New South Wales Submission to the Parliamentary Joint Committee on Law Enforcement *Inquiry into the Spectrum for Public Safety Mobile Broadband*, June 2013

1. The Australian Capital Territory, New South Wales, the Northern Territory, Victoria and Western Australia (jurisdictions) welcome the Parliamentary Joint Committee on Law Enforcement's *Inquiry into the Spectrum for Public Safety Mobile Broadband* (the Inquiry)[1]. The need to ensure public safety agencies (PSAs) have adequate capabilities to respond efficiently and effectively when disasters occur has been agreed by all Australian Governments[2]. This capability must meet business-as-usual operational needs and support responders effectively when crisis events occur.

Background

2. On 29 October 2012, the Australian Communications and Media Authority (ACMA) announced that it would make 10 MHz of radiofrequency spectrum from the 800MHz band (5 MHz+5 MHz) and 50 MHz of spectrum from the 4.9 GHz band, available for a nationally interoperable public safety mobile broadband network (PSMB)[3].
3. In a letter to the Prime Minister in July 2012, the Premiers of Victoria, New South Wales, Queensland and Western Australia requested an allocation of at least 20 MHz (10 MHz + 10 MHz) (letter at Attachment A). All States and Territories consider ACMA's reservation to be inadequate, as it is based on a 'business-as-usual approach,' which does not take into account future needs and is insufficient for large-scale or major events[4].

Joint States and Territories Submission to ACMA and SCPEM

4. To facilitate further consideration of the States' requirement for additional spectrum, States and Territories produced a joint submission outlining concerns about the inadequacy of ACMA's reservation and the policy, technical, operational and financial evidence for the basis of these concerns.
5. The position of jurisdictions on the matter of spectrum for PSMB is outlined in the Joint States and Territories Submission to the Standing Council on Police and Emergency Management (SCPEM) and ACMA in March 2013. This document, at Attachment B for the Committee's consideration, was endorsed by Police and Emergency Services Ministers in all States and Territories via SCPEM in April 2013 and was noted by the Council of Australian Governments (COAG) in April 2013.
6. Jurisdictions acknowledge that the Terms of Reference for the Inquiry are broad, and not all of the Terms of Reference are addressed in this submission. However, jurisdictions consider that this submission sufficiently outlines the issues of primary concern.

Key concerns of jurisdictions regarding the inadequacy of the current reservation

7. As emphasised in the submission, the reservation of 10 MHz in the 800 MHz band and 50 MHz in the 4.9 GHz band for this capability is inadequate due to:

   a) Growth (relevant to the Inquiry's Term of Reference a)

   PSAs' business-as-usual mobile demands will continue to grow as demand for PSAs' services increase due to growth in the Australian population, increased adoption of mobile data services by PSAs' and evolution of PSA mobile broadband applications. This growth is reflected in international comparisons, particularly in the United States, Canada and parts of Europe[5] (pp. 6 – 7 of Attachment B).

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[1] This submission has been endorsed by officials in the jurisdiction outlined.

[2] Council of Australian Governments, April 2013, *Communique*, p4, available from: http://www.coag.gov.au/sites/default/files/COAG_Communique_190413.pdf

[3] Australian communications and Media Authority, *The ACMA to deliver multi-layered spectrum solution to support public safety mobile broadband capability,* Media Release

[4] As expressed by States and Territories in the Joint Submission to SCPEM and ACMA at Attachment B.

[5] Deloitte, February 2013, *Emergency Services Long Term Strategic Plan – International Public Safety Broadband, p3 - 5*

Experience in these countries indicates that 10 MHz of spectrum does not provide sufficient bandwidth for incidents that occur on a daily basis. As a result, Governments have allocated, or are considering allocating, greater amounts of spectrum for use by PSAs. These international case studies are explored in greater detail in a recent study by Deloitte, which is included with the Joint State and Territory Submission at Attachment B.

b) Medium to Large Scale Incidents (relevant to the Inquiry's Term of Reference a)

Spectrum allocation must take into account demand for medium and large scale incidents including the increasing frequency of natural disasters, and likelihood of a major urban incident such as a terrorist attack, natural disaster or security operation for an international event (pp. 8 – 13 of Attachment B). The ACMA did not provision sufficient spectrum for these types of incidents given its view that it is not "appropriate to provide high value spectrum for rare contingencies"[6]. However jurisdictions do not support the ACMA's view that these types of incidents are rare contingencies or "once-in-a-generation events"[7].

c) Proposed Mitigation Options (relevant to the Inquiry's Terms of Reference a and d)

Jurisdictions are concerned about the technical and operational viability of the ACMA's proposed mitigation options, including commercial arrangements, to provide PSAs with sufficient data during a major urban incident. While jurisdictions acknowledge that some arrangements with commercial carriers may be a necessary part of a PSMB capability, it is noted that commercial networks are known to present issues when congested or otherwise under duress, such as during emergency situations[8].

To reduce the risks associated with commercial carrier arrangements, jurisdictions request that the Commonwealth ensure that a sufficient regulatory framework underpins priority access, quality of service and network management arrangements with commercial carriers. Furthermore, jurisdictions consider it important to have no constraints on PSMB spectrum licenses issued to jurisdictions so as to best leverage commercial arrangements and synergies with commercial carriers (pp. 18 – 23 of Attachment B).

Cost sharing and spectrum availability (relevant to the Inquiry's Terms of Reference b and c)

8. As a national PSMB network will produce a significant public safety benefit for the people of Australia, jurisdictions expect that the Commonwealth will make spectrum available at no cost to the States and Territories. After all, radiofrequency spectrum is ultimately a resource that belongs to the citizens of Australia.
9. The costs arising from building this capability must be transparent and equitably shared between the Commonwealth and the States. Given that the Commonwealth has auctioned the 700 MHz spectrum for a significant financial dividend, part of this dividend should be spent on the costs arising from building a technically robust capability for PSAs in the 800 MHz band.
10. Jurisdictions urge the allocation of an adequate amount of spectrum, specifically any additional spectrum to the current 10 MHz reservation, as soon as practicable and no later than 2020. Certainty regarding when, and where in the band, spectrum will become available is essential to inform State and Territory business planning and system design processes. To date, the ACMA has been unwilling or unable to provide advice on these points.
11. Due consideration should be given to jurisdictions' concerns when calculating the overall value of spectrum for PSMB. This includes:
    - the higher level of operational risks to PSAs should spectrum allocation be insufficient;
    - the opportunity costs of additional investments by State and Territory Governments in building a PSMB capability with a lower spectrum allocation; and
    - the public safety benefit that a PSMB capability will provide to all Australians.

[6] ACMA, October 2012, *Spectrum for public safety radiocommunications: Current ACMA initiatives and decisions*, p.15.
[7] *Ibid,* p.14.
[8] Public Safety Mobile Broadband Steering Committee, September 2012, *Public Safety Mobile Broadband National Implementation Plan*, p5.

700MHz and 800MHz bands, cost sharing and availability (relevant to the Inquiry's Term of Reference b)

12. The Commonwealth, States and Territories have noted the similar technical and operational characteristics between the 700 MHz and 800 MHz bands[9]. Despite this, spectrum in the 800MHz band was offered for a PSMB capability. Jurisdictions understand that this was due to:
    - **the importance of regional harmonisation:** the 800 MHz being promoted in the Asia-Pacific region as a band for public protection and disaster relief;
    - **commercial value of the 700 MHz band:** the 700 MHz band is estimated by the ACMA to be valued at approximately 28 per cent higher (per MHz) than the 800 MHz band; and
    - **the assumption that no 700 MHz spectrum would be available following its commercial auction:** this assumption proved inaccurate, as two paired 15 MHz segments (30 MHz in total) in the 700 MHz band remain available following the conclusion of the auction due to a lack of commercial interest**.**

13. Jurisdictions acknowledge the rationale for provision of spectrum in the 800 MHz band for this capability. However, jurisdictions also note that spectrum is now available in the 700 MHz band and that provision within that band is expected to reduce the costs of a PSMB network. The reduction in costs is due to the 700 MHz band's ability to support commercially available public safety grade equipment and systems integration solutions (whereas the 800 MHz band currently does not). Provision within the 700 MHz band would also provide the opportunity to harmonise with a number of countries that have standardised in the 700 MHz band, including the United States.

14. Further, as noted above, it is uncertain when 800 MHz spectrum will become available for PSMB. This uncertainty would be removed if provision was made in the 700 MHz band, which will become available with the orderly switch-off of analogue television across Australia by the end of 2013.

Conclusion

15. The Queensland Floods Commission of Inquiry regards "as vital, the allocation of broadband spectrum to Australia's emergency services organisations, to avoid congestion on narrowband communications and to assist Australian emergency service organisations achieve interoperability, giving them the best means of communicating and co-operating[10]." All Australian Governments have indicated support for such a capability. Jurisdictions encourage due consideration of the concerns outlined in the submission at Attachment B, to ensure Australian PSAs have the capability they need for the protection of life and property both now and into the future.

[9] Department of Broadband, Communications and the Digital Economy, December 2012, *Fact Sheet 3: Public Safety Mobile Broadband Capability 700Mhz v 800MHz – Suitability for Australian Public Safety Use.*

[10] Queensland Floods Commission of Inquiry, March 2012, *Final Report,* p399.

Public Safety Mobile Broadband
Joint States and Territories Submission
to the
Standing Council on Police and Emergency Management
and the
Australian Communications and Media Authority

Further Evidence from Jurisdictions

February 2013

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1. Introduction

It is imperative that all Australian Governments ensure that public safety agencies (PSAs) have adequate capabilities, now and into the future, to meet business-as-usual operational needs and to respond efficiently and effectively when crisis events occur.

Australian Governments agree on the role that all levels of government have in "ensuring the most effective, well-coordinated response from our emergency services and volunteers when disaster hits".[1] Community expectations about Governments' critical public safety function has also been reaffirmed by a number of independent inquires following recent disaster events, including the 2009 Victorian Black Saturday Bushfires and the 2010-11 Queensland Floods.

On 29 October 2012, the Australian Communications and Media Authority (the ACMA) announced that it would make available, for the mobile data communications use of Australia's PSAs:

- 10 MHz of radiofrequency spectrum from the 800 MHz band (5 MHz + 5 MHz) for the deployment of a nationally interoperable public safety mobile broadband (PSMB) network; and
- 50 MHz of spectrum from the 4.9 GHz band to provide supplementary high-speed, short range PSMB capacity in areas of greater-than-usual demand.[2,3]

The ACMA has proposed a 'multi-layered solution' under which four mitigation options supplement the spectrum allocation to provide a 'technically efficient PSMB capability'.[4] These are network 'densification', commercial carrier overflow, use of transportable infrastructure, and legislative provisions enabling access to additional spectrum in extreme circumstances.

At its 23 November 2012 meeting, the Standing Council on Police and Emergency Management (SCPEM) resolved that the Public Safety Mobile Broadband Steering Committee, including the ACMA, would reconvene to, among other things, explore any further evidence jurisdictions may wish to provide to consider further the adequacy of the 10 MHz of spectrum in the 800 MHz band announced by the ACMA to support the nationally interoperable PSMB capability.[5] SCPEM is expected to provide advice on this matter to the Council of Australian Governments (COAG) at the first COAG meeting in 2013.[6]

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[1] Council of Australian Governments, February 2011, *National Strategy for Disaster Resilience*, p iv. Available from: http://www.em.gov.au/Documents/1National%20Strategy%20for%20Disaster%20Resilience%20-%20pdf.PDF

[2] Australian Communication and Media Authority, 'The ACMA to deliver a multi-layered spectrum solution to support public safety mobile broadband capability', *Media Releases*, 29 October 2012. Available from: http://www.acma.gov.au/WEB/STANDARD/pc=PC_600087

[3] N.B. The focus of jurisdictions in this submission is on mission-critical public safety mobile data communications. Issues relating to mission-critical public safety voice communications are not considered in this submission and jurisdictions note that this falls outside the scope of the work of the Public Safety Mobile Broadband Steering Committee. Jurisdictions note that mission-critical voice communications work, utilising spectrum in the 400 MHz band, is being progressed between the ACMA and the National Coordinating Committee for Government Radio.

[4] ACMA's 9 November 2012 Presentation to the PSMB Steering Committee – Slide 18.

[5] Standing Council on Police and Emergency Management, 23 November 2012 Meeting Outcomes.

[6] Council of Australian Governments, 7 December 2012 Meeting Communique, p 6. Available from: http://www.coag.gov.au/node/475

The Australian Capital Territory, New South Wales, Queensland, South Australia, Tasmania, Victoria, and Western Australia[7] (jurisdictions) welcome the ACMA's in-principle policy decision to set aside 800 MHz band spectrum for PSAs' mobile broadband use. Jurisdictions do, however, have significant concerns about the adequacy of the 10 MHz of 800 MHz band spectrum which the ACMA has indicated will be made available for PSAs' use. Jurisdictions have three key concerns regarding the adequacy of the ACMA's decision and the basis for these concerns is outlined in detail in this submission.

The first key concern is the adequacy of 10 MHz in meeting PSAs' future business-as-usual demand profile. Based on overseas evidence and business as usual growth factors, jurisdictions do not consider 10 MHz to be an adequate amount of spectrum to meet PSAs' future needs.

