Australasian
TETRA FORUM

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Melbourne 25th May 2015

Public Safety Mobile Broadband
Productivity Commission
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Re: Public Safety Mobile Broadband Study

This response has been prepared by the **Australian TETRA Forum (ATF),** a chapter of the international TETRA and Critical Communication Association (TCCA). The ATF body represents 23 organisations in Australia that are involved in the Land Mobile Radio Industry (LMR) promoting and raising the profile of the global non-proprietary multi-vendor digital TETRA trunked radio standard in the region. The ATF facilitates workshops, supports Australian and regional conferences and exhibitions, facilitates exchange of information with industry bodies and industry associations in Australasia on behalf of the TCCA and its members. The ATF also helps to secure and maintain sufficient radio spectrum for the betterment of the Australian LMR industry and users, and supports the TCCA objective to create a global single mission critical broadband standard for LTE as part of the convergence of voice and data services demanded by Public safety communities worldwide who use existing LMR digital standards equipment such as TETRA and P25.

The **TETRA + Critical Communications Association (TCCA)** is the sector association representing the interests of over 165 organisations around the world comprising public and private users, operators and manufacturers of mission critical communication networks, hardware, software, and works closely together with global standardisation bodies such as ETSI and 3GPP. The TETRA technology has now also been approved in the U.S.A and Canada.

TCCA Working Groups comprise:

TCCA Board
The Board determines and manages the activities of the TCCA, under the guidance of its Chairman. Individual Board members take on specialist responsibilities. The Board & Chairman report to Members and propose items for a full membership vote at the Annual General Meeting which takes place annually at the Critical Communications World event, incorporating TETRA World Congress.
Apps Working Group
The development and promotion of TETRA applications.
Critical Communications Broadband Group (CCBG)
The Critical Communications Broadband group and its sub-groups leads the Association in the development of mission critical broadband communications.
Technical Forum
The forum manages the development of TETRA Interoperability Profiles (TIP), monitors and reports on the progress of interoperability trials and the status of TIP certification.
Transport Group
The Transport Group evaluates the needs of the Rail Industry and to ensure that the TETRA standard adequately addresses these needs

Marketing Group - The Marketing Group drives the integrated marketing communications activity, defining the positioning and raising the profile of the TCCA. This Group is responsible for the events programme, collateral, media relations and market research activity. We also work with IIR to help define the content and direction of the Critical Communications series of events.

Operator/User Association (OUA)

This body comprises representatives from TETRA Network Operators, TETRA Users and other interested parties, focusing on the issues which concern the development & enhancement of those networks.

Radio Spectrum Group

There is an ongoing need globally for spectrum as requirements and technology evolves.

SCADA, Power Grid and Telemetry Group

TETRA is ideal for these sectors.

Security & Fraud Prevention Group (SFPG)

SFPG concern themselves with operational security issues such as the limitation of fraud on TETRA Networks and the employment of encryption on TETRA Networks. They also administrate the use of particular TETRA Encryption Algorithms (TEA's) and work to ensure that fraud and security issues are dealt with in a manner so as not to act as a barrier to the successful implementation of a TETRA network.

SME

A group of smaller TETRA manufacturers with a common interest in its success.

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The TCCA guarantees an open multi-vendor TETRA market and ongoing product evolution and ensures IOP certification process between TETRA manufacturers. It addresses the evolution of TETRA and future needs of mission critical mobile broadband technologies through its industry and technology workgroups, regional and global conferences, exhibitions (e.g. Critical Communications events and TETRA World Congress) and workshops and is driven by the desire to ensure that users must always have the best technology available to them that comprises open standard based core technologies and applications that evolve from mission critical users.

In order to facilitate interoperability and investments in multi- vendor open standard technology the TCCA also supports the implementation of harmonised spectrum.

Evolution of the current mission critical digital non-proprietary narrowband systems have been successful due to product standardisation and spectrum harmonisation in Europe and other parts of the world.

Today that means digital narrowband technology such as TETRA, TETRAPOL, P25 and PDT technology are the product of choice. Some of the first adopters of standards based digital TETRA and P25 networks were national and state wide public safety networks in Europe and the U.S respectively providing mission critical voice services and limited data.

We understand that the current approach is to continue to refresh and update existing networks with the latest TETRA and or P25 products for their critical communications and consider the use of public networks to provide additional broadband services and or the combination of both narrow band mission critical networks i.e. P25 and TETRA with Broadband through hybrid solutions.

This is seen by some as a long-term migration path towards mission critical broadband services when LTE functionality is standardised and proven to support essential Public safety voice and data services, and when suitable harmonised spectrum is identified and when the necessary funding becomes available.
LTE is a consumer point-to-point broadband data technology that has not been designed to be mission critical operation. However the public safety community around the world has recognised it as the solution to enhance their current narrow band services with broadband capability.

The US, Asia, UK and other European governments, regional standards organisations such as ARIB, ATIS, ETSI, TTA, TTC and TSDI supported by 14 Market partners. Representing the broader industry 4G Americas, CDMA Development Group, Cellular Operators Association of India (COAI), GSA, GSMA, IMS Forum, Info Communication Union, IPV6 Forum, NGMN Alliance, Small Cell Forum, TD Industry Alliance, TD-Forum, UMTS Forum and the TCCA.

All of these organisation including the TCCA have been contributing to the LTE standard under the leadership of the 3GPP group to include critical communications functionality that should include standards based multi-vendor solutions for a healthy market place similar to the current multi-vendor TETRA and P25 networks.

These essential Mission Critical LTE functionalities include:

- *Group Communication System Enablers*
- *GCSE (Group call), Proximity Services*
- *ProSE (Device to Device/Direct Mode)*
- *Isolated E-UTRAN Operation for Public Safety - IOPS (Fall-back)*
- *Mission Critical Push To Talk over LTE – MCPTT*

3GPP, the organisation responsible for the mission critical standardisation, has supported the TCCA in its ongoing efforts to develop and introduce mission critical Broadband standards despite there being over seven billion consumers and fewer than 42 million critical communications users.

