Ref: BN15/1838

28 August 2015

The Chairman
Public Safety Mobile Broadband
Productivity Commission
Locked Bag 2, Collins Street
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Dear Chairman,

Public Safety Mobile Broadband Inquiry

I refer to the Productivity Commission's Issues Paper: Public Safety Mobile Broadband, April 2015 and your request for interested stakeholders to make a submission.

The NSW Government Telecommunications Authority (Telco Authority) is responsible for the overall coordination of operational communications services for the NSW Government, including its spectrum holdings.

The Telco Authority has prepared the attached submission to the Productivity Commission. The submission includes general information for the Commission in its consideration on the costs and benefits for the delivery of a public safety mobile broadband (PSMB) capability in Australia. The submission also seeks to answer the various questions raised by the Commission.

The submission draws out a number of key issues that the Telco Authority considers are of importance to the Commission's study. These include:

- The need for the Commission to consider the quantum and type of spectrum for PSMB purposes, as well as to whom it is allocated, given the impact such decisions will make on the overall cost of a PSMB capability and the ability of the states and territories to enter into fair negotiations with potential suppliers of a capability.
- Consideration on ways to avoid locking the states and territories into long-term arrangements that prevent flexibility, and the ability to seek out alternate service delivery methods in the future.
- How prioritisation of access to a network for public safety personnel can be achieved when using a shared service given the existing technical limitation, particularly during major incidents when congestion is likely to be an issue.

I would encourage the Commission to contact Mr Terry Daly, Program Director – PSMB, at the Telco Authority   to discuss the response further.

Yours sincerely,

Shaun Smith
Managing Director
NSW Telco Authority

Response to
Productivity Commission
Issues Paper:
Public Safety Mobile
Broadband

August 2015

Contents

Executive Summary

The Telco Authority has undertaken extensive research into the development of a public safety mobile broadband (PSMB) capability in NSW, including a comprehensive catalogue of possible costs and benefits. The Authority and the NSW Government have also participated in national discussions more generally on the development of PSMB.

The need for PSMB in Australia has already been established, as has the need to allocate spectrum for this purpose. Dedicated spectrum for PSMB is required to ensure that the future demand levels for a service can be met.

The Telco Authority has identified four significant issues that the Productivity Commission must consider as part of its First Principles for PSMB study:

- Sufficient spectrum must be allocated for PSMB in the most cost effective bands. It is the view of the Telco Authority that this is 10 MHz of spectrum (paired) in the 700 MHz band.

- The Commission could investigate the case for spectrum to be under the control of public safety agencies. The international experience where government does not control the spectrum for mission critical communications services has resulted in it being unable to expose potential suppliers to competitive pressure. Equally, where commercial offerings are financially unviable, government has not been able to develop its own solution.

- Any PSMB solution must be mission critical, as defined by public safety agencies. Business grade solutions are not viable in protection of life and property scenarios.

- While prioritisation can occur once a PSMB user is connected to a network, gaining a connection in the first place remains an issue of concern where a dedicated PSMB network is not provided, particularly for high density and congested areas such as the Greater Metropolitan Area of NSW (Sydney, Wollongong and Newcastle). The issue of connectivity is complex and presents a number of technical difficulties that will need to be addressed by the Commission should it seek to recommend a non-dedicated (shared) offering.

- Options should avoid locking public safety agencies into a long term solution (particularly if their ability to seek alternate solutions is hampered by the use of proprietary equipment or the lack of spectrum for an alternate service). With the uncertainty of future PSMB demand, there is the potential for public safety agencies to be locked into a solution where the commercial operator continues to raise tariffs and other fees given their monopoly position, as has been experienced overseas. A possible way to address this could be through the use of regulation to provide price controls (as happens in a number of monopolistic essential services markets) and by ensuring that service level agreements and universal service obligations are met.

The Telco Authority explores each of these matters in this submission to the Commission.

General Comments

Spectrum for PSMB

Public benefit of spectrum for emergency services, national security and law enforcement

Section 3(b) of the *Radiocommunications Act 1992* (Cth) provides a requirement for the Australian Communications and Media Authority (the ACMA) to allocate spectrum for defence, emergency management and law enforcement purposes. Section 3(b) confirms that a primary purpose of the Act is to ensure that adequate amounts of spectrum are allocated for defence, public safety, law enforcement and public/community services purposes. This position has been reiterated by the Commonwealth Government's Spectrum Review Report which noted that 'Government users of spectrum provide services that offer significant benefits to society beyond a pure commercial return'[1].

In addition to the community safety benefits of allocating spectrum for PSMB purposes, analysis of international experience has demonstrated that a nation's economy can benefit from the provision of a mobile broadband capability for public safety workers. For example, the London School of Economics has undertaken a review of the benefits of a mission critical mobile broadband capability in the United Kingdom[2]. The review found that there are number of economic benefits, including:

- A significant reduction in the cost of crime to the community arising from the earlier and more precise intervention that mobile broadband would allow
- Health care savings due to ambulance crews being able to more quickly arrange treatment for patients
- Increased productivity across the economy
- Increased efficiency

While data on the economic impacts of a PSMB capability in Australia is somewhat limited, research by the Telco Authority on current applications alone has been able to identify a number of benefits, particularly in the health sphere. The benefits of early intervention and remote diagnosis provide an opportunity to treat patients quickly, reducing level of care, the time required to stay in hospital and the length of recovery. Other benefits that would arise include reduced loss of property as fire fighters could better respond to fires.

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[1] https://www.communications.gov.au/publications/spectrum-review-report, page 35

[2] London School of Economics' Centre for Economic Performance Report: 'Socioeconomic Value of Mission Critical Mobile Applications for Public Safety in the UK: 2x10 MHz in 700 MHz'

The allocation of spectrum for PSMB purposes

As noted above, the Telco Authority considers that the Radiocommunications Act places an obligation on the Commonwealth, and particularly the ACMA to allocate spectrum for PSMB purposes. This position is confirmed by the Commonwealth Treasurer in the Terms of Reference which notes "a robust and effective mobile broadband capability is a critical enabler for Australia's public safety agencies'[3]. However, a first principles analysis requires that consideration be given to how that spectrum should be allocated, to whom it should be allocated and at what cost.

It is acknowledged that spectrum is an in-demand resource; and that the spectrum that is most suitable for PSMB is also the optimal spectrum for other services such as commercial mobile broadband.

In determining which spectrum to allocate for PSMB, there may be some benefits in using 700MHz spectrum despite the similarities between 700 and 800 MHz spectrum, and the possibility of developing equipment compatible with 800 MHz frequencies[4]. This is because the United States and Canada are preparing to roll out a PSMB capability in the 700 MHz band, creating a large market that will attract a variety of suppliers and solutions and greater competition. There are potentially a number of other equipment benefits from deploying PSMB using 700 MHz spectrum, including ready access to mature terminal products, the speed of adoption of new technology and access to global innovation.

In offering this view, it is understood that not all spectrum in the 700 MHz was sold during the Commonwealth Government's Digital Dividend Auction and at least two paired 10 MHz segments remain available today to be used for PSMB purposes.

Public interest test for allocating and pricing spectrum

The ACMA has in several forums described the circumstances in which it would apply its version of a total welfare test, called a public interest test, in determining the allocation and pricing of spectrum. The ACMA public interest test provides a method of assessing the impact of a regulatory proposal on the public interest including for citizens, consumers, producers, government and the broader social impact.

While the ACMA generally takes a holistic view, it has previously indicated that it may be appropriate to proceed with a regulatory intervention that delivers a certain outcome for society even if the cost is high. While such a scenario is based around taking regulatory action, it can also be applied to the allocation of spectrum where the benefits of assigning spectrum for emergency

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[3] http://www.pc.gov.au/inquiries/current/public-safety-mobile-broadband/terms-of-reference
[4] Joint submission to the Parliamentary Joint Committee on Law Enforcement Inquiry into the Spectrum for Public Safety Mobile Broadband, June 2013, paragraph 13, page 3.

management and law enforcement purposes may be beneficial despite a high opportunity cost for other users of the spectrum.

It is noted that, where possible, the ACMA will consider quantitative aspects when making assessments under the public interest test. To date, however, the Telco Authority is not aware of circumstances where the ACMA, in considering the allocation of spectrum for PSMB purposes, has been able to utilise the available data which demonstrates the positive effect on levels of economic activity of properly equipping emergency services during the recovery and rebuild after a natural disaster, etc.

The ACMA has stated that the benchmark when undertaking a public interest assessment is not the 'current situation' or the 'best outcome possible', but rather the general environment that will occur if the regulatory approach is taken as opposed to where it is not. The increasing occurrence of natural disasters was recognised by all Australian Governments in February 2011 when COAG endorsed the National Strategy for Disaster Resilience which noted an increasing regularity and severity of natural disasters (including catastrophic bushfires, far reaching floods and damaging storms)[5]. The increase in natural disasters is something that the ACMA may need to consider in future assessments.

Available spectrum in the 700 MHz band was not allocated by the market via the Digital Dividend auction process. Given this, and taking into account:

- the already acknowledged view of the Commonwealth Treasurer that public safety agencies need a PSMB capability
- that the section 3(b) of the Radiocommunications Act requires the ACMA to allocate spectrum for emergency services and law enforcement purposes
- that the previous ACMA decision to provide spectrum for PSMB purposes acknowledges that spectrum is absolutely required for PSMB purposes
- that if the ACMA does not use its powers to allocate spectrum to PSMB it could increase the risk of public safety officers and volunteers not having access to the most efficient and effective fit-for-purpose tools to do their jobs
- that the benefits of an enhanced ability to respond (in terms of saving lives and property, and reducing the costs to the community in relation to health care, crime (and its societal impacts), etc.) will not be realised, and
- agencies will be forced to rely on a land mobile radio offering for mission critical communications that is likely to become unsupported legacy equipment over the longer term as the rest of the world moves to a PSMB capability

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[5] National Strategy for Disaster Resilience, p iv.

This situation should be considered by the Productivity Commission when seeking to respond to the requirements of the Terms of Reference.

Drivers for a PSMB capability

It is important when determining the development and dimensioning of a PSMB capability, how spectrum should be allocated and deployed, to acknowledge the underlying drivers for a PSMB capability. These drivers remain unchanged over time, and are as follows:

- The community expects the maintenance of a reasonable level of public safety to be a core service of government. With the adoption of smartphones by the general community there may eventually be an expectation that public safety agencies have access to similar or better technology to support their critical operations requirements.
- Improving responses to emergencies and other critical incidents – the provision of voice and data via a PSMB service will greatly improve the way that public safety agencies are able to respond to an incident and prevent or reduce adverse outcomes and the associated economic impacts of those adverse outcomes. For example, technology is already being used overseas to help provide quicker treatment for stroke victims ensuring immediate treatment and reduce recovery time and associated health system costs.
- Increased interoperability – the need to ensure that a PSMB service is interoperable, including between agencies (to allow for the inter-agency sharing of data, information and voice services at a local level when responding to an incident); as well as nationally.
- Service delivery improvements – allowing agencies to improve the level and cost effectiveness of services by ensuring that front-line staff are able to access the necessary information and data in the field rather than returning to their base.
- Technology – allowing frontline personnel access to the most advanced technology, building a capability that is not proprietary and is application agnostic. It also recognises that there is no guarantee that land mobile radio services technology will continue to be supported over the longer term, particularly as more jurisdictions, both locally and overseas, move to a mobile broadband service for their public safety workers.

How to allocate spectrum for a PSMB capability

The NSW Government has been consulting with the Commonwealth and other jurisdictions on the allocation of sufficient and appropriate spectrum and the development of a nationally interoperable PSMB capability since 2011. NSW representatives have been actively engaged in this work at the Council of Australian Governments (COAG), COAG Senior Officials, Standing Council on Police and Emergency Management (SCPEM) and SCPEM PSMB Steering Committee levels, as well as co-chairing the Jurisdictions-led PSMB Committee that has taken over responsibility for the development of a PSMB capability since late 2013.

The former NSW Premier has previously advised the current Minister for Communications that state and territory public safety officials have a number of requirements for PSMB in order for it to be viable over the longer term.

These include:

- That public safety agencies have adequate capabilities now and into the future both to meet business-as-usual operational needs, and to respond efficiently and effectively to protect life and property during the most extreme circumstances, and
- To avoid 'solutions' that impose an additional funding burden on the State.

Based on the situation in similar jurisdictions (particularly in relation to geography and law enforcement practises), such as the United States and Canada, the Telco Authority considers that 10 MHz paired spectrum (2x10MHz) in the 700 MHz band is required to provision a PSMB with the required capacity for an effective operational response. The Authority also recommends that the required spectrum be allocated to the states and territories at no charge. This would recognise both the considerable cost required to build a PSMB capability, as well as the wide-ranging benefits it would provide to the community. The substantial proceeds from the sale of 'Digital Dividend' spectrum could also be used to benefit the public by allocating a proportion to assist with the deployment of a PSMB capability. This is in line with existing Commonwealth[6] and NSW Government[7] policy to recycle the proceeds from the sale of existing assets and infrastructure into new infrastructure projects that will benefit the entire community.

As with the Commonwealth, the Telco Authority considers that any PSMB capability must be nationally interoperable, and that while provision will need to be made to allow Commonwealth law enforcement and public safety agencies access to a PSMB service, responsibility for the capability's design and build remains with the individual states and territories (which may wish to collaborate and negotiate with commercial providers for the provision of a PSMB service or part service). With this in mind, work was carried out during 2013 and 2014 by the states and territories on the key issues that need to be considered in building a PSMB capability. The state and territory led PSMB Committee, which the NSW Department of Premier and Cabinet co-chairs with their Victorian counterparts had been tasked with ensuring that PSMB be nationally interoperable, through the development of common specifications and platforms.

What is mission critical?

The Telco Authority considers the definition of mission critical to be an integral part of defining the requirements for a PSMB capability. Emergency services and law enforcement personnel already rely on mission critical communications in order to be able to do their jobs effectively and safely.

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[6] http://www.budget.gov.au/2014-15/content/glossy/infrastructure/html/infrastructure_04.htm
[7] http://www.nsw.gov.au/rebuilding

As the users of a mission critical communications service, it is essential that public safety agencies define what mission critical is in order that they are able to undertake their activities to protect life and property in a safe and effective manner.

Any PSMB service must ensure that public safety communications are generally no worse off when compared to the services currently utilised by front line staff to undertake their duties. The implications of it not being able to provide such availability, capacity and resilience are clear. Officers need to be able to communicate with each other and with their dispatch centre to report on an incident, coordinate in the field and to seek assistance when lives or property are at risk. If their communications fail or are delayed the results have the potential to be catastrophic.

In order to ensure that a PSMB capability is designed to meet the same levels of service that public safety workers currently have, the service must be mission critical, and public safety agencies must be the organisations that define what mission critical is. The Telco Authority has consulted with NSW public safety agencies on what the parameters of a mission critical PSMB service would be. The Telco Authority has sought to define mission critical in a way that ensures that agencies' needs are met without being overly prescriptive.

Defining 'Mission Critical'

In the context of defining public safety operations, we have defined mission critical operations as those concerned with, or that have the potential for, directly saving lives and/or property or avoiding severe injury. This is distinguished from the term 'business grade' operations which are concerned with day to day routine administrative tasks and responses where lives and/or property are not at risk.

