# Annexure A

## Detailed Discussion of Technical Arrangements Section 3 of Discussion Paper

This Annexure provides more detailed discussion of the summary comments provided in Section 3 Technical Arrangements of this Submission These issues relate primarily to the proposed Channel B and its intended application to Mobile TV. This Annexure follows the numbering in the Discussion Paper and this Submission.

### 3.1 Digital channel planning issues

#### (a) Transmission path variations

In the general case, the assumption of a fixed outdoor antenna leads to a situation where the wanted signal path has a Ricean characteristic – that is, there is a single dominant component (possibly a direct ray or a dominant reflected ray) and a (usually small) number of multi-path rays. By comparison, an assumption that reception will use a low-height portable antenna, as would be the case in planning for reception of Mobile TV signals, leads to a signal path displaying a Rayleigh characteristic – multiple reflected rays with no dominant component. The difference is significant because it leads directly to a different set of signal variability characteristics in terms of location and frequency variability with the Rayleigh (mobile) reception case exhibiting greater variability than is assumed for the fixed reception case.

The existing channel arrangements for the television services in the broadcasting services bands in Australia – both free-to-air analogue and digital, and the previously unallocated digital channels (in the Discussion Paper, identified as DTL channels A and B) have been developed on the assumptions of co-sited transmissions and reception with fixed outdoor antennas. These assumptions lead to the required protection ratios and the re-use distance separation between channel assignments.

#### (b) Protection ratio issues

In addition the digital channel plans have been developed assuming that transmissions will use DVB-T coding and MPEG-2 compression. If some other coding and compression schemes are adopted (as could well be the case for DTL Channel B) then it will be necessary to first identify the appropriate protection ratios and to then re-plan the channel availability. There is no basis for assuming that the existing DTL channel planning (based on DVB-T, MPEG-2 and fixed outdoor reception) would be appropriate for services intended for mobile reception or which use other than DVB-T and MPEG-2 coding.

One consequence of this difference in signal level variability is that it will be difficult to reliably achieve the protection ratios that have been used to identify the channels available at each location. The existing adjacent channel protection ratios have been developed with an assumption that there will be minimal level variation across a channel or between adjacent channels - that is, the signal levels on adjacent channel will be correlated. This condition generally exists in the Ricean environment of fixed external receiving antennas.

However, in a mobile receiving environment, there is minimal correlation between adjacent channel signal levels with rapid changes in relative signal levels related to the respective (half) wavelengths of each signal. This means that where channel planning is undertaken on the basis of fixed external antenna use and just meeting the required adjacent channel protection ratio, then the actual reception on a mobile receiver will be "fragmented" on a very fine scale as the actual relative signal levels fluctuate above and below the required protection ratio. A corollary is that because of wide variability in wanted signal level, the protection ratio value used for planning would need to be increased to ensure that the minimum required protection ratio is achieved for an acceptable proportion of the target coverage area.

**(c) Minimum signal level required to provide acceptable service**

The minimum signal level required to deliver an acceptable service is dependent on the minimum receiver sensitivity and the additional allowances need to accommodate factors including location variability, time variability and height gain/loss. The net effect of these allowances is that the predicted median signal level needed to be used for planning purposes (to achieve minimum usable signal levels across an acceptable proportion of the coverage area) will be higher for mobile than fixed services. The consequence of this is then either that coverage of mobile services will be less than that achieved by fixed services or that the required ERP will be higher for the same coverage.

It is difficult to estimate the actual impact of changing the planning assumptions and guidelines developed for the current digital channel planning to include mobile reception because there are so many unknowns at this stage of the process and there is little, if any, available data concerning the impact of multiple simultaneous effects within the current approach taken for digital terrestrial television broadcast planning in Australia.

Planning for digital terrestrial television services in Australia draws upon the criteria established in Recommendation IRU-R BT.1368 *Planning Criteria for Digital Terrestrial Television Services in the VHF/UHF Bands*. Recommendation BT.1368-4 provides co-channel protection ratios for three types of propagation channels (Gaussian, Ricean and Rayleigh).

