



**Strategies for Wireless Access Services
Spectrum Planning Discussion Paper
SPP 1/06**

**Submission to
Australian Communications & Media Authority**

**by
Free TV Australia Limited**

26 April 2006

Executive Summary

- The overriding objective of any spectrum planning process must be to maximise the overall public benefit derived by all Australians from use of scarce spectrum resources.
- Spectrum should only be assigned to a new technology or application where there is clear evidence of consumer demand for the technology or application, and its delivery is supported by sustainable business models.
- ACMA should not consider re-locating mature and established services unless there is overwhelming public benefit in favour of assignment to the new service and all other spectrum options are exhausted.
- Any proposal for re-assignment needs to be subject to further extensive consultation to balance the public benefit in the competing spectrum uses, and the impact of re-assignment on the incumbent spectrum licensee.
- There is still a great deal of work to be done at an international level before spectrum needs for new WAS technologies and applications are standardised.
- There is no current justification for any proposal to re-assign broadcasters from the 2.5 GHz band in favour of WAS.
- Content gathered by broadcasters using the 2.5 GHz band is delivered free of charge to all Australians and fulfils a range of important social and cultural public interests.
- Broadcasters have invested heavily to continue to operate in reduced channels in the 2.5 GHz band since 2005.
- No alternative spectrum has been identified which can support broadcasters' uses. The only bands proposed by ACMA (the 2.0 and 2.2 GHz bands) are not suitable due to the requirements of existing services in those bands.
- Several countries, including the United States, have indicated their intention to retain ENG applications in the 2.5 GHz band.
- The importance of ENG to public warning, disaster mitigation and relief has recently been recognised by the International Telecommunications Union (Radiocommunications Sector).

Introduction

Free TV represents all of Australia's commercial free-to-air television broadcasters. It welcomes the opportunity to respond to the Spectrum Planning Discussion Paper released by the Australian Communications and Media Authority (**ACMA**) in February 2006 entitled *Strategies for Wireless Access Services SPP 1/06 (Discussion Paper)*.

The Discussion Paper seeks comment from stakeholders to guide development by ACMA of short, medium and long-term strategies to support the development and deployment of wireless access services (**WAS**).

Assuming that additional spectrum is needed for WAS, the Discussion Paper identifies a number of spectrum bands as "potential future WAS bands" and seeks comment from incumbent users on the impact of any re-assignment. Free TV notes that the candidate bands proposed by ACMA represent possible approaches only. Any potential for re-assignment will be the subject of further extensive consultation, before ACMA makes any recommendations to the Minister.

One of the medium-term 'potential future WAS bands' identified by ACMA is the 2500-2690 (**2.5 GHz**) band currently licensed to Networks Seven, Nine, Ten and the Australian Broadcasting Corporation (**ABC**). Broadcasters currently use the 2.5 GHz band to produce a range of program material occurring outside the studio including live news and current affairs, sport and other events, and Australian and local content.

Some of the other candidate bands identified by ACMA are also assigned to uses ancillary to broadcasting.

The submission does not seek to address all the issues raised in the Discussion Paper, rather it focuses on the following topics.

Section 1: Spectrum planning – ACMA's overriding objective must be to maximise the public benefit derived by all Australians from use of scarce spectrum resources. Spectrum should only be assigned to new technologies or applications where there is clear evidence of consumer demand and their delivery is supported by sustainable business plans. ACMA should not consider re-locating mature and established services unless all other spectrum options are exhausted, and subject to further extensive consultation to balance the public benefit in the competing spectrum uses.

Section 2: Broadcasters' uses of the 2.5 GHz band – Program content gathered using the 2.5 GHz band is delivered by broadcasters free of charge to all Australians. It has wide audience appeal, fulfils a number of important broadcasting policy objectives and underpins a number of new WAS business models for delivery of content to mobile devices. This content could not be gathered without use of spectrum with the characteristics of the 2.5 GHz band. Broadcasters have made significant investments to operate in the band and their operational practices are considered to be world's best practice.

Section 3: Is 2.5 GHz a suitable 'candidate' band? – There is no convincing evidence of standardisation and no clear public benefit case to support a proposal to assign spectrum in the 2.5 GHz band to WAS. Further, it is not clear that WAS uses could co-exist with existing satellite services licensed in the band.

Section 4: No suitable alternative spectrum identified for broadcasting uses – No alternative spectrum has been identified which can support broadcasters' uses. The only bands proposed by ACMA (the 2025 – 2110 and 2200-2300 MHz bands) are not suitable, due to the requirements of other services operating in these bands.

Section 5: Other candidate bands – The UHF broadcasting services bands are unlikely to support WAS. Any proposal to introduce WAS services in the Extended C-band would

require study to ensure earth stations (used by broadcasters to receive overseas satellite feeds) are protected from interference.

Section 6: Licensing models – The overriding objective of licensing models must be to maximise the efficiency of spectrum usage. Free TV supports further consideration of ‘public park’ class licensing for delivery of niche services in lower density areas.

1 Spectrum planning

The overriding objective of any spectrum planning process must be to maximise the overall public benefit derived by all Australians from use of scarce spectrum resources.¹ Free TV submits that ACMA needs to undertake a range of evidence-based assessments before it is in a position to consider a spectrum strategy which achieves this objective.

These assessments include:

- identifying the technologies or applications warranting spectrum assignment;
- understanding the characteristics of the spectrum required to support these technologies or applications; and
- investigating all options for spectrum assignment to ensure that public benefit is maximised.

These are addressed in turn below.

1.1 Which services?

The range of technologies and applications identified by ACMA as ‘wireless access services’² covers most of the wireless technologies in use today and many more at various stages of development.³ Free TV submits that it is an impossible task to develop a rational and efficient spectrum strategy which accommodates such a range of technologies and applications.

Despite the very broad definition of WAS, much of the discussion in the Paper, and the focus of Government funding programs, is access to broadband services particularly in regional areas of Australia. Free TV submits that the focus of the current spectrum planning process should be broadband wireless access (**BWA**), not WAS. Spectrum planning for other emerging WAS technologies can occur as and when they are standardised, sustainable markets evolve and the public benefit in spectrum assignment becomes clear.

The starting point for any spectrum planning must first be to understand which technologies are standardised and likely to dominate in the medium to long-term; the time-frame for deployment of services; the likely short, medium and long term demand for those services in the Australian market; and the needs in different geographical areas of Australia (urban, urban-fringe, regional and rural areas).

1.2 Spectrum characteristics

Once these questions are answered, ACMA needs to understand the technical characteristics of the spectrum required to support the services. Only then is it in a position to assess issues such as the extent to which demand will be satisfied from use of existing spectrum assignments; whether compatible frequency management plans can be developed

¹ The leading object of the *Radiocommunications Act* requires ACMA “to maximise by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using the radiofrequency spectrum.”: section 3.

² The Discussion Paper states that “WAS covers a range of other terms such as fixed wireless access (FWA), broadband wireless access (BWA), wireless local loop (WLL), multipoint distribution systems (MDS) and radio local area network (RLAN).”

³ A presentation to the recent Wireless Spectrum Strategies seminar hosted by ACMA identified nine separate technologies for mobile television systems alone: See presentation by Peter Ferris, General Manager, Technology and Planning, Optus Networks.

to accommodate new spectrum assignments in available spectrum; and whether existing spectrum assignments can be re-used or converted to satisfy demand for new services.⁴

1.3 Spectrum assignment

Spectrum should only be assigned to new services where there is clear evidence of consumer demand for such services and their delivery is supported by sustainable business plans. Spectrum should be assigned on an incremental basis as the public benefit in further assignment becomes clear.⁵

ACMA should not consider re-locating mature and established services until all other spectrum options, including re-farming, re-use and potential sharing opportunities are exhausted. Any consideration of re-assignment would need to be subject to further extensive consultation to balance the public benefits served by the competing spectrum uses and the impacts of re-assignment on the incumbent spectrum licensee.⁶

Free TV urges ACMA to adopt a thorough evidence-based approach to spectrum planning for WAS. ACMA must avoid repeating errors of the past where spectrum has been cleared at huge cost and disruption to incumbent licensees, only to remain largely unused many years later.⁷

These issues are considered in further detail in Sections 3–5, which consider the nomination by ACMA for potential assignment to WAS of the 2.5 GHz and other bands currently assigned for uses ancillary to broadcasting. The following section considers broadcasters' current use of the 2.5 GHz band.