In an operational context, public safety agencies currently have mission critical communications services (both voice and narrowband data) that are generally available 99.99% of the time. Effort to improve availability to the optimal level of 99.999% is continuing.

It is important to clarify what is required to achieve 99.99-99.999% availability. In order to achieve this, a network:

- must have sufficient back up power available via generators, batteries and other power sources to continue to operate for extended periods of time without mains power which is often compromised during major events,

- must have redundant equipment from the radio site back to the network core (including backhaul links)

- must have equipment stored in secure and robust accommodation

- must have proactive and reactive site maintenance services available which can be quickly deployed when needed, and

- must have disaster recovery plans, processes and equipment (such as disaster recovery network operations centres, readily available spare components, cells on wheels, and alternate services) in place and readily put into operation.

Why is business critical not acceptable?

In addition to setting out the needs of public safety agencies for mission critical communications, and defining what mission critical is, it is also important to explain the limitations of a business critical service. Mission critical generally means that the service is highly available, and that disruptions are addressed urgently in order to ensure the safety of the community. Business critical grade services, which are offered by commercial networks in Australia, do not require such a high level of availability. Services can take a number of hours and occasionally days to be restored[8]. The Telco Authority has examined a number of outages experienced by commercial networks in Australia during natural disasters, where communications are essential, and where public safety agencies would require services to be highly available, and also large scale technical outages covering large parts of the network. A number of these are outlined in the table below.

Ref #	Date	Region	Description
1	2009	Victoria	Victorian Bushfires impacting Telstra Base stations
2	2010	Qld, Cyclone Yasi Cairns, Mackay & Townsville	Severe weather events impacting Telstra Base stations
3	2011	Qld, Brisbane Floods	Flooding impacts Telecommunications
4	2012	QLD wide	Telstra upgrade shuts down mobile network
5	2012	Australia Wide	Vodafone, Melbourne exchange overheats and shuts down
6	2013	Nowra, Ulladulla	Bushfire impacting Optus and Vodafone Base stations
7	2013	Qld, north of Gladstone	Flood impacting Telstra Base stations
8	2014	Qld Cyclone ITA North of Townsville	Flood impacting Telstra Base stations
9	2014	Australia Wide	Virgin phone services impacted by technical fault
10	2014	Australia Wide	Millions of Optus and Vodafone mobile services impacted
11	2014	Martin Place Sydney	known that all commercial mobile networks congested

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[8]http://www.abc.net.au/news/2015-06-02/telstra-customers-left-without-mobile-internet-services-sydney/6513730
http://mpnews.com.au/2015/05/25/agony-of-life-offline/
http://www.techworld.com.au/article/568710/telecom-outages-continue-after-queensland-cyclone/
http://www.abc.net.au/news/2015-02-22/residents-struggle-to-rebuild-after-cyclone-marcia/6183908

12	2014	NSW Wide	Telstra Mobile Data running slow due to technical fault
13	2015	Nowra, Taree, NSW	Severe weather events impacting Telstra Base stations
14	2015	Canowindra, NSW	Telstra outage impacts town
15	2015	NSW Wide	Telstra technical issue impacts 100s of thousands of services
16	2015	Qld Cyclone Marcia, Yeppoon, Rockhampton, South Brisbane	Flood impacting Telstra Base stations

Prioritisation

Impact of network congestion

The Telco Authority has developed its future technology roadmap for public safety agency communications on the basis that PSMB will be able to meet the demand for broadband data applications in the short to medium term and eventually provide a single converged platform for voice and data in the longer term, replacing the land mobile radio network for mission critical voice. Under this scenario, for both voice and data, it is mandatory that PSMB is capable of offering the same service levels and network accessibility that is experienced with land mobile radio systems providing critical voice communications. The time critical nature of the operations and incident decision making made by public safety officers dictates a mandatory requirement for no less than 500m/s voice "Push to Talk (PTT)" call set-up[9].

One of the Telco Authority's concerns is that call set up latency requirements cannot be met with the degree of certainty required during incident scenarios, when the network is needed most. This is due to the potential for congestion on the radio air interface (as well as at other points in the carrier's network) preventing the required certainty for the initial network access.

The Telco Authority has worked with Bell Labs to identify the issues that may affect call set-up times under an emergency scenario where a MNO experiences a mass calling event, and the probability of network congestion increases dramatically. An example would be a scenario of a large scale incident at a mass public event, such as a sports stadium or the New Year's Eve fireworks in and around Sydney Harbour.

If a PSMB service was running on a commercial network the number of callers and associated network access attempts under a mass calling event could number in excess of tens of thousands. Relative to the LTE standard which is capable of supporting a maximum of 64 simultaneous access attempts for each individual sectors (cell) this has the potential to create significant congestion and contention of network resources. The probability of congestion for network access then becomes very high, and may result in users continually "re-trying" to gain network access, further

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[9] "Defining Public Safety Grade Systems and Facilities", US National Public Safety Telecommunications Council, Public Safety Task Group. 22 May 2014

adding to the congestion. Unlike at other points in the carrier's network, this is particularly problematic 'over the air' because users compete for access to the network over a shared medium irrespective of their importance.

It is worthwhile noting that not all network access attempts are user-generated. These attempts can often be initiated by poorly written applications creating further un-controlled access issues for public safety users. This may be the case on commercial networks where end-users devices and the choices of applications are configured by the general public. This is expected to be less of an issue on a dedicated network as configuration of emergency users' devices can be under much tighter control, minimising possible network access issues due to poor application implementation.

How access is controlled

In these circumstances, the 3GPP standard does allow for prioritisation of certain classes of users through a feature called 'Access Control using Access Classes'.

This feature allows for an access class to be stored in the USIM (SIM card). The access classes are as follows:

- Class 0-9 is randomly assigned to the entire mobile population (normal users)
- Class 10 is reserved for 000/112 calls (always allowed, mobile device will override the stored Access Class value)

Additionally users may be members of one or more of 5 special categories:
- Class 11 and 15 are reserved for network administrative purposes PLMN use and PLMN staff respectively
- The remaining classes
    - Class 12 for security services (Police, Federal Police, etc)
    - Class 13 Public Utilities (electricity, water etc.)
    - Class 14 Emergency Services (Ambulance, Fire, etc.)

During a mass calling event the commercial network operator could implement access control by optimising the parameters broadcast to all users and retarding the access for access classes 0-9. The parameters can be set to reduce the probability that the user equipment (UE) will meet the required mathematical condition before attempting to access the network. Network access for PSAs of a different access class would be unaffected and the probability of successful network access would be greater.

In a heavily congested cell (e.g. in a sports stadium), this access control capability will only reduce the probability that a network access attempt is unsuccessful, but will not eliminate it. With the

significant user population of commercial networks and thus the significant number of possible network access attempts that can be generated during periods of peak demand, there is a high probability that congestion would remain. Exposing public safety users to the network user population presents the greatest risk for PSA network access at the most critical times. Access control can be illustrated in the following chart:
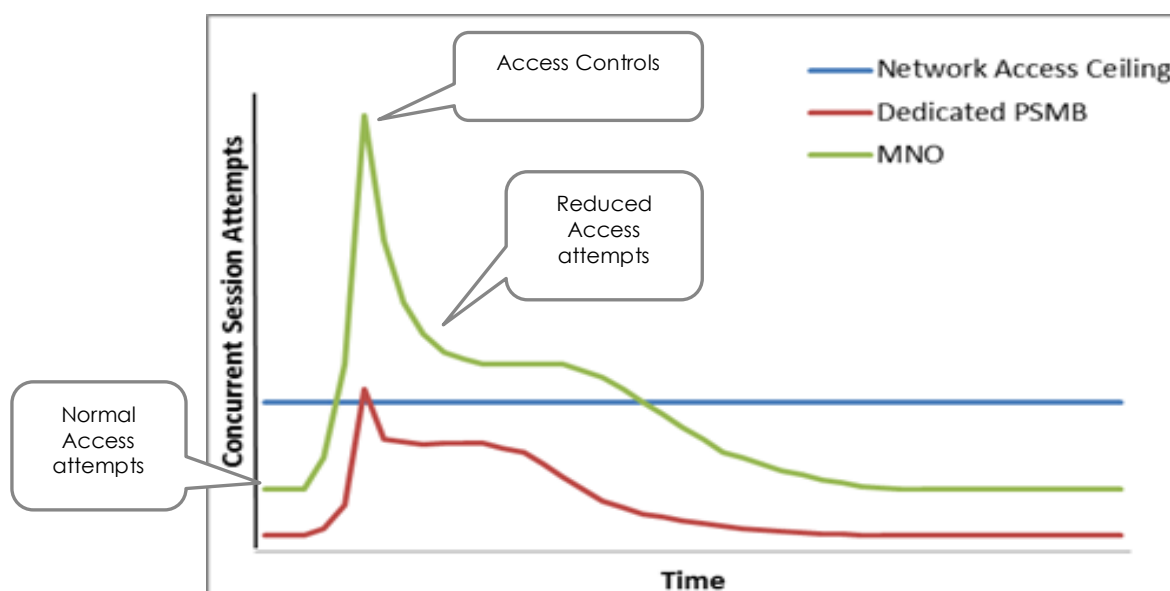
It is also important to note that calls to 000 or 112 are always given the highest priority regardless of access control settings. However, in a mass calling event with continued congestion, it is not unrealistic for the public to become aware of the prioritisation given to 000 calls, and simply revert to calling that number out of helplessness. Again this would dramatically increase the probability of network access failure for PSAs.

Denial of access due to congestion is anticipated to be less of an issue in a dedicated PSMB network due to the relatively small number of PSA-only users expected to simultaneously access the network at any particular location. Dedicated access could be implemented using dedicated PSMB spectrum regardless of whether the network is operated by an MNO or Government. This dedicated configuration would be considered mandatory by state governments and would be expected to be part of any spectrum allocation as a prescribed condition of the licence.

Existing research into PSMB

Research undertaken to date

In its consideration of the first principles review of developing a nationally interoperable PSMB capability, it is our view that the Productivity Commission should consider a range of research

already undertaken. This existing Australian research gives context to the Commonwealth Government's decision to allocate spectrum for PSMB in 2013 and the establishment of a State and Territory led committee to coordinate the development of a capability in lieu of the Standing Council on Police and Emergency Management's PSMB Steering Committee.

The reports and other material that the Telco Authority considers should be taken into consideration include:

- Gibson Quai-AAS reports:
    - Demand requirements
    - Delivery models
    - Spectrum quantum
    - 700 and 800 MHz PSMB band comparison

- Joint States and Territories submission to the Standing Council on Police and Emergency Management and Australian Communications and Media Authority: Further evidence from Jurisdictions (2013)
- Deloitte – Emergency Services Long Term Strategic Plan: International Public Safety Mobile Broadband (2013)
- Ernst and Young – Benefit cost analysis of National Broadband capacity of emergency services organisations (2011)
- Reports from the PSMB Steering Committee Overflow and Timelines Sub-committees
- The report from the Parliamentary Joint Committee on Law Enforcement Spectrum for public safety mobile broadband inquiry
- London School of Economics' Centre for Economic Performance Report: Socioeconomic Value of Mission Critical Mobile Applications for Public Safety in the UK: 2x10 MHz in 700 MHz
- ARCIA Report: Valuing mission critical radio services: A study of the economic value of land mobile radio spectrum in Australia (November 2014) (in so-far as it demonstrates the benefits of a mission critical voice wireless service to the Australian economy).
- TETRA and Critical Communication Association UK Report: The Strategic Case for Mission Critical Mobile Broadband (Dec 2013)

It is important to recognise that the above reports were, in some instances, produced several years ago, and while much of the information remains relevant and will be of assistance to the Commission, other activities since their creation, including the development of new technology, additional research and changes in our understanding of the benefits of a PSMB capability, mean that additional perspective may be required.

Telco Authority research

During 2014 the NSW Government funded the Telco Authority to undertake an assessment of various costs and benefits for a PSMB capability in this State. The analysis, which is still being finalised, includes consideration of the costs for telecommunications and supporting IT systems, a benefits analysis and a trial. The limited analysis within Australia on the costs and benefits of a PSMB service means that this work will be invaluable in helping to determine the optimal delivery model for a PSMB capability. It also provides insight into the costs of such a service.

Quantification of benefits has also been undertaken by the Telco Authority. However, it should be noted that the number of services and applications created to support public safety workers is expected to grow significantly, creating currently unforeseen opportunities. It is evident that predictions around the benefits of telecommunications eight years ago before the introduction of the Apple iPhone would have significantly understated the current state of services and the benefits that they bring that are broadly available. Given the investment lives associated with radio and other infrastructure, it is evident that benefits cannot be accurately predicted at present and any predictions would be likely to underestimate the benefits. Costs on the other hand are relatively static and predictable given that costs are to be incurred in the short term with benefits arising in the future.

The Telco Authority has made a commitment to the Productivity Commission to make its data and analysis available. While the information will be NSW centric, advice on the costs and benefits can, in particular circumstances, be extrapolated across the country given the large urban populations in most states and territories. The findings of the NSW analysis have helped to inform this response to the Commission, however, the actual results will be provided in a separate submission on a confidential basis, given the commercial nature of the material.

International developments

International experience

Australia's development of a PSMB capability cannot be isolated from the experiences of international jurisdictions, which can also provide invaluable lessons on how things can be done correctly or better. The experiences of the US, UK, Belgium and Canada provide insight into the quantum of spectrum required for PSMB services, the most cost effective service delivery model and the best way to build the capability.

As part of the Telco Authority's analysis of the costs and benefits of a PSMB capability, the Authority has undertaken work to investigate the experiences of the key international jurisdictions mentioned above.

The research has shown that:

- Across the board there is an acceptance that mobile data broadband functionality is essential for public safety agencies now and in to the future, with common technology standards to promote interoperability between agencies and responders a key attribute.

- As consideration of PSMB has progressed and the capability is considered as the main operational communications service for the future, most agencies now take a view that a dedicated network (but not necessarily government owned or managed) and dedicated spectrum is required to ensure that mission critical services can be provided free of the capacity and availability constraints that are apparent with commercial networks.

- Generally, a commercial service could be used for PSMB but only in limited circumstances, including:
  - That priority is provided to public safety activities over other services;
  - That there be sufficient competition in place (or other regulatory measures where competition is not available) to ensure that a MNO is unable to gain and then abuse market power;
  - That a regulatory system be put in place to augment contracted service level agreements which are enforced by an independent regulator;
  - That commercial networks (where a dedicated commercially built and operated network is not used) be significantly hardened to ensure that they are able to deliver mission critical grade services; and
  - The commercial network must be able to meet all of the divergent business needs of the various public safety agencies.

- In most countries mission critical land mobile radio voice services are expected to continue to be offered until PSMB is sufficiently able to provide mission critical voice over the network. The use of a single network to provide both voice and data is considered to be more cost effective than operating two separate networks in the longer term.

Canada

The Australian and Canadian public safety landscapes are very similar. Like Canada, Australia has vast areas with low population, with a large proportion of the population living in urban areas (generally located in the south of Canada and in coastal areas of Australia) and a similar governmental structure. In April 2015 the Canadian Government announced that it would provide a further 10 MHz of spectrum in the 700 MHz band to accompany the 10 MHz already allocated thereby creating a 10 + 10 MHz paired allocation. The Canadian Government indicated that this will 'enable the creation of a PSMB, a high-speed mobile network dedicated to emergency management'[10]. The Government also allocated $3 million (CAD) over two years from 2016 to take initial steps to establish the country's PSMB network noting that the investment

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[10] http://www.budget.gc.ca/2015/docs/plan/ch4-3-eng.html#_Toc417204369 'Improving public safety communications'

will 'improve collaboration among public safety agencies to help save lives and keep communities safe'[11].