ITU-R BT.1368 suggests that a change from a Ricean to Rayleigh environment would change the protection ratio requirement by around 3 to 4 dB depending on modulation and error correction schemes. Such a change alone would result directly in a reduction of coverage zone radius to about 70% of that achieved with a fixed antenna. To this we would also need to add the impact of height gain/loss arising from the lower height of the mobile antenna and building/vehicle entry losses. Given the very rapid transition from good reception to loss of signal (typically less than 1 dB change in carrier to noise (C/N) value), even the 3-4 dB variation would have substantial impact on the quality of service provided.

**(d) Special requirements of services designed primarily for mobile reception**

The most obvious requirement for introduction of a service designed for mobile reception is the need to accommodate the very high location variability associated with low height antennas and indoor reception.

Indoor reception is also impaired by the additional loss suffered as the signals penetrate through building walls. Only limited data is available regarding building penetration loss. The study of building penetration loss is currently active in ITU-R Study Group 3 and Working Part 3J. Recent contributions on this topic from the United Kingdom and Nord-Deutscher Rundfunk report the results of building penetration loss measurements. These contributions indicate typical loss figures for UHF television services in residential buildings to be in the range 5-15 dB (approx) depending on building construction and room orientation (with regard to signal arrival path).

The digital television planning in Australia has not taken any account of building entry loss or height loss and there has been only very limited study of this aspect in Australia. One area identified in the DTTB Planning Handbook for further study prior to the commencement of digital services was portable reception.

The Technical Working Group (TWG) on Digital Television Coverage has noted anecdotal evidence that a substantial proportion of the urban/suburban audience makes use of indoor television antennas. For analogue reception the C/N margin between good and poor signal quality is of the order of 20 dB and thus is sufficient to cover both typical building entry loss and signal level variation (such as arises from passing road traffic or people moving in the room). For digital reception where the transition from good signal to failure is very small we might expect that indoor reception of services planned for external antenna reception would be much less satisfactory. This indicates that unless specific allowance is made during planning, there will be only limited ability to use indoor antennas for digital television reception.

The low effective height of the mobile receiving antenna also leads to a more complex signal clutter and multipath environment which generally results in a need for a higher C/N ratio to achieve reliable decoding compared with the fixed outdoor antenna case that is assumed for free-to-air service planning in Australia.

In addition, mobile receivers are constrained by the unavoidable use of very low gain antennas (typically less than 0 dBi gain). The development of compact antennas for use in consumer portable devices is currently a very active issue with numerous papers appearing in the literature. Typical reports indicate that net antenna gains in the range 0 dBi to –5 dBi are reasonably achievable. Although the reported work is generally associated with cell-phone or wireless LAN/WAN devices, we can reasonably expect that similar results would be obtained for portable television or Datacasting receivers operating on UHF television channels.

These considerations suggest that effective mobile services need to be planned on the basis of a cellular architecture (as used for mobile phones) rather than the high-power main transmitter with lower power subsidiary transmitters structure used for existing analogue and digital free-to-air television services in Australia.

A related issue is that of the actual outdoor antenna height typical of suburban areas in Australia. The service planning tools that are currently available assume an outdoor receiving antenna height of 10 metres. It is not coincidental that this height is representative of the rooftop heights of the two storey houses that are typical of suburban areas of North America and Europe. This suggests that the planning tools actually predict signal levels at about rooftop height regardless of the actual height.