2 The 2.5 GHz Band

2.1 Broadcasters' uses of the 2.5 GHz band

Television broadcasters use the 2.5 GHz band to transmit television coverage of program content outside the production studio back to the studio facility for inclusion in a program for broadcast ('link-related spectrum').

The band is also used to provide links for advanced camera applications including wireless cameras used for "stump-cam", "race-cam" and "fly-cam" sporting applications and airborne transmission platforms ('camera-related spectrum').

Broadcasters' uses of the band can be grouped into three main activities.

- Electronic News Gathering (**ENG**) – the rapid, unplanned deployment of radiofrequency video links to cover live news events, generally for short periods of time.

⁴ Considerable portions of the spectrum assigned to 2G (1800MHz and some 800MHz) and 3G mobile services (2 GHz paired and unpaired) remain unused, particularly in regional areas. Further, there has been only limited take-up of the 'use it or lose it' apparatus licences being offered by ACMA in regional areas for fixed broadband services in the 2 GHz unpaired range.

⁵ Whereas Table 1 of the Discussion Paper acknowledges that at least 700 MHz of spectrum below 6 GHz has already been allocated to BWA, studies in Korea indicate that BWA forecast demand will be satisfied by 100 MHz of bandwidth offering 9 million subscriber services to a population approximately 2.5 times Australia's population: *Case Study of Mobile Broadband Wireless Access*, Samsung/KT Document AWF-IM2/25, available at <http://www.apsec.org/meetings/2006/AWF-IM2/AWF-IM2DocList.htm>.

⁶ Relevant considerations would be the impact of re-assignment on the availability, quality and diversity of the existing service; re-assignment and business disruption costs; and changes to the regulatory environment which undermine current and future business investments and confidence.

⁷ This was the experience of broadcasters who vacated parts of the 1.8 and 2 GHz bands at request of the Australian Communications Authority in 2000, yet this spectrum has not had any significant use since then.

- Television Outside Broadcasts (**TVOB**) – a planned use of group radiofrequency video links using a variety of techniques to provide specialist coverage of a range of events which occur outside production studios, including sports, live entertainment and cultural events.
- Electronic Field Production (**EFP**) – a planned use of radiofrequency video links to provide elements of a television production, which can be live to air or recorded for later broadcast, generally with more elaborate television production values.

A detailed description of broadcasters' uses of the band for these purposes is provided in Annexure A.

Program content gathered using the 2.5 GHz band is delivered by broadcasters free of charge to all Australians. It has wide audience appeal, fulfils a number of important broadcasting policy objectives and underpins a number of new subscription business models for delivery of content to mobile devices.

Content has wide audience appeal

Broadcasters deliver many hours of program content which provide coverage of live news and current affairs, sport and other events and Australian and local content gathered using the 2.5 GHz band. Many more hours are spent collecting the content outside the studio and transmitting it back to the station for integration into the program. Crews and equipment are constantly deployed in the band between 6am and midnight in major capital cities for ENG, TVOB and EFP purposes.

Australians rate these programs highly. Annexure B lists the top 50 programs shown on metropolitan networks, regional networks and pay television⁸, compiled from survey data for the first 40 weeks of 2005. Of the top 50 programs, 35 shown on metropolitan networks, 29 shown on regional networks and all 50 programs on the pay television top program list are programs that were produced using wireless cameras or links operating in the 2.5 GHz band. Often it is the wireless camera providing the point-of-view shot from an otherwise unobtainable angle and location that makes these programs compelling viewing. These shots would not be possible without use of spectrum with the characteristics of the 2.5 GHz band.

Content fulfils broadcasting policy objectives

Not only are these programs popular with viewers, they also fulfil a number of broadcasting policy objectives. These include the delivery free of charge to all Australians of high-quality broadcasting services⁹ including

- a range of news and current affairs programs;¹⁰
- matters of local significance (regional broadcasters are required to meet local content quota requirements, including provision of local news);
- major sporting events and other matters of national importance (supported by the long-standing bi-partisan commitment to the anti-siphoning list); and

⁸ Fox Sports coverage of live Australian sporting events such as the AFL and NRL occurs using 2.5 GHz spectrum licensed to broadcasters.

⁹ One of the objects of the *Broadcasting Services Act* is to promote the provision of high quality and innovative content by providers of broadcasting services (section 3(f)). Australian audiences have come to expect high-quality content as well as an interference free broadcasting service.

¹⁰ Another object of the *Broadcasting Services Act* is to encourage commercial broadcasting services to be responsive to the need for a fair and accurate coverage of matters of public interest and local significance: section 3(g);

- high levels of quality Australian content (broadcasters are required to meet minimum quotas of Australian content including sub-quotas applying to drama, children's programs and documentaries);
- the simulcast of programs in analog and standard definition digital;
- broadcast of programs in high definition digital (broadcasters are required to meet a minimum quota of 1040 hours of high definition programs per year).

Broadcasters also fulfil an important public role in times of emergency by providing live coverage accompanied by news updates which provide important, sometimes life-saving, information to people affected by the emergency. The importance of ENG to public warning, disaster mitigation and relief has recently been recognised by the ITU-R.¹¹

The ability of free-to-air broadcasters to deliver these social and cultural objectives has become increasingly important as global sources of media and entertainment flourish. Free-to-air television broadcasters are competing for viewers by appealing to an increasing demand for live news and event programming, live sport and Australian and local content.

Content underpins other business models

Sport and news content gathered using the 2.5 GHz band is also integral to the business models of a number of other content providers. These include SBS (coverage of live Australian sporting events such as soccer); pay television channel providers Sky News¹² and Fox Sports¹³; mobile telecommunications carriers providing streamed sports and news content to mobile devices and internet sites¹⁴; and a range of developing subscription business models based on delivery of content to mobile devices, such as iPods and mobile television. Of course, it is many of these new mobile content business aspirants that are seeking access to spectrum to deliver their content services.

It was recently reported that the Australian Football League was examining models for sale of a range of "new media rights", which was the fastest growing segment of the sports rights industry. New media rights would include "broadband rights, mobile and telephony rights, downloads to portable devices such as iPods and, perhaps, even downloads from archival footage on broadband." It was reported that these rights could attract "over 5 years \$100 million or more, growing year after year as new ways of using new media become apparent."¹⁵ Of course, much of the content forming the basis for these rights is gathered by television broadcasters using the 2.5 GHz band.

2.2 Why is the 2.5 GHz band needed for these applications?

ENG, TVOP and EFP applications require a Primary allocation of contiguous bandwidth. The characteristics of the 2.5 GHz band make it highly suitable for these applications.

This is because the 2.5 GHz band:

- allows signals to be transmitted back to the studio from inaccessible locations; over obstructed paths; and over both long and short links;

¹¹ See ITU-R Recommendation 6/281 "Use of satellite and terrestrial broadcast infrastructures for public warning, disaster mitigation and relief, available at the following link: <http://www.itu.int/md/R03-SG06-C-0281/en>.

¹² Live ENG feeds are provided by Channels Seven and Nine to Sky News for use on a 24x7 basis.

¹³ See note 9.

¹⁴ Hutchison provided live vision of the 2005/6 Australian summer cricket tests to mobile phone subscribers. Telstra produces and operates football website www.afl.com.au which allows Telstra customers to access some of the more popular offerings on the site, such as video streaming of highlights from AFL matches.

¹⁵ John Lehmann, "AFL aims for \$100m in new rights", The Australian, 9 March 2006.

- maximises the immediacy and reliability of signal transmission;
- is available for immediate unrestricted use at all times.

These characteristics are particularly vital to ENG because a broadcaster has no control over the location, timing or duration of a live news or emergency event. Immediacy and reliability of coverage are critical factors.