The Canadian Government recognised that 20 MHz of spectrum in the preferred 700 MHz is required to deliver a PSMB capability that will meet the future needs of public safety agencies. It is accepted that data usage will increase exponentially as the technology grows and user applications are developed. The use of video, from body cameras worn by front line Police in the field, through to cameras and imaging applications on mobile medical devices is expected to contribute significantly to the increase in data requirements.

United States

As with Canada, the United States has allocated 20 MHz of spectrum (10 + 10 MHz paired) in the 700 MHz band for public safety mobile broadband. The United States is developing the FirstNet PSMB network via the First Responder Network Authority. Currently FirstNet is intended to provide mission critical data services to the multitude of public safety agencies across the US. As part of the interoperability requirements for FirstNet, the network must be interoperable between the various jurisdictions and agencies (of which there are more than 9,000), as well as with their voice LMR services. It is expected that the first national FirstNet networks will start to be built and come on line from 2018.

Given the size and scale of FirstNet and the number of agencies involved (more than 9,000 public safety agencies are expected to eventually use the service), it is expected that the service will generate a competitive, robust and innovative market of equipment and service suppliers. However, as FirstNet will operate on 700 MHz spectrum, any benefits for Australian agencies to leverage this rich ecosystem of variety, competition and innovation will be diminished should spectrum in an alternate band be allocated.

Belgium

The Belgian ASTRID network operator in April 2014 confirmed that it would develop a PSMB capability that will utilise the country's three existing MNOs[12]. Under the model, a single SIM card will give public safety workers priority access to whichever of the three networks is available at a particular location and point in time.

There are a number of issues that would make such a model difficult in Australia. Belgium is a geographically small and flat country with a very high population density. The three MNOs operating in the country have very similar footprints.

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[11] http://www.budget.gc.ca/2015/docs/plan/ch4-3-eng.html#_Toc417204369 'Improving public safety communications'
[12] http://www.astrid.be/templates/content.aspx?id=7058&LangType=1033

The Australian experience is very different. The coverage footprint of the various MNOs in Australia vary significantly. There are large areas of the country where no coverage is provided by any commercial carrier. For those remote and regional areas where coverage is provided there is generally only one or possibly two operators.

The lack of universal MNO coverage means that Australia would be unable to benefit from the competition experienced in Belgium. The uneven coverage distribution of networks to support PSMB roaming means that Australia would also not be able to rely on the redundancy produced by three separate commercial networks operating at any one time.

In addition, there are a number of technical complexities arising from the Belgian model. In particular, 'roaming' across the various MNOs will not be seamless. Network roaming will cause a call to be disconnected at the time a handset moves from one network to another and the call restarted. In the case of data, this could mean a pause in the data transfer or, at worst, a requirement to start the transfer again. In the case of voice, the call will be stopped and will need to be restarted. It is for these reasons that Belgium will only use ASTRID operated 'Blue Light' network for data services and these will be offered at 'best effort' levels rather than mission critical.

United Kingdom (UK)

The UK Government has already advanced on the development of a PSMB solution. However, its approach is substantially different to that of other jurisdictions. In particular, the UK is seeking to use commercial mobile networks, with no new specific spectrum allocated.

It was originally proposed by the UK Government that a PSMB service could be offered across the three MNOs operating in that country. While there are a number of factors that led to the UK Government's decision to use a commercial service, a key issue was the lack of spectrum available for the deployment of a standalone dedicated service. Like Belgium, the size, population density and topography of the UK means that there is almost universal coverage by all three MNOs. However, over time the number of interested parties seeking to tender for the PSMB service has reduced, with the MNO O2 withdrawing from the tender process in June 2015 citing 'commercial reasons'[13].

A key factor driving the UK Government's decision to use a commercial service is a need to find a replacement for its current land mobile radio mission critical communication service, the outsourced Airwave Network service provided under contract, which is expensive to use. The UK Government is hampered in its ability to find an alternate solution to the Airwave Network as it no longer controls the spectrum on which the network operates. As it is unable to use the spectrum to source another provider, it must rely on a continued arrangement with Airwave or seek a new

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[13] http://telecoms.com/424831/o2-out-of-uk-emergency-services-lte-tender-ee-lone-runner/

solution through a service provider that owns spectrum that may be suitable, such as the various MNOs.

The reduction in the number of commercial providers, and the lack of spectrum to use in seeking an alternative service, means that the issues experienced in relation to land mobile radio, i.e. being locked into a single supplier, are at risk of occurring in relation to a UK PSMB service.

In addition to the commercial risks, the UK is currently planning to start offering its PSMB service by 2017 prior to the adoption of international standards for LTE, particularly for voice services over 4G. There are a number of risks to this approach, particularly around the adoption of technology that has not yet been standardised and the appropriateness of not having a dedicated communications resource for public safety purposes.

This view has been reiterated by the Radio Communications Expert Group of the European Law Enforcement Working Party in a report it prepared on why public safety agencies in various critical events will be unable to rely on commercial networks given the high levels of congestion[14]. The report concluded that public protection and disaster relief (PPDR - public safety) agencies need to define and manage their networks in terms of coverage, capacity and quality of service, as well as ad-hoc deployments in order for them to be reliable.

The experience of the UK Government and its decision to not retain public safety agency control of the spectrum used for mission critical communications must be considered fully when determining how spectrum should be allocated in Australia.

What should a PSMB capability look like?

Key features of a PSMB capability

As noted previously, there are a number of features of a PSMB capability that are required in order for it to be fit for purpose.   These include that it be:

- *Nationally interoperable* – public safety workers across jurisdictions and across agencies must be able to communicate during operations, and workers must be able to move between jurisdictions when needed without having to be issued with new terminals.
- *A highly available and resilient mission critical architecture* – given that the protection of life and critical property may be at risk, and to protect public safety workers during the conduct of their duties.
- *Able to cope with regular, prolonged spikes in demand through adequate capacity and redundancy-* particularly in major urban areas or during significant natural disasters.
- *Scalable* – Users will require the availability of different types of data and voice communications at different times, regardless of whether they are an Ambulance

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[14] LEWP-RCEG + PT49 Report: Public Protection and Disaster Relief (PPDR) need for dedicated communications and why they cannot rely on public systems for mission critical communications

paramedic responding to a small, contained patient incident, or a major Police and emergency services operation following a natural disaster.

- *Secure* – the network must not have vulnerabilities which may be exploited during cyber or physical attack, compromising data confidentiality, integrity or service availability.
- *Have appropriate levels of coverage* – a PSMB service must be able to cover the entire population, areas where people travel (such as highways, tourist destinations, hiking trails) or where a response is likely to be required (such as in flood areas, areas prone to bushfires, etc.).

Determining demand and benefits

The level of demand for data and voice services is critical in planning and dimensioning a PSMB service, with the required specifications needing to be determined in advance to define the configuration of the network and its cost. While at present, given the relative immaturity of PSMB technology, applications and services it is difficult to be able to fully anticipate the level of demand such a service will create, however, we can be guided by a number of factors.

As part of its assessment of potential costs and benefits of PSMB capability in NSW, the Telco Authority has carried out estimates on the costs for a number of different delivery models. As part of this work the Authority made a number of assumptions that it considers key or minimal for a PSMB service. These basic parameters include:

- A PSMB capability will over time carry both voice and data services.
- The technology and the operational support it can offer has progressed since the reports that were produced for the Public Safety Mobile Broadband Steering Committee. It is now recognised that in order for data services to be effective, data throughput of a minimum 256kb/s at the cell margin is required, with much higher levels towards the centre of a cell (up to 10MB/s). 256kb is required in order to stream standard definition video that is of sufficient quality as to be useable by officers in the field.
- Data usage has been conservatively estimated to multiply steadily and modestly over the first five years after adoption of a PSMB service, and then increase more rapidly over subsequent years. This assumption follows the take up and data usage patterns for a range of mobile data services.

A key factor to consider when determining the dimensioning and design of a PSMB network or service is the amount of spectrum allocated. Smaller segments of spectrum could lead to a higher density of cells to meet the same demand profile. This increases costs and will have a significant impact on the overall investment required. Larger segments of spectrum are also required in order to allow enough capacity to cater for the expected demand increase, particularly for data, as new tools to assist public safety workers to better respond to incidents and protect the community become available.

As part of its modelling of the forecast demand for PSMB services in conjunction with Bell labs, the NSW Telco Authority has undertaken a bottom up forecast of agency data requirements for mobile applications. This analysis was based on currently available mobile applications that are in use by public safety agencies around the world, and that are likely to be used when PSMB becomes available as confirmed by NSW agencies. Based on the specific applications requirements, and an activity estimates of these applications, the following data usage was used in the NSW Government forecast:

1. Average wireless data usage of 268 MB per public safety agency user per month assuming a PSMB start date of 2018. Note that this estimate is considered conservative when compared to forecasts from Cisco for 2.7GB per user per month by 2017[15].

2. Forecast split between each public safety agency for wireless data usage

Agency	Split (%)
NSW State Emergency Service	25
NSW Police	31
Fire and Rescue NSW	11
Ambulance Service of NSW	28
NSW Rural Fire Service	5

The NSW forecast then applied consumer growth forecasts that are in line with those used in a number of international jurisdictions based on the introduction of LTE. This includes the publicly available forecast by realwireless for Ofcom[16].

Options for the delivery of PSMB

The Productivity Commission has proposed investigating two 'bookend' delivery models and a hybrid model in its Issues Paper.

The actual number of models for PSMB is extensive. Even at the 'bookends' there is a level of complexity that will need to be explored by the Commission in greater detail. For example, in the case of a fully commercially provided service, there are a number of variances depending on: how spectrum is allocated; whether an existing MNO network or networks are used; how a service will be delivered across a network whether an existing MNO network, another privately owned or operated wireless network, or via some other means.

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[15] Cisco, 6 February 2013: Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017
[16] realwireless "Techniques for increasing the capacity of wireless broadband networks: UK, 2012-2030" April 2012

The Telco Authority has undertaken extensive modelling on the cost of implementing a number of bookend and hybrid options. This information will be provided to the Productivity Commission on a commercial in confidence basis.

Commercial network solution

The Productivity Commission in its Issues Paper has provided an example of what it considers might constitute a commercial network solution, namely:

- Public safety agencies would purchase a PSMB capability as a service from commercial operators at agreed service levels

- Commercial providers would draw upon their own networks and resources to meet their contractual obligations

- Commercial providers would need to augment or harden parts of their networks to meet PSMB requirements

The most commonly referenced model would see a PSMB capability being delivered by a single MNO or a number of MNOs using existing networks and infrastructure, with additional investment to extend coverage to at least the same footprint as existing mission critical land mobile radio services. A proposal outlined by one MNO would see the MNO increase the capacity of its network and provide dedicated spectrum for use by public safety agencies, with the capacity to overflow onto commercial spectrum if required. When the public safety spectrum is not being used heavily, it would be available for the MNO to use for commercial services.

However, there are other options available including a commercial service provider building a dedicated purpose-built service for use by public safety agencies, or a commercial provider managing existing state and territory owned infrastructure with a view to installing PSMB equipment on some of the infrastructure in order to provide a service in non-metropolitan areas.

Whatever the configuration of a commercially provided service, from a public safety agency perspective, there are a number of features that would need to be considered and costed in order to make a commercial service a viable option. These include:

- Spectrum – States and territories will bear many of the risks associated with the delivery of PSMB and spectrum is one of the most significant inputs to delivering this service. If a commercial service has control over the spectrum, with the MNO being allocated spectrum at a commercial rate, the costs of that spectrum, and any network adjustments for PSMB that will also benefit the MNO, will eventually be shifted to state and territory taxpayers via higher service fees. We would request the Productivity Commission to consider whether state/territory control of spectrum may be a solution to address this issue.

- Mission critical – that the network is able to provide mission critical grade services. It is understood that in the case of Australian MNOs this would include improving alternate supplies of power such as generators and battery back-up, providing a timely maintenance service when a site goes down (including in regional and remote areas), having sufficient stock of spare equipment available if required, having in place disaster recovery plans that guarantee restoration timeframes required by public safety agencies, and increasing security for sites and equipment and address flood and fire issues, particularly in regional and remote areas.

- Priority – that priority be given to public safety communications during an emergency, without unduly restricting community access to triple zero and emergency alert services, nor access alternate paths for notifying emergency services and providing valuable intelligence to promote effective response via a range of channels including social media and smartphone 'apps'.

- Secure – that confidential information with law enforcement, national security, officer safety and community privacy implications can be transmitted securely. There should also be no ability for a carrier to identify and track location of covert operatives.

- Competitive market – the market for the supply of a PSMB capability must be mature enough to allow for enduring competition and disaggregation (where appropriate) so that public safety agencies are able to bring market pressure when seeking to buy a service.

- Contestability – public safety agencies must not be put in a position where they are locked in to a particular supplier. Suitable viable alternatives must be available in circumstances where service levels are not met or when negotiating or renewing arrangements in order to bring market pressure to bear.

- Regulated – were a commercial PSMB service is provided, there would be a need for regulation. This feature is explored further below.

If there is an absence of any one of the above requirements for a PSMB capability, the ability of the states and territories to obtain a fair deal and a reliable and effective mission critical service may be hampered.

In the case of not allocating spectrum to public safety agencies, there is a strong risk of market failure and exploitation if the provider of a service also has control of the spectrum, as evidenced by the UK experience. In such circumstances public safety agencies would not be able to seek an alternative service provider as there would be no spectrum available for them to use. Essentially they would be locked in to one supplier over a long term period creating uncertainty about what services will be provided in the future and at what price, combined with an inability

to seek alternative solutions where service level agreements are not met (particularly where a service provider is willing to absorb penalties, etc. into its costs of doing business).

The Telco Authority engaged Frontier Economics to consider how best to maximise competition and efficiency in the delivery of PSMB[17]. Frontier Economics found that a key factor in the market failure in the UK for the provision of land mobile radio services was the decision to allocate spectrum to a commercial provider and to allow the commercial provider to build an 'end-to-end' network.

In this case the UK Government was essentially locked in to an expensive long-term contract where it was unable to disaggregate certain parts of the service stack that would likely respond to competition (as there was a single whole of network provider), nor was it able to negotiate the provision of a service with another supplier as the spectrum required was allocated to the network owner. At the time, the UK Government was unable to foresee the levels of demand that would be required for a mission critical service, how that would affect the costs and benefits of such a service, and what a monopoly market would provide for in future charges and service provision at the time of contract renewal. It is for these reasons that the UK Government is seeking to roll out a PSMB service early.

Tellingly, Frontier Economics found that market power is most likely to be a problem if the Federal Government were to call for tenders for a single supplier to supply the PSMB for the whole of Australia. In addition, any disaggregation of services (whether by the states or within states) will require the party that coordinates the contracting to also be the party that controls access to the relevant spectrum[18].