The TWG on Digital Television Coverage has also noted evidence from survey results that would support such a view. It is a common survey practice to take measurements both at the reference 10 metre height and at a (lower) height representative of the existing antenna population. The results of such comparative measurements tend to show minimal height-gain differences in the absence of other clutter such as vegetation or terrain obstruction. Similarly, in locations where building height exceeds 10 metres or there is substantial vegetation or terrain obstruction, survey results indicate that signal levels are still rising towards the predicted levels with the receive antenna at 10 metres. It is thus assumed that the existing population of receiving antennas at rooftop height provides acceptable reception, consistent with the planning tools modelling at 10 metres, in the absence of nearby vegetation or terrain obstruction. There is scope for further study of this aspect, particularly for digital reception given it's very rapid transition to failure i.e. the *cliff effect*.

## 3.2 Channel Allocation Issues

### (a) Use of channels adjacent (in frequency) to existing analogue or digital FTA services

The use of adjacent channels is dependent on compliance with restrictive protection ratio requirements to avoid mutual interference between transmissions in adjacent channel assignments. The above considerations (in Section 2 above) suggest that channel assignments that are adjacent to existing analogue or digital services would be unsuitable for use by services intended for reception by mobile receivers.

### (b) Allocation principles

The overriding allocation principle must be to avoid interference between transmissions in adjacent channel allocations. It is particularly important that channels which are adjacent to existing broadcasting services are avoided for Channel B services.

Free TV notes that ACMA does not intend to select channels above 59 for Channel B. This is the case even if the only alternative channel is within the same general frequency range as broadcaster channels at a site. The reason stated in the Discussion Paper is that channel 59 is outside the range that is suitable for mobile television.

As stated in the Submission, the basis for this assumption is not clear. In Europe (where UHF TV is 470 – 854MHz) there is some advocacy for application of DVB-H up to Channel 55 (750MHz). Whereas it has been noted in WRC-07 Agenda Item 1.7 in one country (the United States of America), the band 1 670-1 675 MHz is used for Digital Video Broadcast-Handheld (DVB-H). In addition in Europe national regulators will allocate in total 32 MHz for mobile television from the UHF range (470-750 megahertz) currently used for television broadcasts. It has been also identified that the EU Commission in October 2006 announced plans to offer the so-called L-band (1.4 GHz) as an interim solution to be used before 2012 when analogue broadcasts end in the EU making more frequencies available for new digital broadcasts. In response Nokia announced there was no need for a single radio frequency for mobile television across the European Union and said the Commission's plan for an interim solution was unrealistic. This raises questions about the frequency / band limits ACMA has implied in the Discussion Paper which do not take account of the fact that in the US we have heard they have allocated the frequency range 698 – 806MHz (likewise Japan).

The current literature also provides examples of Mobile TV technologies and applications being proposed equally for both bands IV and V in the broadcasting services bands.

ACMA should not rule out allocation of channels above 59 where interference mitigation could be attained through design of low power single frequency networks operating in the upper frequency ranges of Band V adjacent to existing and planning DVB-T networks. This network design and service planning should also be mindful of the potential requirements for gap fillers by the existing and planned DVB-T services to meet the requirements of same coverage.

Free TV submits that a planning regime similar to the Digital Television Channel Planning Consultative Group should be established for development of a migration plan to implement Mobile TV in Australia. This should be based upon requirements which are more closely aligned to the planning principles adopted previously in Australia for the adoption of broadcasting technologies. Given the adoption in Australia of many business models from the US and the decreasing dependency to adopt systems only based upon a European 50Hz paradigm, these plans may be as equally influenced by developments in the US and elsewhere.

### (c) Specific Allocation Observations

The Discussion Paper states:

*ACMA proposes to only define datacasting service areas for channel B that correspond to channels used at high and medium power sites and at lower*

*power sites that are not contiguous with high/moderate power sites. There are 53 high or moderate power sites with ERP above 10 kW….*

The selection criteria for a high/moderate power site is proposed as a transmitter site with an ERP greater than 10kW[1]. It is not specified if this

[1] Footnote 23 on Page 44 of the Consultation Paper

refers to the analogue or digital ERP of a single service or the combined total ERP from a site. However, it is noted that Table B2 includes assignments for Channel B at sites that are considered low power: including Boonah, Bouddi, Collaroy, King's Cross and Manly/Mosman.