Clearly LTE will be a significant part of the solution for critical communications users worldwide whatever the chosen migration path.

With respect to spectrum, in Europe the TCCA cooperates with the various organisations such as ETSI (European Technical Standards Institute), the Federation of the European Union Fire Officer Associations (FEU) www.f-e-u.org and the Public Safety Communication Europe (PSC Europe) www.psc-europe.eu to identify a single spectrum environment for Broadband Public Protection and Disaster Relief services that includes Public safety and Emergency organisation (PPDR) and to define conditions for taking the 700 MHz band to mobile use, including conditions for PPDR use of the band.
TCCA recommends that a sufficient amount of 700 MHz frequency resources shall be made available for these mission critical communication services in Europe.

Mission critical communication is not just the domain of the law enforcement and the emergency services. Those responsible for the Critical National Infrastructure such as

Gas, Electricity, Water, Transportation, Fuel and Petrochemical also need communications services that can withstand natural and man-made disasters and that enables interoperability with first responders during emergency and disaster situations.

The TETRA and Critical Communication Association (TCCA) and key representatives from its 165 member organisations around the world have also produced material supporting the governmental organisations responsible for PPDR services. Those documents are attached as part of our submission.

We trust that our submission including supporting International information in respect to Public Safety mobile broadband is of interest to you and our directors and members would be happy to provide any additional information and support if so required.

Yours sincerely,

Anton Abrahams
Chairman
Australasian TETRA Forum

Important Note
The opinions and information given by the Australasian TETRA Forum and the international TETRA and Critical Communications Association in the responses and attached documents are provided in good faith. Whilst we make every attempt to ensure that the information contained in such documents is correct, the TETRA and Critical Communications Association is unable to guarantee the accuracy or completeness of any information contained herein. The TETRA and Critical Communications Association, its employees and agents will not be responsible for any loss, however arising, from the use of, or reliance on this information.

Consolidated list of questions/answers from the 'Issues paper'

1. *What is the merit (or otherwise) of the proposed approach to undertaking first principles analysis in this study?*

ATF response - we agree with the methodology, however, it is critical that interoperability by way of implementing standardised "global" technology i.e. no dependence on proprietary technology from single vendors and a harmonised spectrum between various agencies and all states is part of the first principles. It is also vitally important that a measure of the 'Social benefits' offered by the Public safety Agencies is factored into the valuation outcome. We recommend that each PSA considers the overall cost to society from not having an efficient and always-available public safety radio communication service in place taking into account both direct and indirect impacts on human lives, health, property and infrastructure.

Most organisations responsible for PPDR (Public Protection and Disaster Relief) in Europe are convinced that their needs for mission critical broadband services can only be met by dedicated harmonised spectrum. Harmonised conditions for broadband PPDR offer obvious and substantial advantages (in terms of scale economies, equipment portability, cross border communications, and that Public Safety broadband requirements cannot be met by relying exclusively on commercial networks.

The London School of economics in its report "The Socioeconomic Value of Mission Critical Mobile Applications for Public Safety in the UK2 and in the EU3: 2x10MHz in 700MHz." articulated the case where mission critical broadband spectrum can have socioeconomic benefits/consequences: (1) Safety of citizens and frontline officers, (2) Efficiency, (3) Dedicated Spectrum versus using only commercial service and the consequence of degradation of service availability to emergency services in times of mission critical dependency (4) Crime has a significant impact on society and the socioeconomic benefit of crime reduction on house prices has a significant impact of GDP.

The WIK-Consult agency in Germany have with their discussion paper "The need for PPDR Broadband Spectrum in the bands below 1 GHz" presented the case for dedicate spectrum with some key findings in substantial socio-economic benefits in ensuring that PPDR broadband networks can be implemented. As a practical matter, this requires spectrum under 1 GHz. Both the LSE and WIK reports are attached with our submission.

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

ATF Response - The TETRA and Critical Communication Association (TCCA) and key representatives from its 165 member organisations around the world, have also produced material supporting the governmental organisations responsible for PPDR services. Those documents are attached as part of our submission

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

ATF Response -In general it is evident that internationally spectrum regulators in some countries plan to auction all available 700/800 MHz bandwidth to the highest commercial bidder.
In such cases, PSAs and Emergency Services will be forced to purchase capacity from a commercial cellular network operator. They will have to share capacity with business and the general public, even during major incidents where life and property are at stake.
But global experience shows that commercial operators are unable to guarantee the availability, security and stability of communications especially during times when good communications are needed most.

In Australia we have concerns that in developing spectrum management policy the ACMA have made assumptions with regard to the future PSMB system that may be coloured by competing demands for spectrum. The suggested spectrum needs taken into account with the current review of the 800-900MHz band included assumptions that the PSA's would not have large data needs, which we question. There was also the assumption that the various jurisdictions would not be able to fund the building of a private network and so little spectrum should be made available, with more spectrum being set aside for the existing public carriers.
ATF advocates that whenever a PSA decides to implement a broadband service – whether by building a dedicated network, or by outsourcing to a commercial operator, or a combination of both – it must be implemented within the PSA harmonised spectrum range agreed for Australian states and territories to ensure interoperability between states and territories.

PSA's have specific needs that ordinary commercial operators will never be able to meet under their business plans. Those needs cover specific functionalities and specific engineering implementations to ensure robustness, security and availability. We strongly believe that those needs are ultimately best met by implementing a dedicated open standard radio network in a dedicated spectrum allocation, following the principles of the current and well proven PSA narrow band implementations

Based on our TCCA/ATF collective experience we take the view that it is of a substantial advantage for governments to keep control of an adequate amount of radio spectrum under harmonised conditions in order for their PPDR organisations to deliver a future proof service to society. We also expect as the LTE standards evolve with voice and data services essential to PPDR, compliant networks and subscriber hardware and applications in form factors with the durability and ruggedness required are available then migration from existing public safety LMR narrowband will be viable. The demands on the

LTE network traffic will potentially increase with such potential migration and needs to be factored in to the long term spectrum capacity requirements.