The 2.5 GHz band is also particularly suitable for TVOB and some ENG events that require wireless camera links capable of supporting:

- rapidly moving transmitters and rapidly varying transmission paths (such as motor, yacht and horse racing);
- airborne transmission platforms (such as marathons, yacht racing, surf carnivals, triathlons and other long range events or bushfire emergencies, for example);
- wireless applications (such as “stump cam”, “race cam” and “fly cam” sporting applications and coverage of live news events unsuitable for wired cameras).

The importance of each of these characteristics is discussed in more detail in Annexure A.

2.3 Adjacent channel assignments

A very important feature of the 2.5 GHz band is that broadcasters are assigned adjacent channels.¹⁶ This minimises the spectrum assignment required by each broadcaster because broadcasters can coordinate and share channels to meet the bandwidth requirements of individual ENG, TVOB and EFP operations.

Without sharing of bands it would not be possible for broadcasters to cover events such as the Bathurst 1000 motor race, the Sydney to Hobart yacht race, Commonwealth Games, Melbourne Cup and the Indy 300, for example.¹⁷ Broadcasters regularly share channels to accommodate the greater bandwidth required to produce high definition material for integration into programs.

Adjacent channel assignments also assist broadcasters to ensure that interference between their own and other broadcasters' use of the band is minimised. Interference may result, for example, when a TVOB event and EFP operation are taking place in adjacent areas, or if coverage of a news story requires links crossing the area of a TVOB or EFP operation.

2.4 Recent investments in the band

Broadcasters have recently moved to reduced channel assignments in the 2.5 GHz band imposed by ACMA to allocate spectrum below 2500 MHz for radio local area networks (**RLANs**) and other industrial, scientific and medical applications.¹⁸ The reduced channelling arrangements became effective 12 months ago in April 2005.

In order to operate in the smaller channel environment, broadcasters (including the ABC) are investing in new equipment and deploying infrastructure for ENG around Australia. To date broadcasters have committed over \$20 million of capital expenditure to effect this re-configuration.

¹⁶ Refer to Figure E.4.1 at page 68 of the Discussion Paper which illustrates the channelling arrangements in the 2.5 GHz band.

¹⁷ Network Ten's coverage of last year's combined Indy 300 and V8 Supercars event on the Gold Coast required 364 MHz of spectrum, comprising all broadcasters' channel assignments in the 2.5 GHz band and 174 MHz of other temporary assignments in bands down to 2 GHz.

¹⁸ From April 2005 the channelling arrangements in the 2.5 GHz band were reduced from 28 MHz wide channels to 23.5 MHz wide channels. The overall band was reduced from 2463.5–2690 MHz down to 2500–2690 MHz.

This investment commitment has followed several years of investigation by broadcasters and discussion with manufacturers to identify an equipment solution capable of operating within the reduced channel bandwidth, whilst maximising the efficiency of spectrum usage. Ultimately this investigation culminated in broadcasters commissioning the manufacture of the world's first digital ENG systems. Australian ENG and TVOB operational practices are considered to be world's best practice.¹⁹

2.5 Broadcasters' ongoing requirements

Efficiency of spectrum usage will continue to be a paramount consideration for broadcasters.²⁰ Whilst broadcasters are now operating within smaller channels, the demand from viewers for live news, sporting events, local and Australian content is increasing.

As take-up of digital television increases, viewers are investing in widescreen, plasma and other new flat-screen technologies which provide larger and finer-resolution television screens.²¹ The impact on broadcasters is that the quality of the transmitted picture has become critical. This places greater requirements on bandwidth at each stage of the program production chain, particularly the camera-related and link-related spectrum required for ENG, TVOB and EFP activities.

The requirement for high definition programming is also spectrum intensive. Equipment is still evolving however it is clear that to meet the production values for a variety of content genres, high definition standards will demand spectrum bandwidths far greater than employed for standard definition. The issue is under intensive study by broadcasters and manufacturers in Australia and overseas.

2.6 Uses of the 2.5 GHz band by overseas broadcasters

Fourteen overseas jurisdictions, including the United States, United Kingdom, many European countries, Hong Kong and New Zealand, also use the 2.5 GHz band for ENG, TVOB and EFP purposes.²² Several of these countries have recently indicated their intention of retain ENG applications in the 2.5GHz band.²³

Use of the 2.5 GHz band for ENG in common with overseas countries has benefits for broadcasters and Australian viewers. It means that Australian broadcasters can use their domestic equipment and can co-ordinate spectrum usage to cover live news and other programming events overseas. For example, recent news coverage of events in Bali and Sumatra in Indonesia was possible with use of wireless cameras which were able to transmit video and audio content back to Australia using the 2.5 GHz band.²⁴

Use of the 2.5 GHz band in Australia, also means that broadcasters from other jurisdictions which use the 2.5 GHz band for ENG, TVOB and EFP purposes can coordinate use of their

¹⁹ This has been recognised in ITU-R Report 6/268 "Spectrum usage and operational characteristics of terrestrial electronic news gathering (ENG), television outside broadcast (TVOB) and electronic field production (EFP) systems". The Report is available at <http://www.itu.int/md/R03-SG06-C-0268/en>.

²⁰ There is evidence of increasing demand for ENG applications and resulting congestion of ENG spectrum in Australia and overseas. This was evident from presentations given to a ITU Seminar held in March 2006 to consider Spectrum Usage and User Requirements for Terrestrial Electronic News Gathering. Presentations made to the seminar are available at <http://www.itu.int/ITU-R/study-groups/seminars/rsg6-eng/docs/ituseminar.htm>.

²¹ Over 640,000 widescreen receivers were sold in 2005. LCD and plasma screens enjoyed growth rates of 219% and 92% respectively over 2005: 2006 "Record widescreen TV sales in 2005", 25 January, www.dba.org.au.

²² These jurisdictions are: Region 1 – Lithuania, Denmark, Finland, France, Italy, the Netherlands, Portugal, Switzerland and United Kingdom; Region 2 – USA, Colombia; Region 3 – Australia, Hong Kong, New Zealand.

²³ These countries include the United States, Italy and New Zealand.

²⁴ Australian broadcasters received licences from the relevant Indonesian authority to operate their ENG equipment in the 2.5 GHz band for the relevant period.

equipment to cover large scale events in Australia, such as the Formula One Grand Prix. Use of the band by overseas broadcasters is subject to the spectrum requirements of domestic broadcasters but, when possible, coverage of such events contribute to raising Australia's profile overseas.

3 Is 2.5 GHz a suitable 'candidate' band for WAS in Australia?

The 2.5 GHz band is one of a number of 'potential future WAS' bands identified by the Discussion Paper.

Free TV submits that there needs to be convincing evidence of international standardisation, and overwhelming public benefit in favour of assignment of spectrum in the 2.5 GHz band to WAS, before any re-assignment of broadcasters is proposed.

There is a lot of work still to be done before spectrum for WAS is standardised. There is no clear public benefit favouring assignment spectrum in the 2.5 GHz band to WAS in Australia.

3.1 Standardisation issues

The Paper notes that the 2.5 GHz band is under consideration by standardisation interests (the WiMAX Forum) for BWA fixed and mobile applications using IEEE 802.16 and ETSI HiperMAN standards.²⁵

WiMAX is designed to use spectrum in the range 2–11 GHz. The WiMAX Forum has indicated its objective to target interoperability between IEEE 802.16-2004 and the ETSI HiperMAN Standard, which is also targeting operation in the 2 to 11 GHz range.

There is a great deal of work to be done at an international level before particular frequencies are standardised for these technologies.

The business model for WiMAX indicates frequencies below 2.5 GHz are targeted for nomadic and eventually mobile, data, voice and video applications. Frequencies from 3.5 GHz and up (including 5.8 GHz) are targeted for fixed and nomadic data, voice and video.

To date, various countries have identified various candidate bands for deployment of WiMAX certified products.²⁶ The WiMAX forum has identified the frequency range 3.3 to 3.8 GHz as its initial focus for licensing of WiMAX Forum certified products in the next three years. In ITU Region 3 (Australia's region) WiMAX are initially focussing on the 2.3 GHz and 3.4 GHz bands.