It is noted that a site "Collaroy" is allocated Channel 28 for Channel A and Channel 35 for Channel B. It is assumed this site is not referring to Collaroy the suburb of Sydney as the Channel 28 assignment would clash with SBS analog. The only other reference to Collaroy that could be found is a low power site near Merriwa in the upper Hunter.

Boonah and Esk in Queensland have been allocated the same channels for broadcaster's digital services. It is noted that the Channel A assignment is 38 at Boonah and 43 at Esk.

Channel 50 is allocated to SBS analogue at Gympie Town and has been allocated to Channel B at this site and the nearby Gympie site.

The Channel B assignment for the area from King's Cross in Sydney all the way to the Upper Hunter is Channel 35. This is a geographic spread in excess of 200km. This will impose considerable technical restrictions on the Channel B licensee operating an SFN over such a large distance.

## 3.3 Defined Service Areas and DCPs

### (a) ERP or pattern restrictions on DTL transmissions

The Digital Channel Plans for the introduced DTTB services during the conversion to digital in Australia have been based upon a restriction on the ERP of these new DVB-T services at 6 to 10dB down on the existing analogue services to ensure minimum interference to the received analogue signals. At the completion of the simulcast it is proposed that any services initiated with this constraint to minimize interference to analogue will be permitted to increase ERP.

This issue is related to the definition ACMA intends to provide for the *geographic area* for Channel and A and B, and the consequential planning relationship to the existing licence areas for digital terrestrial television broadcasting in Australia.

Each existing Broadcast licensee in a service area should be consulted well in advance of this being proposed. ACMA should be fully briefed an any planning a prospective bidder for the Channel B license on any matters relating to full compliance with the TPGs toward ensuring full protection of the existing services in any existing service/licence area or *newly defined geographic area.* DCPs are macro level plans and assumption made in their development may require review to ensure equivalent / same coverage and digital signal quality has been achieved post the introduction of any new services in the BSBs.

A broader planning regime may be required that takes a *holistic* approach to the entire area impacted by the Datacasting *geographic area* for Channel A and B.

In any transition to Mobile TV it may be necessary to place ERP restrictions on Mobile TV to minimize interference to analogue and digital TV services.

It has been noted that while some technologies can support an MFN configuration, providers of mobile television services would prefer and greatly benefit of an SFN implementation. The assignment of repeater channels at differing frequencies will be unnecessary in an SFN architecture. The lower 700 MHz frequencies have a favourable electrical length relative to the dimensions of a mobile device for these technologies. Conversely, the lower UHF spectrum (below 600 MHz) is preferable for fixed television, due to lower propagation loss and the fact that antenna size is not as critical a factor for fixed reception.[2]

**(b) Additional SFN sites not in DCP's**

This provision implies that DTL services could be provided by means of transmitter sites at locations that are not associated with transmitters for existing analogue or digital FTA services. Such an approach raises two major concerns. The first is that of meeting the required adjacent channel protection ratios to protect reception of existing services. This is a potential problem even at DTL signal levels that do not cause overload of receivers. The second problem is that of "blanketing" of receivers in the vicinity of DTL transmitters. Blanketing arises from the inherent characteristics of the amplifying devices used in receivers and can be expected to be troublesome particularly in situations where the receiver AGC cannot adequately control signal levels in the receiver. A typical case would be that of a low level wanted signal in the presence of a high level unwanted signal. For co-sited transmissions, the receiver AGC usually minimises "blanketing", however, for non co-sited transmissions, experience indicates that "blanketing" can be expected to occur for signal levels of the order of 90 dBuV/m or greater. If "blanketing" occurs, then interference can occur even for non-adjacent-channel services. The implication of this is that if additional SFN sites are needed to provide satisfactory DTL service, then the channel assignments will need much greater channel separations than have been used with current free-to-air digital channel planning if interference from Datacasting to free-to-air services is to be avoided.