NB In Europe, EU member states, in cooperation with the Commission, are in preparation for the ITU World Radio communications Conference 2015 to identify a single spectrum environment for Broadband Public Protection and Disaster Relief (PPDR) services and to define conditions for taking the 700 MHz band to mobile use, including conditions for PPDR use of the band. Emergency services have an increasing demand for access to mobile broadband data services for their PPDR operations. The establishment of mission critical mobile broadband data services requires a frequency band located below 1 GHz. (Re-allocations for mobile service at the World Radio communications Conference in Nov. 2015 (WRC-15).

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

   ATF Response – Mission critical communication is not just the domain of PSAs and the emergency services and in most emergencies there will be other agencies involved beyond the main three PSAs (Police, Fire & Ambulance). With this in mind and to properly cater for future emergency needs, services such as the various State Emergency Services (SES), Life Saving Australia, local Government and these other 'second tier' agencies should also have access such as the critical national or state wide infrastructure such as Gas, Electricity, Water, Transportation, Fuel and Petrochemical also need communications services that can withstand natural and man-made disasters. In times of major disasters there will be a need to be interoperable facilities for all agencies to be involved and have common information.

   With regard to communications between the PSA's and the community, it is critical in times of disaster, both for the PSA's to advise community safety aspects, but even more importantly as part of the information gathering systems as in many cases it is data on 'social media' that provides an additional information to incident commanders on how to respond. This ability also means that for public carriers to prioritise data on their networks for PSA use could potentially limit the amount of information available from the general public due to system capacity limits being reached, a factor that must be considered when evaluating the benefits of public vs private networks for PSMB operation.

5. *How do the 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?*

   ATF Response - No response other than to highlight that many of the PSA's have an inherent distrust of sharing information between agencies, let alone across jurisdictional borders. This will be an issue that will have to be addressed as part of the system security considerations.

6. *What is an appropriate definition of 'mission critical' communication 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?*

ATF Response - Definition of "Mission Critical" **-** Mission critical communication is supplied by special communications systems where the reliability, availability, stability and security of mobile communication is vital to ensure continuous availability of functions critical for society

Or

Mission Critical is defined as a function whose failure leads to catastrophic degradation of service that places public order or public safety and security at immediate risk.

Mission critical communications include communication hardware and software, as well as radio frequency band (spectrum) and availability to transmit and share information between field units and command centres.

In Europe the 27 member states of the Law Enforcement Working Party (European Council) have agreed this definition:
"Mission critical operations' for PPDR organisations address situations where human life and goods (rescue operations, law enforcement) and other values for society are at risk, especially when time is a vital factor."
This means we define 'mission critical information' as the vital information for PPDR to succeed with the operation.

"Mission critical communication solutions" therefore means that PPDR needs secure, reliable and available communication and as a consequence cannot afford the risk of having failures in their individual and group communication (e.g. voice and data or video transmissions).

It is not surprising given the potential impact to the public to find that in addition to specific mission critical functionalities governments require implementations that are resilient, have built in redundancy and excellent coverage coupled with technical solutions for security, reliability and availability there are also extraordinary legal provisions being used to guarantee mission critical service. Examples of today's government's contracts for mission critical voice service are listed below and have commitment periods where 10-15 years are normal and there are even contracts in place that runs into the 2030th.
In Australia there will also be various opinions and definitions on "Mission critical" from within the PSA's. We recommend that early in the discussions there should be agreement on one single definition to be applied to all PSMB considerations.

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

ATF Response - P25 standards are currently the preferred narrowband mission critical radio technologies in Australia with various degrees of encryption within the various PSAs and Emergency organisations by state. The level of sophistication, product release and software differs in most states making interoperability between various states impossible. Spectrum harmonisation is key to the latter as well.

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?*

ATF Response -– this is a question for the PSA's to respond to directly. From an industry perspective it appears to be an ongoing process of renewal over several years subject to product and software releases and upgrades.

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?*

   ATF Response - the PSA's and Emergency services will have to give their own scenarios. Each agency will have totally different requirements, even for a single incident and these must all be factored into calculations. We feel that PSA's have little knowledge or ability to forecast future usage when many applications and products are yet to be developed, e.g. current development of mission critical LTE by the 3GPP. Many of the existing TETRA digital LMR implementations have seen significant growth of voice and data usage on these networks as underlying standards have driven product innovation in response to public safety user business demands and work practice efficiencies. It can equally be expected that LTE standardization will enable business practice driven use of the technology beyond replication of existing usage models.

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?*

    ATF Response – Unable to provide information on this question as this is a question for the PSA's to respond to directly.

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

    ATF Response - Mission critical communication is not just the domain of PSAs and the emergency services and in most emergencies there will be other agencies involved beyond the main three PSAs (Police, Fire & Ambulance). With this in mind and to properly cater for future emergency needs, services such as the various State Emergency Services (SES), Life Saving Australia, local Government and these other 'second tier' agencies should also have access such as the critical national or state wide infrastructure such as Gas, Electricity, Water, Transportation, Fuel and Petrochemical also need communications services that can withstand natural and man-made disasters. In times of major disasters there will be a need to be interoperable facilities for all agencies to be involved and have common information.

    Major resource companies in Australia are hesitant to use public networks for critical systems. A number of major mine sites in Western Australia have installed their own LTE systems to ensure that factors such as reliability, resilience and latency are under direct control for efficient operation of the facilities.
    We are unable to provide information from organisations such as banks and financial institutions that utilise public broadband services.

