Submission to the Parliamentary Joint Committee on Law Enforcement Inquiry into Spectrum for Public Safety Mobile Broadband

1. Introduction

Motorola Solutions welcomes the Government's commitment to ongoing consultation on the critical issues raised in this Inquiry.

As a leading provider of mission-critical technologies to a range of public safety and enterprise markets, Motorola Solutions has a proud history of working in partnership with many public safety agencies and local, state and federal governments.

With a heritage of over 45 years in Australia, Motorola Solutions has been at the forefront of local innovation, and our solutions form the basis of emergency communication networks, applications, devices and services currently relied on by public safety agencies across Australia.

Again, Motorola Solutions welcomes the opportunity to provide an industry perspective on the key issues raised in this Inquiry.

Public safety organisations require the allocation of appropriate and sufficient spectrum to take advantage of increasingly sophisticated ways to collect and share data to help fight and prevent crimes, save lives and properties.

As such, Motorola Solutions recommends the following in direct response to the Inquiry's terms of reference:

1) A minimum of 20 MHz (10 Uplink + 10 Downlink) is required to meet the demand for public safety mobile broadband applications
2) An allocation from the 700 MHz Digital Dividend Spectrum is preferable to the alternative proposal to allocate from the 800 MHz band.
3) Public safety organisations should not be forced to be solely reliant on commercial networks for their future next generation mission critical communications

Should the Committee wish, senior personnel from Motorola Solutions would be available to either brief committee members or present to the inquiry on any of the above points.

2. Background

The internet and wireless technologies have fundamentally transformed the way our society communicates. In line with broader social trends, public safety organisations too are embracing next-generation technologies and are looking to adopt a diverse range of data, imaging and multimedia applications in their day-to-day operations.

Public safety organisations currently rely on dedicated two-way radio networks for mission-critical communications. However, mobile broadband and newer technologies are becoming increasingly important as information sharing tools to help enhance situational awareness in the field and maximise operational effectiveness.

With stronger networks and greater capabilities, public safety agencies can supplement existing two-way radio voice communications with rich data and video content to empower

emergency services responders with the best information when and where it matters most to best serve and protect the community.

This steady drive toward next-generation technology solutions is bringing with it the need for dedicated spectrum and the deployment of dedicated public safety mobile broadband networks.

To achieve this, public safety agencies need support from the Federal Government to ensure sufficient and appropriate spectrum is dedicated to the public safety industry to enable the deployment of dedicated mission-critical mobile broadband capability.

The allocation of sufficient and appropriate mobile broadband spectrum for public safety provides a strong opportunity for government to take the best approach to leverage technological advances to ensure the greatest protection for the community.

Digital dividend spectrum

The migration of Australia's television broadcasting systems from analogue to digital technology has presented a rare opportunity for the allocation of valuable spectrum.

Australia's analogue TV broadcasting systems have for decades occupied several spectrum segments including the frequencies between 520 MHz and 820 MHz. The shift to digital technology will allow TV broadcasters to provide improved services whilst occupying less spectrum. The spectrum between 698 MHz and 820 MHz is thus being made available for other uses.

The same process of updating TV broadcasting services is occurring in many countries around the Asia-Pacific region and within other regions. Globally, this "Digital Dividend" spectrum is in the same or in similar frequency bands to that which is being released in Australia.

Coincident with this international process of spectrum migration is the emergence of an improved broadband radiocommunications technology known as "Long Term Evolution" or LTE.

LTE is widely recognised as the next step in cellular mobile phone technology, a fourth generation (4G) technology. LTE has been selected by many international jurisdictions as an excellent candidate for development as a Public Protection and Disaster Relief (PPDR) broadband communications tool.

In recognition of these two developments, national regulatory agencies like the Australian Communications and Media Authority (ACMA) and international standards bodies like the Third Generation Partnership Project (3GPP) have been working to secure the means for greater international standardisation and harmonisation of both technology and spectrum.

