Productivity Commission's Public Safety Mobile Broadband Study

Western Australian Agencies'
Select Incident Data Demand Profiles
Report

December 2015

Introduction

The purpose of this report is to provide quantitative data demand profiles for select incident responses, developed by Western Australian Government agencies, to the Productivity Commission's Public Safety Mobile Broadband (PSMB) Study. This work is also expected to inform PSMB-related work in the State.

This report has been developed by the Western Australia Police, Department of Fire and Emergency Services, Department of Parks and Wildlife and Department of the Premier and Cabinet. St John Ambulance Western Australia Ltd has also provided input.

Approach

Quantitative data demand profiles for incident responses have been explored through scenario demand modelling of public safety agencies' (PSAs') responses to different incident scenarios. The demand profiles have been developed by Western Australian agencies and have been informed by the operational and technical expertise of the State's PSAs.

The demand profiles provide point-in-time data demand estimates that are based on existing and known emerging mobile data software applications. The estimates do not include growth rate projections. Applying a growth rate to the estimates to project future demand requirements is considered problematic as the future uses of mobile broadband (and their data rates) are not all known. These demand profiles estimates will therefore not be static over time and will need to be revisited to take account of additional uses of mobile broadband that become available to PSAs.

As cellular data networks do not provide uniform capacity throughout the network coverage area (due, among other things, to the amount of available data capacity varying in relation to users' distance from a network site) Western Australian agencies have developed two data demand estimates per scenario:
- A reasonable-use estimate (data use that is considered reasonable for PSAs to require given existing and known emerging data applications).
- A minimum-use estimate (reflecting efficiencies which would be operationally acceptable in the event that reasonable demand exceeded capacity. 'Operationally acceptable' means there may be an increase in operational risk (e.g. that relevant information is not collected, assessed or acted on in a timely manner) but the data applications in use were assessed as still increasing the likelihood of PSAs' effectiveness).

The data demand profiles that have been developed are for localised incidents. It is entirely feasible that the data capacity from a cellular data network available to support a localised incident would be that provided by a single cell sector of a network site (possibly with some overlap from an adjacent cell sector if the incident occurs near the primary cell sector's periphery).

Scenarios

Data demand profiles for three localised-incident scenarios have been developed that correlate to level 1, 2 and 3 incidents (or small-, medium- and large-scale incidents). These three scenarios provide a range of demand profiles against which a PSMB capability could be dimensioned. The scenarios that were selected involve two fire incidents (a structural fire and bushfire) and a non-natural hazard (hostage incident). A non-natural hazard scenario was included to demonstrate how the data capacity requirements (e.g. high-resolution video) can vary between natural and non-natural hazard incidents. The scenarios are outlined in **Table 1**.

The scenarios are all based on real Western Australian incidents and were chosen, in part, as they are scenarios that could feasibly occur in different areas (e.g. regional and metropolitan areas), not just in a relatively small geographical locale (e.g. a central business district). The intention was to make the demand profiles applicable to a greater portion of a dimensioned PSMB network.

Incident Level & Type	Comments	Lead Agency	Incident Description
Table 1 - Data Demand Profile Scenarios			
Level 1 Structural Fire	• This scenario is based on the 2012 Mt Lawley Primary School structural fire • This is a feasible incident for metropolitan and regional areas • This type of incident can occur at any time of the day • An incident of this scale could occur approximately once a week	Department of Fire and Emergency Services	A fire was reported at the Mount Lawley Primary School at approximately midnight on 8 July 2012. The fire rapidly escalated to involve the main school building structure and eventually destroyed more than 80% of the main school building. The damage caused by this fire was estimated at $9 million. The initial response to this fire was from Perth Fire Station appliances and at 0023 hours the Officer In Charge upgraded the incident to 5th Alarm Structure Fire. The fire was brought under control at 0213 hours and the incident was scaled back at 0800 on 8 July 2012. Crews remained on the scene, however, until approximately 1200 hours on 12 July 2012.
Level 2 Hostage Incident	• This scenario is based on the 2015 Bunbury Hostage incident • This is a feasible incident for metropolitan and regional areas • This type of incident can occur at any time of the day	Western Australia Police	A report was received that two males were wired with explosives in a public park in Bunbury at approximately 1812 on 16 July 2015. The incident was quickly confirmed as a hostage situation on the grassed foreshore area of a park. The incident involved the threat of explosives. The initial response was from the local police who confirmed that there were two males in the park and there were wires connecting the two of them. Police set up exclusion zones, activated specialist units and commenced negotiations. The incident continued throughout the night and was resolved at approximately 0710 with the outcomes of the hostage being released and the other male being taken into custody. Exclusion zones and road blocks remained in place until explosives clearance had been given and the incident scene remained secured