It is difficult to be more specific about the potential impact of this potential problem because of the strong influence of local factors such as existing antenna orientation and directivity and any close-in shadowing of the local signal by terrain, vegetation or buildings. It is well proven that the problem is more severe in locations where mast-head amplifiers are in use to achieve reception as the strong local signal causes either gross overload (leading to multiple inter-modulation product generation) or "blocking" of the amplifier (which prevents the amplifier from operating). Experience with the DTTB Interference Management Scheme indicates that problems with mast-head amplifiers exist not only in the fringes of coverage areas but also at many locations where terrain, vegetation or building obstruction results in localised pockets of low signal in locations where the signal is generally of acceptable level. The impact of such situations can be severe simply because of the large number of affected viewers, especially in the metropolitan areas. Any introduction of additional services into broadcasting services band will impact

[2] Refer Qualcomm Submission on Future Use of Unassigned Television Channels

on the threshold at which a large proportion of the existing receiver population has been optimised for the introduction of DTTB.

**(c) Additional sites in remote areas**

With reference to Section 4.2 above, given that free-to-air service reception in remote areas is likely to depend on signal levels at the lower limit set by receiver noise-limited sensitivity, "blanketing" of receivers in the vicinity of the additional DTL transmitters is likely to be even more of a problem.

## 3.4 Re-planning of channel assignments to improve suitability for mobile applications

The literature which has been made available to date on the proposals and trials of Mobile TV applications indicate proposals for cellular type networks planned on the basis of single frequency networks. If DTL services are to be provided primarily for mobile reception and are to be provided by a cellular network structure of transmitter sites, then re-planning for a network of lower powered transmitters may identify additional or new channels that could be used for a cellular network but not for the existing broadcasting structure of a main high-power transmitter with low power supplementary transmitters.

As such a network will depart from the established principle of co-location, central to any planning regime for mobile will be a review of the adjacent channel (n, n+1, n+2 etc) rejection performance of the installed base of digital receivers already in the community, to ensure that these units do in fact meet the parameters used in the existing planning guidelines

**"interference infill repeaters" (IIR's)**

"Interference infill repeaters" (IIRs) (interpreted as meaning additional transmitters for free-to-air services provided at DTL SFN sites by the DTL service provider) are suggested as a possible solution to interference to free-to-air reception from non-co-sited DTL transmitters.

The Discussion Paper notes that the concept of IIRs is unproven. The ability to use IIR's for free-to-air digital services would rely on the disposition of transmitter sites being such as to permit the implementation of "true" SFN systems where the transmitter spacing was well within the guard interval in use. This is in comparison with the current free-to-air use of "pseudo" SFN operation with wide-spaced transmitter sites such that fixed network time offsets are introduced so as to move the resulting "mush zone" out of the intended reception zone. This technique is not applicable in the general case because there are insufficient degrees of freedom to deal with the multiple transmitter case.

Applying principles from existing interference mitigation regimes, the DTL service provider, as the creator of the interference, would need to be responsible for the costs of the solution. In the case of IIRs, this would involve all costs associated with the establishment of the new site and the capital cost of the equipment. However, such a solution requires operational funding to operate and maintain the IIR, which should also be met by the DTL service provider. As the equipment may have a lifetime less that the lifetime of the broadcast licencee, the DTL service provider should also be responsible for any replacement costs into the future.

If IIRs are to use the broadcaster's existing SFN channels, this raises licencing issues that have been encountered in the establishment of Alternative Technical Scheme transmitters. An alternative solution that should be explored would be the assignment of a channel set within a broadcaster service area for infills that could be shared between DTL IIRs, any transmitters installed as part of the digital conversion of current analogue retransmission facilities established under current schemes and any future "black spot" scheme where licences are held by community organisations.