The 2.5 GHz band is one of the candidate bands identified by WiMAX for longer term deployment of WiMAX products. However, as indicated in Appendix B to the Discussion Paper, different countries have indicated a range of intended uses of the band. These include TVOB, ENG, 3G mobile, MMDS, WiMAX, next generation mobile, wireless broadband, IMT-2000 and UMTS. Although a number of these technologies fall under the broad WAS umbrella adopted by ACMA, they are not necessarily compatible technologies (that is they do not interoperate nor has sharing criteria for these applications and technologies been identified and agreed). The range of intended uses of the band does not provide any evidence of overall spectrum standardisation. On the contrary they indicate that any spectrum standardisation for particular WAS technologies is a long way from realisation.

²⁵ Discussion Paper, page 20.

²⁶ Canada – 2.3, 2.5, 3.5 & 5.8 GHz, USA – 2.5 & 5.8 GHz, Central and South America – 2.5, 3.5 & 5.8 GHz, Europe – 3.5 & 5.8 GHz, Middle East & Africa – 3.5 & 5.8 GHz, Russia – 3.5 & 5.8 GHz, Asia Pacific – 2.3, 2.5, 3.3, 3.5 & 5.8 GHz.

Further, a range of work is being undertaken under the auspices of the International Telecommunications Union Radiocommunications Sector (**ITU-R**) which will impact on spectrum standardisation

This work includes studies being conducted by Working Party 8F to determine the candidate bands and bandwidth requirements for 'systems beyond IMT 2000' (now being referred to as 'IMT Advanced'). This work is scheduled to be substantially completed at the World Radio Conference (**WRC**) to be held in July 2007.

Working Party 8F has recognised that the overall spectrum needs of 'IMT 2000 Advanced' applications will not be able to be satisfied with spectrum assignments below 6 GHz. One focus of Working Party 8F has been to identify bands above 6 GHz for nomadic WAS applications.

Already a number of WAS technologies and services including ETSI IEEE 802.16 and the Wireless HiperMAN and ETSI Hiper Access projects (technologies referred to above) are considering higher frequency bands for some applications.

It is not clear why ACMA's Wireless Spectrum Strategy Discussion Paper does not consider any candidate bands for WAS above 5GHz.

In conclusion, there is no evidence of spectrum standardisation to support a proposal to assign spectrum in the 2.5 GHz band to any particular WAS technology. Further, it is not clear that WAS uses could co-exist with existing satellite services licensed in the band (see section 3.2 below).

3.2 Satellite sharing

There are six satellite systems operating in the 2.5 GHz band in ITU Region 3 which are visible from Australia.²⁷ Broadcasters have undertaken studies to ensure that digital ENG fixed service applications are able to share satisfactorily with satellite systems conforming to current ITU Radio Regulations.²⁸ Other services encompassed by ACMA's WAS definition would require a reduction of the satellite levels by up to 12 dB, implying that they cannot satisfactorily share with existing services in this band in Australia.²⁹

3.3 Public benefit considerations

Free TV submits that ACMA will not be in a position to develop a spectrum strategy for WAS which maximises overall public benefit unless and until there is convincing evidence of technology and spectrum standardisation, and clear demand for specific services.

ACMA then needs to consider all options for spectrum assignment.

ACMA should not consider re-assigning mature and established services until all other spectrum options, including re-farming, re-use and potential sharing opportunities are exhausted. Any consideration of re-assignment would need to be subject to further extensive consultation to balance the public benefits served by the WAS and broadcasting uses and the impacts of re-location on broadcasters.

Of course this assumes that suitable alternative spectrum has been identified for broadcasting uses.

²⁷ Many of these systems have replacement satellites under construction so a satellite presence in Australia's region will remain.

²⁸ Studies indicate a mask within 1 dB of RR21.16 is an acceptable sharing criteria.

²⁹ Results of studies are tabulated in JTG6-8-9/91 Annex 5.

4 No suitable alternative spectrum identified for broadcasting uses

No alternative spectrum has been identified which can support broadcasters' uses. The only alternative bands proposed by ACMA are the 2025–2110 (**2.0 GHz**) and 2200–2300 (**2.2 GHz**) bands. These bands are not viable alternatives for broadcasting uses due to the requirements of the space services and Defence licenses currently operating in these bands.

4.1 Space Services (2.0 GHz band)

ACMA has incorrectly assumed that sharing between ENG and the space services currently licensed in these bands is a viable option.

The basis for ACMA's assumption is an ITU-R Recommendation SA.1154.³⁰

The studies referred to in this Recommendation were undertaken in 1995. They considered the characteristics of analog FM ENG systems (then deployed in the United States)³¹ and examined the probability of such systems interfering with spacecraft and earth station receivers.

Based on these studies the Recommendation defines very tight aggregate interference limits for operation of low density systems. The Recommendation suggests that systems with operational characteristics similar to the analog FM ENG system considered in the study may be able to operate within the interference limit. The Recommendation is subject to the qualification that "restrictions may be needed in the future considering the expected growth rate of these [analog FM ENG] systems."

The Recommendation is not applicable to ENG in Australia for two key reasons:

- use of ENG has increased significantly since 1995 (that is the ENG usage which formed the basis for the probability calculations in the study has now increased significantly); and
- the operational characteristics of analog FM ENG systems are not compatible with the digital ENG systems used by Australian television broadcasters.³²

In the Australian digital ENG environment, the limits as prescribed in the Recommendation would be exceeded at excessive levels for unacceptable time periods. For example, an individual broadcaster operating ENG vehicles in Brisbane, Sydney and Melbourne for a 30 minute evening news bulletin, would exceed the prescribed aggregate interference level by 20 times. A detailed analysis of application of the interference limits to the Australian digital ENG environment is set out in Annexure D.

The satellite earth station sites would also cause substantial interference to ENG services. In addition to the three sites identified in the Discussion Paper, there are other licensed sites in urban areas at HMAS Cerberus (Melbourne), Mawson Lakes (Adelaide) and Mt Stromlo (Canberra). The interference that would be caused by these sites is unlikely to be compatible with broadcasters' news gathering requirements.

³⁰ The Paper cites this Recommendation in support of the proposition that "sharing with low-density mobile systems such as ENG is feasible and has been done successfully in other countries (examples include USA, UK and Hong Kong)." The Paper states that, "in light of those studies, sharing with ENG is considered to be a viable option, subject to the establishment of appropriate coordination arrangements with the space services stations [primarily operating at Tidbinbilla (ACT), Gngangara (WA) and New Norcia (WA)]: Discussion Paper, page 19.

³¹ Refer to Annex 3 of Recommendation.

³² The technical parameters of digital ENG systems are not compatible with the analog FM ENG system described in Annex 3. In particular, the 'peaky' spectrum nature of an FM signal means that the interference is not constant. On the other hand, a digital ENG signal creates a broad band of noise at a constant level, so from a probabilistic sense is a worse interferer.

As such, there does not appear to be any realistic basis for sharing between ENG operations and space services in this band.

4.2 Defence Licences

The Discussion Paper makes no reference to the fact that the Australian Department of Defence holds licenses in the 2.2 GHz band for Airborne Mobile Telemetry Services. These Defence services operate at many locations across Australia including in several capital cities.

Obviously, the need to ensure that defence uses of the band are protected from interference is paramount. This has led to caveats being required on licences over wide areas of the country as detailed in the Australian Communications Authority (now ACMA) Document SP 10/01 *Coordination Information for Defence Aeronautical Mobile Telemetry Systems Operating in the 2200 to 2300 MHz Frequency Range*.

This ACMA planning document suggests that any sharing with ENG could only occur on the basis that the broadcasters consult extensively with Defence before each and every ENG deployment (because ENG deployments are unplanned events). A requirement for consultation is clearly incompatible with the need to provide immediate coverage of breaking news events.

Further, ENG receivers in all major capital cities (except Melbourne) would be subject to random interference from Defence operations.

As a result, there does not appear to be any realistic basis for sharing between ENG operations and Defence in this band.