Table 1 - Data Demand Profile Scenarios			
Incident Level & Type	**Comments**	**Lead Agency**	**Incident Description**
			for forensic activities. Extra police units conducted high visibility patrols in nearby Bunbury CBD and suburbs after the incident was resolved.
Level 3 Large-Scale Localised Bushfire	• This scenario is based on the 2011 Kelmscott/Roleystone Bushfire • This type of incident is feasible for outer-metropolitan and regional areas • This type of incident can occur at any time of the day	Department of Fire and Emergency Services	Roleystone is located approximately 38 kilometres by road south east of the Perth CBD in the City of Armadale. During the late morning of 6 February 2011 a fire was ignited in the front yard of a house on Brookton Highway, Roleystone. An initial response was initiated at 1145 with Armadale CFRS, Roleystone VFRS, Roleystone BFS and Bedfordale BFS being mobilised in accordance with DFES Standard Operating Procedures and the operational protocols which mobilise aerial support to support ground based firefighting activities. The resultant bushfire was a significant incident for the State with a total of 71 houses being severely damaged and effectively lost to the fire, while an additional 39 homes and structures were assessed as partially damaged but repairable. The fire was approximately 430 hectares in size (4.3 square kilometres) and required a multi-agency response.

Methodology

The data demand profile estimates were developed using a common methodology. The methodology outlined below draws on a 2011 Canadian PSMB Demand Profile Study.[1]

Planning assumptions for developing the estimates were that:
- while data demand requirements will vary throughout an incident, the estimates' focus is on the expected *peak* usage period for each scenario;
- the data use that is in scope is all of PSAs' wireless data traffic within the area local to the incident. This includes the mobile data use of frontline personnel and incident management teams;
- a mission-critical PSMB capability is available to support PSA operations (estimates were not limited to what can be provided over existing data networks);
- mobile data use is limited to existing or known emerging mobile data applications;
- mission-critical voice communications are not accommodated on mission-critical voice-over-LTE applications (i.e. mission-critical voice services are still provided by agencies' existing Land Mobile Radio (LMR) networks and other means (e.g. VOIP – voice-over-internet-protocol));
- data applications would involve either burst or continuous transmission (e.g. internet usage and video respectively). When calculating the per second data rates of burst transmission applications the data burst size has been averaged across the period of its transmission frequency. For example, the data rate for an application with a burst size of 1500 kilobytes and a transmission frequency of 2 minutes was calculated at 100 kilobits per second.[2] Averaging the data rate is imperfect and the reality might be a higher total peak data rate if all the burst transmissions do not occur in an evenly distributed manner (as is possible); and
- there would be a concurrent need to conduct business-as-usual (BaU) activities around incident areas. The level of BaU activity may vary depending on the nature of the incident. The data capacity required for these BaU activities *does not* form part of the incident data demand profiles.

Integrating mission-critical voice-over-LTE applications and accommodating residual BaU mobile data use would have implications for the PSMB data estimates. There is currently uncertainty about what data capacity would be required to accommodate these uses (and whether an LTE network can provide voice to a mission-critical standard).

The methodology that Western Australian agencies used to develop the estimates involved:
- estimating the number of, and type of, PSA resources/assets that would be deployed in each scenario;
- identifying the types of data applications PSAs could use in each scenario (limited to existing or known emerging mobile data applications);
- calculating the upload and download data rate of each of the applications;
- estimating the type and peak number of specific data applications that PSA resources/assets could have in use during each scenario for:
  - the reasonable-use estimate; and
  - the minimum-use estimate;

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[1] Claudio Lucente, 2011, *700 MHz Spectrum Requirements for Canadian Public Safety Interoperable Mobile Broadband Data Communications*, Defence R&D Canada – Centre for Security Science. Available at: http://www.citig.ca/Data/Sites/1/action700/700mhztechnicalassessmentofpsrequirementsv09final!public.pdf
[2] 1 byte = 8 bits.