Jurisdictions' second key concern is that the ACMA's decision in the 800 MHz band is based on its assessment of adequate spectrum for business as usual and planned event demand profiles, but not a major urban incident scenario (e.g. natural disasters like the 2010-11 Queensland Floods or a terrorist attack in the CBD).[8]

The final key concern of jurisdictions is that the 10 MHz reservation and supplementary mitigation options identified by the ACMA in its 'multi-layered solution' proposal do not sufficiently take into account the operational realities PSAs encounter in the field which would negatively impact on the effectiveness of the mitigation options.

Jurisdictions consider that the operational perspective of PSAs needs to inform the ACMA's decision-making for it to effectively meet its responsibility to "make adequate provision of the spectrum… for use by agencies involved in…law enforcement or the provision of emergency services".[9] For example, among the evidence the ACMA has considered is a Gibson Quai/AAS Consulting (Gibson Quai) study commissioned by the PSMB Steering Committee. The study included operational scenarios and focused on the technical aspects of delivering a nationally interoperable PSMB capability in Australia,[10] while not specifically addressing operational issues. The study did however highlight that, in considering the adequacy of a spectrum allocation, known issues and future risks needed to be taken into account. These include various technical and operational issues such as the requirement for proof of concept regarding the required process, capacity implications and eventual deployment time for a Long-Term Evolution technology (LTE) transportable.[11]

Jurisdictions' concerns include:

- concerns about the availability, robustness and resilience of commercial carrier networks during emergencies to ensure workable overflow arrangements;
- operational risks and issues in the use of Cells on Wheels (COWs) to increase data capacity in localised high-demand areas; and
- concerns that the extreme circumstances provisions in the *Radiocommunications Act 1992* (section 27 and Part 4.4) are untested and unlikely to be able to provide surge capacity in the first few hours of response to a sudden-onset emergency when that capacity is most needed.

[7] Western Australia is in caretaker mode until after the State election of 9 March 2013 and this Submission has been approved at officials level.
[8] ACMA 9 November 2012 Presentation to the PSMB Steering Committee – Slide 10.
[9] *Radiocommunications Act 1992* (Cth) section 3.
[10] Gibson Quai AAS Consulting, November 2011, *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 11.
[11] *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 46.

With regard to the option of network 'densification', jurisdictions assess that there would be a significant cost trade-off in designing, building and operating a PSMB 10 MHz spectrum network in comparison to a network operating on a greater allocation of spectrum, and note that the estimated increase in network costs (to achieve equivalent capacity with a network dimensioned on 20 MHz of spectrum) is likely to be substantially more than the commercial value of the additional spectrum. This would represent a significant cost shift from the Commonwealth to the States and Territories.

Jurisdictions consider that an approach requiring greater infrastructure density may be suitable for commercial organisations which generate profit from their use of spectrum, and whose networks are designed for average use throughout the network, but is not appropriate for PSAs which provide public services to protect lives and property, do not generate profits that can be reinvested in additional infrastructure, and require networks designed for peak usage in concentrated areas.

In this submission jurisdictions consider policy, technical, operational and financial issues of utilising a PSMB capability as outlined in the 'multi-layered solution' proposed by the ACMA. Further evidence is provided and, where relevant, evidence previously provided is revisited. A risk-based approach is taken to illustrate that a greater amount of spectrum would better enable PSAs to protect lives and property and contribute to the ACMA's ultimate goal, shared by jurisdictions, of providing public safety responders with sufficient data capacity when and where they need it.[12]

Jurisdictions consider that the concerns outlined in this paper are sufficient to warrant the ACMA's reconsideration of the quantum of its reservation of spectrum in the 800 MHz band for a nationally interoperable public safety mobile broadband capability.

Jurisdictions suggest that there may be the potential to reduce the size of any additional spectrum allocation to PSAs while still better meeting their operational needs by examining the possibilities of an asymmetric pairing of spectrum bands with an uplink allocation being greater than the downlink. All PSA demand profiles investigated in the Gibson Quai study have found uplink demand to be larger than downlink demand.[13] This differs from commercial demand profiles which are dominated by the downlink. This difference is primarily driven by the need for responders in the field to transfer information to a forward command or operations centre to provide situational awareness and inform decision making.[14] Jurisdictions are aware that such an asymmetric pairing would be counter to the ACMA's practice of making symmetric allocations (i.e. uplink and the downlink are the same amount of spectrum) but note that such an allocation would more closely match PSAs' demand profiles and could represent a more efficient use of spectrum.

[12] ACMA, October 2012, *Spectrum for public safety radiocommunications: Current ACMA initiatives and decisions*, p 12. Available from: http://www.acma.gov.au/webwr/radcomm/frequency_planning/radiofrequency_planning_topics/docs/spectrum_for_public_safety.pdf

[13] Gibson Quai AAS Consulting, November 2011, *Public Safety Mobile Broadband Demand Requirements*, p 12.

[14] *Public Safety Mobile Broadband Demand Requirements*, p 10.

2. Growth in Business-As-Usual Demand Profile

Jurisdictions have concerns about the adequacy of the ACMA's 800 MHz band decision to accommodate future growth in PSAs' business-as-usual demand profile. The data demand figures that the ACMA considered were estimates derived from data provided by PSAs in 2011 that projected forward their operational requirements for mobile broadband to 2020. After collecting this data Gibson Quai formed the view that, "PSAs are at the early stages of developing operational models and business plans that can leverage off the capabilities of mobile broadband services, particularly services such as video… Readers of this report should take into account that these projections of mobile broadband service requirements are very likely to evolve and change over time".[15]

2.1 Demand Profile Growth Factors

Jurisdictions consider that three factors will result in a greater PSA demand for business-as-usual mobile broadband. The first is the natural growth in the number of PSA units that will occur as Australia's population grows and demand for public safety services subsequently increase. Expectations of population growth are based on growth rates that have previously been observed. For example, in the 10 years to 30 June 2007 there was an average population annual growth rate in Australia of 1.3 per cent[16] while in the 2011-12 financial year, Australia's population increased by 1.6 per cent to approximately 22.68 million.[17] Based on assumptions around current demographic trends the Australian Bureau of Statistics projects that by 2026 Australia's population will increase to somewhere between 25.9 million and 28.7 million.[18] Jurisdictions consider that as the population increases it is reasonable to expect commensurate increases in community demands for public safety services.

The second factor that jurisdictions expect will increase PSAs' business-as-usual mobile broadband demand is the operational take-up of mobile data services by PSA units. As the Gibson Quai study noted "[t]he experience has often been that once new mobile data services become available in operational environments the demand increases rapidly and often significantly exceeds the original estimates of demand".[19]

The third factor that jurisdictions expect will increase PSAs' business-as-usual mobile broadband demand by 2020 is the likelihood that PSA mobile broadband applications and their associated uses will have evolved, at least in part, to a point that is not readily discernible today. The uncertainty in estimating mobile data demand requirements 7 years into the future can be illustrated by considering some aspects of the mobile data device landscape 7 years ago in 2006:

- smartphones had entered the market in 2000 but the iPhone was not released until 2007 and the rapid spread of smartphones did not occur until 2008; and
- the Kindle tablet was not released until 2007 and the rapid spread of tablet devices did not occur until 2010 when the first iPad entered the market.[20]

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[15] *Public Safety Mobile Broadband Demand Requirements*, p 2.
[16] Australian Bureau of Statistics, 4 September 2008, *3222.0 – Population Projections, Australia, 2006 to 2101*. Available from: http://www.abs.gov.au/Ausstats/abs@.nsf/mf/3222.0
[17] Australian Bureau of Statistics, 18 December 2012, *3101.0- Australian Demographic Statistics, Jun 2012*. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/mf/3101.0
[18] *3222.0 – Population Projections, Australia, 2006 to 2101*.
[19] *Public Safety Mobile Broadband Demand Requirements*, p 26.
[20] Ericsson, *The Unplug Story*. Available from: http://www.ericsson.com/unplug/our-story/

The introduction and uptake of these and other mobile data devices and applications has had a very significant impact on mobile data demand. Jurisdictions note that in 2011 the ACMA estimated that between 2007 and 2014 there would be a 30-fold increase in mobile broadband demand in Australia.[21] This increase is, at least in part, a result of developments whose effects could not be readily quantified in 2006.

Jurisdictions consider that PSAs' business-as-usual demand profile could increase at the same rate as the commercial sector. Even a modest sustained growth rate in data demand would impact on the adequacy of the ACMA's PSMB spectrum decision for PSAs' future needs. If, for example, PSAs' business-as-usual demand profiles increases by 5 per cent per annum, LTE technology advances are unlikely to keep pace with such growth year on year and further bandwidth allocation will be necessary.

2.2 International Comparisons

A recent Deloitte study[22] commissioned by Victoria (attached to this Submission) has surveyed PSMB decisions and studies across select countries in North America and Europe. The findings of this survey indicate that other countries have concluded that a 10 MHz spectrum allocation will not provide sufficient bandwidth for incidents that occur on a daily basis, and have allocated, or are considering allocating, greater amounts of spectrum accordingly.[23]

In the United States of America (USA) PSAs were initially allocated 10 MHz in the 700 MHz band, however, in February 2012 the United States Congress passed legislation increasing the total PSA spectrum allocation to 20 MHz.[24] Canadian PSAS are currently allocated 10 MHz of spectrum for PSMB purposes and the Canadian Government is currently considering a proposal to increase this allocation to 20 MHz.[25]

The European Conference of Postal and Telecommunications Administrations established a working group to investigate an allocation of spectrum for public protection and disaster relief mobile broadband. The working group undertook an analysis of typical scenarios faced by PSAs and concluded that a minimum of 15 MHz (7.5 MHz + 7.5 MHz) was required for everyday scenarios with at least 20MHz (10 MHz + 10 MHz) required for large-scale planned events.[26] A separate study commissioned by the German Federal Ministry of Economics and Technology concluded that, in the German context, a minimum of 15 MHz (uplink) and 10 MHz (downlink) would be required.[27]

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[21] ACMA, May 2011, *Towards 2020 – Future spectrum requirements for mobile broadband*, p 27. Available from: http://www.acma.gov.au/webwr/_assets/main/lib312084/ifc13_2011_toward_2020-future_spectrum_requirements.pdf

[22] Deloitte, February 2013, *Emergency Services Long Term Strategic Plan – International Public Safety Broadband.*

[23] *Emergency Services Long Term Strategic Plan – International Public Safety Broadband*, pp 3-5.

[24] *Emergency Services Long Term Strategic Plan – International Public Safety Broadband*, pp 3-5.

[25] Industry Canada, August 2012, *Gazette Notice SMSE-007-12*. Available from: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf10460.html

[26] Report from CG spectrum requirements, FM 49 Radio Spectrum for BB PPDR, October 2012 cited in *Emergency Services Long Term Strategic Plan – International Public Safety Broadband*, p 5.

[27] WIK-Consult, 2010, *PPDR Spectrum Harmonisation in Germany, Europe and Globally*, p 3. Available from: http://www.bmwi.de/English/Redaktion/Pdf/ppdr-spectrum-harmonisation-germany-europe-globally,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf

3. Frequency of 'Major Urban Incidents'

Jurisdictions' second key concern is that the ACMA's decision regarding the 800 MHz band is based on its assessment of adequate spectrum for business as usual and planned event demand profiles, but not a major urban incident scenario (e.g. terrorist attack in a CBD or natural disaster like the 2010-11 Queensland Floods).[28]

In part, the ACMA's policy decision is based on its assessment that "it would be highly economically inefficient to try and dimension spectrum provisions around what might be a once-in-a-generation event"[29] and that it was not considered "appropriate to provide high value spectrum for rare contingencies".[30] Jurisdictions disagree with the ACMA that a major urban incident "might be a once-in-a-generation event" and request that the ACMA revisit this assessment to take account of, and consider as further evidence the following:

- natural disasters;
- terrorist acts;
- security operations for international events; and
- small and medium-scale incidents.

Providing sufficient spectrum bandwidth to meet any (and all) mobile broadband demands that the capability may require, is not the realistic expectation of the jurisdictions. The PSMB demand models developed to date have been based on estimates of future needs and the resultant solution architectures are based around statistically averaged performance and service availability. Practically, 100 per cent availability and 0 (zero) per cent Grade of Service (congestion) are not rational service benchmarks, in the same way as providing *all* the spectrum that would be necessary to meet any possible demand. But it is the obligation of all Governments to deliver the levels of response required by PSAs for each scenario with sufficiently reliable support capabilities. Knowingly starting with less than 50 per cent of the necessary mobile broadband capacity in the field to support the most severe demand events/scenarios is an unacceptable proposal by the ACMA.

3.1 Natural Disasters

A recent Deloitte study[31] commissioned by Victoria (attached to this Submission) has analysed natural disasters in Australia and found that there is an increasing trend in both frequency and financial cost. This increasing trend is illustrated by the experience of Victoria, where 40 per cent of the natural disasters that have been reported since 1967 have occurred in the last 10 years.[32] Combined with events in other States and Territories, this indicates such "once-in-a-generation" events are likely to occur far more frequently. Experience also demonstrates that these events do occur in urban areas (e.g. 2011 Brisbane flooding and Perth Hills bushfires), where PSMB networks would provide support for responders.

