Emergency Services Long Term Strategic Plan

International Public Safety Broadband

26 February 2013

Introduction

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

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

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

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

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

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[1] Spectrum for public safety radio communications, Current ACMA initiatives and decisions, October 2012

[2] Final Report, Public Safety Mobile Broadband Spectrum Quantum Calculation for Public Safety Mobile Broadband Steering Committee, November 2011

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

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

Allocation of spectrum across the globe

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

North America

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

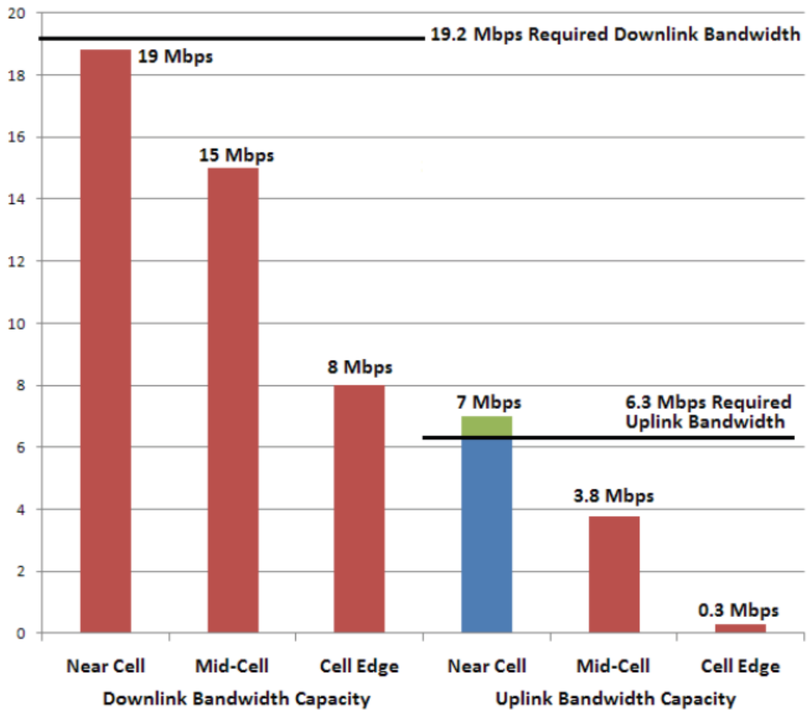
Independent, real-world tests have also demonstrated that the 5+5 MHz spectrum did not provide sufficient bandwidth for incidents that occur on a daily basis.[5] The East Bay Regional Communications System Authority in partnership with the Bay Area Urban Area Security Initiative (UASI) developed Project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

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

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

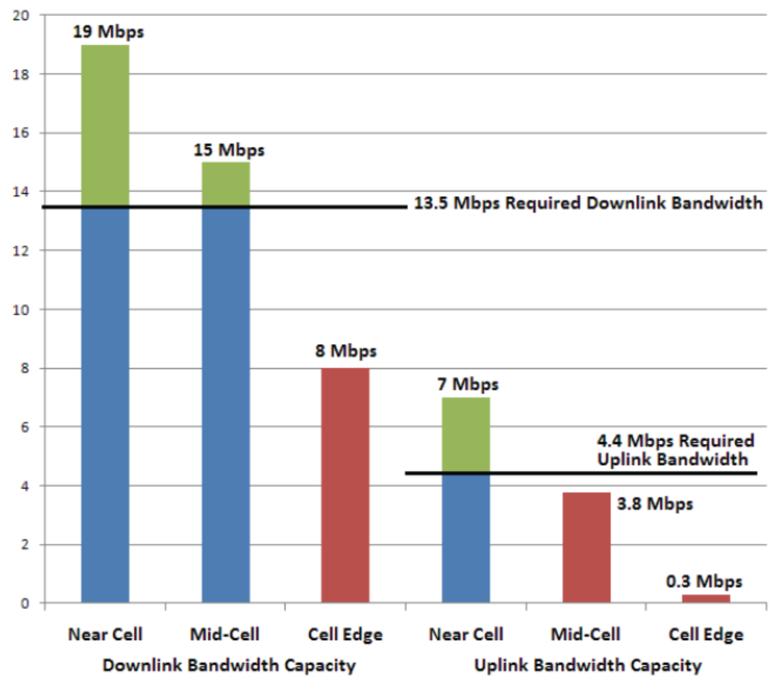
[3] US Federal Communications Commission (FCC), Public Safety and Homeland Security Bureau: Interoperability, available: http://transition.fcc.gov/pshs/emergencyinformation/interoperability.html
[4] 700 MHz Public Safety Broadband Task Force Report and Recommendations, NPSTC
[5] Project Cornerstone Network LTE Testing, www.andrewseybold.com