Finally, Frontier Economics notes in relation to the market failure in the UK, which is largely due to the uncertainty of requirements, 'in a world in which uncertainty is present to a non-trivial degree, parties to a contract cannot know the future. Because of bounds to their rationality, they cannot allow for all possible contingencies in a contract, and because people behave opportunistically, long-term contracting is dangerous'[19]. We would request that the Productivity Commission considers what options may be available to address this issue.

If the Productivity Commission were to recommend that a service that is purchased from a single or duopoly of MNOs and allocates spectrum to an MNO for PSMB purposes, the Telco Authority considers that a strong regulatory regime would need to be put in place. Regulation would help to contain prices in a market with no competition, help to manage long term uncertainty and compel a service provider to meet service level requirements that they would otherwise not achieve as they are commercially unviable or it is less costly to simply pay a penalty. This already

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[17] Frontier Economics: Maximising competition and efficiency in the delivery of PSMB – Telco Authority May 2015
[18] Frontier Economics: Maximising competition and efficiency in the delivery of PSMB – Telco Authority May 2015
[19] Frontier Economics: Maximising competition and efficiency in the delivery of PSMB – Telco Authority May 2015

occurs for a number of monopoly markets (including for MNOs which are subject to licensing and Australian Competition and Consumer Commission requirements (particularly for wholesale services offered by a vertically integrated provider), and universal service obligations), with the regulator able to enforce service levels and set prices. It is expected that a similar arrangement would be required for a PSMB capability.

Having said this, as considered by Frontier Economics, such an arrangement is not considered preferable, and avoiding a situation where regulation would be required is a better outcome[20]. Even with a level of disaggregation and public safety agency spectrum control (or in the absence of either, a regulated market), a requirement to use a commercial service would still be characterised by a strong market balance bias towards the MNOs.

In relation to maintaining a mission critical service, it is understood that significant effort would be required to 'harden' (i.e. bring them to mission critical level) commercial networks to make them suitable for public safety agency use. As recently as June and July 2015, one MNO experienced significant network outages that lasted for several hours and resulted in mobile call drop outs and difficulties for mobile phone users to make calls[21]. If a similar incident were to happen during a critical incident or if a network were to be crippled by congestion, the effects on the safety of and the ability for frontline emergency services workers to do their jobs would be severe.

The costs of hardening a MNO network would need to be considered by the Commission as part of its wider deliberations; along with the cost shift of network improvements that will ultimately benefit the MNO to state and territory governments (and subsequently the community and taxpayers) through the prices charged for PSMB. Not only do network sites need to be upgraded and redundancy and availability increased to a mission critical level, but so do backhaul and network core and control services. In addition, MNOs would need to ensure that they have the capability and manpower so that site repairs and maintenance are done in a matter of hours, including in rural and remote areas.

Finally, it is essential that any PSMB service provide priority to public safety workers. This can be achieved most effectively by providing a dedicated network whether commercially run or not. A PSMB network in NSW would have tens of thousands of users compared to a MNO service which can have millions of registered handsets. The risk of congestion and the need to prioritise public safety agency access is mitigated by having a dedicated network.

It is noted that one option being considered by the Productivity Commission involves a commercial operator setting aside parts of its network for use by public safety agencies for

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[20] Frontier Economics: Maximising competition and efficiency in the delivery of PSMB – Telco Authority May 2015
[21] http://www.smh.com.au/business/optus-hit-by-major-outage-in-nsw-20150623-ghvepe.html
http://www.smh.com.au/digital-life/mobiles/optus-suffers-major-mobile-network-outage-in-nsw-victoria-and-tasmania-20150724-gik0sr.html

business as usual functions (such as the many calls responded to by Police and Ambulance every day) with the capability to overflow to spectrum used for commercial purposes during a spike in demand such as when responding to a natural disaster or some other incident.

The Telco Authority has two concerns with this approach. Firstly, the proposed model only deals with making spectrum and cell access available to public safety agencies as a priority. It does not deal with those circumstances where a public safety worker is unable to connect to the network in periods of congestion in order to be prioritised. Although technically feasible, it is also unclear how this model deals with how priority along backhaul networks and with the mobile network will be achieved once a call is established.

Secondly, pushing citizens off the network may result in a person needing assistance or having valuable intelligence for public safety agencies not being able to make contact, nor will public safety agencies be able to send out updates and warnings. While there may be some benefit in also prioritising triple zero and emergency alert services, the reality is that crucial video, photographs and updates of an incident are now shared and disseminated via social media networks rather than traditional emergency contact channels. Likewise, people now use the NSW Rural Fire Services Fires Near Me app to gain updates on fires in their local area. To put this in to perspective, during severe bush fires between 13-26 October 2013 in NSW, the NSW Rural Fire Service had 5.7m visitors to its website with 14.1m page views, 24.2m impressions on its twitter feed, 108.4m impressions on its Facebook page, 46,545 calls to its Bush Fire Information Line, 188,000 new downloads of its Fire Near Me app and 219,000 searches per hour from this app during the peak of the incident[22]. As a further example, the CSIROF has undertaken extensive work to monitor social media such as Twitter to detect trends of incidents so that emergency services and law enforcement agencies can be notified. All of these benefits would be lost if citizens were unable to connect to a communications network during a major incident.

Dedicated PSMB network (including where delivered as a commercial offering)

The Productivity Commission has noted that a dedicated PSMB network might have the following attributes:

- deploying dedicated network infrastructure and systems (potentially, but not necessarily owned and controlled by public safety agencies or another government entity)

- the allocation of dedicated spectrum (potentially for exclusive use), and

- reuse of elements of existing public safety agency narrowband networks

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[22] http://melbourne.comms-connect.com.au/pages/2014-presentations-sydney

Like with a commercially provided network, there are a number of 'shades' to a dedicated PSMB network. Also, as with a commercial service, there are number of benefits and costs for a dedicated PSMB network, including one that is owned and operated by government.

A fully government owned, operated PSMB capability, with spectrum owned by the network provider presents opportunity cost dilemmas:

- The opportunity cost of providing spectrum for this purpose alone

- The opportunity cost for state and territory governments in investing heavily in a full PSMB network

On the positive side, the spectrum could eventually be used also for non-public safety purposes by other government agencies, or it could, in limited circumstances, provide an emergency triple zero call service in very remote parts of Australia where MNOs do not operate as commercial returns are insufficient and where congestion is not likely to be an issue.

There are a number of other possibilities that could also be considered to enhance the benefits of a dedicated PSMB network. These, along with the examples above need to be considered by the Productivity Commission along with any negative impacts.

The Productivity Commission also needs to fully consider the different mixes of a dedicated network, such as infrastructure and spectrum owned by public safety agencies that is operated by a commercial provider or providers, a publicly owned network that is disaggregated with different operators providing segments of the service stack and a dedicated network that is commercially owned and operated, with states and territories retaining control of the spectrum.

Hybrid model

As with the two previous models, there are numerous variations for a hybrid model. It is likely that a hybrid model will ultimately be deployed in Australia, gaining the best aspects of existing MNO and public safety agency infrastructure, and balancing the needs of higher population densities in the cities and larger town centres against the low density population and lower demand anticipated in rural and remote areas.

Which model?

Prior to undertaking its own cost benefits analysis on the delivery of a PSMB capability in NSW, the Telco Authority considered that whichever model is selected, it is important that it meets the underlying principles for a PSMB service, provides a mission critical service, is highly available and reliable, and that it meets the business requirements set out earlier in this document, i.e.:

- that it represents value for money both in the short term as well as the long term

- that long term contracts and the uncertainty they create are not a part of the offering

- that spectrum is controlled by state and territory governments

- that it is secure and resilient, and

- that there is a high level of competition and contestability in the marketplace or that strong regulation is in place.

In keeping with these principles, the Authority has considered a number of options for the delivery of PSMB within NSW, including a government-built network, the buying of a mission critical commercial offering and a number of hybrids, including:

- providing a dedicated PSMB network in the Greater Metropolitan Area (GMA - Sydney, Newcastle and Wollongong) with mission critical services provided by a commercial operator in regional and rural areas

- providing a dedicated PSMB network in the GMA with mission critical LMR voice and business grade data in regional and rural areas, and

- retaining LMR services for mission critical voice communications and buying a business grade data service across the entire State.

The Telco Authority will make its costings and data on both the preferred model as well as the various other iterations available to the Productivity Commission for its consideration on a confidential basis given its commercial in confidence nature.

Specific issues for comment

Question 1

What is the merits (or otherwise) of the proposed approach to undertaking first principles analysis in this study?

The Telco Authority notes that extensive work on the foundations for a PMSB capability has already been carried out at a national level, resulting in previously awarding of spectrum and establishment of governance arrangements for specifying a network. Nevertheless, a first principles analysis may provide further insight in to the delivery of a PSMB capability.

As has already occurred in NSW with the undertaking of a state-based costs and benefits analysis, it is good governance for each state and territory to determine the merits and benefits of a PSMB capability for their own jurisdiction, with a nationally cooperative approach to ensure common standards and platforms to allow for interoperability, as already occurs for mission critical land mobile radio services.

Question 2

What domestic or international developments, reports or experiences in PSMB (or related matters) are relevant to consider in this study?

As noted earlier in this document, there are a number of studies that clearly demonstrate the need for a PSMB capability, the need for spectrum to be allocated to public safety agencies, and outlining the benefits such a service could provide to the Australian community and national economy.

The Telco Authority takes a view that the many similarities between Australia, Canada and the US mean that the experiences in those countries are of particular relevance. While the Canadian situation is particularly aligned with the Australian experience, the benefits of following the US in respect of the spectrum allocated, the systems used and the network specifications include being able to buy off the shelf equipment from a variety of suppliers in a competitive market, thereby achieving better value for money. Likewise, the experiences of market failure and the subsequent negative effects of not allocating spectrum to public safety agencies in the UK also warrant close consideration.

Question 3

What are the implications (if any) of the Australian Government's review of spectrum policy and management framework, and ACMA's ongoing work on spectrum allocation matters, for the delivery of PSMB in Australia?

The Commonwealth Government recently released the report from its review of spectrum management arrangements. Given the role of the Minister and Department of Communications and the ACMA in regulating and allocating spectrum, the Spectrum Review has significant implications for the work of the Productivity Commission.

The Commonwealth Spectrum Review seeks to improve licensing by reducing red tape, increasing transparency and devolving certain spectrum management arrangements for bands to licensees and band managers.

It is noted that in addition to devolving responsibility to band managers as much as is possible, the Review also found that the use of state and territory spectrum holdings is different to that of commercial and amateur services and that there are alternative ways of ensuring that spectrum is used efficiently and effectively[23]. These alternative ways include through the use of nationally agreed principles around public safety wireless communications. Already, states and territories manage their own dedicated spectrum holdings in the 400 MHz band government harmonised

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[23] https://www.communications.gov.au/publications/spectrum-review-report

segments. The ACMA has also approached the states and territories about further devolving spectrum licensing responsibilities.

The decision of the NSW Government in 2010 to take a whole of sector approach to the management of its operational communications sector and establish the Telco Authority as a central policy coordination and reform agency means that this State is advanced in how it manages spectrum and achieves efficiency improvements.

The Productivity Commission should give due consideration to the move towards reducing red tape and regulation and devolving responsibility for spectrum management, as set out in the Spectrum Review and the ACMA in relation to its long-term licensing strategy, and not be prescriptive in how spectrum allocated for PSMB purposes should be used or managed by the states and territories.

Question 4

Are there any other PSAs that should be considered within scope of this study? To what extent are communications between PSAs and the community relevant to this study?

In relation to part 1 of this question, the Telco Authority notes the broader role non public safety agencies play as part of an overall emergency response. For example, in an urban emergency, coordination of power outages, transport for evacuation, and health and welfare services for people who are adversely affected all play a significant role in the emergency response. Creating a seamless one stop network with interoperable equipment that can be used by all agencies involved in an emergency response has obvious benefits. Furthermore, it is the Authority's view that the 'mission critical' nature of wireless services required by essential service providers are very similar to those required by PSA. This presents further opportunity to realise benefit from a mission-critical mobile broadband capability.

The Telco Authority also takes a view that communications between the community and public safety agencies have a significant role to play. As mentioned earlier in this document, the community is a growing source of intelligence for public safety agencies when responding to an incident.

Crowd sourced video, photographs and reports of what is happening at the scene, for example, can be helpful to emergency responders and will become a critical component of an emergency response. For example, there is a tendency for members of the public to 'tweet' about an incident rather than ring triple zero on the basis that someone else will have already reported it (the bystander phenomenon) meaning that public safety agencies can gain an early warning that a public disturbance or other event is underway long before it is reported through conventional channels.

In addition, the community, through alerts, website updates and push notifications in apps, etc., is able to receive information directly from public safety agencies (rather than relying on community television and radio broadcasts) in order to make informed decisions on the best way to protect their families and property, including when to evacuate, etc. As noted previously in this submission, the figures describing the public's use of social media and mobile 'apps' during the October 2013 fires in NSW to communicate with the NSW Rural Fire Service demonstrates how reliant we have all become on these mediums for communication during major incidents.

For the above reasons, it is essential that the Productivity Commission consider the communication links between public safety agencies and the community when exploring options for prioritising public safety access to a commercial network and what levels of congestion on a commercial network are bearable given that the community has a significant contribution to make.

Question 5

How do organisational and institutional arrangements for PSAs vary between the Australian jurisdictions? What implications (if any) does this have for the way in which PSAs procure, operate and use communications services?

The organisational and institutional arrangements in each state and territory should not be a driver for the configuration of a PSMB capability. Jurisdictional arrangements can be and are varied regularly to better align with key priorities and new ways of doing business. Whatever design is ultimately decided for a PSMB capability, states and territories will configure their institutional arrangements, and other service delivery enablers to provide the best available service to citizens in a way that achieves value for money.

Ultimately, the key drivers for a PSMB capability remain that it be nationally interoperable, with consistent standards across the country. Interoperability and standardisation in themselves, will provide a way of addressing any differences there may be in institutional arrangements as they allow all public safety workers to communicate via a common platform.

Question 6

What is an appropriate definition of 'mission critical' communications systems and capability for the purposes of this study? What metrics should be used to assess whether capability is being delivered to adequate levels during mission critical circumstances? What evidence is there that existing capabilities are satisfactory or unsatisfactory?

A key 'line in the sand' for NSW public safety agencies in the delivery of a PSMB capability is that whatever service is ultimately provided they are no worse off than the service levels they

currently experience for mission critical voice services. Agencies must have confidence that when required, their communications devices will work and work well. This confidence is achieved by ensuring that communications are available anywhere and at any time, and this level of availability can only be achieved through mission critical service levels.

As outlined earlier in this document in the section 'What is mission critical?', public safety agencies currently have mission critical communications services (both voice and narrowband data) that are generally available 99.99% of the time. Effort to improve availability to the optimal level of 99.999% is continuing. These services also have multiple failure modes which reduce the impact when the network is unavailable. For example, when the network is unavailable due to a failure of backhaul links to a radio site, the site is still able to switch calls within its local coverage footprint. It is expected that an identical level of service would be provided by a PSMB capability.

A key issue for consideration by the Productivity Commission in determining the costs of delivering a PSMB capability would be the expenses incurred by MNOs in order to harden their networks to provide 99.99-99.999% availability. Hardening measures, such as the installation of generator power and battery backup, along with much more proactive and timelier maintenance arrangements are expensive to implement. As the support services to provide mission critical levels are not generally used by MNOs on a widespread basis it can be expected to add a considerable cost load to their operations.