12. *What lessons or insights can be taken from the previous trials of Telstra's LANES model, including during the G20 summit in November 014?*

ATF Response – We are not party to this information.

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?

ATF Response - Providing that technology of all networks used is of the same standard and operates in same spectrum there should be no issues. Commercial barriers could be the issue e.g. PSAs and Emergency Services will be forced to purchase capacity from a commercial cellular network operator. They will have to share capacity with business and the general public, even during major incidents where life and property are at stake. Experience globally show that commercial operators are unable or reluctant to engage in service level agreements that guarantee the availability, security and stability of communications especially during times when good communications are needed most

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

ATF Response - PSA broadband is still a new technology and other than use for database enquiry, video and location services, little else has been explored at this stage as many agencies are still evaluating their pilot or trial programs. Consequently it seems much of the trialling is to some degree limited and adhoc in nature. This means that many future applications such as mission critical LTE currently being developed by the 3GPP group (LTE with typical mission critical LMR functionalities) could be deemed as critical to an incident response could have data demands that would stress the public carriers services and cause significant problems if used on agency wide basis.

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

ATF Response – other than Broadband data such as video, multimedia applications and large data file transfers, standard LTE as provided by commercial operators will not provide and or replace the mission critical functionalities and high levels of network availability that most of the PSA and Emergency organisations currently utilise. To achieve the same mission critical functionalities LTE requires to evolve or transform into "LTE Mission Critical" currently developed by the 3GPP group.

These LTE mission critical network functionalities to include:

- Group Communication System Enablers
- GCSE (Group call), Proximity Services
- ProSE (Device to Device/Direct Mode without network access)
- Isolated E-UTRAN Operation for Public Safety - IOPS (Fall-back)
- Mission Critical Push To Talk over LTE – MCPTT

There are also specialist agencies or departments with agencies who demand highest levels of encryption security that need to be standardized to the same levels deployed within current LMR networks or for closed group local operations

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

ATF Response – We are unable to provide information on this issue, other than to point out that we understand to be an increasing reliance on 'social media' information in incident response planning.
With regard to communications between the PSA's and the community, it is critical in times of disaster, both for the PSA's to advise community safety aspects, but even more importantly as part of the information gathering systems as in many cases it is data on 'social media' that provides an additional information to incident commanders on how to respond. This ability also means that for public carriers to prioritise data on their networks for PSA use could potentially limit the amount of information available from the general public due to system capacity limits being reached, a factor that must be considered when evaluating the benefits of public vs private networks for PSMB operation

17. *What PSMB capability characteristics should be considered in this study?*

ATF Response – Much of the questions and answers so far have related to the devices and demand in the field at incidents, however, in order to have this information available there has to be a 'backhaul' path to the main data resources for incident monitoring and control. With the plans for the NBN to now be available to localised 'nodes' around Australia, this will make available a backhaul facility with the pricing and facilities under control of the Government. With a decentralised core system the actual traffic on the backhaul network would hopefully fall well within the capabilities of the NBN and this would then offer a suitable format at potentially lower cost than the carrier-owned backhaul for centralised systems.

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

ATF Response - National interoperability' should extend to all jurisdictions and all emergency services. The interoperability between PSA's and Emergency organisations will increase over time making it possible that there should be sufficient capacity to cover all the requirements built-in to the system.
Being so, it is critical that a standardised (= non-proprietary) PSMB technology is implemented and that an interoperability (IOP) regime is in place for the vendors of such technology as is currently the case with narrowband TETRA and most P25 digital trunked LMR systems.

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

ATF Response – The implementation of PSMB is an opportunity that offers the first real capability for true interoperability to date. No doubt inherent conservative attitudes within agencies regarding sharing of information will still exist but there will be fewer technical constraints involved than is currently the case.
Existing LMR networks have a degree of interoperable features, however, the equipment choices and facilities selected by the various jurisdictions have limited the degree of success for interoperability.
With the proposed PSMB network the network configuration is capable of re-configuration at any stage, this would mean that equipment from many agencies can be brought together and facilities equalised between terminals to provide true interoperability, providing that a standardised (= non-proprietary) PSMB technology is implemented and that an interoperability (IOP) regime is in place for the vendors of such technology as is currently the case with narrowband TETRA and most P25 digital trunked LMR systems.

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

ATF Response – We suggest that that a PSMB system(s) will need to be rolled out over a period of time. It may also have different requirements or functionalities for various locations.

One option for delivering new generation of services is by utilising a combination system with some private network operations in major CBD areas to commence and public carriers for the other areas, the provision of facilities could be made available relatively quickly. Make use of upgraded commercial networks with network deployment to meet the specific operational requirements of the PSAs and Emergency services.
Also use the existing LMR narrow band systems to provide mission critical voice functionality.

Or roll-out a new generation dedicated critical mobile PSMB develop that has LMR functionalities that will replace existing mission critical LMR systems over time. After that, as demand or finances decreed, the PSMB private systems could be extended further out from the CBD areas. . This is seen by some as a long-term migration path towards mission critical broadband services whilst functionality is standardised and proven, and when suitable harmonised spectrum is identified and when the necessary funding becomes available.

One area that should be kept in mind as the systems are developed is the ability for the PSAs to operate Cells-on-wheels (COWS). With some services, these would not necessarily be trailer-mounted or towable devices, for instance, organisations like the Victorian CFA and South Australian CFS have 'forward command vehicles' located in many brigade premises around their respective states. It is entirely feasible that selected vehicles could be fitted with COW facilities and as long as they could access the NBN they would become an extension of the PSMB network to provide coverage for significant incidents. With 4G technology these units would service ALL PSA terminals in the area.

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

ATF Response – Unable to contribute a response.