The increasing occurrence of natural disasters was recognised by all Australian Governments in February 2011 when COAG endorsed the *National Strategy for Disaster Resilience*. This Strategy notes:

[28] ACMA 9 November 2012 Presentation to the PSMB Steering Committee – Slide 10.
[29] *Spectrum for public safety radiocommunications*, p 14.
[30] *Spectrum for public safety radiocommunications*, p 15.
[31] *Emergency Services Long Term Strategic Plan – International Public Safety Broadband*.
[32] *Emergency Services Long Term Strategic Plan – International Public Safety Broadband*, pp 7-8.

- "[T]he increasing regularity and severity of natural disasters", which includes "catastrophic bushfires, far reaching floods, and damaging storms".[33]
- "[T]hat disaster risks are likely to increase and magnify as our climate changes, our population grows and ages, and our society and economy become increasingly dependent on technology".[34]
- The increasing vulnerability of society to disasters.[35]
- The need to base emergency management planning on risk.[36]

More recently, the Prime Minister, commenting on the recent catastrophic fire and heatwave conditions experienced in January 2013 in five out of six Australian States, noted that "…[w]e do know over time that as a result of climate change we are going to see more extreme weather events and conditions".[37]

The increasing impact of natural disasters is also being observed. This is illustrated by the natural disasters that occurred in Australia between November 2010 and February 2011. During these disasters more than 99% of Queensland was disaster-declared, with 37 lives lost, while all other Australian States and the Northern Territory experienced severe weather events or other natural disasters, such as bushfires.[38] In Victoria, financial damage from the 2009-2011 period alone cost more than the sum of the total damages incurred over the preceding 40 years.[39]

The evidence of increasing frequency and severity of natural disasters appears to be at variance with the ACMA's assessment that demand profiles for such incidents should be excluded from 800 MHz band decisions as such events might only occur in major urban areas "once in a generation".[40] The ACMA's assessment is also inconsistent with the view of the Queensland Floods Commission of Inquiry, which regarded "as vital, the allocation of broadband spectrum to Australia's emergency services organisations, to avoid congestion on narrowband communications and to assist Australian emergency service organisations achieve interoperability, giving them the best means of communicating and co-operating".[41] It is noted that the Inquiry's identification of broadband spectrum as 'vital' for PSAs was in the context of a major emergency affecting major population centres and was not confined to business-as-usual or planned event scenarios.

3.2 Terrorism

The Australian Government has assessed that the threat of terrorism to Australia is a real and permanent feature of Australia's security environment.[42] Australian intelligence agencies have

[33] *National Strategy for Disaster Resilience*, p iv.
[34] *National Strategy for Disaster Resilience*, p 14.
[35] *National Strategy for Disaster Resilience*, p 1.
[36] *National Strategy for Disaster Resilience*, p 2.
[37] Taylor, R. 'Australia braces for "catastrophic" wildfire day', *Reuters*, 7 January 2013. Available from: http://www.reuters.com/article/2013/01/07/us-australia-wildfires-idUSBRE90502U20130107
[38] Australian Bureau of Statistics, 24 May 2012, *Article – The 2010-11 Summer of Natural Disasters*. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/1301.0Main+Features1952012
[39] *Historical Disaster Statistics – Insurance Council of Australia, 2012*
[40] *Spectrum for public safety radiocommunications*, p 14.
[41] *Queensland Floods Commission of Inquiry – Final Report*, March 2012, p 399. Available from: http://www.floodcommission.qld.gov.au/publications/final-report
[42] Australian Government, 2010, *Counter-Terrorism White Paper – Security Australia, Protecting Our Community*, p 7. Available from: http://www.dpmc.gov.au/publications/counter_terrorism/docs/counter-terrorism_white_paper.pdf

assessed that further terrorist attacks could occur at any time,[43] and the National Terrorism Public Alert System, which guides national preparation and planning, has been at 'MEDIUM – terrorist attack could occur' since its introduction in 2003.[44] The alert system that was in place prior to this had been at medium since 12 September 2001.[45]

The terrorism threat to Australia has been demonstrated by the charging and conviction of a number of individuals with terrorism offences. Between 2001 and 2010, 35 individuals were charged with terrorism offences in Australia and 20 individuals had been convicted by the end of that period. There have also been more than 40 Australians who have had their passports revoked or their applications denied for reasons related to terrorism.[46]

Publically available details of the terrorist threat Australia faces are outlined in several Australian Government documents, including the Australian Security and Intelligence Organisation's (ASIO's) 2011-12 Report to Parliament which states:

> "Australia is a terrorist target. The challenge of terrorism is real and persistent… Over the past decade, we have seen individuals involved in four significant terrorist plots in Australia convicted and jailed. Others have been disrupted at earlier points… Overseas influences, including through the internet, will continue to inspire some Australians to terrorism and drive their commitment".[47]

These assessments have recently been reaffirmed in the Australian Government's 2013 National Security Strategy where terrorism is identified as a persistent threat and a key national security risk.[48] In the Strategy the Prime Minister also emphasises that "there is no higher responsibility for a government than the security of the nation".[49]

Jurisdictions would also like to bring to the ACMA's attention a classified intelligence report that elaborates on the current and future domestic terrorist threat (particularly paragraphs 29-31). This document is classified SECRET and may be obtained by contacting ASIO or the Australia New Zealand Counter-Terrorism Committee (ANZCTC) Secretariat in the Department of the Prime Minister and Cabinet.

These long-standing national threat assessments have led to extensive funding by Australian Governments to develop and maintain a nation-wide counter-terrorism capability to respond to these threats. This funding has come from jurisdictions and the Commonwealth Government, including through the Special Fund administered by the Commonwealth Attorney-General's Department on the basis of advice of the multi-jurisdictional ANZCTC.

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[43] *Counter-Terrorism White Paper – Security Australia, Protecting Our Community*, p 7.
[44] Australian Government, 'National Terrorism Public Alert System', *National Security website*. Available from: http://www.nationalsecurity.gov.au/agd/WWW/NationalSecurity.nsf/Page/Information_for_Individuals_National_Security_Alert_System_National_Counter-Terrorism_Alert_System
[45] Council of Australian Government, 27 September 2005 Meeting Communique, p 1. Available from: http://archive.coag.gov.au/coag_meeting_outcomes/2005-09-27/index.cfm
[46] *Counter-Terrorism White Paper – Security Australia, Protecting Our Community*, p 7.
[47] Australian Security and Intelligence Organisation, 2012, *ASIO Report to Parliament 2011-12*, p 2. Available from: http://www.asio.gov.au/img/files/ASIO-Report-to-Parliament-2012-update.pdf
[48] Department of the Prime Minister and Cabinet, *Strong and Secure: A Strategy for Australia's National Security*, Australian Government, pp 10-11, 16. Available from: http://www.dpmc.gov.au/national_security/docs/national_security_strategy.pdf
[49] *Strong and Secure: A Strategy for Australia's National Security*, p ii.

This capability development and maintenance has led to sustained expenditure by all levels of government on counter-terrorism assets, including tactical response groups (TRGs) within jurisdictional police forces. The Commonwealth contribution to jurisdictional TRGs has recently included funding for the acquisition of Bearcat armoured vehicles which are expressly intended to give them the capability to assault a significant and heavily armed terrorist force. The scenarios in which a Bearcat would be used are likely to create a very high demand on available bandwidth. It seems inconsistent to evaluate the threat as justifying funding for a large-scale assault capability, while at the same time withholding the bandwidth that such an operation would likely require.

Similarly, all jurisdictions have invested heavily in establishing and maintaining State Crisis Centres to support the strategic management of major terrorist events. The Australian Government Crisis Coordination Centre (CCC) in Canberra was established to improve the Government's capability to assist in the response to large scale natural disasters or acts of terrorism. Operating from its temporary premises from September 2010, the CCC coordinated Australian Government assistance during the Queensland floods, Tropical Cyclone Yasi, the New Zealand earthquake and Victorian floods.

Australian Parliaments have also considered the likelihood of a terrorist attack to be sufficient to warrant enacting legislation that could, in the event of an attack, be used to grant extraordinary legal powers to responders.

These threat assessments by Australian intelligence agencies and the significance attached to investing in counter-terrorism capability development and maintenance by Australian Governments appears inconsistent with the ACMA's determination that it would be inappropriate to provide high value spectrum for such 'worst case' events.[50]

3.3 Security Operations for International Events

Jurisdictions further note that other security-related tasks can, and will, impose extremely high demands on mobile broadband. Major security operations, such as those for the 2011 Commonwealth Heads of Government Meeting (CHOGM) and the future G20 security operation, place greater demand on broadband services and it can be safely assumed that Australia will actively seek to host future engagements of this type. While it is possible to provide for such events through detailed planning and engagement with commercial carriers, a PSMB network would reduce the reliance upon commercial carriers to deploy additional infrastructure to meet demand and mitigate the associated operational risks (see sub-section 4.2.2).

[50] *Spectrum for public safety radiocommunications*, p 15.

3.4 Small and Medium-Scale Incident Demand Profiles

The ACMA's omission of the large-scale incident demand profile has also had another consequence that jurisdictions have serious concerns about - that by not considering large-scale incidents the demand profiles for both small and medium-scale incidents have also been effectively disregarded by the ACMA. The use of mobile broadband capabilities at small and medium, as well as at large, unplanned incidents is considered fundamental to the ability of PSAs to deliver improved services to the Australian community.

As the ACMA has noted, the large-scale incident demand profile represents the upper limit of PSA demand profile scenarios.[51] In considering the range of scenarios to examine, the PSMB Steering Committee agreed, at a meeting attended by ACMA officials, that additional scenario demand profiles would be unlikely to impact the findings as the existing scenarios already represented an adequate order of magnitude for the various demand profiles (i.e. a lower and upper limit). [52]

This, however, meant that once the large-scale incident scenario was omitted from the ACMA's consideration the demand profiles for small and medium-scale incidents also became effectively disregarded as the revised upper demand limit became those of the business-as-usual and planned event demand profiles. The demand profiles for small and medium-scale incidents are expected to exceed those of business-as-usual operations but to be less than those of large-scale incidents (i.e. a middle range). Additional data demand of planned events will be able to be more readily addressed through pre-deployment of COWS than is possible during emergencies. The omission of these demand profiles is of concern to jurisdictions as small and medium-scale incidents regularly occur - for example, PSAs respond to numerous small-scale emergencies each year.

Examining the demand profile of these small and medium-scale incidents is essential in considering the adequacy of the ACMA's decision as a greater allocation of spectrum may be able to meet PSAs needs in such circumstances. Jurisdictions note the finding of a 2011 Canadian PSMB study which concluded that, with spectral efficiency improvements, a 20 MHz allocation could be sufficient for PSAs' responses to small-scale incidents (which can include severe multi-vehicle accidents, train derailments, aircraft emergency landings etc.).[53]

Jurisdictions are aware that this Canadian finding was included in the Gibson Quai study, however Gibson Quai assessed that the assumption used in the Canadian study - that such incidents are localised events, and subsequently only one cell sector's capacity is available to support operations (with any overlap from the adjacent sector) - was overly pessimistic. Gibson Quai's view is that there would be at least 3 cells sectors providing coverage at a small-scale incident, and most likely more.[54] Jurisdictions disagree with Gibson Quai's assessment that at least 3 cell sectors would be available to support the response to small-scale incidents.

Jurisdictions consider it highly probable that for localised incidents (be they small, medium or large-scale) the primary PSA response could occur within a single cell sector. For example,

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[51] *Spectrum for public safety radiocommunications*, p 15.
[52] 21 October 2011, *Public Safety Mobile Broadband Steering Committee – 4th Meeting Summary Record*, p 3.
[53] Lucente, C. February 2011, *700 MHz Spectrum Requirements for Canadian Public Safety Interoperable Mobile Broadband Data Communications*, Defence R&D Canada – Centre for Security Science, pp 8, 39. Available from: http://www.citig.ca/Data/Sites/1/action700/700mhztechnicalassessmentofpsrequirementsv09final!public.pdf
[54] *Public Safety Mobile Broadband Demand Requirements*, p 22.

consider a 3 cell sector fixed network site with a radius of 3.65 kilometres (the cell radius used in the Gibson Quai study for **inner metropolitan** areas):[55,56]

- the total coverage area for the entire fixed cell site is approximately 41.85 square kilometres; and
- the coverage area for each of the 3 cell sectors is approximately 13.95 square kilometres.

These coverage area calculations increase for the 9 kilometre cell radius used by Gibson Quai to calculate the number of network sites required for **suburban** areas[57] with the coverage area for:

- the entire fixed cell site increasing to approximately 254.46 square kilometres; and
- each of the 3 cell sectors increasing to approximately 84.82 square kilometres.

It seems entirely probable to jurisdictions that localised emergency incidents (of any scale) might occur within a single cell sector. For example, there are a number of incidents where it is expected that the primary PSA response would occur within an area of one square kilometre or less (e.g. structural fire, building or bridge collapse, hostage siege, severe multi-vehicle accident, train accidents etc.). It appears to jurisdictions that it is more likely that such incidents would occur within a single cell sector than be spread across 2, 3 or even more sectors and that the operational assumption used in the Canadian study is correct. The operational effects of this on PSAs are further outlined in Sub-Section 4.1 Mitigation Option 1: 'Densification' of fixed infrastructure.