While network operators generally indicate that they will upgrade their equipment to meet the needs of their client, little data is available as to the overall expense for a network wide hardening process. In order to garner the same level of confidence that agencies experience with existing voice LMR services, it is the Authority's experience that MNOs would need to provide detailed network architectural information on their networks and any details of hardening activities. In addition there would have to be confidence that MNOs are able and willing to achieve the required service levels, and that there is an appropriate contract management and regulatory framework in place to ensure that they do, with the results being made available to all customers. Contracted service levels alone simply would not suffice as experience has shown that this often does not result in acceptable performance. Finally, public safety agencies would need to be intimately involved in any decisions to change the network to ensure confidence that service levels will not be adversely affected.

Question 7

What applications do PSAs currently use on their LMR networks that are provided for mission critical purposes? Does this differ by jurisdiction?

NSW agencies currently use land mobile radio for a number of mission critical services, including:

- duress alarms
- voice communications
- narrowband data for a variety of uses such as computer aided dispatch, paging first responders, situational awareness, asset location tracking, text messaging, etc.

Question 8

How often are PSA narrowband networks (such as LMR networks) renewed or upgraded, and to what extent are different jurisdictions at different points in this process? What are the costs involved in maintaining these networks?

The Government Radio Network, which is owned by the Telco Authority, is a shared trunked digital P25 network with around 30 different agencies using the service. Separately, a number of public safety agencies also operate their own private mobile radio networks. The Telco Authority has a remit from the NSW Government to work towards removing duplication and inefficiency across all networks. To this end, the Authority has started planning to rationalise existing networks and eventually integrate the Government Radio Network with other networks including the NSW Police Radio Network to create a single managed shared network[24].

To assist with this rationalisation work, the Telco Authority has developed a longer-term Technology Roadmap. The Roadmap will eventually see a migration towards a PSMB service for firstly data from 2018 and voice from 2019, with less critical voice services migrating first until confidence in the ability to provide mission critical voice services over LTE is established. Given these timeframes, it is expected that as part of the overall effort to rationalise assets and infrastructure, a partial refresh of existing networks and assets will be carried out in order to ensure that integration is successful.

Question 9

How do the different types of events that PSAs deal with affect their demand for communications capabilities? Can you provide examples or evidence to illustrate this?

There are a number of recent high profile incidents in NSW that could have benefited from the deployment of a PSMB capability. For the Sydney CBD siege in December 2014, NSW Police had to rely on the fortuitously located Channel 7 facilities to obtain high quality live video of events unfolding in the siege location. Had the Channel 7 News facilities located across from Martin Place not been available, obtaining an enduring and reliable video feed of the scene would have been much more difficult. This unfortunate type of incident provides a definitive use case for a PSMB capability which would have allowed a live, high quality, highly available (uninterrupted or slowed or subject to possible congestion on commercial networks) video feed

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[24] http://arp.nsw.gov.au/ofs-2014-02-nsw-government-radio-communications-strategy

from the site using technology that is already available. Likewise, by allowing public safety agencies to carry out their high data use activities on a dedicated network uninterrupted, there would be no need for members of the community to be 'kicked off' their commercial network meaning that public safety agencies can continue to receive community sourced intelligence.

Another recent example of where a PSMB capability would have been of assistance are the 2015 storms experienced by communities along the northern and central coastal areas of NSW. PSMB services to assist emergency crews in their flood planning and modelling on site, as well as in coordinating rescue efforts using remotely piloted aircraft, high quality maps and other geospatial information would have been invaluable.

The Australian community has been experiencing a series of 'once in 100 year' events that have occurred one after another over recent years including 2009 Victorian Bushfires, the 2010/11 Queensland Floods and the October 2013 NSW Bushfires. Planning for these low probability, high consequence events is as vital as the regular work of public safety agencies, particularly the day to day efforts of police to fight crime and assist the community and ambulances services to provide emergency paramedic services to hundreds of thousands of Australians each year.

Question 10

How, and to what extent, are PSAs using mobile broadband capability provided over commercial networks, and related products and applications, to support their operational activities? Are there any lessons or insights from these experiences, including the benefits that are being realised?

In NSW, public safety agencies only use commercial mobile broadband for non-mission critical services. It cannot be assumed that the data applications would be used in the same way under a PSMB scenario. At present, data services and agency standard operating practices are designed around the fact that these data services may not be available at all times and that they cannot be relied upon and used to protect life or property. When in a critical incident communications always fall back to mission critical voice and narrowband data services.

For these reasons, the Productivity Commission could use existing data services as some type of guide as to the types of services that would be used on a PSMB capability; however, the correlation is limited. It is likely that the key use of data on a PSMB network will be video which requires a lot of bandwidth, and which has limited use at the present time. In addition, over time, as new applications are developed in response to the needs of public safety agencies, other applications that use data broadband services will become available. In the past five years the number of data intensive health based applications has grown significantly and in 2010 it would have been impossible to predict many of those applications or how much bandwidth they

would require. Therefore, any estimation the Productivity Commission makes about future data use will need to take into account these areas of likely exponential growth.

Question 11

How do other organisations (such as government and corporate organisations with certain requirements which may be similar to those of PSAs) currently use mobile broadband services on commercial networks?

Public safety agencies (which are government bodies) have mission critical business needs for both voice and data communications. Other organisations do not require mission critical services and so a comparison of how they use mobile broadband is not relevant. Where a non-mission critical service fails there is a loss of revenue and inconvenience, something most organisations are willing to tolerate, and so they opt to buy a business critical service. Where a mission critical service fails the implications are much more serious, including loss of life.

Possibly the closest example to organisations with public safety-like requirements are the essential service providers. These organisations, such as electricity transmission and distribution companies do use commercial mobile broadband services in some contexts. For example, electricity distributors in NSW use commercial mobile broadband services for remote monitoring and control of electrical assets (11kV and below). Although there are rare exceptions, generally this is limited to lower voltages in the distribution network where the impact of a failure of commercial networks is limited to small numbers of customers. Where communications are mission critical (for example differential protection schemes which isolate the high voltage network in the case of an earth fault), commercial services are not used because they cannot be relied upon.   Rather communication is via dedicated fibre optic and microwave links. These networks are built with high degrees of redundancy.

Question 12

What lessons or insights can be taken from the previous trials of Telstra's LANES model, including during the G20 summit in November 2014?

No public information, such as summary reports is available on the performance of the service. It is noted that the G20 summit and the deployed communications services were delivered in very unique localised circumstances. The Telstra LANES service was purpose built and resourced on the basis that it could not fail given the international reputational implications for the Commonwealth and Queensland Governments and Telstra, and that it operated in a very small area on a purpose built network on days that were declared as public holidays and at a time when, anecdotally, it is understood that many residents and local workers stayed away from the area. The very unique circumstances around the demonstration of this service make it irrelevant

in determining what would happen in a wider context or where any of the elements are different.

It should also be noted that jurisdictions have not been able to acquire any relevant information about the LANES deployment to support the G20 summit that could be factored in to a decision making process.

Question 13

Can commercial network solutions that involve dedicated spectrum for PSAs (and prioritised capacity in other spectrum bands during emergency incidents) allow for interoperability between networks operated by other mobile carriers and/or for end user to roam across multiple networks? Are there any technical, institutional or commercial barriers that would prevent this outcome?

The PSMB Steering Committee's Overflow Capability Sub-Group considered these issues in its 2013 final report[25]. At the time the Sub-Group found that there was industry support to work with Government on providing overflow and roaming support between a PSMB network and commercial mobile services. However, the Sub-Group also found that there were a number of technical issues - particularly regarding capacity overflow - but also with roaming.

These technical issues are still present today, and have been identified as issues in the Belgian efforts to allow for PSMB to be delivered across a MVNO network using that country's existing carriers. The most significant technical issue relates to the 'hand over' of calls and the maintenance of a session (whether or voice or data) as network boundaries are crossed.

For a number of reasons (including technical, policy and commercial), calls are ended as a handset moves out of a network's footprint and must be re-initiated using the new network. In the case of data, depending on the application used, there may be a delay (of multiple seconds rather than milliseconds) as a new connection is made and upload or download resumes, or the disconnection could result in a stopping of the data transfer altogether. In the case of voice calls, the call will end, and a new call is required.

The cost and complexity of addressing these issues, and their commercial impact on network operators makes it unlikely that MNOs in Australia would be willing to support roaming and capacity overflow at a reasonable cost. This is the case in Belgium where hand over will be undertaken via the disconnect and then reconnect method. For these reasons Belgium is retaining mobile radio for mission critical voice and offering a 'best efforts' service for data across the "Blue Light" network.

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[25] PSMB Steering Committee Overflow Capability Sub-Group report: Supplementing Capabilities for a Public safety Mobile Broadband Network – Overflow Capabilities Sub-Group Report (Oct 2013)

Question 14

What applications could PSAs use if they had access to a PSMB capability? How could this be expected to vary across PSAs?

As part of its work on analysing the costs and benefits of a PSMB capability for NSW, the Telco Authority has conducted a survey of currently available applications. The full list of applications identified will be provided to the Commission as part of the package of information arising from the analysis that will be submitted to the Study.

The number of applications identified by the Telco Authority can broadly fall into four main groups:

- field information access and capture

- video

- dispatching and monitoring, and

- logistical.

By category of public safety agency, the various applications include:

- Ambulance – patient information checking, electronic patient reporting, videoconferencing between paramedics and hospitals, parties triage, status updating, drone services for delivery of equipment such as defibrillators to a scene, and vital signs/biometric monitoring using sensors.

- Rural fires – Fire location information and trends (including map displays), weather information, surveillance video for high risk locations, helmet mounted video cameras, personnel locations, and fire alerts to the public.

- Metro fires – field inspection report capture, venue information, field access to airborne video stream (e.g. remotely piloted aircraft), vehicle location, environmental sensors, and firefighter distress unit.

- Emergency services - disaster impact information, weather information, real time video of emergency situations, water level monitoring sensors, and flood and storm alerts to the public.

- Police – event/intelligence data access and capture, biometric/pattern identification, heads-up display, officer video camera, surveillance video, and automatic vehicle and officer location.

It is expected that the types of applications will grow as the PSMB market matures and more agencies both in Australia and worldwide deploy the technology. Overtime, it is also anticipated that video applications, both for intelligence gathering and evidence collection purposes will be a significant driver of application development and PSMB usage.

Question 15

To what extent could these applications replace or supplement the capability and systems currently used by PSAs on their narrowband networks?

Services currently provided over existing mission critical land mobile radio services include:

- Voice

- Duress alerts, and

- Narrowband data (small packets of data).

The Telco Authority's modelling of a PSMB capability indicates that it is more cost effective to provide all mission critical services over a single network rather than manage two networks, one for voice and one for data. For this reason, the Authority considers that an eventual migration of the mission critical services currently provided over land mobile radio migrate across to a new PSMB capability.

The LTE standard for mission critical voice, features and functionality is still to be ratified. The features that would be required include, for example, include allowing cells to continue to provide local communications even if connections to the broader network are down and direct mode operation (handset to handset). It is expected that data applications will be able to take advantage of the increased bandwidth provided by a PSMB service and offer an enhanced mission critical service than is currently experienced.

Question 16

How important are communications between PSAs and the community during emergency incidents?

Communications between public safety agencies and the community during emergency incidents are vital. The community traditionally contacts public safety agencies by calling triple zero, however, the use of social media as a way of alerting law enforcement and emergency services organisation to incidents is growing. In return, the historical practice of public safety agencies providing information to the community was through passive means such as emergency radio and television broadcasts (particularly through the ABC services). This also is changing as the community gains information on emergencies and impending risk direct from

public safety agencies via emergency alerts and through apps like the NSW Rural Fire Services' Fires Near Me service.

It is essential therefore that communications between the two groups remain open. Network congestion and prioritising user access can weaken the links between public safety agencies and the community. Pushing citizens off commercial mobile networks may result in a person needing assistance or having valuable intelligence for public safety agencies not being able to make contact, nor will public safety agencies be able to send out updates and warnings. While there may be some benefit in also prioritising triple zero and emergency alert services, the reality is that crucial video, photographs and updates of an incident are now shared and disseminated via social media networks rather than traditional emergency contact channels (and this will likely grow with development of next generation triple zero). The ability to identify and prioritise all forms of traffic over the network that is directly relevant to the emergency response is limited by the large number of potential channels for communication.

Question 17

What PSMB capability characteristics should be considered in this study?

As discussed in the section 'Key features of a PSMB capability' there are a number of features that should be achieved in a PSMB capability, namely:

- *Dedicated spectrum* – PSMB dedicated spectrum with sufficient bandwidth (i.e. 10 MHz paired) to meet the ongoing needs of public safety agencies.
- *Nationally interoperable* – public safety workers across jurisdictions and across agencies are able to communicate during operations.
- A *highly available and resilient mission critical service* – given that the protection of life and critical property may be at risk, and for the protection of public safety workers during the conduct of their duties.
- *Able to cope with spikes in demand through sufficient capacity adequate redundancy* - particularly in major urban areas or significant natural disasters.
- *Scalable* – Users will require the availability of different types of data and voice communications at different times and regardless of whether they are an Ambulance paramedic responding to a small, contained patient incident, or a major Police and emergency services operation following a natural disaster.
- *Secure* – the network must be secure.
- *Have appropriate levels of coverage* – a PSMB service must be able to cover the population, areas where people travel (such as highways, tourist destinations, hiking trails) or where a response is likely to be required (such as in flood areas, areas prone to bushfires, etc.).

There is also an expectation by public safety agency workers that any PSMB service is equal to or better than the mission critical services that they are receiving at the time of any migration.

The selected option needs to be of a mission critical standard (defined elsewhere in this document) and meet the key capabilities outlined above, particularly in relation to the amount of spectrum required. In addition, it must be efficient, effective and represent value for money. If a commercial offering is included in the service delivery mix, then the following conditions must be met:

- That Service Level Agreements clearly specify the expected level of service to be provided, with appropriate penalties, rebates and other measures in place if they are not met

- That there is a competitive market

- That there is sufficient contestability in the market

- That state governments control the spectrum, and

- That appropriate regulatory and contractual controls are in place to ensure both an equitable price and the delivery of mission critical services as required, with a much higher level of regulatory intervention required where the states do not control the spectrum.

Question 18

How should national interoperability be interpreted in this study? Does it include interoperability between networks, devices and applications used by PSAs in different jurisdictions? Does it extend to integrating communications services between different local PSAs (for example police, fire and ambulance and other responders)?

The Telco Authority takes the view that national interoperability relates to interoperability between networks and devices. The main enablers for interoperability are common platforms, specifications and technology.

Jurisdictions (both separately and collectively) and agencies themselves will make determinations around which applications they will use and the inter-personnel and inter-agency protocols for communicating and sharing information. This will ensure that the command and control procedures that are put in place for different types of emergencies and other incidents are adhered to in the interests of ensuring that the response is properly coordinated and resources are used most effectively.

Question 19

Does delivering a PSMB capability raise any new opportunities for achieving national interoperability?