4.3 Existing fixed links (2.0 and 2.2 GHz bands)

Free TV further notes that there are around 500 spectrum assignments in the 2.0 GHz band and more than 280 point-to-point links for fixed services located in the 2.2 GHz band Australia-wide. The Paper notes that introduction of WAS services in these bands would require some of these links to be cleared, particularly in urban areas.

Metropolitan and regional broadcasters are current licensees in these bands. These links are used for transmission of broadcasting services to viewers. It is not clear where these links would be relocated to. As these links provide long-haul paths, it is unlikely that bands above 3 GHz would be suitable for broadcasters' links and many of the other fixed link applications in the band. Any re-assignment would require re-design of these point-to-point link networks.

5 Other candidate bands

5.1 UHF bands (520–820 MHz)

The Discussion Paper notes that there is potential in the long term that spectrum in the UHF bands (520–820 MHz) currently used for television broadcasting, may become available following the conversion from analog to digital television. The Paper describes planning for the introduction of WAS in this band, as 'very long term'.

The Paper goes on to note that in the US and UK (where analog/digital conversion is more advanced) parts of the band are now being considered for other uses.

Free TV notes that planning requirements for broadcasting in the US and UK are very different to Australia, where the population is highly dispersed across a vast land mass and most of the population relies on terrestrial signals to receive free-to-air broadcasting services.

As such, any parallels between the US, UK and Australia regarding the potential for non-broadcast uses of this spectrum need to be treated with caution.³³

Free TV submits that there are limitations to the range of non-broadcast uses for this spectrum in Australia as the power levels of broadcast transmissions limit the utility of the band for more typical radiocommunications services. The most logical alternative use for such spectrum is for other broadcast-type services that have similar emission characteristics.

Free TV is also concerned that the introduction of significant numbers of low power devices into the band will lead to increased levels of interference with television broadcasting signals.³⁴ These services would raise the noise floor potentially creating widespread interference to broadcast services in high-density urban areas. This would have the likely effect of adversely affecting broadcasters' ability to provide interference-free services across the large areas which represent television broadcasting licence areas. These concerns have also been raised by European and US broadcasters in the context of proposals to open up broadcast spectrum to wireless devices, particularly in rural areas.

5.2 Extended C-band (3575–3710 MHz)

Australian television broadcasters rely on Extended C Band satellites to receive video feeds from overseas broadcasters and content providers.³⁵ For example, vision of the Tsunami in South-East Asia in December 2004 was obtained by Australian broadcasters via satellite feeds to Australian earth stations transmitted via this band. It is likely that WAS applications in this band would interfere with the earth stations used by broadcasters to receive these feeds. Any proposal to introduce WAS services in this band would require further study to ensure that these earth stations are protected from interference.

6 Licensing models

The Paper seeks comment on improved regulatory arrangements for licensing of WAS. Free TV does not comment in any detail on any of the models proposed.

We simply submit that the overriding objective must be to maximise the efficiency of spectrum usage. We would support further consideration of 'public park' class licensing for delivery of niche services in lower density areas.

Finally, we note that some comparisons have been made between a 'public park' approach and the way broadcasters manage their operations in the 2.5 GHz band. Such a comparison is flawed.

As outlined in section 2 above, the assignment to broadcasters of adjacent channels is a very important feature of the 2.5 GHz band. This minimises the spectrum assignment required by each broadcaster because it allows broadcasters to coordinate and share channels to meet the bandwidth requirements of individual ENG, TVOB and EFP operations.

However, it is also critical to broadcasters' operations that where co-ordination or sharing is not possible, each broadcaster has access to dedicated licensed channels. This is particularly important for competitive news gathering activities, and to manage interference to signals which is always a paramount consideration for broadcasting services.

³³ This is recognised in the ACMA Discussion Paper *Future Use of Unassigned Television Channels*.

³⁴ The reference digital receiver assumes that the co-channel interference will be at least 20 dB below the carrier level of the wanted channel. The planning for DTTB coverage has assumed that the noise in the BSB is thermal (and, to a limited extent, man-made) noise.

³⁵ This band is heavily used for satellites in Region 3, because design requirements to meet rain attenuation in tropical areas of Asia do not allow for use of higher frequency bands.

Annexure A: Broadcasters' use of the 2.5 GHz band – spectrum operational requirements

1 Electronic News Gathering

The 2.5 GHz band is the only band licensed to broadcasters which is suitable for use for ENG.

ENG refers to the live coverage of news and emergency events. Coverage of live on-the-ground news relies on use of 2.5 GHz spectrum to transmit the report from the location of the news event back to the studio for broadcast. This includes daily coverage of press conferences, court reports, traffic reports, weather reports, State and Federal elections, emergency events and all other live news reporting that occurs outside the studio.

Examples of recent well-known television footage gathered using the 2.5 GHz band spectrum include coverage of events, such as the Macquarie Fields riots, ethnic unrest on Sydney beaches, the collapse of a Sydney apartment block above the Lane Cove Tunnel excavation, bushfires in the eastern states of Australia and regular coverage of road accidents on Australian roads in all states and territories.

1.1 Spectrum characteristics

The nature of news gathering determines the spectrum characteristics necessary for ENG. In particular, the nature of news gathering means that:

- a broadcaster has no control over the location of a live news or emergency event;
- a broadcaster has no control over the timing or duration of a live news or emergency event;
- there are usually several broadcasters attempting to cover the same news or emergency event;
- spectrum usage needs to be coordinated to maximise usage at peak times and to cover very large wide-scale news or emergency events.

These factors make the 2.5 GHz band highly suitable for ENG purposes. This is because ENG requires spectrum with the following characteristics:

- **allow signals to be transmitted over obstructed paths.**¹ This increases the probability of a successful transmission from any particular location;
- **allow signals to be transmitted over both short and long-links;**
- **allow signals to be transmitted from any particular location.** Less reliance on rigid/semi-rigid waveguides for transmission in lower frequency bands allows signals to be transmitted using equipment suitable to the location of the event and the transmission path available. A transmission link may be established using a portable antenna, telescopic mast or helicopter mounted antenna, as appropriate;
- **maximise the immediacy and reliability of signal transmission.** Higher transmitter powers and better receiver sensitivities available in lower frequency

¹ The 2.5 GHz band provides greater operational margins for the operation of an ENG link, than available in a higher frequency band. This is due to the propagation characteristics associated with lower frequency bands, which include a lower diffraction loss for obstructed paths; a lower receiver noise figure; and a higher available transmitter power. These factors all contribute to an increase in available system gain, which maximise the probability of a successful transmission over an obstructed path.

bands reduces reliance on directional antennas. This reduces the time and technical expertise required to align an antenna to achieve a reliable signal and allows for use of portable antennas, attached to a hand-held camera, for example. Immediacy and reliability are critical factors in live news broadcasting;

- **allow broadcasters to operate in contiguous channels.** This allows broadcasters to pool resources and to coordinate channel usage. Competitive news gathering often requires several channels to operate simultaneously over virtually the same path. Contiguous channels ensures efficiency of spectrum usage is maximised at peak times;
- **available for immediate, unrestricted use at all times.** ENG links are necessarily unplanned. A broadcaster has no opportunity to plan or to coordinate a transmission configuration to accommodate other services which may cause interference to an ENG transmission;
- **has a high level of interference protection.** Interference with other services needs to be managed so that television coverage of live news and emergency events is not compromised. Broadcasters are experienced in managing interference with other services operating in or near the 2.5 GHz band.

1.2 Spectrum usage

Metropolitan broadcasters use the 2.5 GHz band heavily in metropolitan areas with each commercial television network deploying at least five news crews in the central business districts and suburban areas of Brisbane, Sydney, Melbourne, Adelaide and Perth. ENG news crews are also based in Canberra and Darwin. Regular news collections take place in other major centres including the Queensland Gold Coast and Sunshine Coast, the Newcastle/Hunter and Wollongong/Illawarra regions of NSW and Geelong in Victoria.

News crews operate using wireless camera systems and video links which can cover an area extending up to 150km from the nearest collection site. News gathering beyond the 150km radius limit occurs frequently using helicopters as receive and transmit platforms back to ENG collection sites in the capital city.