Figure 1 – Barricaded Hostage Scenario Bandwidth As Measured And Required



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

Figure 2 - Suspected Bomb Scenario As Measured And Required



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

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

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

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

EU

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

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

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

The FM49 analysis considered the following scenarios:

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

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

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

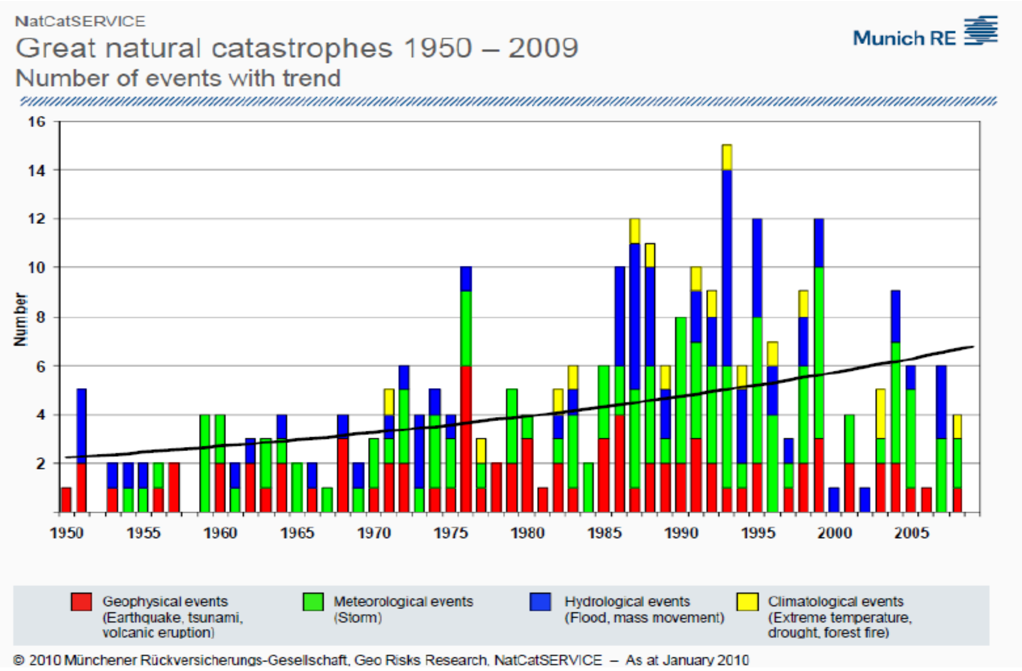
[6] The Middle Class Tax Relief and Job Creation Act of 2012
[7] http://www.wiley.com/legacy/wileychi/molisch/supp2/appendices/c07_Appendices.pdf
[8] Report from CG spectrum requirements, FM 49 Radio Spectrum for BB PPDR, October 2012