At present interoperability for mission critical communications only relates to voice and some narrowband data. A key aspect of existing national interoperability arrangements is that interoperability requires the use of dedicated spectrum in a suitable band. In the case of land mobile radio, COAG determined that steps to harmonise spectrum and move government agencies to the harmonised segments was required to promote interoperability. Furthermore, the National Coordinating Committee for Government Radiocommunications (NCCGR) has issued a licensing instruction (RALI GSI) directing technology standardisation in certain segments. As a result, national arrangements provide for the same block of harmonised spectrum to be used exclusively by state and territory governments across Australia in the 400 MHz band. By ensuring that all public safety agencies across the country are operating on the same block of spectrum, and using the same technology, interoperability is enabled.

In order for PSMB to be nationally interoperable each state and territory needs access to sufficient dedicated spectrum in a suitable band. As discussed earlier, the Telco Authority position is that 10 MHz (paired) of spectrum in the 700 MHz band is the preferred quantum and segments for spectrum.

If a PSMB capability is purpose built using the right amount of spectrum in the right band in a common way across Australia, this will provide the best opportunity to allow for national interoperability rather than having to find solutions at a later time such as moving spectrum users around and having to find and allocate additional spectrum.

Question 20

Would the benefits, costs and risks of achieving national interoperability vary under different deployment options? If so, how?

Technology and standards for PSMB via LTE are continuing to be developed. For example, while it is anticipated that mission critical voice services under a PSMB capability, as the standards have not been fully developed, tested, trialled and deployed there may be some as yet unforeseen limitations in relation to interoperability. Likewise, as discussed in relation to Question 13, depending on whether one or multiple MNOs are used (and depending on how roaming onto and between those networks and a PSMB network) there may be a need for unique technical solutions. The cost of implementing interoperable systems would also vary to the extent that commercial negotiations for 'roaming' and 'overflow' between networks would be required to be undertaken under some scenarios.

Question 21

What progress has been made in putting in place arrangements to better coordinate emergency communications within and across PSAs and jurisdictions?

The Commonwealth, States and Territories have all agreed that a PSMB capability should be nationally interoperable and are working towards that end. The development of a PSMB capability will not be impacted by any existing arrangements to improve interoperability and overall coordination in relation to existing emergency communications, networks and services.

While it will have no impact on a PSMB capability, the Telco Authority provides the following advice in relation to emergency and public safety communications arrangements for the Productivity Commission's general information.

At a national level, the Council of Australian Government has in place a National Framework to Improve Government Radiocommunications Interoperability. The Framework seeks to achieve a harmonised radiocommunications environment for public protection and disaster relief. The guiding principles for the Framework include:

- Jurisdictions will work together to develop a framework to deliver an appropriate level of interoperability between and across jurisdictions and agencies

- Jurisdictions will work together to establish a baseline plan for interoperability with existing systems

- Jurisdictions will work collaboratively to define interoperability standards

- Jurisdictions will work collaboratively towards harmonising and aligning technologies

- Jurisdictions will develop and implement networks in appropriately identified harmonised spectrum

- Jurisdiction will establish arrangements for the effective and efficient operation of radiocommunications equipment nationally, and

- Jurisdictions to assess common requirements for high speed mobile data interoperability as well as assessing emerging technologies.

The overall coordination work to implement the Framework is being carried out by bodies such as the National Coordinating Committee for Government Radiocommunications and the Law Enforcement and Security Radio Spectrum Committee. The Framework is currently undergoing a mid-term review.

The Authority can see no impediments to similar working arrangements being in place for a PSMB capability. Indeed, the state and territory led committee established to replace the Commonwealth led Public Safety Mobile Broadband Steering Committee was created to ensure cooperation and collaboration in defining the underlying specifications required for a nationally interoperable PSMB capability.

At an intra-jurisdictional level, the Telco Authority provides the following advice in relation to the experience in NSW. The NSW Government established the Telco Authority to drive reform in the operational communications sector.   The Authority sets sector policy and standards. A number of common policies, standards and guidelines, as well as shared services Service Level Agreements, are available on the Authority's website. The use of common policies, etc. ensures increased coordination across agencies.

The Authority and its Board (which sets sector policy) also established a Business and Strategy Group to examine current and future operational and business requirements for agencies, including appropriate approaches and strategies for how best to meet those needs and identify and realise opportunities and cooperation. Senior executives from key operational communications using agencies are represented on the Business and Strategy Group. The Authority has further established the Technology and Planning Review Group, which also has representation from key agencies across the sector, to examine and define technology architectures and solutions, technical policy, technical standards, and opportunities to improve integration, collaboration and coordination. This work is already underway with the Telco Authority leading work in NSW to move towards non-proprietary inter RF subsystem interface (ISSI) to interconnect jurisdictional radio networks and improved radio programming to assist with interoperability.

Question 22

What level of network coverage do the existing networks used by PSAs (for narrowband voice and low-speed data capability) currently provide? How does this vary across jurisdictions?

The Telco Authority can only provide advice in relation to public safety agency networks in New South Wales. Public safety agencies operate throughout the State, including in areas with very small populations, along highways where people travel and in remote areas that are prone to flooding or bushfires. The footprint of public safety agencies' communications networks in NSW is not directly comparable to MNO networks which have been designed to meet different requirements. The footprint of public safety networks are influenced by a number of considerations including where incidents occur (both minor and major), workplace health and safety (particularly when working in isolated areas), and changes in population and the mix of population.

With their current footprint, it is unlikely that existing commercial networks will be able to meet the needs of public safety agencies should they be used to carry a PSMB capability. It is possible, therefore, that PSMB will be delivered via a mixture of public and commercial services (or commercial services with investment by government to augment the existing footprint).

Question 23

What level of mobile broadband network coverage do PSAs require across metropolitan and regional Australia? Does this vary for different PSAs?

Mobile broadband coverage is required where people live or travel. Areas prone to natural disasters, national parks, places where people visit and along transportation corridors also require coverage. The location of services should not affect the quality of service received. Residents in small population centres and rural communities are entitled to benefit from the support of public safety agencies. In all circumstances, a PSMB service should provide at least 256kb/s uplink bandwidth at the cell edge.

Question 24

What is the most appropriate measure of network coverage for use in this study?

There are a number of measures that should be used including signal strength over a given area, per head population coverage, square kilometres covered, amount of highway covered, etc.

Question 25

What options are there for extending the mobile coverage of commercial networks?

The Telco Authority considers that wherever possible a cooperative approach should be taken for joining up community coverage. Public safety networks currently extend beyond the footprints of commercial operators. As commercial services move towards these areas there may be opportunities for sharing services such as backhaul, sites, power supply, etc. However, for this to occur there would need to be a number of measures in place to ensure that the extension is viable and in the best interests of both parties. The motivation for the design of the footprint of public safety agency services is related to the protection of life and property. For commercial networks, the motivation is profit, with coverage in non-financially viable areas limited unless heavily subsidised by government, as would likely occur in this situation. There is a risk that MNOs will benefit from a substantial investment in either shared infrastructure or for the MNO to extend its own coverage, the costs of which will be passed through to state and territory taxpayers. In order to ensure that the investment delivers a level of service required, contractual and, more importantly, regulatory arrangements will need to be enhanced to ensure that service level agreements and universal service obligations are met.

Question 26

Would the benefits, costs and risks associated with achieving an acceptable level of network coverage for PSAs vary under different deployment options? If so, how? And with what operational consequences?

There are a number of different deployment options for a PSMB capability. The risks, costs and benefits of each vary depending on the options configuration. The Telco Authority has set out in this document a number of principles and basic standards required for a PSMB capability that should be applied. This approach allows for the greatest flexibility in developing a delivery model, however, any such model must meet these minimum requirements.

It is likely that extending PSMB coverage to the final 20% of NSW (included areas covering both the static population as well where people travel and visit and where public safety officers are required to operate) will account for a large proportion of the costs. This has been a persistent issue for the supply of public utilities (including telecommunications services) in regional and remote areas. Communications systems deficiencies were an area of concern for the Royal Commission into the 2009 Victorian Bushfires, which noted that fire-fighters were 'hindered by poor coverage, lack of interoperability by emergency agencies, and insufficient investment in new technologies'[26]. This incident clearly shows that there are operational consequences should coverage under a selected PSMB delivery option not be adequate.

From an operational perspective, the provision of PSMB capability in regional and remote areas is necessary in order for public safety agencies to respond appropriately to an incident and to operate effectively. It is important to note that extending coverage to these areas does not necessarily mean providing blanket coverage across an entire state. A prudent financial management approach requires that coverage extension be determined based on business needs and a risk analysis to ensure that vital resources are not wasted.

Question 27

How could voice services – traditionally carried on narrowband networks – be integrated into a mobile broadband capability? What challenges and risks need to be accounted for? Are the challenges at a local level (legacy factors) greater than those at a national level?

An LTE standard for mission critical voice services is currently being developed. The Telco Authority has developed a long term Technology Roadmap for the NSW operational communications sector that provides for a migration of voice services to a PSMB capability. However, a migration cannot occur until the appropriate standards have been developed and a successful trial has been undertaken, and the risks around change management and user

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[26] 2009 Victorian Bushfires Royal Commission: Final Report, July 2010

acceptance are appropriately addressed. In addition, there needs to be a mature market for equipment that is able to carry mission critical voice services using whichever frequencies are assigned for PSMB in Australia (with equipment built for the US and Canadian markets, i.e. for use on the 700 MHz band, likely to offer the most variety at the most competitive prices). Finally, migration cannot occur until public safety agencies are confident that the services can be relied upon during an incident and that the service provider can be trusted to ensure that the service will meet their needs, particularly for commercial service providers who have only extremely limited experience in delivering a successful mission critical service to date.

Question 28

What challenges or opportunities arise (from a technical, institutional and/or commercial perspective) from such an integration, and would the benefits, costs and risks vary under different options for PSMB? If so, how so?

There are a number of opportunities for providing a voice service over PSMB. From a cost perspective, the Telco Authority considers that over the longer term there is significant benefit from operating a single mission critical network rather than a separate voice and data network. Providing all services, including voice over a common platform has advantages as well, particularly in relation to interoperability (it is far cheaper and easier to build interoperability into a new network rather than attempt to retrofit solutions as has occurred in relation to mission critical land mobile radio).

While the benefits are clear, there are also a number of risks. The standards for mission critical voice over LTE are yet to be ratified. Any attempt to develop a voice service for LTE before the standards are finalised may result in the service running over proprietary systems and equipment, rather than open standard devices built to the standard. The costs, competition and flexibility impacts of using proprietary systems rather than open standard equipment can be significant.

Question 29

The Commission understands that there is currently work underway to develop voice applications for 4G/LTE networks for use in mission critical circumstances. When are these applications likely to become available?

It is understood that standards for mission critical voice over LTE are to be developed as part of Revision 13 by the 3GPP Consortium. Development of the standard will require industry participation. It is not expected that the finalised standards will be available for a few years, noting that it is premature to provide a precise timeframe.

Once the standards have been finalised, it will take time for equipment manufacturers to establish demand levels in order to expend resources on designing, developing and

manufacturing equipment. Further, there will be a period where the market has to mature, equipment trialled and confidence built.

There are a number of risks in building a PSMB service and purchasing equipment too early in order to meet an artificial deadline such as having a PSMB capability in place by 2020. These include:

- That the standards are not sufficiently developed and tested so as to have confidence in their ability to deliver a mission critical services
- Procuring equipment that does not eventually meet the standards
- Getting locked into proprietary systems
- Purchasing expensive and un-trialled equipment as an 'early adopter', and
- Not being able to obtain the benefits of a competitive market and having limited choice in terms of the type of equipment used and the various features offered.

Noting the above, the Authority is currently trialling PTT over commercial mobile broadband networks allowing office based staff the ability to communicate with users on the NSW Government Radio Network via an application on their smartphone. However this will not be used by front line staff for emergency response as the commercial networks are not 'mission-critical' and cannot be relied upon during major incidents.

Question 30

What factors are important in ensuring the integrity and security of communications for PSAs? To what extent does this differ for different types of PSAs?

While services such as rural fire services and ambulance require secure communications for operational reasons, the needs of police and other law enforcement bodies will be key drivers for security standards on a PSMB capability. Communications concerning criminal investigations, covert surveillance and national security operations must be secure. Security in this context does not just mean that communications cannot be intercepted and interfered with, but also that other information such as the location of handsets and devices is not available to non-authorised personnel, nor the meta data generated by and from these devices.

Question 31

Would the costs and risks associated with ensuring the integrity and security of communications differ depending on how a PSMB capability is delivered? If so, how?

While the Telco Authority has not modelled this issue specifically, it can be assumed that there may be a cost premium for a PSMB capability over commercial networks given that measures would need to be put in place (including criminal sanctions for breaches) to keep information

secure from non-law enforcement users of the shared network and from network managers and other non-law enforcement staff.

Question 32

What methods or metrics could be used to define and/or measure the level of security provided over a network that delivers mobile broadband capability?

The Telco Authority considers that the methods or metrics used to define and measure security on a PSMB network would need to be determined in consultation with public safety agencies and particularly police and other law enforcement groups. In advance of these discussions, the Authority anticipates that security would be measured in accordance with international security standards and national guidelines, such as the ISO27000 suite of standards, the Australian Government Information Security Manual and Protective Security Policy Framework.

Question 33

What additional security needs do PSAs have compared to other sectors with high security requirements for their communications?

Generally, the security requirements for other sectors are not publicly available (for operational reasons) making a comparison impossible to undertake. However, the Telco Authority has identified documentation from the Department of Defence which is in the public domain and can be found at: http://www.asd.gov.au/infosec/ism/index.htm The Authority has also identified documentation from the International Standards Organisation: http://www.iso.org/iso/home/standards/management-standards/iso27001.htm

As outlined in the answer to Question 31, police and law enforcement have unique security needs and it is difficult to identify any sectors that would have a higher security need than that which would be required for communications dealing with national security issues.

Question 34

How should PSA demand for mobile broadband capability be estimated in this study, including their expected demand requirements into the future?

As set out in the section 'Key features of a PSMB capability', the level of demand will be a key driver in dimensioning a PSMB capability. Demand manifests itself in two ways, the demand peaks that will be experienced during a major incident as well as the overall long-term demand growth that will be generally experienced over time. In determining likely demand levels, a first instinct would be to estimate current demand for business critical data services. However, using this as a starting point does have limitations. This is because the demand for business critical services does not directly correlate to demand for a PSMB data service. Public safety agencies

use business critical data in a particular way. They would use similar services in a different way if they were offered as a mission critical capability. Therefore, any modelling for demand based on existing business critical services would need to include a number of assumptions.

Using existing mission critical voice demand levels is less problematic. Public safety agencies are moving towards computer aided dispatch, using data rather than voice communications. However, voice remains the key way of communicating. By understanding demand levels at these peaks and the types of incidents involved it may be possible to make a number of assumptions about demand levels during periods of extremely high usage.

While it is difficult to determine a starting point for demand overall, the Telco Authority considers that making assumptions about the growth in demand is less troublesome. The Telco Authority has reviewed data growth in a number of markets, including the UK and US. In the examples considered, the pattern of growth follows the same path. Growth increases by multiples of between 2 to 8 over the first five years of a new data service. Once the service has matured and new applications and uses become available, the growth in data increases significantly over the outlying years. In some instances, by multiples of between 12 to 16 during the period from 10 to 15 years after adoption of the original service.