4. Proposed Mitigation Options

The ACMA has advised jurisdictions that in making spectrum allocation decisions it takes an evidence-based approach from an economy-wide perspective.[58] The ACMA has also identified four mitigation options it contends could, alongside a fixed network, provide PSAs with sufficient data capacity during a major urban incident:

1. 'Densification' of fixed infrastructure
2. Commercial carrier overflow
3. Use of transportable infrastructure
4. *Radiocommunications Act 1992* (Cth) provisions

This part of the paper outlines jurisdictions' concerns about technical and operational viability of the proposed mitigation options and the financial implications of the ACMA's decision. Jurisdictions request that the ACMA inform the PSMB Steering Committee of the evidence that has convinced it that these mitigation options "are likely to be more effective in practice"[59] (not efficient) than allocating additional 800 MHz band spectrum to PSAs.

[55] Gibson Quai AAS Consulting, November 2011, *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 77.
[56] Noting, as advised by the ACMA, that the Gibson Quai study rounded the 3.65 kilometre figure up to 4 kilometres. ACMA 9 November 2012 Presentation to the PSMB Steering Committee – Slide 15.
[57] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 77.
[58] ACMA 9 November 2012 Presentation to the PSMB Steering Committee – Slide 6.
[59] *Spectrum for public safety radiocommunications*, p 14.

4.1 Mitigation Option 1: 'Densification' of fixed infrastructure

The ACMA has advised PSAs that, to ensure the data capacity required to support operations on a 10 MHz spectrum allocation, owners need to increase the density of their fixed network sites and that there needs to be a balance between the size of spectrum allocations and infrastructure investments.[60] This position of the ACMA towards infrastructure density is consistent with its advice to industry that it expects commercial carriers to increase infrastructure deployments in order to ease the pressure on spectrum.[61]

4.1.1 Operational Analysis

Across the same coverage area, increasing fixed infrastructure density with a 10 MHz allocation can result in a comparable total data capacity as a greater allocation (e.g., in comparison to a 20 MHz allocation, through the doubling of network sites). However, multiple PSA responders at the point of operational need in a specific cell (or part of the cell) will not necessarily have access to the equivalent level of data capacity as they would with a greater spectrum allocation (see Figure 1 below for an example).

The Gibson Quai spectrum calculations across all demand profiles (business as usual, planned event, regional large-scale incidents and inner metropolitan large-scale incidents) assumed that PSA responders and demand were evenly distributed across the coverage area.[62] This assumption diverges with the operational experiences of PSAs that indicate responders more commonly operate in a cluster, or series of clusters, around the most critical point(s) of response. Gibson Quai noted that where there is an uneven demand distribution (e.g. through units being clustered together), a greater data demand peak than that used in the calculations can result.[63]

For example, during mission-critical operations where PSAs' primary response is concentrated around a relatively small area (e.g. within one square kilometre around a large structural fire, building or bridge collapse, hostage siege, major motor vehicle crash, train crash etc.) a greater allocation of spectrum is likely to better meet PSAs' operational needs, *even if infrastructure density has been increased*. For example, to achieve the equivalent total data capacity as a 20 MHz network site, two 10 MHz sites covering the same area would be required. This would however, mean that the total data capacity is divided between 6, as opposed to 3, cell sectors, which reduces the amount of data accessible by responders at any given point. From a PSMB network perspective the clustering of responders around the incident site may well occur within a single cell sector - if this does occur responders could have immediate access to only 50 per cent of the data capacity with a 10 MHz network compared to a 20 MHz network (this is illustrated in Figure 1).

The ACMA has recognised that responding to such localised incidents may require significantly more capacity than a 10 MHz network would provide and identified that deploying 4.9 GHz 'MESH' devices as well as transportable infrastructure Cells on Wheels (COWs) could provide PSAs with the necessary additional capacity when and where they need it.[64] Jurisdictions' operational concerns with this approach are outlined in Sub-Section 4.3 Mitigation Option 3: Use of Transportable Infrastructure.

[60] *Spectrum for public safety radiocommunications*, p 17.
[61] *Towards 2020 – Future spectrum requirements for mobile broadband*, pp 2, 12.
[62] *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 38.
[63] *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 38.
[64] *Spectrum for public safety radiocommunications*, pp 11-12.

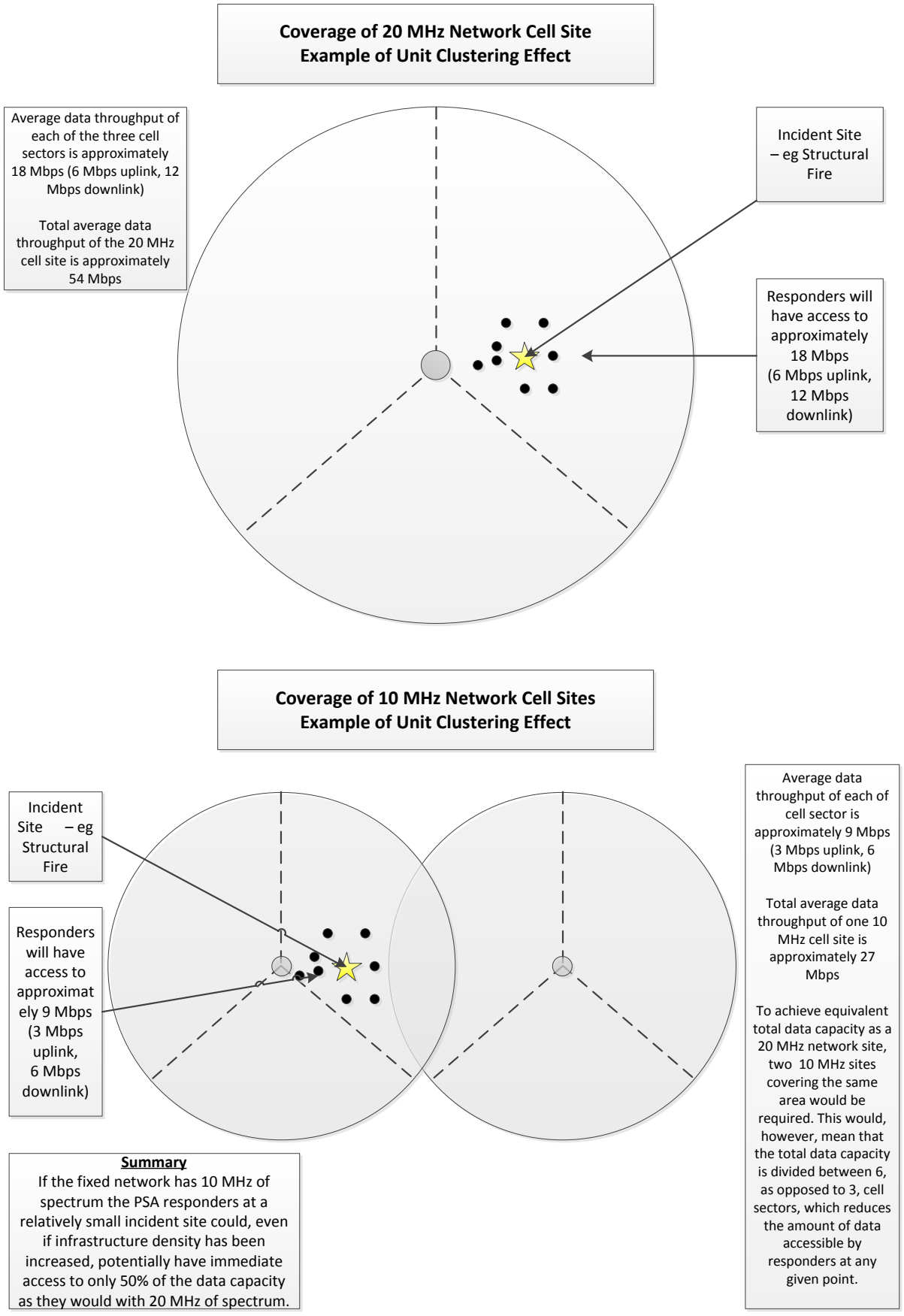

Figure 1. Example of Unit Clustering Effect – 20 MHz versus 10 MHz Networks.[65]

[65] Average cell sector data throughput figures are from Motorola's 4 September 2012 Long-Term Evolution Technology Demonstration Presentation in Perth.

Providing PSAs with a greater amount of 800 MHz band spectrum could, even if infrastructure density has increased, provide PSAs with more immediate capacity at a localised incident site than a 10 MHz network. This is critical to PSAs as the consequences of these likely incidents could be major or catastrophic (loss of life, injuries etc.). Even if additional capacity were still required in such incidents, a greater allocation of spectrum could better support PSAs' operational responses during the critical time period it would take to deploy COWs to provide that additional capacity.

4.1.2 Financial Analysis

There is a cost trade-off in designing, building and operating a PSMB 10 MHz spectrum network in comparison to a network operating on a greater allocation of spectrum.

The ACMA advised the PSMB Steering Committee that it did not expect there would/should be an increase in network costs between a 10 MHz and 20 MHz allocation.[66] This is despite the evidence provided in the PSMB National Implementation Plan by Western Australia that estimated an increase in both capital and operating costs to provide, in the greater CBD area only, comparable total data capacity through a 10 MHz network rather than a 20 MHz network.[67]

Indicative Cost Estimates - 10 MHz versus 20 MHz Networks

To illustrate the cost trade-off that jurisdictions would incur if required to develop PSMB networks on only 10 MHz of spectrum, indicative cost differentials for select jurisdictions are outlined below. Table 1 shows as a percentage the estimated increase in financial costs for a 10 MHz network in comparison with a 20 MHz network. It should be noted that these indicative cost differentials are subject to refinement following further planning and analysis and do not represent a funding commitment by jurisdictions. They also do not take into consideration any costs associated with spectrum, design, training or project management.

Jurisdiction	**Indicative Cost Differentials over 15 Years (Increase in costs for a 10 MHz network in comparison with a 20 MHz network)**
Australian Capital Territory	40% – 50%
New South Wales	23%
Queensland	25% – 50%
Western Australia	20%

Table 1. Select Jurisdictions' Indicative Cost Differentials - Increase in costs for a 10 MHz network in comparison with a 20 MHz network.

It should be noted that the indicative cost differentials for a 10 MHz network do not necessarily assume jurisdictions attaining an equivalent data capacity throughout the entire coverage area as a 20 MHz network. To achieve an equivalent data capacity the number of network sites

[66] 9 November 2012, *Public Safety Mobile Broadband Steering Committee – 13th Meeting Summary Record*, p 3.
[67] Western Australian Annexure to the PSMB Steering Committee, October 2012, *Public Safety Mobile Broadband National Implementation Plan*.

would have to be approximately doubled and additional costs could be greater (e.g. for New South Wales, costs are estimated to increase by 51 per cent).[68]

Where the indicative cost differentials do not involve attaining equivalent data capacity throughout the entire coverage area, the differential reflects a greater density of infrastructure only in those areas where regular higher usage is expected to occur (e.g. for Western Australia, the estimate assumes increased infrastructure density only in the greater CBD area). This approach, while reducing additional financial costs, increases the level of risk that:

- within these areas of regular higher usage responders will have less immediate data capacity at the point of operational need (see Sub-Section 4.1.1); and
- outside of these areas of regular higher usage responders will have less immediate data capacity which could:
    - affect PSAs' responses to small, medium and large-scale emergencies that occur in these areas (e.g. bushfires and flooding); and
    - restrict PSAs' ability to accommodate growth in business-as-usual demand requirements (see Section 2 – Growth in Business-As-Usual Demand Profile).

These risks may be able to be partly mitigated by overflow arrangements with commercial carriers (noting there are further risks associated with this, see Sub-Section 4.2 - Mitigation Option 2: Commercial Carrier Overflow). However, jurisdictions note that this would likely increase the frequency with which PSAs need to access commercial networks, which would subsequently result in jurisdictions incurring higher recurrent commercial overflow costs than on a network utilising a greater allocation of spectrum.

Antennae Height Variation

In its technical analysis of the PSMB spectrum requirements, the ACMA considered that the antennae height assumption used in the Gibson Quai study for fixed network sites was not representative of that used by cellular networks and that a spectrum recalculation based on a more likely height figure had an impact on the spectrum requirement.[69]

Gibson Quai assumed an antenna height of 80 metres above the surrounding ground level. By lowering the antennae the cell radius reduces significantly and additional cell sites are required to cover a given region while increasing total data capacity (assuming the same spectrum allocation).[70]

To assess the financial implications of reducing the antennae height New South Wales commissioned UXC Consulting (formerly Gibson Quai) to conduct an analysis of the impact this would have on infrastructure density. UXC recalculated the number of network sites that would be required to provide coverage to the same geographical area (containing 80 per cent of the New South Wales population) based on antennae height variations of 80, 40 and 20 metres. UXC estimated significant increases in New South Wales PSMB costs, ranging from 72 per cent to 364 per cent.[71]

[68] UXC Consulting, November 2012, *PSMB Spectrum Impact Analysis NSW Telecommunications Authority*, p 6.
[69] *Spectrum for public safety radiocommunications*, p 16.
[70] *PSMB Spectrum Impact Analysis NSW Telecommunications Authority*, p 4.
[71] *PSMB Spectrum Impact Analysis NSW Telecommunications Authority*, p 5.

