the costs of transition with and without employing the sixth mux to support transition. Finally, it assumes that the upgraded platform is funded for rollout to all sites where there are five licence holders and all TXA and RBAH re-transmission sites, totalling 461 sites. If you were to include all the self-help sites, this number would increase to 605. The outcomes are summarised below.

Table 3: Estimated cost to transition to DVB-T2/HEVC under different RF channel plans (transmission only)

		Five RF Channel Transition	6 RF Channel Transition
4/3 Plan	No. of Transmitters (#)	1,464	
	Capex ($m)	$111m	$135m
4/4 Plan	No. of Transmitters (#)	1,860	
	Capex ($m)	$148m	$168m
5/4 Plan	No. of Transmitters (#)	1,929	
	Capex ($m)	$155m	$175m

While the details of transition will require significant additional work to be undertaken, it is evident that it will be difficult for the broadcasters to fund the costs of transition themselves, particularly in the regional markets, with a heavier reliance on broadcast transmission infrastructure. It is a natural conclusion that some of the proceeds from the auction and subsequent release of the spectrum could be used to support the evolution to the future state as was the case when the DTT platform completed its switch from analogue to digital services.

2.4.4 Recommended next steps

Transition planning will be a product of the RF channel plan and broadcast and compression standards selected for the future state of the platform. The actions to agree on what the future state will look like are a precursor to defining the transition model.

3 Conclusions

Free-to-air television plays an integral role in the cultural and social fabric of Australia and its continued success and sustainability delivers a significant public good to the community. Additionally, the DTT platform that underpins it provides an equitable, reliable, ubiquitous service to over 99% of Australians free of charge. As the government and broadcasters contemplate decisions around the future-state of the industry and platforms that sustain it, it is critical that these unique attributes are maintained.

In responding to the Green Paper, BAI has endeavoured to illuminate how the government and broadcast industry can think about achieving key public policy objectives, including:

- Releasing the scarce public resource of spectrum to support evolving alternative uses
- Reinvesting some of the proceeds from the reallocation of spectrum to assist the broadcast industry remain competitive, given the critical role it plays in informing and entertaining Australians
- Preserving technology optionality to allow the industry to compete effectively with the many SVOD services and other internet-based services that contest audience attention, now and into the future.

We have provided an overview of the key technologies that underpin the DTT platform, the choices that lay ahead and the additional work that should be completed to validate key assumptions. However, fundamentally, our submission makes two core recommendations:

- Preserve optionality to move to an upgraded DTT platform, using DVB-T2 and HEVC as the enabling technologies.
- Consider further investment to support regional delivery of FTA over the DTT platform to preserve the public good provided today.

BAI appreciates the opportunity to contribute to the discussion and would welcome discussing our submission in more detail.

4 Technology glossary

DVB-T is the existing transmission standard used for digital television in Australia.

DVB-T2 is an evolution of the DVB-T transmission standard, generally selected in new deployments, which can offer >40% more data capacity for the same coverage than DVB-T.

Guard interval – is a part of Coded Orthogonal Frequency Division Multiplex (COFDM) signal that allows for echoes and co-channel, identical content signals to be received without suffering co-channel interference under specific circumstances. The length of the guard interval determines the allowable delay between the received signals. The guard interval reduces the useful payload of the RF channel, but the benefit provided through mitigating the impact of echoes and the ability to operate in SFN balance this penalty. The range of guard intervals in DVB-T2 is significantly larger than that available in DVB-T allowing larger physical spacing between SFN transmitters.

HD (High Definition) refers to picture quality better than SD (Standard Definition), being either 720 (progressively scanned) or 1080 (interlace scanned) rows of pixels in each picture, but generally the latter these days.

HD+ refers to an enhanced version of the current HD picture quality which includes High Dynamic Range (HDR), Wide Colour Gammut (WCG) and uses progressive scanned images (1080p) as defined in the 2018 ITU Recommendation, 'ITU-R BT.2100-2 Image parameter values for high dynamic range television for use in production and international programme exchange'.

HEVC (High Efficiency Video Coding): is a standard of video coding, also known as H.265: The newest defined standard, it has ~50% greater compression than MPEG-4.