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?*

ATF response – over recent times the availability of 'gateway devices' which utilise IP-connected formats have meant that it is basically possible for equipment from various agencies to have the ability to communicate between each other in emergency incident situations.
It would seem that in many cases the agencies involved have not had the impetus to sit together and establish the guidelines and formats for the devices to be installed and how the communications protocols would apply.
This raises the actual requirements for interoperability, in many minds of those outside of the PSA's the thought is that every person involved can communicate between each other, Police, Fire, Ambulance, etc. In the real world this is not the level that interoperability is really required. Each agency needs the ability to communicate with and control their own personnel, with support from other agencies to realise their operational needs. With this in mind it becomes apparent that interoperability is really needed at an 'administrative' level rather than

the actual 'first responder level'. Once this scenario is accepted the degree of interoperability is clarified and much easier to configure and maintain.

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

    ATF Response – there should be equal coverage for metro and regional Australia as well as in-depth coverage penetration inside buildings, irrespective of location. The general public would not be happy knowing they were not being protected by the best available facilities. This must also be based on actual geographic coverage and not a 'population percentage' metrics. Bushfires, floods, major road and rail accidents and similar emergencies are not restricted to areas of population density.
    This does not match the typical roll-out of a commercial network.
    The obvious concern is that absolute coverage is not economically feasible, however, smart system design can account for much of the requirement. For instance, if a system with de-centralised switching is utilised, then the traffic from any particular 'Cell' back into the main database or control locations is kept to a minimum. Under this format the latency (amount of signal delay) is not as critical and so a satellite terminal could be used to give the backhaul with a COW to give the local incident area communications.

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

    ATF Response– We recommend that the coverage requirements should be based on geographic estimates and not only on 'population density' metrics.

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

    ATF Response – There are options to extend coverage of commercial networks such as transportable infrastructure or COW (Cell on Wheels) that already are in use by the commercial carriers for special events e.g. Melbourne Cup, Grand Prix and more. This COW can be used to increase the range or capacity of the commercial networks. The question then arises whether the commercial networks could/would permit PSA COWs to be used for emergency coverage in certain conditions. One significant restricting factor would be the backhaul capacity as the commercial networks have their own backhaul and this may be tailored to suit the existing infrastructure and not be capable of readily accommodating extra temporary cells.

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?*

    ATF Response – define what is an acceptable level of network coverage? See question 23 response.

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

    ATF Response – Yes, they can be assimilated onto a broadband network that has similar mission critical functionality of the digital narrow band networks e.g. Press-to-talk (PTT) voice services, Instant communications (<200 msecs), Group calls, etc. i.e. mission critical LTE currently being developed through the 3GPP group.

One of the major risks is that if equipment that is not to an international multi-vendor and open standard is utilised, then the system and products will become proprietary and this then introduces the possibility of limited or restricted supply options and higher cost in the future.

This situation has already arisen with existing LMR services where the initial P25 radio equipment supplied to many agencies differed from the true equipment standard in relation to the features and facilities of the supplied equipment. This did not appear to create a problem when the equipment was first supplied as there was very limited availability of equipment. However, as the supply market matured it has been found that many agencies have almost become 'locked in' to one supplier because of the lack of clarity regarding equipment standards. We would suggest that to work with any form of equipment that is not fully compliant with international standards, or has any degree of proprietary configuration may not be in the best interests of the PSA's.

Some examples of national implementations.

Finland has commenced their strategy of working towards a future mission critical LTE system starting off with parallel networks i.e. existing digital narrow band infrastructure for mission critical voice and narrow band data (TETRA) that works along a standard broadband infrastructure commercially available for large data, using the best of both technologies in evolutionary steps towards a fully integrated and standardised mission critical LTE system.

Step one is to set up a data mobile virtual network operator (MVNO) to address the increased everyday data requirements. This will be accomplished by extending the subscriber and services provisioning system to support provisioning users on a broadband network. At first the PSA can use externally purchased subscriber identity module (SIM) cards, but eventually the second step will be to own and control subscribers in the LTE core.

In this second step, the critical voice and messages will run in the narrowband network, and high-speed non-critical (but secure) data will run in the commercial broadband network. The natural follow-up — step three — is to expand the owned LTE core to an owned dedicated broadband radio access in chosen locations, providing critical-grade data services.

Once the critical voice over LTE standardization is ready and the TETRA supplier supports group call over LTE functionality in the TETRA side, then the two networks can be connected, which will be the fourth step. This way the large development investments in TETRA group communications functionalities, such as prioritization, could be used. Then the same voice services are available both in narrowband and broadband — in the dedicated networks on critical service levels and in the commercial operators' networks up to the levels they can provide.

The final fifth step is dismantling the TETRA narrow band radio access once broadband service availability and reliability meets public safety's requirements (+/- 2030). In some — most of all rural — areas, this might take place first when the narrowband network spare parts stock runs out.

During these five steps, the narrowband TETRA network will transform to a TETRA critical voice service server, the operator will gain knowledge and understanding about how to operate a broadband network, and users will have access to a high-speed data service that enables them to benefit from data applications and to develop information-centric ways of working.

We have attached examples of other countries moving forward with the implementation of mission critical broadband systems.

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

ATF Response – the introduction of a nationwide single PSMB with interoperability for all States and PSA and Emergency organisations will have major benefits in costs. But we believe that one of the major risks is that if PSMB equipment that is not to an international multi-vendor and open standard, then the system and products will become proprietary and this then introduces the possibility of limited or restricted supply options and higher cost in the future and there will be issues with interoperability.