### 3.6 Changes to DTTB Planning Handbook and TPG's to deal with mobile reception

In view of the limited data that is currently available regarding height gain/loss and building penetration loss, it appears premature to be considering changes to the DTTB Planning Handbook or the TPG's specifically to deal with mobile reception. However to ensure the integrity of the Implementation Plans initiated by the free-to-air television broadcasters in accordance with the DCPs the following principles should be applied when planning unassigned digital channels where those channels may be considered for mobile television:

DTTB Planning Handbook

- Changes should only be made to the DTTB Planning Handbook which arise out of a consultation process with existing DTTB licensees.
- All planning parameters transmit and receive system characteristics and specifications for notional receiving systems for mobile TV should be compliant with Australian standards.
- There shall be no modifications to the *protection ratios* for DTTB. Co and adjacent channel protection ratios should be established for planning of DVB-T with high power DVB-H or other COFDM-based technologies as might be employed by the Channel B licencee.
- The mobile TV receiving system needs to be defined.
- *Minimum field strengths* should be established for mobile TV.
- The reference modulation parameters for planning of mobile TV planning needs to be established.
- *Guard band* requirements should be established for mobile TV where there is the potential to the existing DTTB services.
- During the transition out of analogue TV and full power DTTB, maximum ERPs should be established for mobile TV.
- *Protection ratios* should be established for mobile TV.
- Appendix G of the DTTB Planning handbook outlines the principles upon which SFNs have been planned for DTTB in Australia. Planning of SFNs for services in the Channel A and B assignments should be in accordance with and complimentary to these principles.

Technical Planning Guidelines

No changes are required to the Technical Planning Guidelines for the implementation of Channel A. The following sections summarize the relevant parts of the TPGs which may need to be considered for the introduction of mobile television in Channel B.

Part 6 relates to Digital television.

Upon reviewing Part 6 of the TPGs ACMA has identified that the Note to item 84 and Note 1 to item 106 may require modification to reflect the higher field strengths that may be required for mobile television.

The note to item 84 states :

*Note No Minimum Level of Service Requirements are applicable to datacasting services. However, protection of a datacasting service against interference from other services will only be provided on the basis that the datacasting service provides a median field strength equal to, or greater than, the planned minimum field strength.*

ACMA *proposes to:*

A. *attribute one of these unassigned channels to a channel A DTL for each site that has been planned in a DCP; and*

B. *another unassigned channel to a channel B DTL for major sites that have been planned in DCPs*;

and determine the definition of a geographic area for a datacasting service which will be :

*in compliance with the technical specification in the DCP, or by way of additional repeater stations that meet the conditions specified in the Technical Planning Guidelines (TPGs)*Further extensive studies are required to determine minimum field strengths for datacasting or mobile TV which meet the protection requirements of the existing DVB-T services.

Note 1 to item 106 of the Technical Planning Guidelines states

*Note 1 Guidelines 82 to 84 define the Minimum Level of Service Requirements for digital television broadcasting services. For the purpose of application of paragraph 106(a) to datacasting services, an area may be considered under served if the received median field strength is less than the planned minimum field strength.*

This is true for the Datacasting service as long as the Datacasting / Mobile TV service causes no interference to the *primary* Broadcasting service.

**Part 7** relates to the *Interference management scheme for digital television.* It applies to *digital television broadcasting and datacasting transmitter licensees.*

ACMA state in the Discussion Paper that Part 7 *is designed to ensure that a viewer's analogue television service is protected from interference from digital transmissions, and where such interference does occur, that resolution is achieved in a timely manner.*

Part 7 also states :

*A digital licensee is also the licensee of an apparatus licence under the Radiocommunications Act 1992. The authorisation procedure mentioned in the definition is set out in Division 4 of Part 3.3 of that Act.(p35)*

Free TV submits that Part 7 Items 109 – 146 and 151 – 176 could be as equally applicable to a newly introduced digital service other than DVB-T.