Each metropolitan network operates a number of ENG collection stations in major city areas. Most networks also have an alternative dedicated ENG collection station mounted on their broadcast transmission tower. In most cities these are located near the edge of the urban area. The collection station configuration ranges from steerable (e.g. parabolic dish) to fixed (e.g. panel array with 360 degrees of azimuthal coverage) antennas.

ENG collection stations operate continuously, picking up program material collected by news crews. ENG collections provide live news feeds for the multiple news bulletins provided by each network each day. ENG collections also provide feeds for news flashes and updates, which are broadcast frequently and as often as possible during emergency events. Live ENG feeds are also provided by Channels Seven and Nine to Sky News for use on 24x7 basis.

News collection using the 2.5 GHz band occurs around the clock, including between the hours of midnight-6am on weekdays, in preparation for early morning current affairs programs, such as the *Ten Early News*, *Today Show* and *Sunrise*. Each news crew performs up to ten ENG collection operations per day. On average, ENG collections take between ½ to 1 hour in duration, with some events of durations of between 2 to 5 hours. On occasions coverage of events such as bushfires has extended over many days.

Congestion in the 2.5 GHz band can occur on a daily basis in the major capital cities.

Metropolitan broadcasters deploy news crews by helicopter to regional areas to cover news and emergency events which are then transmitted back to the station using the 2.5 GHz band.

Metropolitan and regional broadcasters work together to cover matters of local significance matters using the ENG capabilities of metropolitan broadcasters. A licence condition imposed on regional broadcasters by the then ABA in 2003 requires regional licensees to transmit minimum levels of local content, including local news. Regional broadcasters provide separate local news services to up to 6 sub-markets in their local licence area. Comprehensive local news services would not be possible without use of spectrum licensed to metropolitan broadcasters for ENG in regional areas.

For example, regional broadcaster NBN Television, which operates in the Newcastle area of New South Wales, produces one hour of local news every evening and local news updates for each of its coverage areas throughout the day. It has news bureaus located in Newcastle, the Central Coast, Taree, Port Macquarie, Coffs Harbour, Lismore, Coollangatta and Tamworth. These areas contain usually two or three news crews on the road, which deliver live news back to the studio using 2.5 GHz spectrum under a spectrum sharing arrangement with the Nine Network. Some of these areas cover vast distances, and the use of ENG links to return the footage to the local area bureau enables NBN to meet news deadlines. This is also especially important for stories dealing with natural emergencies such as bushfires and floods that can affect a wide area. Use of the 2.5 GHz band to provide immediate coverage enables NBN to keep the general public informed of emerging problems in local areas.

2 Television Outside Broadcasts

Broadcasters use the 2.5 GHz band to cover a range of events which occur outside production studios. These include live entertainment, sports and events of national importance within Australia. For example, coverage of Christmas carols, New Years Eve celebrations, concerts, cricket, football (all codes), tennis, motor racing, marathons, Olympic and Commonwealth Games, street parades, remembrance ceremonies and large scale pre-determined news and current affairs coverage of heads of Government meetings and visits by Heads of State.

These events are often located in suburban areas of capital cities and are often adjacent to ENG collection activities. TVOB occurs in addition to news coverage of these events.

The duration of coverage of such events varies from three days to weeks, depending upon the type of event and its timing. Some sports coverage requires television outside broadcast facilities to be installed, operational and de-rigged at a location over a period which could span several weeks and possibly months at one location. For example, coverage of football (all codes), tennis, cricket events and motor racing. Coverage of the Bathurst 1000 motor racing event by Network Ten in October 2005 involved 32 fixed or flying cameras located around the track and 46 cameras mounted in race cars. Transmissions are co-ordinated from a temporary 'station' built at Mount Panorama.

Broadcasters also use spectrum in the 7.2, 8.3 and 13 GHz bands for specific TVOB applications, however the propagation characteristics of the 2.5 GHz spectrum is particularly important for coverage of events:

- **which must be transmitted back to the studio from inaccessible locations.** The 2.5 GHz band reduces reliance on highly directional antennas and low elevation angles, which is important where an event is in a location where line of sight is obstructed by natural or man made barriers. This frequently occurs in built-up urban areas and other locations of varying topographical relief;
- **which must be transmitted back to the studio over obstructed paths;**
- **that require mobile video link applications,** such as motor, yacht and horse racing. Mobile applications require spectrum and equipment able to accommodate obstructed paths that vary rapidly with transmitters sometimes travelling at high speeds (up to 300

km/hour). The 2.5 GHz band provides radiofrequency spectrum characteristics which are more robust than those available in higher frequency bands. This means that mobile transmissions are less likely to be lost;

- **that require transmission using airborne platforms** such as helicopters to provide high angle coverage or mobile coverage. For example, in long range outside broadcast events such as marathons, yacht racing, surf carnivals, rallying and triathlons helicopters are often used to provide a transmission path for up-linking live video and audio signals; and
- **that require use of wireless applications** with low transmit power, such as coverage using miniature cameras and transmitters. This allows for applications such as “stump cam” in cricket matches and “race cam” in motor racing.

In many cities TV networks also operate TVOB collection stations, often mounted on their broadcast tower facilities in the bands assigned for TVOB. In many cities these are located near the edge of the urban area. Where the 2.5 GHz band is used in a TVOB event the same infrastructure developed for ENG is applied to the TVOB application.

The 2.5 GHz band is used heavily for TVOB purposes on weekend days, particularly for coverage of sporting events. Annexure C is a list of major sporting events which were broadcast during 2005. These events were all covered using wireless cameras or links in the 2.5 GHz band.

Coverage by pay TV channel Fox Sports of sporting events such as the AFL and NRL also occurs under sub-licence arrangements for use of broadcasters' 2.5 GHz spectrum.

3 Electronic Field Production

Australian television broadcasters shoot program content outside the studio for a range of pre recorded program genres such as current affairs, reality, lifestyle, travel, gardening, do-it-yourself, hospitality/catering, agriculture, conservation, wildlife and sports programs. These include programs such as *Today Tonight*, *A Current Affair*, *60 Minutes*, *The Today Show*, *Sunrise*, *9am with David & Kim*, *Backyard Blitz*, *Ground Force*, *The Great Outdoors*, *Getaway*, *Rove Live* and *Totally Wild*, for example.

EFP operations have similar characteristics to ENG, including use of collection stations. EFP is planned and requires higher production values that dictate a higher quality level in the video link performance, often HDTV which requires higher bit rates and increased channel bandwidth in the 2.5 GHz band.