Natural Disasters

Global trends in disasters

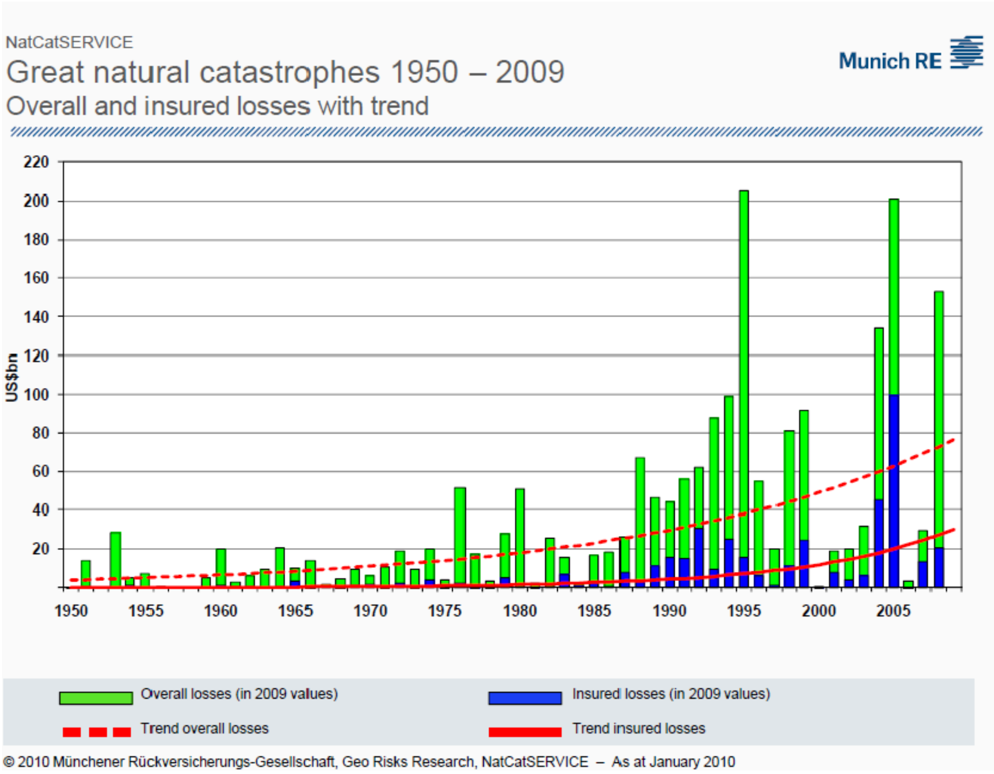
The incidence of natural disasters in Australia and around the World is increasing. Figure 3 shows the number of natural disasters worldwide from 1950 to 2009.

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



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

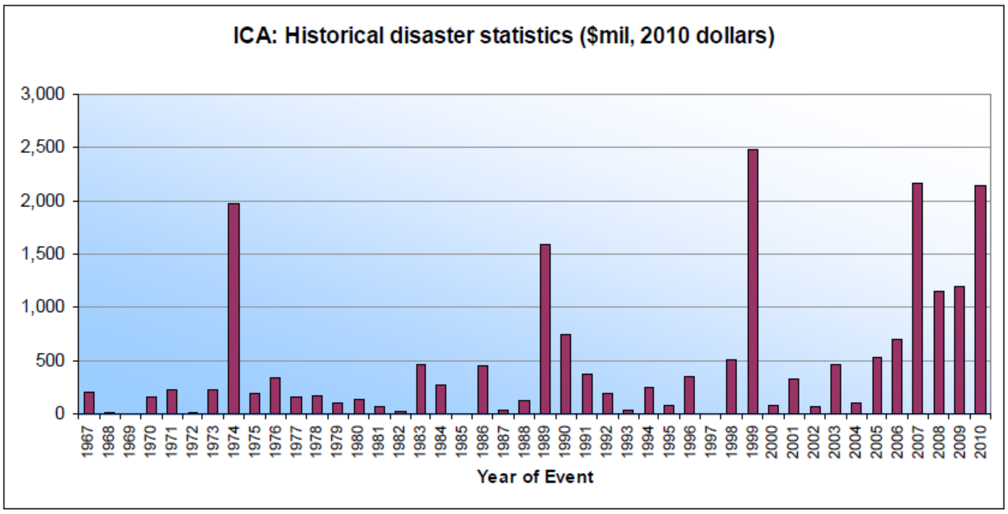
Figure 4 - Overall and insured losses, Great Natural Catastrophes 1950-2009