Conclusion

Jurisdictions recognise that the ACMA's position towards PSMB infrastructure density is consistent with its advice to industry that it expects commercial carriers to increase infrastructure deployments in order to ease the pressure on spectrum.[72]

Jurisdictions consider that an approach requiring greater infrastructure density is suitable for market-oriented organisations, such as commercial carriers, which generate financial profits from their use of the spectrum that can be reinvested in additional infrastructure, and whose networks are designed for average usage throughout the network. Jurisdictions do not, however, consider that this approach is suitable for PSAs, which are focused on providing public services in order to protect lives and property, and require networks designed for peak usage in concentrated areas with a critical Grade of Service that exceeds that of commercial entities. PSAs do not generate profits that can be reinvested in additional infrastructure. Any additional investment would need to come from State and Territory Governments and would involve diverting investment away from other community services that also produce a public benefit.

As indicated above, the total additional infrastructure investment required by States and Territories is likely to be substantially more than the commercial value of the additional spectrum indicated by the Commonwealth. It would also represent a significant cost shift from the Commonwealth to the States and Territories.

Jurisdictions appreciate that in making spectrum management decisions the ACMA seeks to balance the cost of deploying additional infrastructure against the *overall* value of spectrum[73] (i.e. not only assessing additional deployment costs against the commercial value of the spectrum). Jurisdictions request that the ACMA factors into its consideration of the overall value of spectrum the opportunity costs of additional State and Territory Government investments required to build and operate PSMB networks with a lower spectrum allocation - investments that would not provide PSAs with the same level of operational support as a higher allocation of spectrum, and would otherwise be used to fund other community services that produce public benefits.

4.2 Mitigation Option 2: Commercial Carrier Overflow

Another mitigation option the ACMA has identified to provide PSAs with additional data capacity during a major urban incident is the establishment of overflow arrangements with commercial carriers.[74] Jurisdictions agree that arrangements with commercial carriers will form part of a PSMB capability and note this has been accepted throughout the work of the PSMB Steering Committee. Jurisdictions do not, however, consider that overflow arrangements with carriers replace the need for an adequate provision of dedicated 800 MHz band spectrum.

Jurisdictions have significant concerns about the effectiveness of overflow arrangements in providing responders with a significant portion of the additional mission-critical data capacity that would be needed during a major urban incident. These reservations were noted in the PSMB National Implementation Plan, endorsed by SCPEM and treated as evidence by the ACMA in its PSMB decision making process,[75] which identified that commercial "networks are known to

[72] *Towards 2020 – Future spectrum requirements for mobile broadband*, pp 2, 12.
[73] *Spectrum for public safety radiocommunications*, p 17.
[74] *Spectrum for public safety radiocommunications*, p 14.
[75] *Spectrum for public safety radiocommunications*, p 14.

present issues when congested or otherwise under duress such as… during emergency situations".[76]
Jurisdictions' concerns are also supported by the Gibson Quai study which found that "[p]ublic [s]afety requirements for mobile broadband do not map well onto the existing mobile broadband commercial service best effort offerings, whilst at the same time require access to at least the same capability of a commercial network user. Specifically PSAs have a need to allow for well-defined service levels which are expected to provide a level of availability, robustness and consistency of performance that is keeping with critical nature [sic] of public safety operations".[77]

4.2.1 Technical Analysis

The ability to roam or overflow onto a commercial network(s) is recognised by jurisdictions as a mitigation option but with caveats and noting that it requires significant detailed planning. It also requires cooperation amongst stakeholders to be of significant utility to PSAs, as the rich ecosystem of frequency bands and standards does not assure the ability of a PSA device to roam from a PSA network onto a commercial network(s) in times of need.

Among the three major commercial carriers which provide mobile broadband services in Australia, each has access to a number of frequency bands and standards to deploy their networks. For example, currently the carriers operate their mobile telephone networks on the frequency bands below (noting that in the future the 700 MHz and 2500 MHz LTE bands will also become available):

Network Type	Band	Carriers	Notes
2G GSM + GPRS	900 MHz	Optus Telstra Vodafone	Main frequency for Australian GSM (2G) mobile carriers
	1800 MHz	Optus Telstra Vodafone	Supplementary frequency for Australian GSM (2G) mobile carriers
3G (UMTS) WCDMA + HSDPA	850 MHz	Telstra Vodafone	Used for Telstra's NextG 3G network Used mainly for Vodafone USB modems
	900 MHz	Optus Vodafone	Used by Optus (Yes G) and Vodafone 3G networks in rural areas
	2100 MHz	Optus Telstra Vodafone	The standard 3G frequency for Optus, Vodafone and Telstra's non-NextG services
4G LTE	1800 MHz	Optus Telstra	Presently used only for 4G data devices

Table 2. Australian commercial carriers' frequency bands for mobile telephone services.[78]

Whilst there appears to be a high level of harmonisation between frequency bands and standards, the varying combinations worldwide present device manufacturers with unprecedented challenges to deliver seamlessly workable and affordable devices. Figure 2

[76] *Public Safety Mobile Broadband National Implementation Plan*, p 5.
[77] *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 5.
[78] Access Communications Pty Ltd, *Australian Mobile Telephone Networks*. Available from: http://www.accesscomms.com.au/reference/mobnet.htm

outlines some of the radiofrequency bands in which mobile telephone services are provided globally. It is noted that in Australia the following radiofrequency bands are also, or are planned to be, utilised:

- GSM900
- GSM1800
- LTE700
- LTE1800

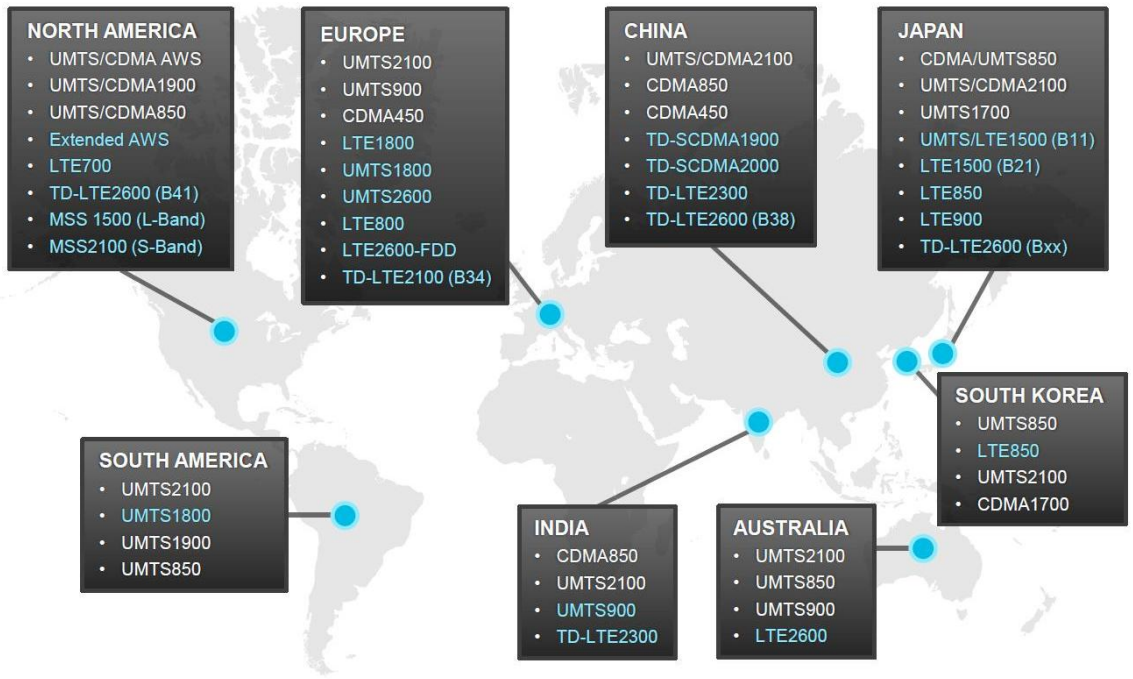

Figure 2. Global Radiofrequency Bands.[79]

The technical success of this mitigation option is heavily dependent upon the availability of devices with chipsets compatible with PSAs' networks (800 MHz and 4.9 GHz bands) and commercial network infrastructure in the geographic location where the roaming is to take place. Jurisdictions have been advised that currently one chipset vendor can provide seven different radio access modes within one device on a single chip layer which significantly reduces cost, whereas other vendors require multiple chips, increasing cost and complexity while reducing reliability.

Jurisdictions note that the diverse range of radiofrequency bands used globally by commercial carriers and the relatively small Australian PSA market leads to uncertainty about whether jurisdictions will be able to procure suitably compatible devices from vendors and, if such devices are available, whether they will be able to obtained at costs that leverage economies of scale.

[79] Qualcomm Inc. Presentation at the 2011 Industry Analyst Summit in Istanbul, Turkey.
Available from: http://www.qualcomm.com/media/documents/files/emea-summit-modem-leadership.pdf

4.2.2 Operational Analysis

The first few hours of a mission-critical operational response are generally considered by PSAs to be the most important period in which to save lives and property. For responses to major urban incidents, the initial PSMB capability that responders would be reliant on would be the fixed PSMB network and any overflow arrangements with commercial carriers.[80]

Availability

The availability of commercial networks during emergencies is a significant risk for PSAs. There is a demonstrated history of carrier networks failing during emergencies due to direct (e.g. fire, flood) and indirect (e.g. power outages) impacts. For example, during the 2010-11 Queensland Floods commercial carriers' network sites were disrupted in many locations. Power outages were the cause of many of these disruptions.[81] Again in 2013, damage to infrastructure caused by the Queensland flood events resulted in significant disruptions to commercial networks[82,83] with a Member of Federal Parliament noting "*…the on-off collapse of the entire telco system throughout north-eastern Australia during what was a relatively contained natural disaster, with Gladstone to Cairns to Mount Isa having only intermittent triple-0 emergency service over 24 hours, and leaving internet reliant services…inaccessible*".[84]

Another recent example is from the USA during Hurricane Sandy in October 2012 where 25 per cent of commercial cell sites across 10 states were estimated to have been disabled for multiple reasons, including downed towers, widespread electrical outages, drained backup batteries and flooded generators.[85]

The fragility of commercial networks is contrasted to the comparatively greater reliability, robustness and resilience of a PSA network. This was demonstrated during the June 2012 extreme storm event in Perth, during which power outages caused disruptions to a large number of carrier network sites in some areas for up to three days, while the Western Australia Police low-speed data network was able to be sustained through greater system resilience augmented with battery-backed power systems, real-time system monitoring and deployment of maintenance staff with transportable generators as needs dictated. This meant that support for police operations was able to continue throughout. Recognition of the need for reliable and robust radiocommunications support for PSAs' mission-critical operations has also underpinned jurisdictions' investments in independent PSA voice radio networks which are built to a higher standard of resilience and redundancy than those of commercial networks, and with appropriate support mechanisms.

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[80] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 35.
[81] *Queensland Floods Commission of Inquiry – Interim Report*, August 2011, p 222. Available from: http://www.floodcommission.qld.gov.au/publications/interim-report
[82] Telstra, '31 Jan update: Communication impacts due to flooding in Queensland', *Media Release*, 31 January 2013. Available from: http://www.telstra.com.au/abouttelstra/media-centre/announcements/31-jan-update-communication-impacts-due-to-flooding-in-queensland.xml
[83] Lui, S., 'Telcos battle Queensland floods', *ZDNet*, 28 January 2013. Available from: http://www.zdnet.com/au/telcos-battle-queensland-flood-7000010394/
[84] House of Representatives Hansard, Tuesday 5 February 2013, p 10 (The Hon Bob Katter, Member for Kennedy).
[85] Parker, T., 'Hurricane Sandy exposed flaw in public-safety LTE plan', *Fierce Broadband Wireless*, 10 December 2012. Available from: http://www.fiercebroadbandwireless.com/story/hurricane-sandy-exposed-flaw-public-safety-lte-plan/2012-12-10#top_select

Priority Access and Quality of Service

Even when commercial networks remain functional during emergencies they are very likely to experience greater than usual usage from customers. This can result in network congestion, posing additional risks for responders' access to these networks at such times. This was demonstrated during the March 2010 extreme storm event in Perth when a PSA, which was solely dependent on arrangements with commercial carriers for its mobile data communications capability, was unable to access the commercial networks due to network congestion.

Entering into priority access arrangements with commercial carriers is expected to allow responders to access commercial networks during times of congestion (which would not be limited to emergencies but also planned events such as New Year's Eve and Australia Day celebrations). In their technical study Gibson Quai assumed that priority access and quality of service arrangements with carrier were included in all PSMB delivery models.[86]

Jurisdictions' concern is that there is currently a large degree of uncertainty that entering into such arrangements with commercial carriers is possible. Jurisdictions' understanding is that PSAs in the USA have been unable to reach agreement with carriers on priority access arrangements, primarily due to carriers' concerns about their exposure to legal liability claims from other customers who would need to be deprioritised. The Gibson Quai study noted that legal issues like this could also arise in the Australian context.[87]

Network Management and Carrier Capacity

If priority overflow of mission-critical and operational PSA traffic onto commercial carrier networks were possible, the Gibson Quai study identified that it would "need to be managed, prioritised and rationed by the PSAs as the carriers may also have insufficient capability at any point in location or time".[88] To make most effective use of the carrier data capacity, PSAs would need to have the ability to manage and control responders' use of the commercial networks in a similar way as they would be able to on the PSA network. Other issues to be considered include the need for processes to enable the seamless transfer or handoff of data communications between PSAs and carrier networks, including security and encryption. Like priority access and quality of service arrangements, the likelihood of being able to reach agreement with carriers regarding network management is currently uncertain.