Within the Asia-Pacific region the Asia-Pacific Telecommunity (APT), of which the ACMA is a member, has developed a regionally-harmonised spectrum plan for the 698 MHz to 806 MHz band[1] as shown below in Figure 1.

[1] http://www.apt.int/sites/default/files/APT-AWF-REP-14_APT_Report_Harmonized_Freq_Arrangement.doc

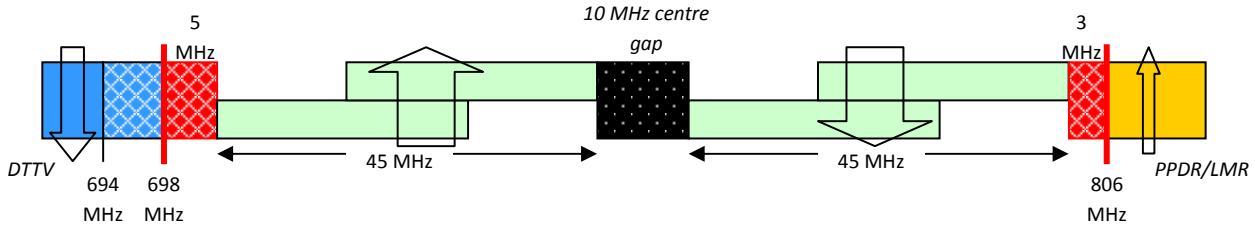

Figure 1. The APT Regionally Harmonised 700 MHz band.

Many countries in the South American region have also agreed to adopt the APT 700 MHz band plan and Europe is currently discussing options to adopt part of this band.

It should be noted that Figure 1 describes the spectrum above 806 MHz as “PPDR/LMR”. This refers to the harmonised allocation of this spectrum for use by PPDR agencies for their narrowband (25 kHz or less) Land Mobile Radiocommunications (LMR) voice and narrow band data services. It is well used for this purpose and is not available for broadband use in most countries of the Asia-Pacific region.

The USA has already developed a different 700 MHz band plan as shown below in Figure 2.

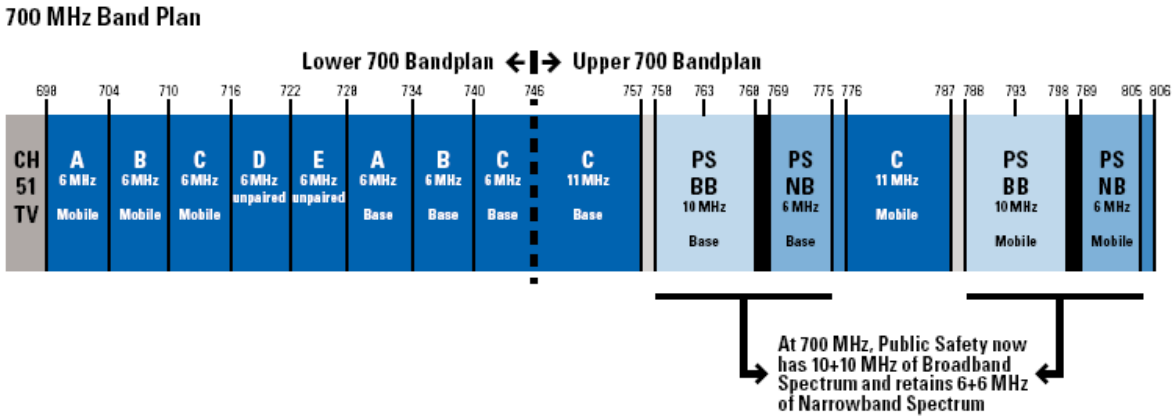

Figure 2. The 700 MHz band plan for the USA

The widespread, international use of LTE in the 700 MHz band, regardless of the actual plan adopted is almost certain. LTE will also be available in several of the other existing cellular telephone bands.

3. Motorola Solutions Response to Terms of Reference

Motorola Solutions is happy to provide the following information which it believes is pertinent to the Inquiry's terms of reference.

(a) how much broadband spectrum law enforcement agencies need to be able to communicate safely and effectively during mission-critical events such as natural disasters and potential terrorist incidents;

The adequate provision of spectrum for use by agencies involved in law enforcement or the provision of emergency services is of immense importance.