While growth in data based on experience overseas can be used to calculate demand for a PSMB service, there are two caveats. There will be no price signal for the public safety workers when using a PSMB capability. Secondly, the use of high bandwidth video, which will likely be the most significant data use for PSMB, is growing and becoming integral to the way public safety agencies operate (such as body worn cameras by police officers and aerial cameras installed on remotely piloted aircraft for monitoring bush fires).

The unknown levels of data that could be experienced by a PSMB capability was a factor in the decision of the Canadian Government to allocate 20 MHz (2x10MHz paired) of spectrum for PSMB purposes. The Telco Authority recommends a similar approach in Australia.

Question 35

What methods or metrics could be used to define and/or measure the level of service capacity provided to PSAs?

The Telco Authority currently defines service capacity on the NSW Government Radio Network via Grade of Service (GoS) - the probability that a call is queued when a user attempts to access the network. Practically this is measured by determining the number of calls that are queued as a proportion of total calls serviced at each site over a given time period, and is also assessed by determining average and peak call queue times.

In consideration of a PSMB network, the following metrics may be more relevant:

- Network performance – throughput, latency, packet loss, data volumes, day to day peak and average metrics.
- Availability – uptime vs downtime, including for the whole network as an average as well as for individual sites as well as components in the end to end services (such as backhaul, core, etc.).
- Redundancy as measured by design/target system availability and as determined by reliability analysis.
- Quality of service metrics such as traffic classification, priority, marking and scheduling techniques, pre-emption, etc.
- Security (including confidentiality and reliability).

Question 36

What level of capacity will PSAs need for a PSMB capability, and how will this differ between business as usual activities and large scale emergency incidents?

The Telco Authority understands that the Productivity Commission has requested service demand data for existing state and territory services. This data will provide context on the general day to day experiences for agencies such as police and ambulance and the spikes that occur during incidents, particularly widespread incidents.

Most state and territory networks are based around being able to deal with low probability, high consequence incidents, such as large bushfires, large area flooding or a significant or prolonged police operation. This leads to a large amount of latent capacity in the networks. However, there remains a strong expectation from public safety agency leadership, frontline workers and the community that the networks be dimensioned to allow for the spikes. For example, the Queensland Floods Commission of Inquiry noted that future technologies such as mobile broadband can be used to address congestion in public safety agency communications, indicating that limiting congestion and improving interoperability were essential to ensuring that emergency services organisations' communications are effective[27].

Question 37

How might demand for PSMB capability differ between types of PSAs? How could competing demands amongst PSAs be managed? Should particular uses be prioritised?

As noted previously, different public safety agencies have different business needs. Police and ambulance services have a constant demand for their services and so form a large proportion of the business as usual use of mission critical communications. Rural fire services and state emergency services usage is characterised by peak periods of high demand when responding

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[27] Queensland Floods Commission of Inquiry Final Report 2012 (page 399)

to natural disasters. Regardless of the agency, while the applications used by the various organisations will differ, they will all rely on the same underlying architecture and systems over which many different types of applications can be used.

As is currently the case with large scale incidents which require involvement from all public safety agencies as well as support groups (such as welfare organisations, transport authorities, etc., operational protocols dictate responsibilities and priorities in how the response is managed. It is important to note that these protocols may be weakened should PSMB be delivered over a non-dedicated commercial network as other users of the network will use the service in a more random manner. While this can be addressed somewhat through measures such as limiting their access to a network during an incident, in general these types of users will continue to have access to the network and use it.

Outside of clearly defined rules of engagement, there are a number of technical remedies that can help to address network management issues in periods of peak demand. These include the use of talk groups, prioritisation of talk-groups according to type and use, channel management, and through network configuration.

Question 38

How would the benefits, costs and risks of ensuring sufficient capacity vary under different deployment options?

The two main determinants of network capacity are the amount of spectrum available and the infrastructure build of the network. The amount of spectrum allocated for PSMB purposes is expected to be consistent across all three delivery models.

In relation to the network design and infrastructure, there are a number of variations depending on the model:

- A smaller amount of spectrum allocated will mean that more cells may have to be developed for a PSMB network, increasing capital costs.

- If PSMB is to be carried over a commercial network or networks then there will be a cost in order to harden those networks and provide for a PSMB capacity. There will be a significant cost difference in the hardening of a commercial network with millions of users and numerous sites compared to a dedicated PSMB network with a much smaller number of users.

- Costs could be reduced by infrastructure sharing.

- If a MVNO hybrid model is selected then there will be a cost associated with allowing users to roam across networks, and it is not clear how many networks would be involved and whether

all MNOs would be willing to participate, noting that in the UK a number of MNOs originally expressed an interest in the delivery of a PSMB in that jurisdiction, however, over time all but one have decided to no longer participate.

- If a geographically based hybrid model is selected (with differing types of services provided in different geographic areas) there will be a mixture of the above costs spread across the network.

Question 39

What level of resilience to PSA narrowband networks usually provide and how does this differ from commercial broadband networks?

Narrowband networks are mission critical grade. Commercial broadband networks are currently business grade services. Mission critical grade services have a much higher level of resilience in order to achieve an availability of 99.99 - 99.999% reliability. In order for commercial broadband services to reach mission critical grade significant hardening of the networks will be required. Hardening includes:
- Providing alternate power supplies to allow for a number of days without power (including via battery back-up or generators) at each base station site as well as within the backhaul network.
- Providing multiple backhaul paths to radio sites.
- Highly responsive proactive and reactive maintenance including undertaking repairs in a matter of hours including in regional and remote areas.
- Making sites less susceptible to damage during fires and floods and other natural disasters.

Question 40

What methods or metrics could be used to define and/or measure the level of resilience provided by the networks used to deliver PSMB?

There are a number of metrics to measure network resilience that are currently used for narrowband networks that could readily be used for a PSMB capability. The key metric remains the level of availability and the key performance indicators underlying it, including maintenance times, backhaul performance measures, etc.

At present the performance of government networks are well known to public safety agencies, providing them with confidence around the level of service being provided. The provision of similar data in relation to commercial networks is not as freely available. In order for public safety agencies to have confidence in the level of network performance for commercial networks and be satisfied that performance indicators are being met there would need to be a requirement for MNOs to provide such data in a clear and transparent way.

Question 41

What priority should be given to the capacity to stand up a replacement service within a specified timeframe in the event of a physical or network based disruption?

Disaster recovery is essential for mission critical communications in order to maintain high levels of availability. It is expected that any PSMB capability will be built with a level of redundancy in place. A number of measures can prevent disruption such as designing the network with no single points of failure, having alternate backhaul paths, providing a disaster recovery network operations control centre, and developing and implementing business continuity plans. In the event of a localised disruption, having in place well developed maintenance plans, an availability of on call maintenance resources (including manpower and spare parts) and protocols for arranging emergency repairs in a disaster zone are essential. In addition, having available cells on wheels (COWS) can provide temporary coverage when infrastructure is rendered inoperable.

Question 42

Are there any barriers (for example, institutional, informational and/or technological) to, or challenges associated with, delivering a resilient PSMB capability? How might this differ between different deployment options?

Public safety agencies and state and territory governments more generally, have extensive experience in providing resilience support to their respective networks and are willing to provide resources in order that expected service levels are met. A similar level of service would be required from commercial operators. The resilience levels of commercial networks are generally not at a mission critical level, with a number of incidents over past years experiencing delays in restoring services[28]. It is important to note that a key driver for commercial network operators is profit rather than the protection of life and property and this is reflected in how they manage their networks and the levels of resiliency built in at an institutional level, with a general avoidance in offering non-profitable services. There would need to be a significant change in the way that commercial operators view service delivery and the minimum effort required to provide a highly available, highly reliable service.

The provision of wireless communications to the G20 Summit in Queensland in 2014 provides a recent example of the delivery of a mission critical service provided by a commercial operator. At this stage no reports have been issued on the levels of service and resilience achieved by the offering in order to gauge the ability of the commercial sector to deliver such services.

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[28]   http://www.geelongadvertiser.com.au/news/geelong/telstra-says-cut-cable-causing-extended-phone-outage-at-aireys-inlet/story-fnjuhovy-1227160372308

Question 43

How could future developments in technology, or growth in demand for mobile broadband services and capacity, affect the sustainability of PSMB capability under different deployment options?

Technology in the PSMB context is developing rapidly, and will continue to do so as the market matures. As the technology advances it is essential that a PSMB network not be locked in to a particular proprietary technology or network provider. Careful planning will be required to avoid this.

Being locked in to proprietary technology can be avoided by using open standard technology, encouraging a vibrant and innovative market, allowing diversification of services and equipment on the network and by introducing competition and contestability into the equipment and service delivery markets.

A number of steps should be taken to prevent a single commercial provider from exercising monopolistic behaviour. This includes requiring the use of MVNOs, allowing cross-network roaming and competition, and providing the option of a dedicated government-controlled network in areas where there is no MNO competition. Public safety agency control of spectrum, key strategic assets and decision making may also help to ensure that a single market operator does not have unfettered monopoly control over a network.

There are a number of other issues that need to be considered:

- Provision of adequate spectrum to support operational requirements (ie 10 MHz paired) early will help to address the expected exponential increase in demand and avoid a need to find appropriate spectrum in an already congested band in the future.
- The growth in demand is difficult to predict and if a commercial service (whether dedicated or not) is selected for PSMB, care will need to be taken to ensure that this does not have pricing implications over the longer term. Frontier Economics has considered the experiences of the UK Government in relation to its contract with Airwave (UK) for the delivery of the Airwave Network. Frontier found that "*unforeseen increases in costs have been caused, in part, by the Government's requesting extra services that they did not foresee at the time of the original contract and, in part, by usage charges because has been used for voice to a greater extent than was originally envisaged and, for that reason, the Government is incurring charges for exceeding the cap on voice calls*"[29]. Levers to avoid this situation occurring include avoiding long term contractual arrangements, disaggregating the service provision, enhancing competition for the delivery of a PSMB

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[29] Frontier Economics: Maximising competition and efficiency in the delivery of PSMB, March 2015, page 9

service. However, the main mechanisms available to state and territory governments to prevent a similar situation developing in relation to PSMB are to place the spectrum under the control of public safety agencies so that they are able to seek alternate solutions in the case of market failure, and a strong regulatory approach that may include regulating prices and ensuring a minimum service provision requirement.

- Migrating from one form of technology to another and across platforms would require a longer lead in time for a PSMB service compared to many commercial services. High levels of competition, heavily subsidised handset prices and the phenomenon of 'early adopters' means that with a few exceptions, most consumers are happy to adopt new technology and move across technologies in order to upgrade their service. Public safety agencies will require a much longer time frame which could prove to be an issue if PSMB is delivered over commercial network(s) without adequate contractual or regulatory provisions in place.

Question 44

How will the convergence of voice and data services affect the sustainability of PSMB capability under different deployment options?

Telco Authority modelling (which will be provided to the Productivity Commission on a commercial in confidence basis) indicates that migrating voice onto a PSMB capability is essential in order to make the service the continuation of public safety communications efficient and sustainable.   While migration of voice is considered likely, this will not occur for some time. Standards for mission critical voice on LTE will need to be developed, product needs to become available and then mature, and confidence that a PSMB capability can provide voice services with the same or better levels of reliability and availability will need to be demonstrated.

Without convergence public safety agencies would need to pay for the provision of two networks and there is no guarantee that existing voice land mobile radio services will continue to be supported by suppliers and industry over the longer term. As with all technology, as newer services become available and the majority of users of an existing type of technology readily transfer across given the additional benefits and services that can be obtained, the financial incentive for suppliers to continue to support the older technology is diminished. Eventually the technology becomes obsolete. For example, Telstra recently announced the closure of its 2G service given that the majority of its customers now use later platforms (e.g. 3G and 4G)[30]. The same scenario is likely for public safety land mobile radio as more and more jurisdictions internationally move towards voice over PSMB.

The Telco Authority expects that data, and particularly video, will have the most significant impact on a PSMB service regardless of whether voice is carried across the network or not. Over

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[30]   http://www.smh.com.au/digital-life/computers/gadgets-on-the-go/telstra-2g-nana-phones-living-on-borrowed-time-20150706-gi5yun.html

time, the use of computer aided dispatch indicates a trend towards using data for dispatch rather than voice.

Question 45

What challenges are involved with delivering a mobile broadband capability to PSAs by 2020? Do these differ under alternative deployment options?

The Telco Authority has developed a long term Technology Roadmap for the NSW operational communications sector that anticipates the commencement of the use of a PSMB capability from 2018 for data and prior to 2020 for voice communications.

As network specifications and detailed architectural information is considered by carriers to be commercial in confidence, it is unclear what would be required to design and configure commercial networks to deliver a PSMB capability, and how long such work would take to complete. Network design, build and configuration times would also need to be considered for a publicly built network as well a hybrid network.

It is essential that the development of a PSMB capability not be rushed, or an 'off the shelf' solution selected, resulting in public safety agencies being locked in to a single supplier for the long term in order to meet an arbitrary timeline. Public safety agency demand for PSMB is strong, acts as a standalone driver for the development in the shortest possible time without the need for artificial deadlines.

Question 46

What obstacles exist to a mobile broadband network being fully compatible with a range of end-user devices? Does this depend on the network deployment option?

The two main obstacles to ensuring full compatibility for end user devices are:
- A failure to build the network based on open standards to allow for equipment produced by a range of suppliers to be compatible with the network.
- A need to purchase customised equipment due to unique aspects of the network, the main one being operating the network in spectrum that is not widely used internationally for public safety applications. For this reason the NSW Government maintains that spectrum in the 700 MHz band be allocated for an Australian PSMB capability.

Question 47

How does the method of interoperability impact on the cost of the system to PSAs?

The main driver for interoperability is expected to be the delivery of PSMB over a common platform with common technical standards. At an operational level, agencies will then establish protocols for how officers interact on an inter-agency and inter-jurisdictional basis. Agencies

already establish these protocols for a range of operational reasons and across all aspects of their operations, not just communications.

Questions 48 and 49

What detailed options should be evaluated in this study? What underlying assumptions and key parameters would be associated with each option?

What (if any) assumptions or parameters should be 'common' across all options?

There are numerous models available for the provision of a PSMB capability. The continuum runs from a dedicated network built owned and operated internally by state governments for public safety agencies, through to a full commercial service, with a range of hybrid models comprised of a mixture of aspects from the two 'bookends'.

The various states and territories, which will be the ultimate purchasers of a PSMB capability regardless of the model, will select the model which meets their business needs and is the most cost effective. As noted previously, there are a number of features of a PSMB capability that are required in order for it to be fit for purpose, regardless of the model. These include that it be:

- *Nationally interoperable* – public safety workers across jurisdictions and across agencies are able to communicate during operations.

- A *highly available and resilient mission critical service*– given that the protection of life and critical property may be at risk, and for the protection of public safety workers during the conduct of their duties.

- *Able to cope with spikes in demand through adequate redundancy*- particularly in major urban areas or significant natural disasters.

- *Scalable* – Users will require the availability of different types of data and voice communications at different times and regardless of whether they are an Ambulance paramedic responding to a small, contained patient incident, or a major Police and emergency services operation following a natural disaster.

- *Secure* – the network must be secure.

- *Have appropriate levels of coverage* – a PSMB service must be able to cover the population, areas where people travel (such as highways, tourist destinations, hiking trails) or where a response is likely to be required (such as in flood areas, areas prone to bushfires, etc.).