Interlaced scan video is a "Display technique, used in current analogue televisions, in which the electron beam refreshes (updates) all odd-numbered scan lines in one field and all even-numbered scan lines in the next. Interlacing takes advantage of both the screen phosphor's ability to maintain an image for a short period of time before fading and the human eye's tendency to average subtle differences in light intensity. By refreshing alternate lines, interlacing halves the number of lines to update in one screen sweep."[2]

MPEG-2 is a standard of video voding and is the standard mandated for digital television in Australia today.

MPEG-4 is a standard of video coding also known as H.264 or AVC (Advanced Video Codec). A widely used standard, ~50% better compression than MPEG-2.

Multiplex ('mux' or 'muxes') is a technical term for combining or aggregating of a number of signals into one. In this context, it represents the final aggregation of several television channels and related information into one signal for carriage on a single transmitter. Each multiplex broadcasts over an allocated 7 MHz channel.

Progressive scan video is the display technique used in computer monitors and modern television receivers. "In progressive scanning, the image is refreshed one line at a time."[2]

SD (Standard Definition) refers to picture quality or resolution similar to the old analog television system. In Australia, generally 576 rows of pixels in each picture, but with the screen shape the same as modern televisions which is in a 16:9 aspect ratio.

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[2] European Broadcasting Union (EBU), August 1998, "EBU / SMPTE Task Force for Harmonized Standards for the Exchange of Programme Material as Bitstreams: Final Report: Analyses and Results", EBU Technical Review Special Supplement 1998, https://tech.ebu.ch/docs/techreview/ebu-smpte-tf-bitstreams.pdf

Single Frequency Network (SFN) is where two or more transmitters provide the same content on the same RF channel within a defined area. When well planned, the use of a guard interval allows these transmissions to be received by the audience without interference. They are very spectrally efficient as a single RF channel can be used where in other cases two or more RF channels would be required.

Transmission is the means to broadcast data from the transmitter to the end users. In this context, it also refers to the specific transmission standard used to do so.

UHD (Ultra High Definition) refers to emerging standards offering better picture quality than HD. This is either 4K (3840 pixels wide by 2160 pixels tall) or in the future 8K (7680 pixels wide by 4320 pixels tall). Other improvements will include better colour and improved fast motion achieved by capturing pictures more clearly (defined by the frame rate).

Video coding is a term for the method and system used to reduce the amount of data required to carry a complex video signal in the limited bandwidth available. This reduction in data is often called compression.

5 Contact

For further information or enquiries relating to this submission, please contact:

Casey Whitehead – Director of Broadcast

Stephen Farrugia – Chief Technology Officer

6 Appendix: response to questions in the Green Paper

Question		BAI Response
3.1	Is the deregulatory benefit on offer sufficient to encourage commercial television broadcasters to take up this offer?	*No response provided.*
3.2	Are there any other features which could attach to a new licence that would assist in broadcasters transitioning to a new and more sustainable business model?	*No response provided.*
3.3	What elements of the existing regulatory framework should continue to apply?	*No response provided.*
3.4	Should the new licence arrangements be uniform for all commercial television broadcasting licensees, or should there be differences for metropolitan and regional / remote broadcasters?	*No response provided.*
3.5	When do you think the new licence framework should come into effect?	*No response provided.*
3.6	What further measures should be considered that would assist regional commercial broadcasters in remaining sustainable?	See Section 1.2.4. BAI's view is that ongoing support to the regional broadcast market is warranted and that consideration should be given to subsidising the significant costs of terrestrial transmission given the geographical coverage required.
4.1	Should Australia continue to operate digital television systems using the DVB-T standard and the MPEG-4 compression technique? Are there other options that should be considered?	See Section 2.2 and 2.3. BAI lays out the range of options available for the future state of the platform in terms of number of RF channels used, the broadcast standard selected, and the compression standard employed. The ultimate future state of the platform is a question for the government and broadcasters to resolve.
4.2	How should the new multiplex transmitter licences operate? Should broadcasters be required to form a company for the purposes of holding the new multiplex licences?	*No response provided.*
4.3	How can the Government work with industry to minimise disruption for households during the proposed transition?	See Section 2.3.3. The main risk is in not understanding the receiver population ahead of making any transitions to the future state, so it is our strong recommendation that the ACMA leads a research project to determine what the installed base looks like today and what it is likely to look like into the future when transition is planned to occur.