Motorola Solutions recommends that 20 MHz (10 MHz +10 MHz) of spectrum for LTE be allocated as an absolute minimum to satisfy the current and future needs of law enforcement.

The standard we're seeing globally has been for 10+10MHz and we believe that's the minimum level required here in Australia.

Early in the development of LTE and a spectrum allocation to public safety organisations, the United States of America (USA) allocated what it thought to be an adequate amount of spectrum for LTE public safety broadband communications. The USA allocated 5 MHz (for uplink) + 5 MHz (for downlink).

As the specifications for LTE were further developed and public safety agencies became more aware of the capabilities of LTE, the limitations of a 5 MHz + 5 MHz allocation became apparent. After years of lobbying the FCC agreed to an additional allocation for use by public safety agencies[2]. The USA has now allocated 10 MHz + 10 MHz of spectrum to PSBB.[3]

Canada is following the lead of the USA. Canada has also allocated 5 + 5 MHz and an ensuing public safety campaign has generated a debate which is seeking the allocation of an additional 5 MHz + 5 MHz. The conclusions of a paper developed by Defence Research and Development Canada supports the allocation of 10 MHz + 10 MHz of 700 MHz spectrum for PSBB.[4]

In Europe, a study for the German Federal Ministry of Economics and Technology (BMWi) found that a spectrum allocation of 15 MHz + 10 MHz was needed.[5]

As shown below in Figure 2, a system that makes use of 20 MHz of spectrum (10 MHz for the downlink and 10 MHz for the uplink, or 10 MHz +10 MHz) provides significant improvements over a network which uses only half the spectrum. The difference is clear.

The contrasting views show the difference between being fully informed and being partially informed.

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[2] http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db1001/DA-12-1571A1.pdf

[3] http://reboot.fcc.gov/spectrumdashboard/searchSpectrum.seam

[4] http://www.citig.ca/Data/Sites/1/action700/700mhztechnicalassessmentofpsrequirementsv09final!public.pdf

[5] http://www.bmwi.de/English/Redaktion/Pdf/ppdr-spectrum-harmonisation-germany-europe-globally,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf

Figure 2. The difference between 10 MHz and 20 MHz of spectrum

(b) which of the 700 or 800 MHz bands is the most appropriate for law enforcement agencies given the current licensees occupying spectrum;

An allocation from the 700 MHz band is preferable to an allocation from the 800 MHz band for the following reasons:

Availability of Spectrum

The ACMA is currently reviewing spectrum allocations in the 800 MHz band and has already proposed an allocation for public safety as one of the possible scenarios for any new spectrum plan.[6]

Within the 800 MHz band, there are a large number of existing users who would need to be relocated to other parts of the spectrum if more than the ACMA's offer of 5 MHz + 5 MHz of spectrum is to be allocated to public safety.

Given the high level of incumbency in the 803–960 MHz band and the requirement to potentially relocate a significant number of users from parts of the band, it is envisaged that implementation will occur over an extended period.

In particular, new spectrum for cellular mobile telephony services is not likely to be available until 2017 at the earliest and depending on the detailed implementation plan, potentially 2019. The exception to this is the offered 5 MHz + 5 MHz of spectrum for public safety

[6] The ACMA http://www.acma.gov.au/theACMA/Consultations/Consultations/Current/ifc-472012-the-803960-mhz-bandexploring-options-for-future-change

mobile broadband that will be made available as early as 2015 in areas where public safety agencies advise that it is required.[7]

If 10 MHz + 10 MHz of public safety mobile broadband spectrum is to come from the 800 MHz band, the most suitable location would be that which the ACMA has suggested could be allocated to cellular mobile telephone services between 814 MHz and 824 MHz paired with 859-869 MHz. As such, the ACMA's estimated timeframe for availability is "2017 at the earliest".

In contrast, the recent auction of 700 MHz spectrum which is being made available through the digital dividend process has left 15 MHz + 15 MHz of unallocated spectrum.