Annexure B: Top 50 Programs (2005) Usage of the 2.5 GHz Band

FREE TV		PAY TV			
Metro Average '000s	Regional Average '000s	National Average '000s			
1 Tennis: 2005 Aust Open Mens Fnl	4,043	1 Tennis: 2005 Aust Open Mens Fnl	1,522	1 NRL: Cowboys v Sharks	331
2 2005 AFL Grand Fnl Syd/West Coast	3,386	2 State of Origin R/League NSW v QLD 2nd	1,237	2 NRL: Bulldogs v Rabbitohs	325
3 2005 AFL Gnd Fnl Wrap Up	2,981	3 State of Origin R/League QLD v NSW 3rd	1,220	3 NRL: Cowboys v Broncos	311
4 2005 AFL Gnd Fnl Pre Match	2,593	4 State of Origin R/League QLD v NSW 1st	1,207	4 NRL: Roosters v Warriors	299
5 Tennis: 2005 Aust Open Finals - Pre Final	2,485	5 Tennis: 2005 Aust Open Fnl - Pre Final	1,031	5 NRL: Broncos v Raiders	298
6 Tennis: 2005 Aust Open - D12 Night	2,466	6 Tennis: 2005 Aust Open - D8 Night	1,005	6 NRL: Knights v Storm	292
7 Dancing with Stars - Grand Final	2,340	7 Dancing with Stars - Grand Final	959	7 NRL: Dragons v Rabbitohs	291
8 Tennis: 2005 Aust Open - D8 Night	2,297	8 Tennis: 2005 Aust Open - D12 Night	932	8 NRL: Raiders v Cowboys	289
9 Desperate Housewives Finale	2,290	9 2005 AFL Grand Final Syd/West Coast	909	9 NRL: Storm v Bulldogs	289
10 Big Brother - Winner Announced	2,282	10 Tennis: 2005 Aust Open - D10 Night	908	10 NRL: West Tigers v Roosters	284
11 Desperate Housewives	2,147	11 Lost: The Finale	891	11 NRL: Panthers v Raiders	281
12 TV Week Logie Awards Arrivals	2,147	12 Big Brother - The Winner Announced	869	12 NRL: Bulldogs v 5 Eagles	275
13 Lost: Finale	2,083	13 Border Security - Aust's Front Line - Tues	866	13 NRL: Panthers v Knights	275
14 One Day Cricket: Asia/Rest World	2,082	14 Rugby League Final Series PF 2	863	14 NRL: Roosters v Dragons	273
15 Everybody Loves Raymond - Finale	2,066	15 The 2005 Grand Final Wrap Up	858	15 NRL: Storm v Broncos	269
16 Tennis: '05 Aus Open Fnl Post Mens Fnl	2,038	16 Lost	827	16 NRL: Raiders v Broncos	269
17 Tennis: 2005 Aust Open D10 Night	2,027	17 Tennis: 2005 Aust Open D11 Night	821	17 NRL: Storm v Panthers	267
18 Tennis: 2005 Aust Open D10 Late	1,957	18 McLeod's Daughters	816	18 NRL: Eels v West Tigers	265
19 Desperate Housewives: Dirty Laundry	1,952	19 National News Sunday	809	19 NRL: Cowboys v Storm	263
20 Lost	1,949	20 Dancing with the Stars 3	805	20 NRL: Panthers v Cowboys	262
21 2005 Grand Fnl Pre Match Entertainment	1,928	21 Dancing with the Stars	786	21 NRL: Panthers v Dragons	261
22 Dancing with Stars 3	1,924	22 60 Minutes	762	22 NRL: Eels v Warriors	259
23 47th Annual TV Week Logie Awards	1,893	23 Rugby League Final Series PF 1	761	23 NRL: Sharks v Eels	259
24 State of Origin R/League QLD/NSW 3rd	1,861	24 Mythbusters - Jaws Special	746	24 NRL: Wests Tigers v Warriors	259
25 Dancing with Stars	1,859	25 Desperate Housewives	739	25 NRL: Rabbitohs v Sharks	256
26 Big Brother - Final Eviction	1,840	26 Dancing with Stars - Highlights	737	26 NRL: Bulldogs v Storm	254
27 Border Security - Aust Front Line - Tues	1,822	27 TV Week Logie Awards Arrivals	735	27 NRL: Cowboys v Roosters	251
28 Tens AFL Fnl 2005 1st PF St Kilda/Syd	1,811	28 Everybody Loves Raymond - Finale	729	28 NRL: Cowboys v Rabbitohs	250
29 Tennis: 2005 Aust Open - D11 Night	1,770	29 Rugby League Final Series SF 2	727	29 NRL: Sharks v Panthers	250
30 State of Origin R/League NSW/QLD 2nd	1,758	30 True Stories	726	30 NRL: Storm v Warriors	249
31 State of Origin R/League QLD/NSW 1st	1,733	31 Medical Emergency - Tues	722	31 NRL: Cowboys v West Tigers	248
32 Mythbusters - Jaws Special	1,730	32 Desperate Housewives Finale	718	32 NRL: Warriors v Knights	248
33 50 Years 50 Shows	1,727	33 Lost: The Journey	712	33 NRL: Storm v Sharks	244
34 National Nine News Sunday	1,693	34 A Current Affair	706	34 NRL: Knights v Eels	243
35 Dancing with Stars - Highlights	1,692	35 Category 6: Day of Destruction	702	35 NRL: Rabbitohs v Panthers	241
36 CSI: Crime Scene Investigation	1,670	36 Desperate Housewives - Dirty Laundry	698	36 NRL: Cowboys v Knights	240
37 60 Minutes	1,662	37 Tennis 2005 Aust Open D10 Late	692	37 NRL: Sharks v Cowboys	239
38 Tennis 2005 Aust Open D12 Late	1,645	38 Dancing with Stars - Judges Verdict Girls	691	38 NRL: Rabbitohs v Dragons	239
39 Big Brother - Lies Exposed	1,644	39 National News	679	39 NRL: Sharks v Rabbitohs	238
40 Happy Days 30th Anniversary Reunion	1,636	40 All Time Greatest Aussie Bloopers	675	40 NRL: Broncos v Bulldogs	238
41 Big Brother - Intruders	1,623	41 Big Brother - The Final Briction	675	41 NRL: Rabbitohs v Raiders	236
42 Australian Idol - Audition 1	1,609	42 M-Snow Dogs	674	42 NRL: Dragons v West Tigers	236
43 Graham Kennedy: King of Television	1,605	43 Ed Sullivan's Legends of Rock & Roll	672	43 Twenty 20 Cricket	231
44 Dancing with Stars - Judges Verdict Girls	1,605	44 Backyard Blitz	672	44 NRL: Warriors v Eels	230
45 Dancing with Stars - Judges Verdict Boys	1,592	45 50 Years 50 Shows	671	45 NRL: Dragons v Storm	230
46 True Stories	1,583	46 Super Nanny USA	668	46 NRL: Cowboys v Raiders	225
47 Big Brother - Live Surprise	1,580	47 Tennis 2005 Aust Open Finals - Post Fnl	666	47 NRL: Warriors v Raiders	225
48 Big Brother - Opening Night	1,576	48 Australia's Guinness World Records	666	48 NRL: Knights v West Tigers	223
49 One Day Cricket - 2nd Fnl A. Aust/Pak	1,564	49 CSI: Miami	665	49 NRL: Broncos v Eels	217
50 Category 6: Day of Destruction	1,553	50 Tennis 2005 Aust Open - D9 Night	662	50 NRL: West Tigers v Eels	216

Source: Data sourced from OzTAM and RegTAM and compiled by Survey Audits - Weeks 1-40, 2005

FREE TV		PAY TV	
Metro Average '000s	Regional Average '000s	National Average '000s	
9 Desperate Housewives Finale	2,290	11 Lost: The Finale	891
11 Desperate Housewives	2,147	13 Lost: The Finale	2,083
13 Lost: The Finale	2,083	13 Border Security - Aust's Front Line - Tues	866
15 Everybody Loves Raymond - Finale	2,066	16 Lost	827
16 Lost	827	18 McLeod's Daughters	816
19 Desperate Housewives: Dirty Laundry	1,952	19 Desperate Housewives: Dirty Laundry	1,952
20 Lost	1,949	20 Lost	1,949
22 60 Minutes	762	24 Mythbusters - Jaws Special	746
24 Mythbusters - Jaws Special	746	27 Border Security - Aust Front Line - Tues	1,822
27 Border Security - Aust Front Line - Tues	1,822	28 Everybody Loves Raymond - Finale	729
28 Everybody Loves Raymond - Finale	729	30 True Stories	726
30 True Stories	726	32 Desperate Housewives Finale	718
32 Desperate Housewives Finale	718	33 Lost: The Journey	712
32 50 Years 50 Shows	1,727	35 Category 6: Day of Destruction	702
35 Category 6: Day of Destruction	702	36 Desperate Housewives - Dirty Laundry	698
36 CSI: Crime Scene Investigation	1,670	37 60 Minutes	
37 60 Minutes	1,662	40 All Time Greatest Aussie Bloopers	675
40 Happy Days 30th Anniversary Reunion	1,636	42 M-Snow Dogs	674
42 M-Snow Dogs	674	43 Ed Sullivan's Legends of Rock & Roll	672
43 Graham Kennedy: King of Television	1,605	44 Backyard Blitz	672
44 Backyard Blitz	672	45 50 Years 50 Shows	671
45 50 Years 50 Shows	671	46 Super Nanny USA	668
46 Super Nanny USA	668	47 Big Brother - Live Surprise	1,580
47 Big Brother - Live Surprise	1,580	48 Australia's Guinness World Records	666
48 Australia's Guinness World Records	666	49 CSI: Miami	665
49 CSI: Miami	665	50 Category 6: Day of Destruction	1,553
50 Category 6: Day of Destruction	1,553		