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?*

ATF Response – Likely within the next decade. The international standard needs to be completed first. This is currently developed by the international 3GPP group with a host of standardisation and support organisations including the TCCA.
Other organisations include:

- US DoC/FirstNet (The First Responder Network Authority)
- NPSTC (National Public Safety Telecommunications Council)
- The UK Home Office
- APCO (Association of Public Safety Communications Officials)
- TIA (Telecommunications Industry Association)
- OMA (Open Mobile Alliance)
- ETSI - TCCE (TC TETRA and Critical Communications Evolution) has opened a work item: DTR/TETRA-01203, User Requirements Specification Mission Critical Broadband Communications Part 2 Critical Communications Application
- Korean Government

Once the standard has been developed (+/- 2020), then the terminal design would follow and manufacturing behind that. Add approx. 2 years for chip design, product development, Interoperability ("IoP") testing etc. General estimates are that it will still be several years after 2020 before equipment configured to 3GPP mission critical specifications will be available.

- **Standards based solutions are needed for a healthy market place**
- **Standards making takes time**

Please refer to the documentation we have attached -
CRITICAL BROADBAND STANDARDIZATION: Outlining The Current Status Of International, Cooperation Towards Common Standards And Harmonized Spectrum For Mobile Broadband by **Adrian Scrase, Head of 3GPP MCC**

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?*

ATF Response – we are unable to respond.

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?*

ATF response –a private, or Government owned PSMB network would have a higher degree of security than one shared with the general public.

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?*

ATF Response – we are unable to respond.

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

ATF Response – we are unable to respond.

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

ATF Response – In the early days of mobile broadband the public carriers' forecast in capacity of their networks proved to be incorrect and we would venture to say that all of these forecasts fell well short of the actual demand.
The PSA's run a very real risk of the same situation when forecasting now, we would believe that the original forecasts on which the initial PSMB discussions took place several years ago have now been dramatically modified over and above the critical voice requirements (=narrow band critical LMR functionalities).
Estimate of application and user requirement's forecast:

- ✓ Mobile office
- ✓ Transfer of images
- ✓ Biometric data
- ✓ Automatic number plate recognition
- ✓ Digital mapping and location services
- ✓ Remote data base access
- ✓ Personnel monitoring
- ✓ Sensor devices/networks
- ✓ Remotely controlled devices
- ✓ Non-real time video
- ✓ Real time video

Although the PSMB market is nowhere near the size of the general telecommunications market, the similarities fall within the development of new 'Applications' (Apps) and the increasing data demands of these Apps.

The public safety market for mobile broadband is still a developing market world-wide and so not a lot of time or effort has been put into App development, to this end the PSA's don't know what is coming or what future requirements may be. Any forecast for demand should be treated as an indication only and factored by a significant amount for planning purposes.

The bottom line for data demand is the amount of spectrum available, the public carriers confirm this with their constant and apparently insatiable demand for new spectrum, the PSA's cannot be restricted by insufficient spectrum to gain future benefits.

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

ATF Response - The PSA would expect high levels of network availability, reliability and integrity and network control, resilient networks with various layers of redundancy, geographic coverage including remote areas, low latency of voice delay, interoperability, ability to support mixed traffic and the various Apps, applicable to their operations.

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?*

ATF Response – Normal standard operational requirements can be forecast with relative ease, although each of the agencies will have differing amounts as their normal operations are very different.

The forecast of incident requirements should be re-classified into perhaps various levels to enable the agencies to build demand algorithms as they go, e.g. low, medium and high level incident requirements it may be easier for agencies to develop better indications. This planning should also look at various types of incidents where the major agencies are involved in different formats, for instance bushfires and floods would have totally different needs from agencies. Similarly a serious transport accident in a rural area would be totally different to the same incident in a suburban area. This level of design will be critical to the success or failure of any PSMB system.

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

ATF response – This is not our expertise but we do understand that the three major agencies (Police, Fire & Ambulance) would all have different data needs and at different stages of any critical incident, in addition, the second tier responders will also have different needs which will probably be more administrative but still vitally important in the overall picture. With this in mind the relevant agencies will all need to plan out their potential data needs and input from all agencies must be considered.

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

ATF Response – similar to the above response. And if a PSMB is operating on a public network, either permanently or in an overflow capacity one will have to be sure that it doesn't swamp the network capacity under various conditions.

39. *What level of resilience do PSA narrowband networks usually provide and how does this differ from commercial mobile broadband networks?*

ATF Response – this will differ between agencies, however, our members report that for LMR narrow-band voice systems it is usual practice to have at least three days of power back-up for 'high density' population areas, and between seven and ten days as a minimum in remote

or high-risk areas. It is also usual to have some form of back-up to communications back-haul links to ensure that remote transmission sites have a degree of protection from loss or failure of equipment.
System resilience is one of the major factors that must be considered in PSMB system needs. Anecdotal evidence from major incidents, both within Australia and internationally, is that often the narrow-band systems continue to operate long after other communications systems fail, and in many cases the public carrier networks cease to operate from either loss of power or the backhaul link systems are out of commission in a much shorter timeframe.
The PSAs would expect high levels of network availability, reliability and integrity and network control, resilient networks with various layers of redundancy, geographic coverage including remote areas, low latency of voice delay, interoperability, ability to support mixed traffic and the various Apps, applicable to their operations.

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?*

ATF Response – We understand that with LTE systems the power requirement of the equipment is constant and so there are calculations to configure standard power requirements and the amount of back-up power required. If a site is to operate of alternative energy sources such as wind or solar, the equipment suppliers have algorithms available for all areas of Australia to provide the necessary calculations.

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?*

ATF Response –The PSA's will have arrangements already in place for their narrow-band radio systems and the same plans should be in place for the PSMB network.
An incident controller will already have an indication of his system reliability and has every right to believe that his mobile data will perform to similar levels.
Should the ultimate decision be made to operate on a public network, then it may be necessary to ensure that local access arrangements are in place to cover any eventualities where the network might be down.