The need for such network management is driven by the likelihood that commercial networks, designed for average usage throughout the network, may not have sufficient capacity to provide responders with enough additional data capacity to accommodate PSAs' needs during peak usage in concentrated areas. Jurisdictions also note that commercial networks are designed for larger download capacity, which is contrary to the PSA operational models where the upload demand has been found to be greater.[89]

Conclusion

Jurisdictions hope that suitable and reasonable arrangements with commercial carriers (e.g. public interest charges) are able to be entered into so that the PSMB capability is enhanced.

[86] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 7.
[87] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 46.
[88] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 50.
[89] *Public Safety Mobile Broadband Demand Requirements*, p 12.

Jurisdictions note that Telstra has expressed interest in reaching priority access arrangements with Australian PSAs, but consider that this should not be considered as evidence that suitable arrangements will eventuate, as negotiations have yet to commence and some of the elements of Telstra's proposed approach may not be possible (e.g. access by Telstra's public customers to public safety spectrum when not required by PSAs).[90] The suitability of Australian carriers' networks for mission-critical public safety data communications has also not been proven. Jurisdictions note that reporting from the USA indicates that some carriers have acknowledged that their networks are not up to the standard required for mission-critical public safety operations and would be suitable only for lower-priority usage.[91]

To reduce the level of risk associated with commercial overflow arrangements, jurisdictions' preference is that a regulatory framework underpins any priority access, quality of service and network management arrangements with commercial carriers. Jurisdictions note, however, that this would not mitigate the risks associated with carrier network availability. Jurisdictions consider that these risks need to be managed by reducing the level of PSAs' dependency on commercial networks through the reservation of additional 800 MHz band spectrum for public safety use.

4.3 Mitigation Option 3 – Use of Transportable Infrastructure to Increase Data Capacity in Localised High-Demand Areas

The ACMA has identified the use of COWs as one of the mitigation options PSAs can use to adequately increase their data capacity in localised high-demand areas (e.g. major urban incidents, planned events etc.)

Jurisdictions note that a 10 MHz network would lead to a greater reliance on COWs for two reasons:

1. the data capacity available to PSAs from the fixed network at localised incident sites could be significantly less (see Sub-Section 4.1) and would likely require more frequent use of COWs in PSAs' operations; and
2. the number of COWs required to provide adequate supplementary data capacity at incident sites would likely be greater as a 10 MHz COW would have less capacity than a COW that can utilise more spectrum (e.g. a 10 MHz COW would have approximately half the capacity of a 20 MHz COW).

4.3.1 Technical Analysis

The operational application of 4.9 GHz solutions to supplement public safety mobile broadband capacity is highly constrained by the following factors:

- limited coverage range - if the site antenna is not directly visible, the likelihood of maintaining a reliable connection is low;[92]
- multipath performance and high particle environments (smoke) put reliability of 4.9 GHz propagation at risk in the vicinity of the incident;

[90] Telstra, November 2012, *Delivering 4G/LTE Mobile Broadband for Emergency Services*, p 10. Available from: http://www.telstra.com.au/business-enterprise/download/document/business-4g-lte-mobile-broadband-emergency-services.pdf

[91] Seybold, A., 'Partnerships and Public Safety Broadband', *Public Safety Advocate*, 2 November 2011. Available from: http://andrewseybold.com/2745-partnerships-and-public-safety-broadband

[92] Parker Fire Protection District, April 2006, Colorado 4.9GHz Project, p 1. Available from: http://people.cs.clemson.edu/~jmarty/projects/PublicSafety/Colorado49GHzProject.pdf

- current 4.9 GHz product does not support LTE technology; and
- no seamless and secure integration references between WiFi (4.9 GHz) and public safety LTE (800 MHz) exist today.

Transportable cell solutions require access to a viable and consistent transmission solution throughout the proposed deployment area/region. While fixed cell-sites can be implemented with (very) high capacity fibre optic or microwave transmission, a transportable solution would be either limited to the capacity of "commercial grade" (relay) urban solutions, or pre-deployment of a wide area Multipoint Distribution System. Access to a dedicated and suitable wideband spectrum allocation to facilitate transportable deployments may require 4.9 GHz spectrum to be provided for transmission and not the terminal air-link.

4.3.2 Operational Analysis

The Gibson Quai study noted that the use of COWs raises a number of operational issues and risks for PSAs.[93] In the context of unplanned events the initial PSMB capability available to responders would come from the fixed PSMB network and PSA priority access arrangements with commercial carriers[94] (if such arrangements are able to be established and the commercial network(s) is available in the circumstances).

The operational risk of utilising COWs in unplanned event scenarios relates to the time it takes to deploy them. This issue was identified by Gibson Quai as needing to be taken into account in considering a PSA spectrum allocation.[95]

Increased reliance on COWs is of considerable concern to jurisdictions as the time taken to deploy them to incident sites would overlap with the first few hours of an incident. These first few hours are generally considered by PSAs to be the most important period of a mission-critical operational response. Lack of sufficient data capacity during this period is likely to magnify operational risks and would lead to an increased level of risk that lives will be lost and property damaged.

Even if PSAs apply a range of measures to minimise the time for COW deployment there would still be uncertainty about their availability to support responders in the critical period. Once a decision is made to deploy a COW(s) there are a number of factors that will impact on deployment time - including the time it takes to transport, select a suitable location, establish backhaul connections, and test and commission. This is assuming that the COW is even able to access the incident area which, depending on the nature of the incident, is not guaranteed, and that backhaul can be established. Microwave backhaul requires line of sight which may be difficult to effect due to buildings and land formation.

The short-range coverage of COWs can also be of operational concern when the incident itself does not occur in a static location but is dynamic and moves over a wider geographical area (e.g. bushfires or floods).[96] In such circumstances it is possible that COWs will have to be repositioned (in some cases more than once) to provide responders with supplementary capacity where they need it. The time it would take to redeploy COWs, and possibly re-establish

[93] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 8.
[94] *Public Safety Mobile Broadband Delivery Models (Project 2)*, p 35.
[95] *Public Safety Mobile Broadband Spectrum Quantum Calculation*, p 46.
[96] Floods and bushfires can occur in the areas proposed for PSMB network coverage - e.g. The 2010-11 Queensland Floods occurred in metropolitan areas and the 2011 Perth Hills Bushfires occurred within the proposed Western Australian PSMB network coverage area.

backhaul connections, would further restrict the reliability of their coverage and reduce their accessibility by responders.

These collective concerns were expressed by the City of New York in 2010:

> "Public safety emergencies occur in all areas, not merely in pre-defined or anticipated locations. Time is of the essence when lives are at stake. It is far more desirable for public safety first responders to have a wireless network in place that provides adequate broadband coverage in all locations than to call in a special unit to deploy an ad-hoc network. Incidents that unfold quickly or change locations further underscore the need for ubiquitous broadband network coverage rather than relying on ad-hoc networks to be set up and broken down repeatedly. Fixed wireless network assets are a much more permanent, reliable and effective solution for public safety".[97]

These concerns have contributed to jurisdictions' preference for a greater allocation of 800 MHz band spectrum, based on an assessment that there would be a lower level of operational risk in comparison to a 10 MHz allocation as:

- in the time taken to deploy or redeploy COWs responders would have access to more data capacity per fixed cell sector (see Sub-Section 4.1 Mitigation Option 1: 'Densification' of fixed infrastructure); and
- when COWs are utilised the data capacity per COW would be greater which could reduce the number required for an incident. By decreasing the number of COWs the level of logistical risk associated with deploying additional infrastructure is expected to be reduced (e.g. not having to identify as many suitable locations, establish more backhaul connections, undertake as much testing etc.).

4.4 Mitigation Option 3: Use of Radiocommunications Act 1992 (Cth) Provisions

The ACMA has suggested that additional spectrum could be made available to meet the needs of public safety agencies in extreme circumstances through provisions in the *Radiocommunications Act 1992* (Cth) that would allow the ACMA to authorise PSAs to operate concurrently in other licensees' spectrum (section 27); or to clear other licensees from areas of spectrum and give PSAs access to the cleared spectrum (Part 4.4).

4.4.1 Technical Analysis

The ACMA has stated that Part 4.4 provisions have never been utilised. To date, the need to make use of this provision in the legislation for voice communications has not been necessary as there have been sufficient resources to satisfy demand. With growing need for spectrum, this may change.

Regardless of the provision within the Act, without a determination from the Commonwealth on the technical parameters defining the use of the additional spectrum, it is impossible to implement any strategy to use it. In addition, without a determination, compatible equipment that would enable immediate use of the additional spectrum cannot be purchased nor deployed by jurisdictions.

[97] City of New York, February 2010, *700 MHz Broadband Public Safety Applications and Spectrum Requirements*, p 12. Available from: http://andrewseybold.com/wp-content/uploads/2010/03/700MHz-Whitepaper-on-Spectrum-Feb-2010-FINAL.pdf

4.4.2 Operational Analysis

In the State and Territory Technical Experts Meeting convened by the ACMA on 19 November 2012, the ACMA indicated that the section 27 provisions have been used in Australian Defence Force (ADF) war game exercises. It would be useful to test these provisions in an emergency management context, although jurisdictions note that ADF exercises, with their significant preparatory lead time, are similar to PSAs' preparations for large-planned events rather than sudden-onset major urban incidents.

Part 4.4 of the Act provides for exclusive access to additional spectrum in extreme circumstances through the Governor-General declaring a period of emergency and the Minister subsequently making and publishing a restrictive order regulating the use or operation of communications equipment in a specified area. The Minister can only make a restrictive order if it complies with guidelines on restrictive orders that are in force[98] (jurisdictions understand that no such guidelines are currently in place). Further, the order cannot come into force before the date/s of publication in the *Gazette* of the Governor-General's declaration and the Minister's order.[99] The operation of these provisions is untested and it seems highly unlikely that they could be used to enable time-critical surge capacity in an emergency, due to the length of time required firstly for decision-making, approval and publication processes, and secondly to give effect to the decision (i.e. clearance of spectrum for PSA use).

This gives rise to the same operational time-delay issues as deploying COWs - that data surge capacity is likely to be unavailable during the time it is most needed. Given the untested and unproven utility of these provisions, assumptions about their operational effectiveness should not be relied upon as evidence in the evaluation of the adequacy of public safety spectrum decisions.

5. Conclusion

Jurisdictions consider that the policy, technical, operational and financial concerns outlined in this submission are sufficient to warrant the ACMA's reconsideration of the size of its 800 MHz band in-principle reservation for PSAs.

Jurisdictions request that the ACMA engages with jurisdictions to assess the option of making an additional allocation of 800 MHz band spectrum for public safety purposes. As part of the proposed assessment, jurisdictions ask that the ACMA factors jurisdictions' concerns into its calculation of the overall value of any additional spectrum, including the:

- higher level of operational risks PSAs would be exposed to in mission-critical operations with a lower spectrum allocation and the subsequent impact this could have on achieving better public safety outcomes;
- opportunity costs of additional investments by State and Territory Governments in building and operating PSMB networks with a lower spectrum allocation - investments that would otherwise be used to fund other community services that produce a public benefit; and
- high-value whole-of-community benefit of using spectrum for public safety purposes – a high value reflected in the expectation the Australian community has that PSAs will have the resources they need to effectively conduct business-as-usual and emergency public safety operations.

[98] *Radiocommunications Act 1992* (Cth) sections 219, 222 and 230.
[99] *Radiocommunications Act 1992* (Cth) sections 219 and 222.

Deloitte.

Emergency Services Long Term Strategic Plan

International Public Safety Broadband

26 February 2013

Introduction

Australian public safety agencies (PSAs) primarily rely on narrowband (voice and data) communications, delivered through dedicated Land Mobile Radio (LMR) networks, to meet their business-as-usual (BAU) and emergency operational needs. Mobile broadband data capabilities, delivered through commercial carrier networks, are used sparingly in formal BAU activities.

PSAs have identified a growing need for access to mobile broadband data capacity in order to exploit new and powerful capabilities that have been enabled by the rapid evolution of communication and data technology. High speed mobile broadband data capabilities have the potential to significantly enhance a wide range of operational functions, such as, more timely assessment of incidents, more effective command, control and co-ordination activities, faster and more appropriate response to incidents, and do this with more productive use of resources and improved personnel safety.