Sufficient public safety spectrum could be allocated from this band almost immediately and it would become available for use after the television re-stack process is completed around the end of 2014.

Following is a table of the auction results[8]:

Bidder	**Spectrum secured**		**Total price**
	700 MHz band*	**2.5 GHz band***	
Optus Mobile	2×10 MHz (20 MHz in total)	2×20 MHz (40 MHz in total)	$649,134,167
Telstra	2×20 MHz (40 MHz in total)	2×40 MHz (80 MHz in total)	$1,302,019,234
TPG Internet	Nil	2×10 MHz (20 MHz in total)	$13,500,000
Total spectrum sold	**2×30 MHz (60 MHz in total)**	**2×70 MHz (140 MHz in total)**	**$1,964,653,401**
Total spectrum unsold	**2×15 MHz (30 MHz in total)**	**Nil**	**N/A**

**Under the allocation limits, a single bidder could not acquire more than 2×25 MHz (50 MHz in total) in the 700 MHz band and more than 2×40 MHz (80 MHz in total) in the 2.5 GHz band.*

Expected Relative Costs of Equipment.

The cost of equipment for both infrastructure and users with similar types of applications and characteristics is determined by the scale of manufacture. If equipment includes features required by only a few users, the differences in costs can vary due to reduced market size.

[7] The ACMA http://www.acma.gov.au/webwr/_assets/main/lib550052/ifc47_2012-803-960mhz_band.docx
[8] The ACMA http://www.acma.gov.au/Industry/Spectrum/Digital-Dividend-700MHz-and-25Gz-Auction/Reallocation/digital-dividend-auction-results

In the world today there are, broadly speaking, four grades of products. These are described below in descending order of toughness and increasing size of the market served.

Military-grade: These products are almost indestructible, and their price is high because of the environment that they are expected to operate in. They are expected to perform in the battlefield, in rain and snow, in blowing dust and sand, in extreme temperatures, and constant off-road environments. These products are usually custom-designed for the military. The price is high because the market for these products is extremely limited.

Mission-critical grade: May also be known as “public safety grade” or “industrial grade”. These products are specifically designed for tough environments that the average person doesn’t usually work in. These can be hazardous environments or environments that become unsafe unexpectedly. Products must be designed to more stringent standards of durability, safety, performance, reliability, and functionality. Some military organisations will buy these products for use in non-battlefield environments. The military classifies these products as “commercial off-the-shelf” or COTS products. Failures in mission-critical products can mean the difference between life and death.

Commercial-grade: Products made to this grade are generally for the office environment. Commercial grade products are not expected to be as tough as the mission-critical products, but they are expected to work reasonable well in a business environment over several years. They can break if care is not exercised. These products also tend to be less expensive than mission-critical grade products because they are designed to provide for lower performance requirements and they have broad appeal to many people. Most commercial grade products cannot work in known hazardous environments. Many laptop PCs and cell phones are commercial-grade. Failures of commercial grade products can result in inconvenience to the owner.

Consumer-grade: Products in this grade are generally for the home or for leisure activities. Consumer products are not tough but they must meet product safety requirements. Consumer products are supplied to the largest and most diverse markets and will have the lowest prices. They are generally for personal use only.

LTE equipment will be manufactured by a number of different vendors. Most of the user equipment will be designed and manufactured for commercial and consumer markets and will be used on commercial cellular networks. The selected bands will include many of the existing commercial cellular bands and the new APT 700 MHz band.

Specialised, mission-critical equipment will be designed and manufactured for public safety users. This specialised equipment will include many public safety features specifically designed to provide users such as police, fire and ambulance officers with features to improve safety and efficiency in emergency situations.

The market for this equipment will be smaller than that for commercial and consumer equipment.

Globally, national regulators are deciding which bands are to be allocated to their public safety agencies. The largest market is expected to be in the North American 700 MHz band. The APT 700 MHz band is also expected to be significant with many APT counties already preferring to allocate segments to new public safety mobile broadband services within it.