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?*

ATF Response – Resilience of the backhaul network. There is a high likelihood that the backhaul operate on commercial networks, either in part or fully. This means that the backhaul network has to be 'hardened' to the same level at each cell site.
If the system is designed to operate with centralised switching this becomes even more critical, as a backhaul failure will potentially disable every terminal beyond the point of failure, so they may still be capable of operation on a local site but without system administrative contact they cannot function, this is why backhaul resilience is more critical in some design formats than others.

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?*

ATF Response –PSA's may not have a full understanding of the possible future applications that could form part of their operational needs. From a network and cost perspective it would be safer if the PSMB was a private network where any system revisions or changes were under the control of the relevant jurisdictions and that any new revisions and or Apps are part of a global standard and multi-vendor IOP.
Operation on a commercial network could see the network parameters modified to suit features that bring in the money from the public and this could lead to a situation where the needs network of the PSMB are compromised to meet the commercial demands of the network operator. On the other hand a commercial system cannot be compromised by external forces and a competitive edge lost?

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

ATF Response – Given the high availability, resilience and reliability designed into the existing narrow band digital voice and data systems, users expect that the move of narrow voice and data services onto a PSMB system based on a mission critical LTE platform is equal to or better than reliability of present systems.

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

ATF Response – See our response to question 27 – Finnish example.

Also under the current 3GPP development plan for a global standard for mission critical PSM (LTE) the specification could be finalised by 2020.
Once the standard has been developed (+/- 2020), then the terminal design would follow and manufacturing behind that. Add approx. 2 years for chip design, product development, Interoperability IoP testing etc. General estimates are that it will still be several years after 2020 before equipment configured to 3GPP mission critical specifications will be available

46. *What potential 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?*

ATF Response –. Standard mobile Broadband is a highly consumer driven technology and the network and terminal manufacturers respond to consumer demand and technology advances.
Again we stress the point of a standardised mission critical PSMB (LTE) product and Apps, specifically for PSA and Emergency organisations as per the 3GPP standard in the near future.
Also spectrum considerations needs to be kept in mind, as the product development goes ahead and new spectrum areas are developed, the 'device chip-sets' will have to reflect the spectrum plans of the public carriers
In some way this could mean that the Australian PSMB allocation might be better served to be in the unallocated 700 MHz spectrum where it will remain adjacent to the major carriers and chip-sets are more likely to be maintained, operation in the 800MH segments might see a situation where there is a restricted availability of devices due to the spectrum not being a widely used segment for mobile broadband in other areas of the world.

47. *How does the method of ensuring interoperability impact on the cost of the system to PSAs?*

    ATF response –with the LTE technology the interoperability of terminal devices will primarily be a function of the core network configuration. It may be that the 'Chinese walls' will become a function of the agency internal networks and they may have more challenges than at a terminal level.

48. *What detailed ptions should be evaluated in this study? What are the underlying assumptions and key parameters would be associated with each option?*

    ATF Response – We are unable to respond

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

    ATF Response – We are unable to respond

50. *What are the sources of costs relevant to this study?*

    ATF Response – We are unable to respond

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?*
    ATF Response – We are unable to respond

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?*

    ATF Response – We are unable to respond

53. *Are the network cost elements identified in box 4 relevant for 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?*

    ATF Response – We are unable to respond

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?*

    ATF Response – We are unable to respond

55. *What network cost 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?*

    ATF Response – We are unable to respond

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

ATF Response – We are unable to respond

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

ATF response –The network costs comprising the actual LTE base station equipment will probably be the lowest cost part of the fixed cell cost. But the costs associated with fixed Infrastructure such as equipment masting, power sources, site access and other items will be much higher than actual LTE equipment costs, and will be ongoing expense.
If the system is to be a private network, then consideration must be given to utilising as much existing infrastructure that the agencies either own or have good access to with arrangements already in place. In some cases it may be worth that added equipment remains on low-cost sites, given the ongoing cost consideration.

If the proposed system were to be operating with de-centralised network switching there is the potential for the NBN to become part of the back-haul capability, plus there are many other back-haul options such as 'State-owned' railway systems with spare Fibre-Optic capacity, and utility companies who also have FO capacity available.

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?*

ATF Response – we agree with the Australian Radio Communication Industry Association (ARCIA) relating to spectrum evaluations and social benefit of the spectrum. (Refer to ARCIA reports).

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

ATF Response – we agree with the Australian Radio Communication Industry Association (ARCIA) concerns with the estimates used by the ACMA economists regarding recent review of Opportunity Cost Pricing (OCP) for the 400 MHz band. (Refer to ARCIA)

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

ATF Response – We are unable to respond

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

ATF Response – Historically we understand that equipment refresh and update for PSA's has been measured in terms of fifteen ten years or more.

The issue that with mobile broadband the technology refresh and update, i.e. roll-out is probably more likely to be two to three years and it will all depend on what PSMB model is chosen, a combination of current narrow band system and PSMB, i.e. evolution path (e.g.

Finnish model) or a dedicated PMSB with mission critical functionality that will be available next decade from 2020 onwards.

From a fixed infrastructure perspective the refresh rate would be in the vicinity of fifteen years to twenty years and could be evaluated on a ten year cycle, however, terminal devices should be considered to refresh in a much quicker timeframe. This will be an unexpected expense item for PSA's as terminal equipment refresh is going to be much higher but maintenance on terminal devices will potentially be much lower with a move towards disposable terminals.

6**2.** *What are the sources of benefits relevant to this study?*

ATF Response – We are unable to respond

63. *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?*

ATF Response – We are unable to respond

64. *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)?*

ATF Response – There are a number of trials and or systems rolling out:.