Trends in Australia

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

Figure 5 - Insurance Council of Australia - Historical Disasters



Source: Insurance Council of Australia - Historical disaster statistics

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

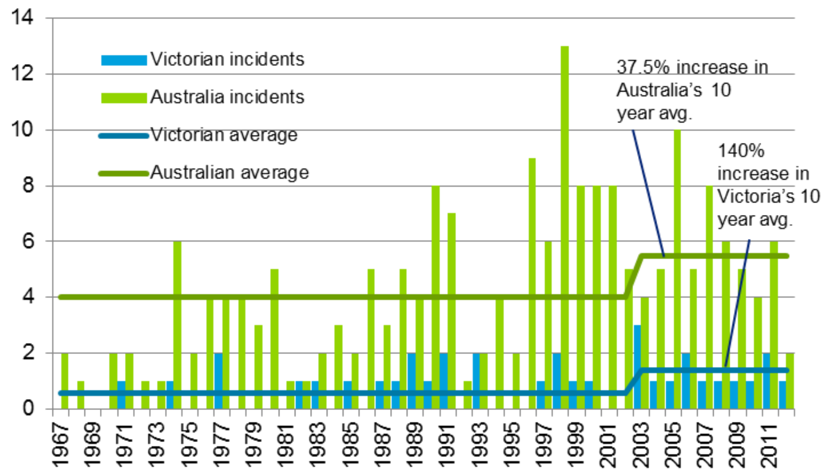
The 5 largest insured events between 1967 and 2010 were:

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

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

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

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



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

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

Why these increases?

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

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

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

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

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

Outlook for the future

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

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

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

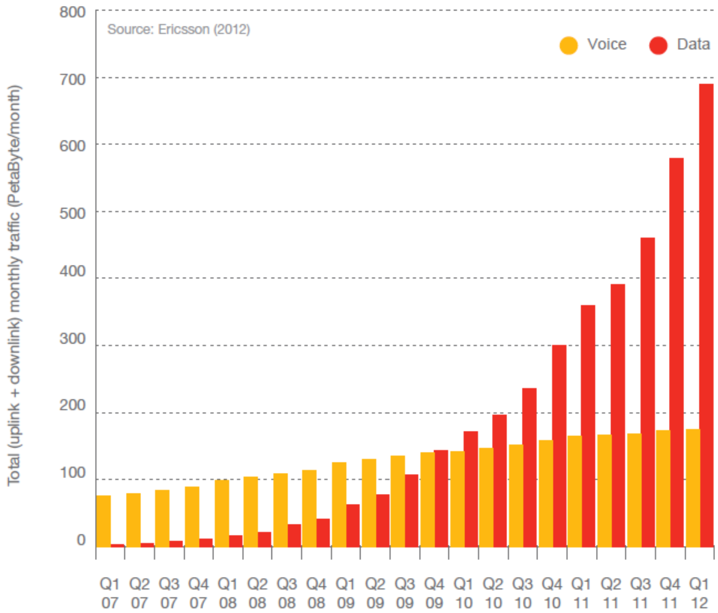
Growth in mobile data usage

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

To date

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

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



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

Future (2012-2017)

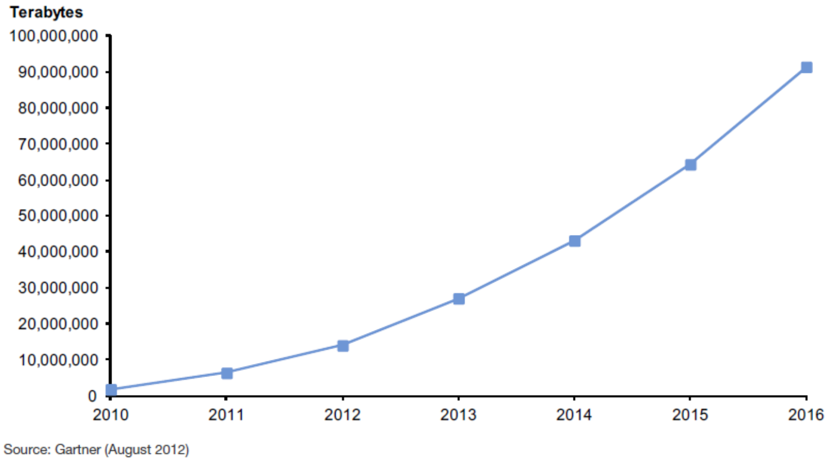
Industry predictions are for this growth in traffic to continue;

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

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

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

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



The growth in mobile data usage has been driven by

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

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

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

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