Source: Data sourced from OzTAM and RegTAM and compiled by Survey Audits - Weeks 1-40, 2005

Top 50 programs using wireless links

Metro	Regional	Pay TV
35	29	50

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Annexure C: List of Major Sporting Events Broadcast in 2005 which use the 2.5 GHz Band

EVENT	BROADCAST BY	BROADCAST COVERAGE	LOCATION
Horse Racing Melbourne Cup Epsom Randwick Guineas Caulfield Caulfield Cup Cox Plate Mooney Valley Derby Day Flemington Emirates Day Flemington Oakes Day Flemington Golden Slipper Rosehill Sydney Cup Randwick AJC Derby Day Randwick	Seven Seven Seven Seven Seven Seven Seven Seven Seven Seven Seven Seven	8 hours 4 hours 4 hours 4 hours 4 hours 8 hours 8 hours 8 hours 8 hours 4 hours 4 hours 4 hours	Melbourne Sydney Melbourne Melbourne Melbourne Melbourne Melbourne Melbourne Sydney Sydney Sydney
Australian Rules Football Australian Football League Premiership	Nine / Ten	5 games per round x 22 rounds x 3 hours per game	Sydney, Melbourne, Brisbane, Adelaide, Perth, Canberra, Geelong
Rugby League National Rugby League Premiership competition National Rugby League State of Origin Series International "test" matches involving senior Australian representative side played in Australia	Nine Nine Nine	2 games per round over 26 rounds @ 2 hrs per game 9 finals @ 2 hours per game 2 Games in 2005 4 games @ 2 hours per game	Sydney, Wollongong, Melbourne, Brisbane, Townsville, Canberra Sydney, Brisbane Melbourne, Sydney
Rugby Union International "test" matches involving the senior Australian representative team played in Australia	Seven	9 Games at 2.50 hours per game	Sydney, Melbourne, Brisbane, Perth
Cricket "Test" matches involving the senior Australian representative team played in Australia One day cricket matches (including World Series Cricket matches) involving the senior Australian representative team played in Australia	Nine Seven / Nine	Hours played Hours played	Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart Sydney, Melbourne, Brisbane, Adelaide, Perth, Hobart
Tennis Australian Open tennis tournament AAPT Championships tennis tournament (now the Next Generation Mens Hardcourt Championships) The Uncle Tobys Hardcourts tennis tournament The Adidas International tennis tournament Davis Cup tennis tournament rounds involving Australian representative team played in Australia	Seven Seven Seven Seven Seven	395 games: 10 days x 11 hours + 4 days at 7 hours 38 games: 5 days x 10.5 hours + 1 day x 4.5 hours + 1 day x 2.5 hours 38 games: 5 days x 9 hours + 1 day x 6 hours + 1 day x 4.5 hours 92 games: 1 day x 6.5 hours + 5 days x 9.5 hours + 1 day x 6 hours Aust vs Argentina (July05) and Aust vs Austria (Mar05)	Melbourne Adelaide Brisbane Sydney Sydney, Adelaide
Swimming Australian Telstra World Championship Trials Qantas Swimming Skins Telstra Fina Swimming World Cup	Nine Nine Nine	1-2 hours per day over 8 days Highlights Highlights (1 hour per day over 2 days)	Sydney Sydney Sydney
Golf Australian ("Mastercard") Masters tournament Australian Open tournament Ladies Masters Golf	Seven Seven Ten	4 rounds over 4 days x 10 hours per day 4 rounds over 4 days x 10 hours per day 5 hours x 1 day	Melbourne Melbourne
Motor Sports F1 Australia / Albert Park Moto GP (race held on Phillip Island, Victoria) V8 Supercar Championship Series rounds held in Australia, including the Bathurst 1000 Champ Car World Series (IndyCar) held in Australia Telstra Rally Australia	Ten Ten Ten Ten Ten	Day 1 = 4 hours, Days 2 -3 = 8 hours each 4 hours on Saturday, 5 hours on Sunday. From 2.5-12hours for one event 1 race x 10.5 hours 6 hours x 2 days 3 hours over the course of a day	Melbourne Melbourne (Phillip Island) Various locations in Australia, China and NZ Bathurst Gold Coast Perth
Other City to Surf Sydney to Hobart Yacht Race Ironman	Ten Seven Seven	2 hours 6 hours (with testing) 6 hours	Sydney Sydney Sydney

Annexure D:

2.0 and 2.2 GHz ‘Candidate Bands’: Sharing between ENG and Space Services – Analysis of ITU-R Recommendation SA.1154

Recommendation ITU-R SA.1154 defines aggregate interference limits at the input of the spacecraft and earth station receivers, then states that high density mobile systems should not be introduced in the 2025–2110 MHz and 2200–2290 MHz bands but that low density systems with technical parameters as defined in the annexes would be acceptable for guidance. Annex 3 refers to analog ENG characteristics of systems previously deployed in the USA in the band 2025–2110 MHz which is the satellite uplink band i.e. the interference is from ENG transmitter to satellite receiver, or from earth station transmitter into the ENG receiver. Annex 4 refers to aeronautical mobile telemetry systems operating in the band 2200–2290 MHz where the reverse interference cases apply.

ENG Transmitter into Satellite Receiver (2025–2110 MHz Band)

The specified interference into the satellite receiver should not exceed -180dB(W/kHz) , for more than 0.1% of the time. A low earth orbiting (LEO) satellite at a height of 250km (as specified in the Recommendation) sees an area of the earth approximately the size of Australia, so all ENG operations are potentially visible at once. Three depointed (at 60 degrees from the satellite, pointed to the ENG receivers) ENG vehicles operating at the same time would produce -177 dB(W/kHz) at the satellite input. For example if a broadcaster were operating ENG vehicles in Brisbane, Sydney and Melbourne for their evening news, the level would be exceeded. As these would operate for a 30 minute news bulletin, that alone exceeds 2% of the time, well in excess of the 0.1% time limit. Similarly, the limit would be reached for 18 outdoor co-incident wireless camera operations across the country (based on 100mW transmitters into omni antennas). If the LEO receiver was within 5 degrees of the ENG transmit beam (as would be the case at some point as it orbits the earth), the interference level would be exceeded by up to 30dB from one vehicle alone.

Earth Station Transmitter into ENG Receiver (2025–2110 MHz Band)

Currently there are nine sites with licenced earth station transmitters in the band which could interfere with ENG receivers if ENG operations were relocated to this band. Of these, six are in or near major capital cities where ENG operations already have established central receive sites so an interference impact assessment would need to be completed that satisfies the continuation of current ENG operations in Australia.

ENG Transmitter into Earth Station Receiver (2200–2290 MHz Band)

If ENG services were relocated to the band 2200–2290 MHz, an investigation of the reverse interference mechanisms would be required to satisfy the continuation of current ENG operations in Australia. As the number of earth station sites is limited (the Radcom database contains eight sites, Mt. Stromlo is not licenced for receive), these could be calculated on a case-by-case basis, however there would most likely be problems as five of these sites are adjacent to major capital cities.

Satellite Transmitter into ENG Receiver (2200–2290 MHz Band)

Sharing studies would need to be undertaken to similarly gauge the impact of LEO satellites on the horizon interfering with ENG receivers to satisfy the continuation of current ENG operations in Australia.

Conclusion

Recommendation ITU-R SA.1154 is based on a probabilistic methodology with a frequency modulated analog ENG carrier. The peaky spectrum nature of an FM signal will mean that

the interference is not constant. On the other hand, a digital ENG signal creates a broad band of noise at a constant level, so from a probabilistic sense, is a worse interferer.

In conclusion, the increase in ENG use and change to digital modulation will limit the opportunities to share in these bands without further detailed investigations and Recommendation ITU-R SA.1154 does not reflect the current operating environment of ENG in Australia.