- reviewing and validating PSAs' estimates in a multi-agency workshop; and
- calculating both reasonable- and minimum-use total data usage for each scenario.

This report does not consider how the expected data use would be met.

Demand Profile Estimates

The data demand profile estimates are summarised in **Table 2**. Detailed breakdowns of each of the scenario estimates, identifying the PSA resources deployed and the number of users of specific data applications, have been provided to the Productivity Commission on a confidential basis.

Appendix A contains the data rates for the software applications used in the estimates. The data rate for each software application was multiplied by the number of users of each application for each of the scenario estimates.

For each scenario two estimates were calculated: a reasonable-use estimate and a minimum-use estimate. Maximum-use estimates were not included as the purpose was to establish data capacity baselines. If additional data capacity were available PSAs would make use of it.

Western Australian agencies first calculated the reasonable-use estimate. This estimate included what agencies consider is reasonable for PSAs to require given existing and known emerging data applications. These requirements are grounded in Western Australian PSAs' existing operational practices.

After the reasonable-use estimate was calculated Western Australian agencies considered how data demand could be reduced to a level below what was considered to meet reasonable use, but at which data applications in use could still increase the likelihood of PSAs' effectiveness. The minimum-use estimates involved reducing the number of users of some data applications and/or reducing the video data capacity requirements by lowering the video resolution (e.g. substituting a 1080P video with a 720P video, or a 720P video with a 480P video).

Western Australian agencies note that the possible availability of data efficiencies such as lowering the video resolution used in the response to individual incidents should not be assumed to inform the standard for operational requirements. The minimum-use estimates provided reflect efficiencies that were considered operationally acceptable in relation to those specific scenarios in the event that reasonable demand exceeded capacity.

These data capacity minimisation measures could increase the level of operational risk that relevant information is not collected, assessed and acted on in a timely manner. This is particularly the case with the level 2 hostage incident scenario where high-resolution tactical video would preferably be in use.

- A minimum-use estimate (reflecting efficiencies which would be operationally acceptable in the event that reasonable demand exceeded capacity. 'Operationally acceptable' means there may be an increase in operational risk (eg that relevant information is not collected, assessed or acted on in a timely manner) but the data applications in use were assessed as still increasing the likelihood of PSAs' effectiveness).

Table 2 - Data Demand Profile Estimates				
Scenario & Comments	**Minimum-Use Estimate (kilobits per second)**		**Reasonable-Use Estimate (kilobits per second)**	
Level 1 Structural Fire • Agencies: Department of Fire and Emergency Services, Volunteers, Western Australia Police • PSA resources deployed: 58	Download	10,489	Download	17,164
	Upload	9,505	Upload	16,119
Level 2 Hostage Incident • Agencies: Western Australia Police, Department of Fire and Emergency Services, St John Ambulance WA Ltd • PSA resources deployed: [total withheld] • Minimum-Use Estimate: Reduced video resolution and used dual-rate video to decrease video requirements. Note this would increase the level of operational risk that relevant information is not collected, assessed and acted on in a timely manner	Download	27,811	Download	55,348
	Upload	7,699	Upload	24,789
Level 3 Large-Scale Localised Bushfire • Agencies: Department of Fire and Emergency Services, Volunteers, Department of Parks and Wildlife, Western Australia Police, St John Ambulance WA Ltd • PSA resources deployed: 228	Download	29,682	Download	42,426
	Upload	11,701	Upload	18,961

Conclusion

The data demand estimates provided in this report are intended to assist the Productivity Commission's Public Safety Mobile Broadband Study. Western Australian agencies developed these estimates through scenario demand modelling which was informed by the operational and technical expertise of the State's PSAs.

The estimates are, however, limited in scope. They have been designed to provide data capacity baselines and only consider existing and known emerging data applications. The estimates do not include:
- applying a growth rate to the estimates to project future demand requirements (this is considered problematic as the future uses of mobile broadband and their data rates are not all known);
- use of mission-critical voice-over-LTE applications; and
- the data demand of residual BaU activities that would be occurring around incident areas.