Many APT countries already have significant allocations for narrow band radiocommunications uses in the 800 MHz band and will not re-farm this band in the foreseeable future, if ever. The South American 700 MHz band market is also expected to be large and if the Europeans also select a portion of the APT 700 MHz band as their preferred option the market will be a global one. The 800 MHz band will be small by comparison.

As mentioned above, the scale of manufacture will determine the cost of the equipment. The comparatively large public safety user base expected in the 700 MHz band will drive prices down and public safety agencies can expect to realise the benefits of lower costs if they are allocated spectrum at 700 MHz.

(c) how the necessary spectrum for public safety should be secured in a timely manner;

At 800 MHz, an allocation of 5 + 5 MHz can be allocated in about two years.

However, as indicated in (a) above, 5 + 5 MHz will be insufficient to meet the demands of public safety. At 800 MHz, the necessary additional 5 + 5 MHz will take more than five years to allocate. This is because the spectrum is currently occupied and will need to be cleared before being re-allocated. The ACMA's estimated availability for this spectrum is "2017 at the earliest".

At 700 MHz there is 15 MHz + 15 MHz of spectrum which remains un-allocated after the recent digital dividend spectrum auction. Sufficient public safety spectrum could be allocated from this band almost immediately and it would become available for use after the television re-stack process is completed around the end of 2014.

The digital dividend spectrum auction for the 700 MHz spectrum only attracted two purchasers. One of the major cellular network carriers did not participate in the auction for 700 MHz spectrum. Each successful purchaser could have purchased more 700 MHz spectrum if they had the requirement.[9]

(d) what arrangements should be put in place to ensure that, in extreme circumstances, law enforcement agencies can effectively use spectrum of commercial carriers to protect public safety and maintain public order;

The nature of the "extreme circumstance" will determine the viability of any use of commercial carrier spectrum. For example:

The use of commercial carrier spectrum and networks during a terrorist incident is not always viable. Explosive devices can be triggered through the use of commercial cellular networks. When public safety authorities suspect the use of this tactic they can call for the immediate closure of commercial carrier networks.

The use of commercial carrier spectrum and networks during widespread natural disasters such as bushfires, floods and earthquakes is additionally not always viable. Such disasters

[9] The ACMA http://www.acma.gov.au/Industry/Spectrum/Digital-Dividend-700MHz-and-25Gz-Auction/Reallocation/digital-dividend-auction-results

produce two often repeated outcomes which would restrict public safety access to commercial spectrum and networks.

- Commercial networks are built to maximise profit and the resilience of sites is less than that which is expected from sites which are built to perform during emergency situations. Equipment redundancy, link path redundancy and power system backup capacity, physical security and protection against cyber attack are all factors which contribute to the resilience of public safety network sites. Furthermore, commercial networks are fundamentally designed to maximise the number of users, with relatively large number of small cell size sites compared to public safety networks. This makes it less viable to harden commercial networks.

- Commercial networks are built to maximise profit and the design capacity of sites is limited to the expected "normal day" peak loads. During widespread emergencies the general public wants to know about the status of family members, friends and businesses. Commercial spectrum and networks experience overload conditions during such situations. Public safety dedicated sites are designed with emergency situations in mind. They are expected to cope with the peak loads expected during an emergency.

A situation where sites are unavailable for use due to equipment failure and where members of the general public are trying to check the status of family members and friends is a situation where commercial spectrum and networks are at or beyond their design capacity and are not available for public safety use.

Additional supporting recommendations[10] can be located at the Nation Public Safety Telecommunications Council web site.

(e) what applications dependent on broadband spectrum will contribute significantly to saving lives and property;

Just as there is growing demand among the community and business for reliable, high-speed broadband with mobile connectivity, real-time, accurate information is more crucial than ever for public safety.

Public safety agencies are embracing next-generation technology, which enables emergency services responders to realise tailored mobile broadband connection speeds and access rich-media applications with the appropriate level of prioritisation from advanced collaborative data devices.