In addition, there are a number of parameters on what those business needs are based that will need to form part of any underlying assumption of the various options. These basic parameters include:

- A PSMB capability will over time carry both voice and data services.

- That in order for data services to be effective, that data throughput of a minimum 256kb/s at the cell margin is required, with much higher levels towards the centre of a cell (up to 10MB/s). 256kb uplink is required in order to stream standard definition video that is of sufficient quality as to be useable by officers in the field.

- Data usage has been conservatively estimated to multiply steadily and modestly over the first five years after adoption of a PSMB service, and then increase more rapidly over subsequent years. This assumption follows the take up and data usage patterns for a range of mobile data services.

Regardless of which options are modelled, they must provide for spectrum to be allocated to public safety agencies and allow for sufficient spectrum to be allocated for a PSMB to be effective over the longer term. These basic assumptions in relation to spectrum are required to ensure long term certainty for public safety agencies.

The Telco Authority has undertaken a costs/benefits analysis for a number of options including the 'bookends'. The Authority will make the outcomes of this research available to the Commission on a commercial in confidence basis.

Question 50

What are the sources of cost relevant to the study?

Costs for any PSMB capability will vary and be jurisdiction specific.

The Telco Authority has sought advice from Telstra (as the largest operator in the market) for pricing to assist its analysis and act as a comparative baseline. To date, commercial operators have not provided the requested pricing, including for the Telstra LANES product. Advice from Telstra, Vodafone and Optus on their pricing and the costs they are likely to experience in hardening and increasing the footprint of their respective networks to accommodate PSMB may be of assistance to the Commission in its deliberations.

Question 51

In what ways could delivering a PSMB capability affect non-PSA users? How would these effects differ across deployment options? What methods could be used to estimate these effects?

The greatest impact on non-public safety agency users (i.e. non-government users such as consumers and businesses) will occur where the solution requires PSMB to be delivered across a shared commercial network and under which non-public safety agency users would receive less priority. In these circumstances, during an incident that results in network congestion, non-public safety agency workers may be 'kicked-off' the network in order to provide priority access to a public safety agency user.

At the simplest level, the user may experience a minor or major inconvenience (for example not being able to advise child care or family that they will be delayed). More profoundly, a person in distress or bystanders to an incident may not be able to contact emergency services or report an issue (while commercial service providers have indicated that prioritisation will be provided for triple-zero new channels for reporting incidents are growing as is identification of an event through monitoring social media for trends). Helpful community driven intelligence would be lost to public safety agencies in their organising a response in such a scenario.

The Productivity Commission has a number of options for estimating the costs of these impacts. At the most simplistic level the loss could be simply the cost of a phone call or SMS or the amount of data required to make a posting on a social media application. For more significant impacts, there are a range of measures to help estimate costs ranging from the estimated costs of lost productivity where workers lose communications services, such as the costs where parents are unable to make alternate arrangements for children in day care (for example late pick up fees), through to the more extreme, such as the medical cost where an injured person is unable to contact emergency services and ultimately costing loss of life.

It is also important for the Commission to give due consideration to the costs avoided by PSMB. For example, where a person at risk of death survives as they were able to receive immediate treatment because of PSMB.

Question 52

Is it appropriate to consider option values as part of the cost benefit analysis in this study? If so, how? What information or data is relevant?

The Telco Authority considers that work on the development of a PSMB capability can proceed even without all the information being available at this point in time. There is a body of work that needs to be undertaken before investment decisions can be made, including defining technical requirements, considering models, establishing arrangements for interoperability, scoping network specifications, and putting into place agreements for how the national aspects of a PSMB service will be managed.

For commercial providers interested in providing a PSMB service it will provide them with an opportunity to determine pricing, scope the efforts required to harden their networks and scope the specification for network design.

Question 53

Are the network cost elements identified in box 4 relevant to this study? What specific cost items would fall within these categories? What other network costs should be considered? What is the nature and materiality of these (and other relevant) costs under alternative PSMB options?

The Telco Authority considers the elements identified in box 4 to be relevant.

Additional network costs that the Commission may wish to consider include:

- Site acquisition and build costs

- Costs associated with providing services to a site

- Administrative and compliance costs – business continuity and disaster recovery planning, network management software (including supplier management, asset management systems, fault and performance management, user management and billing systems)

- Depreciation and amortisation costs, and

- The cost of spare parts, back up equipment, fuel for generators and batteries etc.

Question 54

What method(s) should be used to estimate the network costs of different deployment options for delivering PSMB? What studies should inform the Commission's thinking in this area?

The Telco Authority supports a 'bottom up' cost modelling approach to be undertaken by the Commission. The Authority used the same approach in the modelling work for its own costs/benefits analysis for a PSMB capability in NSW. The Authority will make the outcomes of this research available to the Commission on a commercial in confidence basis.

Question 55

What network costs components are interdependent with other costs, or other parameters (such as assumptions about the amount of spectrum allocated)? What is the nature of these interdependencies?

The amount of spectrum allocated for PSMB purposes will have a significant impact on network costs as it will affect how the network is designed and dimensioned. The allocation of 10 MHz of paired spectrum (2x10MHz) will mean that fewer cells are required than for 10 MHz, improving the cost effectiveness of the network immensely.

The cost of the spectrum will also affect the costliness of the network.

The Telco Authority has undertaken extensive modelling of the costs of various options for the delivery of a PSMB capability. Costs include, supporting IT systems, handset refreshes as well as the delivery of PMSB. The Authority will provide advice to the Commission on the modelling, the underlying assumptions and any cost interdependencies on a commercial in confidence basis.

The Authority has sought advice from MNO operators as to the likely prices they would charge for a PSMB service for comparative purposes. To date, details of pricing have not been provided. Likewise, information on the likely costs that would be experienced by carriers in order to harden their networks is not publicly available. This information would provide a full understanding of the true costs of a commercial offering (which may in fact be significantly less costly than a state and territory purpose built network).

Question 56

What data sources could be used to estimate expect PSMB traffic requirements, and the network infrastructure elements required to deliver PSMB capability under different deployment options?

This information could come from a variety of sources. The ACMA may have undertaken an examination of traffic requirements as part of its work in relation to the allocation of spectrum for PSMB. Another source of information is any data held by state and territory agencies on existing network traffic, and it is noted that the Commission has sought data from the Telco Authority in a separate request for information. Finally, network design and configuration experts may be able to provide independent advice to the Commission on this matter.

Question 57

What data sources could be used to estimate the costs of the infrastructure, equipment and operation in delivering PSMB capability under different deployment options?

For passive infrastructure (sites, towers, huts, etc.) there are a number of options available to the Commission to obtain data. The Telco Authority has considered costs as part of its study into the costs and benefits of a PSMB capability, details of which will be made available to the Commission.

For passive infrastructure, equipment and backhaul combined, a large body of estimating costs was undertaken by MNOs and the Department of Communications as part of the Mobile Blackspots Programme. The Commission may be able to access this information.

It is also recommended that the Commission explore the savings that could be achieved by sharing existing infrastructure that is already in use, including infrastructure and sites owned and managed by NSW agencies where appropriate. Sharing provides a significant way of reducing

costs for PSMB. It can negate the need to establish 'greenfield' sites in many locations and would also allow communities to gain extended use of infrastructure already invested in.

Question 58

What is the appropriate approach (or approaches) to model the opportunity costs of spectrum under different deployment options? What issues does 'spectrum sharing' raise for estimating these opportunity costs, and how might they be addressed?

There are a number of approaches that could be used to model the opportunity cost of spectrum for PSMB. An alternate approach to determining the opportunity cost. One is to use the *Optimal Deprival Value (ODV)* which calculates the hypothetical marginal change in spectrum on the cost of an 'average firm' – under this model, the opportunity cost price would be based on the cost for government users to move to the next most viable form of communication, namely the incremental cost of a business grade mobile broadband service in addition to an existing voice and narrowband data services.

The Telco Authority considers that whatever method is used to determine the opportunity cost for spectrum, that it also includes a quantification of the opportunity cost to the community of spectrum not being allocated for PSMB and the impact on the ability of public safety workers to respond to incidents. A number of studies have been undertaken as to the benefits of a PSMB to the community, and the costs of undue events such as crime and natural disasters to society. A number of these are outlined in the response to Question 67.

Question 59

What data sources could be used to estimate the opportunity costs of spectrum under different deployment options for PSMB?

The ACMA has undertaken extensive work on opportunity cost pricing for the 400 MHz band which is used by Government for land mobile radio services. In addition, a number of reports outlined in response to Question 67 and the section 'Research undertaken to date' may have data of use to the Commission.

Question 60

What is appropriate discount rate, or range of discount rates, to use in this study?

NSW Treasury has an existing policy in relation to the application of discounting of future costs and benefits. NSW agencies would generally use the existing NSW Treasury policy when applying discounting to an investment in PSMB.

The NSW Treasury policy notes that while there may be no universally accepted 'correct' discount rate, interpretation of appraisal results will be impossible if different agencies and

organisations use different rates. The solution is the application of a standard rate, which for NSW is a recommended real discount rate of 7%, with 4% and 10% applied as testing measures. Each rate is applied to see if the outcome is sensitive to such variations[31]. If the outcome is sensitive, then the critical break even rate should be made clear.

Question 61

How far into the future should costs and benefits be measured?

Generally it would be the Telco Authority's view that the time period should be 20 years which aligns with the average length of life for PSMB assets and equipment. It is also in line with the approach recommended in the NSW Government Guidelines for Economic Appraisal[32].

Questions 62 and 63

What are the sources of benefits relevant to this study?

How can the potential benefits of PSMB capability (in terms of PSA outcomes) be estimated? Is scenario analysis useful? How should scenarios be constructed to reflect an appropriate range of situations faced by PSAs?

The overall benefits of PSMB to the community at large are well established. The lack of maturity in a PSMB both here in Australia and internationally makes undertaking a quantifiable assessment of the benefits difficult, as a result there is little material in the public domain. Unlike costs, benefits will only be realised into the future once PSMB is available and so are difficult to quantify now. Nevertheless, a number of studies listed in the section 'Research undertaken to date' provide an international insight that could be translated to the Australian experience.

The Telco Authority has sought to assess benefits as part of its costs/benefits analysis. The difficulty in obtaining quantitative information means that a qualitative approach has been undertaken (generally in the form of scenario analyses). Wherever possible, where benefits can be assigned a monetary figure efforts have been made to include it in the analysis. The Authority will make the outcomes of this research available to the Commission on a commercial in confidence basis.

Questions 64 and 65

Can you identify any trials or pilot programs of PSMB capability? Are there any insights to draw from these experiences about potential benefits (or costs)?

Can you identify evidence or examples that illustrate the effects of PSMB capability on PSA outcomes?

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[31] NSW Treasury – NSW Government Guidelines for Economic Appraisal 2007
[32] NSW Treasury – NSW Government Guidelines for Economic Appraisal 2007

Internationally there have been a number of PSMB trials/pilots and other research into PSMB. For example, in 2013 Alcatel Lucent undertook a FirstNet demonstration held in Las Vegas using 700 MHz to demonstrate the benefits of PSMB. In addition, the Public Safety Communications Research Lab in Boulder Colorado undertakes PMSB related research.

Locally, Telstra provided a mobile broadband capability for the 2014 G20 Summit in Brisbane. While this use of the technology may provide some insight to the Commission it is important to understand that no public information, such as summary reports, is available on the performance of the service. It is noted that the G20 summit and the deployed communications services were delivered in very unique circumstances. The service was purpose built and resourced on the basis that it cannot fail given the international reputational implications for the Commonwealth and Queensland Governments and Telstra, and that it operated on a purpose built network on days that were declared as public holidays and at a time when, anecdotally, it is understood that many residents and local workers stayed away from the area.

In September 2015, the Telco Authority will undertake a PSMB Trial/Demonstration as part of its own review of the costs and benefits of PSMB. The Authority can provide the Commission with information on the outcome of this activity if requested.

Question 66

What method(s) should be used to value the effects of PSMB capability on PSA outcomes?

Methods will vary on a state by state (and possibly agency by agency) basis. The Authority's study into the costs and benefits of PSMB in NSW has undertaken some research on the effects for agencies, however, changes to internal arrangements and business as usual activities that may arise from PSMB were out of scope and have not been assessed.

Question 67

Is there research that considers how the costs of responding to natural disasters, crime and other events could be affected if PSAs had access to mobile broadband?

The need to develop and implement a PSMB capability has been established for some time. The Council of Australian Government's established the PSMB Steering Committee in recognition that the delivery of a PSMB capability will revolutionise the way public safety personnel work and are able to respond to emergencies and other incidents. The position established in Australia is strengthened by the experiences overseas where a number of jurisdictions have decided to implement a PSMB capability in some form.

While the case for a PSMB capability has been established, the Telco Authority appreciates that the Productivity Commission must undertake a quantitative assessment in order to comply with the Terms of Reference for the Inquiry. It is for this reason that the following advice is provided.

The Telco Authority has undertaken qualitative research on the benefits of a PSMB capability in NSW. For example, the Authority has examined the financial benefits to the community through early remote diagnosis and treatment of stroke victims using high bandwidth video. The Telco Authority will make that evidence available to the Productivity Commission separately.

In addition, there are a number of studies that could contribute to the Productivity Commission's understanding on the economic and financial benefits of a PSMB capability. A number of these are detailed in the section of this response titled 'Existing research into PSMB'. In general, reports that may be of relevance to the Productivity Commission fall within two categories, those that provide findings in relation to the financial benefits of a mobile communications for public safety agencies and the economy as a whole, and those that provide findings in relation to the overall cost of crime, emergencies and natural disasters more generally.

In particular, the London School of Economics' Centre for Economic Performance Report: *Socioeconomic Value of Mission Critical Mobile Applications for Public Safety in the UK: 2x10 MHz in 700 MHz* provides the most comprehensive examination of the socioeconomic benefits of a PSMB capability to a national economy. A review of the underlying assumptions of the Report did not identify any reasons why the results would not have relevance to the Australian public safety landscape.

While it deals with land mobile radio rather than PSMB, the ARCIA Report: *Valuing mission critical radio services: A study of the economic value of land mobile radio spectrum in Australia* demonstrates the benefits of a mission critical voice wireless service to the Australian economy.

Other reports that may be of relevance to the Productivity Commission, in that they seek to quantify the cost of crime and other public safety incidents to the community, include:

- Bushfires and Natural Hazards Cooperative Research Council Conference Paper: Estimating the Impacts of Natural Hazards on Fatalities and Building Losses (2014)

- Bushfires and Natural Hazards Cooperative Research Council Conference Paper: Disruption of Critical infrastructure during prolonged natural disasters (2014)

- Bushfires and Natural Hazards Cooperative Research Council Article: A century of natural disasters – what are the costs (2015)

- Australian Institute of Criminology: Counting the Costs of Crime in Australia (2014)

- Australian Bureau of Transport Economics: Economic Cost of Natural Disasters in Australia (2001)

Acronyms used in this document

Acronym	
3GPP	3rd General Partnership Project
ACMA	Australian Communications and Media Authority
COAG	Council of Australian Governments
kV	Kilovolts
LMR	Land Mobile Radio
LTE	Long Term Evolution
MHz	Megahertz
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator
PSA	Public Safety Agency
PSMB	Public Safety Mobile Broadband
PTT	Push To Talk
Qld	Queensland
SCPEM	Standing Council on Police and Emergency Management