Western Australian agencies also note the following caveats:
- Averaging the data rate of burst transmission applications across the period of their transmission frequency is imperfect. The reality might be a higher total peak data rate if all the burst transmissions do not occur in an evenly distributed manner (as is possible).
- The availability of data efficiencies such as lowering the video resolution used in the response to individual incidents should not be assumed to inform the standard for general operational requirements. Where the video resolution was reduced in these estimates this reflected what was considered operationally acceptable in relation to those specific scenarios in the event that reasonable demand exceeded capacity.

These estimates will need to be revisited as new PSA uses of mobile broadband develop and mobile broadband applications evolve.

Data Application Bandwidth Requirements per User								
Application Category	Data Application List	Average Data Rate - Download (kilobits per second - kbps)	Average Data Rate – Upload (kilobits per second - kbps)	Approximate Burst size (kilobytes - KB)	Transmission Frequency	Burst or Continuous Transmission	Resolution	Codec
Monitoring	Automatic Vehicle Location (AVL) Transmit	0	4	30	1 minute	Burst		Text
VOIP phones & ROIP	G729	32	32	8		Continuous		G.729
Web Usage - Light	General website browsing (low-bandwidth) • Bureau of Meteorology (weather) • Agencies' public websites, social media, news sites	13.33	0.5	500	5 minutes	Burst		HTML
Web Usage - Medium	Web-based Incident Management Systems (e.g. text-based use of WebEOC) Spatial Support Systems - Light Usage (up to 720P geospatial products) Bushfire predictive mapping applications	100	0.5	1500	2 minutes	Burst	720P	HTML

Data Application Bandwidth Requirements per User								
Application Category	Data Application List	Average Data Rate - Download (kilobits per second - kbps)	Average Data Rate – Upload (kilobits per second - kbps)	Approximate Burst size (kilobytes - KB)	Transmission Frequency	Burst or Continuous Transmission	Resolution	Codec
Web Usage - Heavy	Spatial Support Systems - Heavy Usage (e.g. 1020/4KP Geospatial products and multiple spatial layers)	267	0.5	4000	2 minutes	Burst	1080P to 4K	HTML
Remote Desktop	Text-focused work	16	4	2.5	Latency sensitive	Continuous	720P	RDP
In-vehicle	Tasking and Dispatch Information System	43.2	0	5.4		Continuous		
VDI (Virtual Desktop Infrastructure)	Spatial Remote Desktop (e.g. Remote Desktop Protocol (RDP) Citrix Remote Desktop)	32	10	5.25	Latency sensitive	Continuous	720P	RDP
Light - Email and Mobile Data Applications	Applications and email	25	5	2250	10 minutes	Burst		HTTP/ Active sync
Heavy - Email	Attachment heavy email	67	67	4000	4 minutes	Burst		IMAP/ Active Sync
File management	Media and files • Including record management and shared network drives	134	134	10000	5 minutes	Burst		CIFS

Data Application Bandwidth Requirements per User								
Application Category	Data Application List	Average Data Rate - Download (kilobits per second - kbps)	Average Data Rate – Upload (kilobits per second - kbps)	Approximate Burst size (kilobytes - KB)	Transmission Frequency	Burst or Continuous Transmission	Resolution	Codec
Video Streaming (one way - UL or DL)	480P @ 30fps	1000	1000	125		Continuous	480P	H.264[3]
Video Streaming (one way - UL or DL)	720P @ 30fps	3000	3000	375		Continuous	720P	H.264
Video Streaming (one way - UL or DL)	1080P @ 30fps	6000	6000	750		Continuous	1080P	H.264
Video Conferencing	720P @ 30fps	3375	3375	844		Continuous	720P	H.264[4]
Video Conferencing	1080P @ 30fps	6150	6150	1538		Continuous	1080P	H.264
Skype Video Conferencing	240 @15fps	300	300	75		Continuous	240	Skype

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[3] The data rates used for the video streaming applications are based on the H.264 video codec bitrates advised by Google (available from: https://support.google.com/youtube/answer/2853702?hl=en). From the data rate range provided by Google the selected rate reflects State agencies' experiences.

[4] The data rates used for the videoconferencing applications (except for Skype) are based on the H.264 codec bitrate advised by Cisco (available from: http://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Video/Medianet_Ref_Gd/medianet_ref_gd/chap2.html#wp1192894). The selected data rate reflects State agencies' experiences.