4.4	Is it important for free-to-air broadcasters to maintain the precise number and picture quality of channels currently offered?	See Section 2.2. The future number of program streams that the broadcasters wish to provide and the quality at which they wish to provide them is a matter for them to determine, but we lay out the required decisions to determine the platform's capacity to support these choices.
4.5	Should the transition model prioritise the capacity for broadcasters to provide significantly more services, or services of a significantly higher audio-visual quality (such as UHD)?	See Section 2.4 for a discussion on potential transition models and the capacity of the platform to support different amounts and quality of content.
4.6	What would the cost savings be for broadcasters? Over what period would these potential savings be realised?	No response provided. The savings generated are highly dependent on the future state of the platform selected by the government and broadcasters.
4.7	What would be the impact on owners of transmission facilities?	No response provided. The impact on owners of transmission facilities is highly dependent on the future state of the platform selected by the government and broadcasters.
	Do you consider that revenue from the sale of spectrum could be used to support public policy initiatives for media?	See Section 1.2.4. BAI believes that one important use of the spectrum proceeds would be to put in place support to ensure a sustainable regional broadcasting industry. See Section 2.4.3. Proceeds from the sale of spectrum could be used to fund the transition to a future-state of the platform.
5.2	Are there examples of best practice in providing sustainable and targeted support in other jurisdictions?	*No response provided.*
	Should the investment obligation apply to all types of SVODs, BVODs and AVODs including those that specialise in content such as sport?	*No response provided.*
6.2	Would a rate of investment of five per cent of Australian revenue be reasonable? Is there an alternative rate that is more appropriate?	*No response provided.*
6.3	Should alternative models, such as a percentage of overall programming expenditure, be considered?	*No response provided.*
6.4	Is the proposed revenue threshold of $100 million reasonable?	*No response provided.*
6.5	Should the investment obligation be able to be fulfilled with any genre of Australian content, or genres such as drama, children's programming or documentaries?	*No response provided.*
6.6	Should the investment obligation be geared to commissioned content, or broadened to permit	*No response provided.*

	the acquisition of Australian content that would satisfy the first release requirement?	
6.7	Should the investment obligation capture broader categories of content investment, such as pre and post-production?	*No response provided.*
7.1	Is the current amount of Australian content produced and commissioned by the ABC and SBS appropriate?	*No response provided.*
7.2	How should a statutory obligation for the ABC and SBS to provide Australian content be constructed?	*No response provided.*
7.2.1	Should this focus on the investment in Australian programming, or require the provision of certain levels of Australian programming?	*No response provided.*
7.2.2	Should the obligation focus on Australian programming broadly, or target particular genres such as drama and children's programming?	*No response provided.*
7.2.3	To what extent should the obligation differ for the ABC and SBS to accommodate their differing roles and remit?	*No response provided.*
7.3	What impact would the imposition of a clear Australian content obligation for the ABC and SBS have on the Australian screen production industry, and the provision of Australian content more broadly?	*No response provided.*
	Is the timeframe proposed in this chapter realistic?	*No response provided.*
8.2	Are there any particular stages that would require a greater or lesser period of time?	See Section 2.4.1. BAI's view is that the while the planning phases are relatively easy to understand, the period over which the platform operates in transition mode will be determined by factors such as the receiver population and the risk appetite of the broadcasters and government, therefore it is difficult to comment on the overall timeline.
8.3	Are there particular risks and factors that need to be taken into account in terms of the timing for the transition to the new licensing and regulatory model?	See Section 2.3.3. The main risk is in not understanding the receiver population ahead of making any transitions to the future state, so it is our strong recommendation that the ACMA leads a research project to determine what the installed base looks like today and what it is likely to look like into the future when transition is planned to occur.