In October 2012, the Australian Communication and Media Authority (ACMA), reserved 5+5 MHz of spectrum from the 800 MHz band for the specific purpose of realising a nationally interoperable Public Safety Mobile Broadband (PSMB) network based on Long Term Evolution (LTE) technology.[1] ACMA's decision was based on the outputs from the Public Safety Mobile Broadband Steering Committee (PSMBCC) commissioned GQ-AAS report[2] and its own analysis. While the PSMBCC evidence made a case for 5+5 MHz of paired spectrum, ACMA's analysis showed that 3+3 MHz would be sufficient to serve day-to-day and pre-planned traffic. However, ACMA allocated 5+5 MHz in order to provide "headroom" for future needs. ACMA proposed that PSA's data demand over and above this will be met through a combination of new and existing provisions, including:

- additional use of commercial networks for non-mission critical traffic
- use of the 4.9 GHz band to enable deployment of high capacity, localised 'hot spots' for data offload, video transfer and incident area networks (IANs), among other applications
- as needed deployments of mobile base stations, or 'cells on wheels' (COWs) to absorb additional local demand
- specific provisions under the Radio communications Act that could, if enacted, enable access to additional spectrum by responders in extreme circumstances

The allocation of spectrum for PSMB has been a hotly debated topic in Australia and around the world. ACMA's decision to allocate 5+5 MHz is a good start. However, we believe that 5+5 MHz of spectrum is unlikely to be sufficient to meet the needs of the PSAs over the next decade. Various countries, such as the USA and Canada, commenced with an allocation of 5+5 MHz for PSMB, but subsequently revised it to 10+10 MHz based on subsequent analysis of operational requirements. Results from the EU have also shown that even for BAU activities, a minimum of 7.5+7.5 MHz is required with large scale disasters requiring 10+10 MHz at a minimum.

[1] Spectrum for public safety radio communications, Current ACMA initiatives and decisions, October 2012
[2] Final Report, Public Safety Mobile Broadband Spectrum Quantum Calculation for Public Safety Mobile Broadband Steering Committee, November 2011

Research has also shown that large scale disasters are no longer once in a generation events, but rather are growing in frequency and severity. The demand for bandwidth will also be tested further by exponential growth rates in mobile data usage across the community and the PSAs.

This report provides a summary of spectrum allocation in key jurisdictions, combined with a summary of the drivers of demand. It is based on a set of more comprehensive reports currently being prepared for the State Government of Victoria.

Allocation of spectrum across the globe

In terms of evaluating the amount of spectrum allocated, it is worthwhile considering the allocation of spectrum for PSMB across different jurisdictions.

North America

The United States of America (USA) has taken the lead in developing a PSMB network. In 2007, the US Federal Communications Commission (FCC) allocated 5+5 MHz in the 700 MHz band to implement a PSMB network[3] with a nationwide level of interoperability. The US National Public-Safety Telecommunications Council (NPSTC), in 2009, endorsed LTE as the technology of choice for the PSMB and also formed a 700 MHz Broadband Task Force (BBTF) to develop the minimum recommendations necessary to ensure roaming and interoperability.[4] In addition to several key recommendations for the development of the PSMB, the BBTF recommended that an additional 5+5 MHz in the 700 MHz be allocated for public safety use. This was based on its finding that the current 5+5 MHz of spectrum available for public safety use for broadband data systems would not be sufficient to support disaster operations.

Independent, real-world tests have also demonstrated that the 5+5 MHz spectrum did not provide sufficient bandwidth for incidents that occur on a daily basis.[5] The East Bay Regional Communications System Authority in partnership with the Bay Area Urban Area Security Initiative (UASI) developed Project Cornerstone as a proof of concept for the larger LTE network planned for the Bay Area. The Project conducted in-depth testing of the LTE network in the following scenarios

- Barricaded hostage: a gunman holds one or more hostages in a building
- Suspected bomb: a suspicious package turns out to be a bomb and must be deactivated

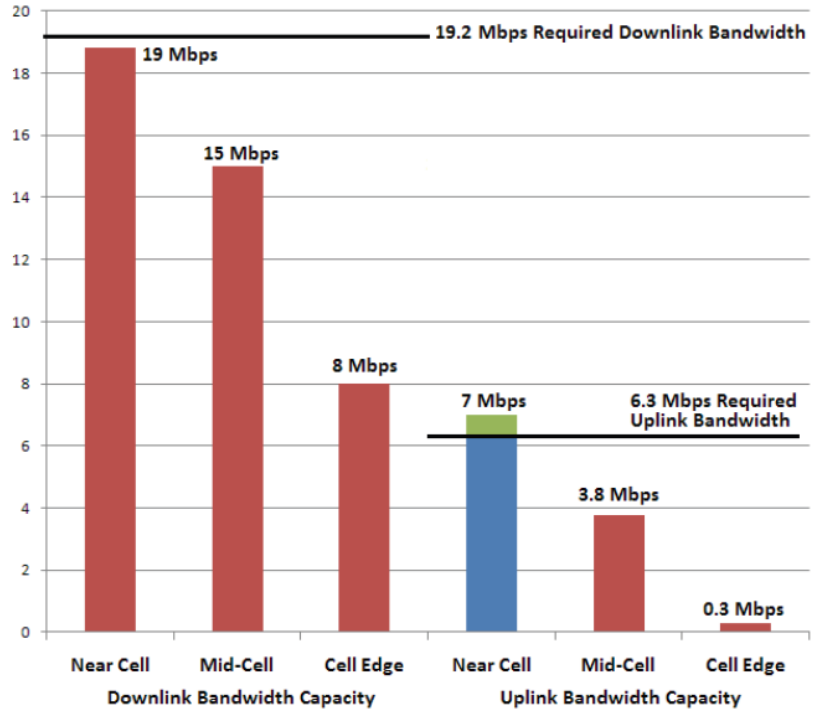
The tests were designed around each of the incidents. The results from the test i.e. projected bandwidth required for the incident and the bandwidth that was available on a 5+5 MHz system are shown in Figure 1 and Figure 2. Where the bandwidth available was inadequate it is highlighted in red (below the line indicating required bandwidth).

[3] US Federal Communications Commission (FCC), Public Safety and Homeland Security Bureau: Interoperability, available: http://transition.fcc.gov/pshs/emergencyinformation/interoperability.html

[4] 700 MHz Public Safety Broadband Task Force Report and Recommendations, NPSTC

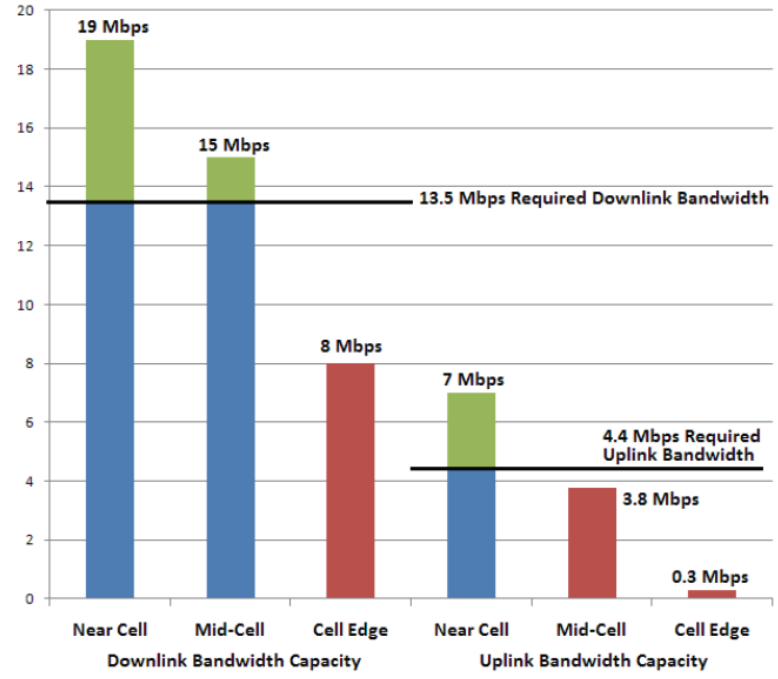
[5] Project Cornerstone Network LTE Testing, www.andrewseybold.com

Figure 1 – Barricaded Hostage Scenario Bandwidth As Measured And Required



In this scenario, the amount of bandwidth required exceeded that available with a 5+5 MHz network.

Figure 2 - Suspected Bomb Scenario As Measured And Required



In this scenario, the 5+5 MHz network could only support the bandwidth requirements very close to the cell site or the antenna.

The results from both the scenarios showed that the bandwidth available on a 5+5 MHz network was insufficient to meet PSMB requirements.

Subsequently, in February 2012, legislation[6] was passed allocating a further 5+5 MHz, adjacent to the original allocation, to public safety, there by bringing the total spectrum allocation for the nationwide PSMB to 10+10 MHz.

Canada's public safety spectrum allocation mirrors that of the USA. Canada initially allocated 5+5 MHz for PSMB but is now moving to 10+10 MHz.

EU

The European Conference of Postal and Telecommunications Administrations (CEPT) in EU setup the FM49 working group to investigate the allocation of spectrum for public protection and disaster relief and spectrum harmonisation. As part of the work to determine the spectrum required, FM49 undertook analysis of typical scenarios faced by PSAs. The methodology was based on

- estimating the number of simultaneous incidents during these scenarios,
- estimating the bandwidth required for each incident
- adding up the bandwidth necessary for the simultaneous incidents (taking into account differences in spectral efficiency within a cell).

The analysis also included background communications (i.e. day to day communications not covered by the incident scenarios).

The FM49 analysis considered the following scenarios:

- Everyday life scenarios i.e. routine patient service and a traffic stop
- Large scale planned event based on the Royal Wedding

The analysis was based on LTE specifications (release 10). To estimate the cell size, a reference LTE modulation was chosen which was used to provide the spectral efficiency at cell edge. For spectral efficiency well within the cell, two other modulations were proposed providing a range of values. The cell ranges were computed using Okumura-Hata model[7] for propagation in different environments. Using assumptions for location of incidents within the cells, bandwidth for each incident as well as for background communications were estimated. A range of values were provided taking into account that spectral efficiency varies within a cell with results from the conservative value presented here.

The results of this analysis concluded that a minimum of 7.5+7.5 MHz was required for the everyday scenarios with at least 10+10 MHz required for the large scale planned event.[8]

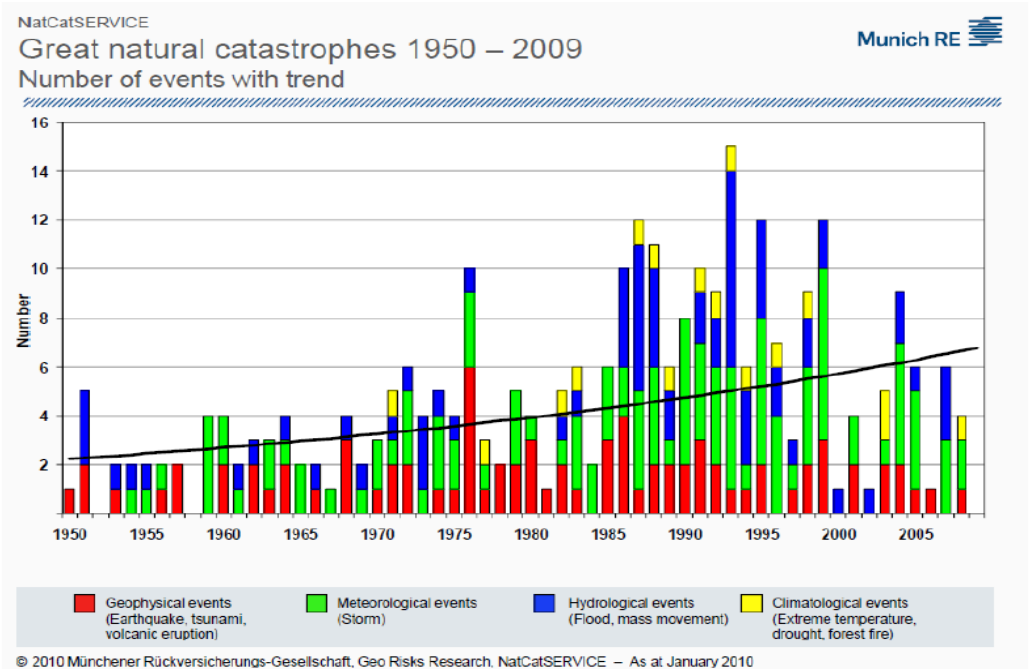
[6] The Middle Class Tax Relief and Job Creation Act of 2012
[7] http://www.wiley.com/legacy/wileychi/molisch/supp2/appendices/c07_Appendices.pdf
[8] Report from CG spectrum requirements, FM 49 Radio Spectrum for BB PPDR, October 2012

Natural Disasters

Global trends in disasters

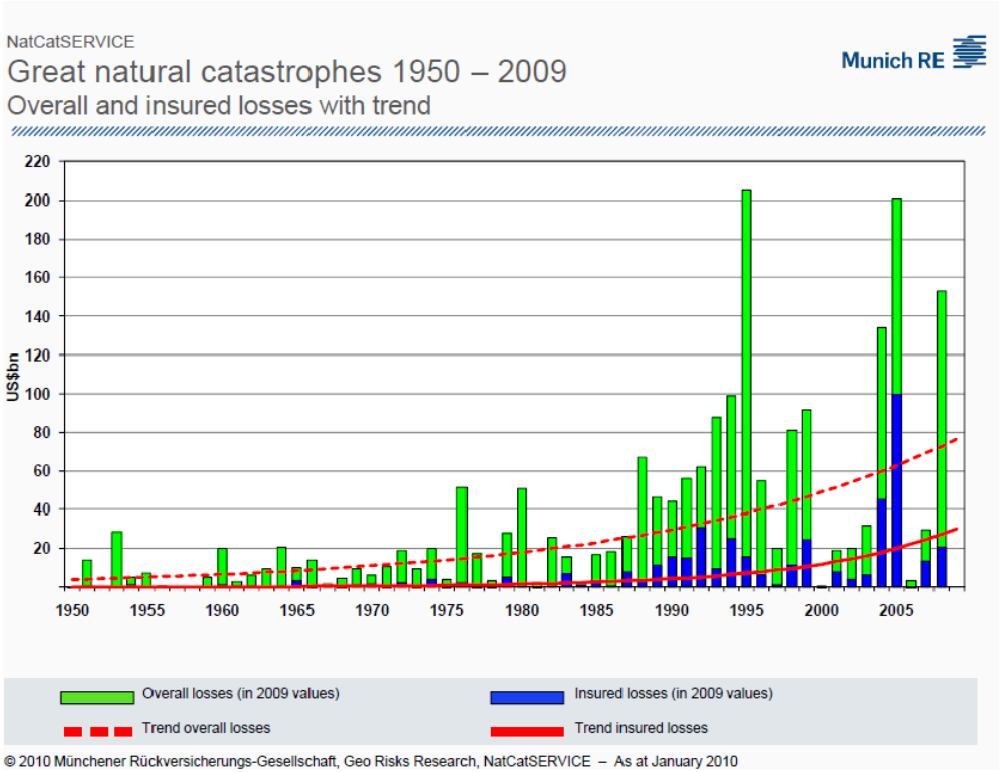
The incidence of natural disasters in Australia and around the World is increasing. Figure 3 shows the number of natural disasters worldwide from 1950 to 2009.