Some examples of applications that have been identified by public safety organisations are summarised in the following table:

[10] The NPSTC http://www.npstc.org/download.jsp?tableId=37&column=217&id=2712&file=Why_Cant_PS_Just_Use_Cell_Phones_NPSTC_130415_orig.pdf

Application	Feature	Public Safety Example
Video	Video streaming, live video feed, Download/ Upload of video clips	Video clips
		Patient monitoring (may require dedicated link)
		Video feed of in-progress incident
		Video communications from wireless clip-on cameras used by in building fire rescue
		Image or video to assist remote medical support
		Surveillance of incident scene by fixed or remote controlled robotic devices
		Assessment of fire/flood scenes from airborne platforms
		Assessment of fire/flood scenes from airborne platforms
Real-time multimedia Intelligence	Real time optimisation of video or other multimedia content	Optimize throughput capacity by adjusting rich media content to available bandwidth and device screen size.
Imagery	Download/upload of High resolution Images	Downloading Earth exploration-satellite images
		Real-time medical imaging
		Biometrics (finger prints)
		ID picture
		Building layout maps
Voice	Person-to-person	Selective calling and addressing
	Push-to-talk	Push-to-talk
	Instantaneous access to voice path	Push-to-talk and selective priority access
Group Voice	One-to-many	Dispatch and group communication
Direct Mode Voice	Talk-around/direct mode operation	Groups of portable to portable (mobile-mobile) in close proximity without infrastructure

Direct mode operation of Video and data	Direct unit to unit video and data communication without infrastructure	Direct handset to handset, on-scene localized command and control

(f) the impact on law enforcement agencies which utilise the available spectrum in relation to budgets, implementation strategies, current infrastructure and existing technology; and

The latest generation of digital public safety cores being deployed across government two-way radio networks already have the capability to support public safety mobile broadband (LTE) deployment and operation in the future.

Public safety mobile broadband network architecture is scalable, and can be deployed initially with a relatively small number of strategically located public safety mobile broadband sites, overlaid on existing public safety two-way radio communications networks.

Coverage and capacity may be expanded over time with available budget as required to meet business requirements.

It is envisaged that other established government assets such as fire, police and ambulance stations may be used as strategic site locations for future infill coverage. Commercial networks can additionally be used to augment coverage as required for non-mission critical communications, or where roll out of dedicated PSMB networks is not justified.

4. In Summary

Public safety organisations require the allocation of appropriate and sufficient spectrum to take advantage of increasingly sophisticated ways to collect and share data to help fight and prevent crimes, save lives and properties.

Public safety broadband networks are scalable, and can be implemented cost effectively by strategically overlaying on existing agency infrastructure and selective augmentation by commercial networks as required to meet business requirements.

As such, Motorola Solutions recommends that:

- A minimum of 20 MHz (10 Uplink + 10 Downlink) is required to meet the demand for public safety mobile broadband applications
- An allocation from the 700 MHz Digital Dividend Spectrum is preferable to the alternative proposal to allocate from the 800 MHz band.
- Public safety organisations should not be forced to be solely reliant on commercial networks for their future next generation mission critical communications

Acronyms and Abbreviations

3GPP	Third Generation Partnership Project [an international Standards body]
4G	fourth generation [cellular technology]
ACMA	Australian Communications and Media Authority
APT	Asia-Pacific Telecommunity
AWG	Asia-Pacific Telecommunity Wireless Group
BB	broadband
CMTS	cellular mobile telephone service
COTS	commercial of the shelf
FCC	[United States] Federal Communications Commission
ITU	International Telecommunications Union
kHz	kilohertz
LMR	land mobile radiocommunications
LTE	Long Term Evolution [a fourth generation cellular technology]
MHz	megahertz
Motorola	Motorola Solutions Australia Pty. Ltd.
NB	narrow band
NBN	National Broadband Network
PPDR	public protection and disaster relief
PS	public safety
PSMB	Public Safety Mobile Broadband
PSA	Public Safety Agency [police, fire and ambulance]
the Act	Radiocommunications Act 1992
USA	United States of America
TV	television