Korea (4/6/15) - A pilot public-safety Long Term Evolution (LTE) network will launch this month in three South Korean cities and continue through the end of the year, said Dujeong Choi, project manager, public safety communications testing and certification, South Korea's Telecommunications Technology Association (TTA). The US$45 million pilot network will launch in Gangneung, Pyeongchang and Jungsun with 205 base stations and 2,496 handsets. The pilot will offer testing and validation of the country's planned nationwide public-safety LTE network. South Korea's three commercial carriers have interest to bid on the contract for the network, which will comprise three separate bidding phases — pilot, extension and completion phases. The Ministry of Public Safety and Security is the supervising entity for South Korea's public-safety LTE network.

The network will comprise about 12,000 base stations and around 200,000 mobile stations, including fixed mobile stations, vehicle-mounted radios, smartphones and two-way radios, in eight mandatory areas. The network must also address interoperability with different vendors and legacy proprietary equipment such as VHF, UHF and TETRA. Implementation must also coincide with railway and maritime LTE networks, which will be planned separately with the nationwide public-safety LTE network.

Several public-safety mobile radio and broadband technologies are used in South Korea. VHF is used by 40.1 percent of the market, TETRA comprises 38.3 percent of the market, UHF 14.9 percent, iDEN 5.1 percent and WiMAX 1.6 percent. "With global cooperation, we can accomplish the economies of scale and solve the interoperability, standardization and security challenges in the public-safety LTE deployment," Choi said.

In **Belgium**, ASTRID, the specialist telecom operator for Belgian emergency and security services launched Blue Light Mobile in 2014 – a mobile broadband data service that utilises three Belgian commercial networks . This formula is already established as a world first. The

digital TETRA-technology on which the ASTRID radio network is based has been developed principally for voice communications and light data applications.

ASTRID predicts a strong growth in data applications and has responded to this by launching a mobile broadband data service that is tailored to the specific needs of the emergency and security services in and around the nation including cross border areas. With Blue Light Mobile, ASTRID becomes in part a Mobile Virtual Network Operator (MVNO), supplying services via third-party networks. 'We are the first in the world to use this formula', says Christian Mouraux, project leader for Blue Light Mobile. 'Already quite a few experts from abroad have been contacting us with an interest creating a similar service. In the 1990s ASTRID was involved at the birth of digital radio networks. With Blue Light Mobile it once again leads the way forward.'

Also refer to our response to question 27 in which we indicated that **Finland** has commenced commenced with their strategy of working towards a future mission critical LTE system starting of with parallel networks i.e. existing digital narrow band infrastructure for mission critical voice and narrow band data (TETRA) that works along a standard broadband infrastructure commercially available for large data, using the best of both technologies in evolutionary steps towards a fully integrated and standardised mission critical LTE system

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

ATF Response – We are unable to respond

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

ATF Response – We are unable to respond

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

ATF Response – We are unable to respond

Attached Documentation that is relevant to the Australasian TETRA Forum submission

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Attachment 1.

Critical Broadband Standardization
ETSI Presentation: Outlining the Current Status Of International, Cooperation Towards Common Standards And Harmonized Spectrum For Mobile Broadband
26 Feb/15 - Presented by Adrian Scrase, CTO ETSI, Head of 3GPP MCC - for Critical Communications Asia

Attachment 2.

The need for PPDR Broadband Spectrum in the bands below 1 GHz - WIK-Consult Discussion Paper, **October 2013** -WIK-Consult GmbH Rhöndorfer Str, 68 53604 Bad Honnef, Germany

Attachment 3.

P3 – Communications GmbH - Study on the relative merits of TETRA, LTE and other broadband technologies for critical communications markets, **February 2013**
P3 communications GmbH
Am Kraftversorgungsturm 3 (Alter Schlachthof)
52070 Aachen, Germany

Attachment 4.

The Strategic Case for Mission Critical Mobile Broadband
A review of the future needs of the users of critical communications
December 2013 (Document 2)
Issued by TETRA and Critical Communications Association's (TCCA) Critical Communications Broadband Group (CCBG),
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Attachment 5

Mobile Broadband for Critical Communications Users
A review of options for delivering Mission Critical solutions
December 2013 (Document 1) Issued by TETRA and Critical Communications Association's (TCCA) Critical Communications Broadband Group (CCBG)
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Attachment 6

Mobile Broadband in a Mission Critical Environment –
as seen from a TETRA perspective
February 2012
Issued by TETRA and Critical Communications Association's (TCCA) Critical Communications Broadband Group (CCBG),
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Attachment 7

Public Safety mobile broadband and spectrum needs
report for TETRA Association
March 2010
By Analysis Mason limited
Bush House, North West Wing
Aldwych, London WC2B4PJ, UK

Attachment 8

Harmonised spectrum for Critical Communications
An Executive Summary
December 2013
Issued TETRA and Critical Communications Association (TCCA),
Critical Communications Broadband Group (CCBG),
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Attachment 9

Broadband spectrum for mission critical communication needed
(European perspective) by Jeppe.Jepsen@tandcca.com, September 2013,
issued by TETRA and Critical Communications Association's (TCCA), Critical Communications Broadband Group (CCBG),
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Attachment 10

Socioeconomic Value of Mission Critical Mobile Applications for Public Safety in the EU: 2x10MHz in 700MHz in 10 European Countries
Paper by Dr Alexander Grous, December 2013
Centre for Economic Performance
London School of Economics and Political Science

Attachment 11

How to source a Mission Critical Service, July 2013
Issued by TETRA and Critical Communications Association's (TCCA), Critical Communications Broadband Group (CCBG),
TETRA + Critical Communications Association
14 Blandford Square
Newcastle upon Tyne, NE14HZ, UK

Important Note

The opinions and information given by the Australasian TETRA Forum and the international TETRA and Critical Communications Association in the responses and attached documents are provided in good faith. Whilst we make every attempt to ensure that the information contained in such documents is correct, the TETRA and Critical Communications Association is unable to guarantee the accuracy or completeness of any information contained herein. The TETRA and Critical Communications Association, its employees and agents will not be responsible for any loss, however arising, from the use of, or reliance on this information.