Figure 3 – Number of events, Great Natural Catastrophes 1950-2009



Over the last 60 years there has been increasing trend in the number of natural disasters, most notably since the 1980s. The trend over the same period in the cost of losses (in 2009 values), shown in Figure 4, from natural disasters also shows an increasing trend.

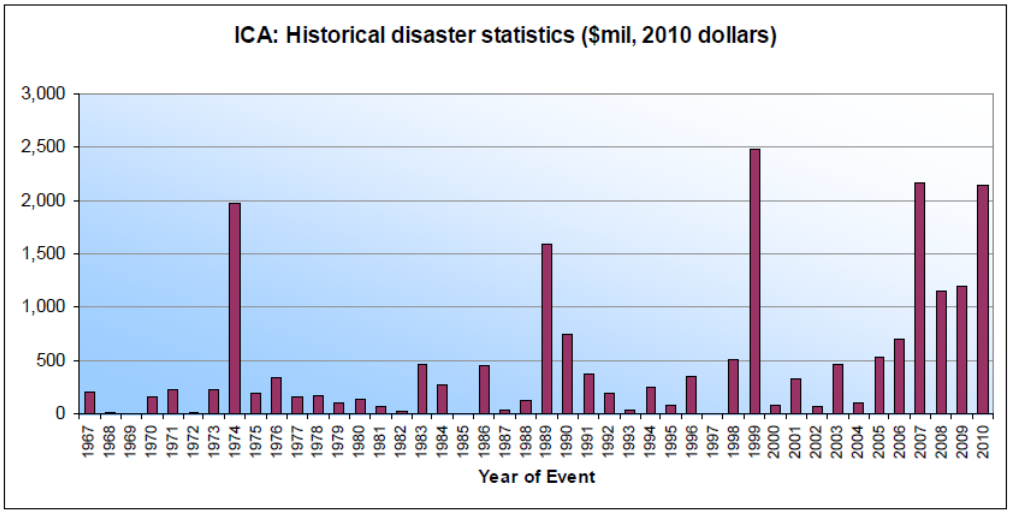
Figure 4 - Overall and insured losses, Great Natural Catastrophes 1950-2009



Trends in Australia

Turning to the Australian experience closer to home, Figure 5 shows the rising cost of insured losses from natural disasters in Australia since 1967.

Figure 5 - Insurance Council of Australia - Historical Disasters



Source: Insurance Council of Australia - Historical disaster statistics

We see a similar situation to the broader global environment, with an upward trend observed since 1967, as well as significant costs from events in the last 4 years.

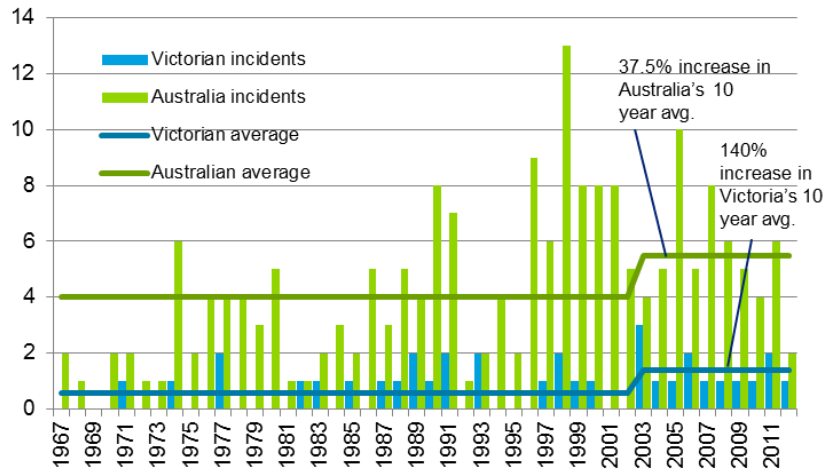
The 5 largest insured events between 1967 and 2010 were:

- $2.3b: Sydney Hailstorm (1999)
- $1.6b: Newcastle and Hunter Valley severe storms (2007)
- $1.5b: Newcastle earthquake (1989)
- $1.3b: Cyclone Tracy – Darwin (1974)
- $1.1b: Black Saturday Bushfires (2009)

The Queensland Floods and Cyclone Yasi of 2011 cost $2.4b and $1.4b respectively.[9]

In Victoria, there is an increasing trend in the incidence of natural disasters with 40% of events reported since 1967 occurring in the last 10 years[10] as show in Figure 6.

Figure 6 - Incidence of Great Natural Disasters in Victoria and Australia (1967-2012)[11]



Based on historical incident growth rate, shown in Figure 6, it is projected that Victorian natural disasters are set to grow by 2.68% and Australian natural disasters to grow by 11.5%[12] not factoring for population growth or climate change.

This reflects a broader trend in Australia and globally with more than half of the world's reported disasters since 1900 occurring after 1998.[13] In 2010 alone, 385 natural disasters killed over 297,000 people worldwide.[14]

Why these increases?

As we have seen, experience from both Australia and around the world shows an upward trend over time in both the number and cost of natural disasters.

Some of the reasons for these increasing trends over time include:

[9] http://www.insurancecouncil.com.au/industry-statistics-data/disaster-statistics/historical-disaster-statistics
[10] Historical Disaster Statistics – Insurance Council of Australia, 2012
[11] Historical Disaster Statistics – Insurance Council of Australia, 2012
[12] Historical Disaster Statistics – Insurance Council of Australia, 2012
[13] Towards a more disaster resilient and safer Victoria – Victorian Government, 2011
[14] All Hazards: Digital Technology & services for Disaster Management – CSIRO, 2012

- socio-economic developments, such as increasing concentrations of values (i.e. more people living closer together in cities)
- rising population and settlement and industrialisation of exposed areas (e.g. increased settlement of coastal areas)
- increase in major weather-related natural disasters, possibly exacerbated by long term climate change.

Societal factors have been the major driver of historical long-term increase in disaster losses.[15] The main societal factors driving this increase include population growth (both number and location) and GDP growth. Although it is arguable that climate change has had only a limited impact on the losses to date this may become a more significant driver of both numbers and costs of disasters in the future. This notwithstanding, future disaster losses are likely to increase as a result of societal factors and economic development, independent of potential climate change impact

Outlook for the future

In the short to medium term it is likely that we will see more people moving to and living in cities, increasing population and continued settlement and industrialisation of exposed areas. These and other societal factors will lead to further increases in the cost of natural disasters in Australia.

A NASA climate model projects that high fire years like 2012 would likely occur two to four times per decade by mid-century, instead of once per decade under current climate conditions[16]. The UN also warns that we will see more and more disasters due to unplanned urbanization and environmental degradation, with weather-related disasters sure to rise due to a number of factors, including climate change.[17]

[15] Catastrophe Losses in the Context of Demographics, Climate, and Policy, Roger Pielke Jnr, Laurens Bouwer, Ryan Crompton, Eberhard Faust, and Peter Höppe, 2007, Aon Re
[16] Climate Models Project Increase in US Wildfire Risk – NASA 2012
[17] Killer year caps deadly decade – UNISDR 2011

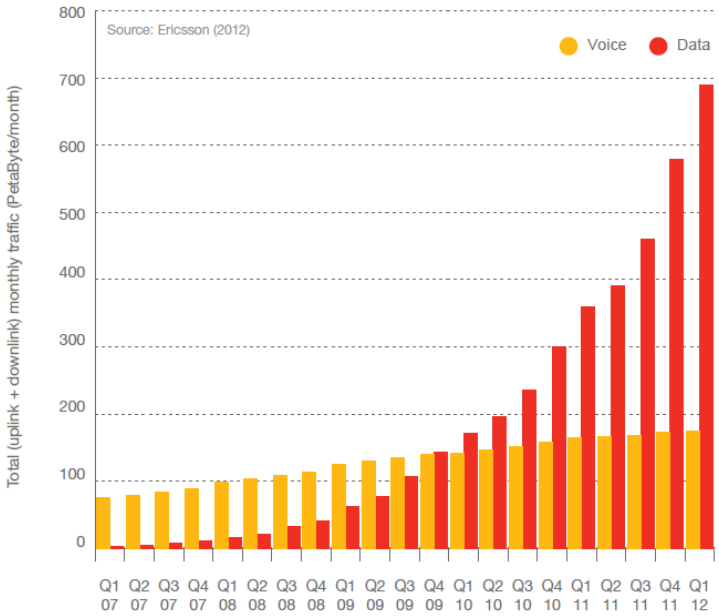
Growth in mobile data usage

Mobile data growth has increased exponentially, compared to the linear growth of voice traffic, exceeding all expectations, including those in the industry.

To date

- Based on Ericsson's 2012 Traffic and Market Report, mobile data traffic around the world has grown rapidly in the past 5 years and surpassed mobile voice traffic.[18] As shown in Figure 7 global mobile data traffic almost doubled between Q1 2011 and Q2 2012.

Figure 7 - Global total traffic in mobile networks, 2007-2012



- Cisco's mobile data traffic growth rate for 2011 was higher than anticipated, with a 2.3 fold growth, more than doubling for the fourth year in a row[19]

Future (2012-2017)

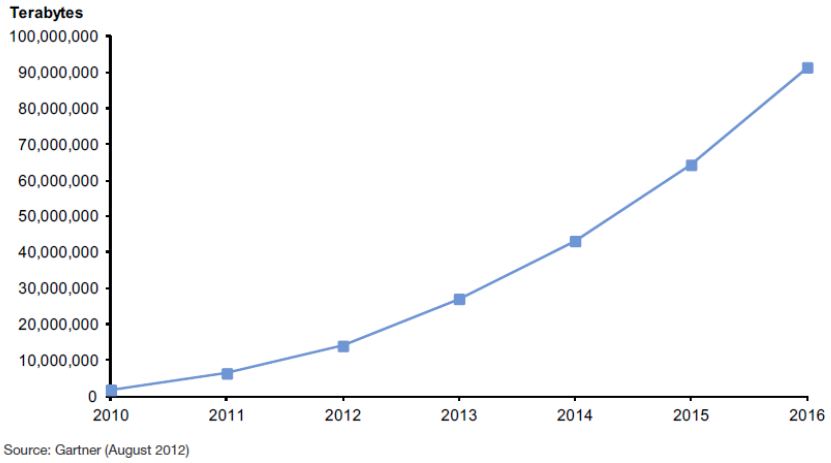
Industry predictions are for this growth in traffic to continue;

- Cisco predicts that global mobile data traffic will increase 13-fold between 2012 and 2017 with a compound annual growth rate (CAGR) of 66 percent from 2012 to 2017[20]
- Gartner expects mobile data traffic is expected to grow 14 times over the coming five years[21]. Gartner had to revise this year's data traffic prediction for 2015 to 64 million

[18] Ericsson Traffic and Market Report, June 2012
[19] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017
[20] Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017

terabytes, from 42million terabytes in last year's report due to a faster increase in mobile data usage.

Figure 8 - Mobile Data Traffic, Worldwide, 2010-2016



Source: Gartner (August 2012)

The growth in mobile data usage has been driven by

- increased consumption of mobile video particularly driven by increased demand for videos at higher resolutions on faster networks
- introduction of faster mobile networks such as HSPA+ and LTE
- an increase in uptake of smartphones, connected devices and a growing number of mobile Internet users
- a growing number of users on faster networks increasing the average amount of data consumed

In addition to the increase in mobile data usage, the cost per unit of data is on a downward trend. With decreasing data costs, traditional voice services are being replaced with equivalent data applications. Commercial organisations have already moved to new technologies and business models to cater for this increase in data usage.

We believe that usage of mobile data by PSAs will follow that of the wider commercial market. While there is limited use of mobile data by PSAs today, with access to faster networks (LTE) and better devices (smartphones, tablets and specialist LTE enabled devices such as sensors and drones) PSAs will increasingly use data capabilities, potentially replacing voice communications with data communications where possible. While 5+5 MHz spectrum might meet today's PSA needs, we believe it is unlikely to be sufficient to meet the needs of the PSAs over the next decade.

[21] Market Trends: Mobile Data and Video Traffic, Gartner, 2012