Digital Productivity Flagship
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CSIRO Submission

Inquiry into Public Safety Mobile Broadband
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Enquiries and Main Submission Authors

Mr Peter King

Manger, Design Integration, Digital Productivity Flagship

CSIRO Corporate Centre, Limestone Ave, Campbell ACT 2612

Mr Gavin Walker

Principal Experimental Scientist, Digital Productivity Flagship

GPO Box 664, Canberra, ACT, 2601

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1 Introduction

CSIRO welcomes the opportunity to comment on and provide input to the Productivity Commission's inquiry into Public Safety Mobile Broadband (PSMB).

The properties of a PSMB network will define what applications on the network can do. This submission looks at the discussion of a PSMB network from the point of view of applications that could run on a PSMB network. CSIRO has significant research activities in applications to assist Public Safety Agencies (PSAs). Their impact on the design of a PSMB network is described in this document.

2 Application areas

The CSIRO applications can be grouped in application areas.

2.1 Location services

Tracking staff and equipment via GPS over PSMB not only allows for positive deployment of assets but can also be used to deduce the:

- extent of incidents such as fire fronts, and floods
- context of incidents
- speed of transit

With the right applications, first responders can quickly map and annotate an incident, providing valuable intelligence back to base. CSIRO's Emergency Response Intelligence Capability (ERIC) platform is an example of collecting spatial and other information about an incident. With responders from multiple PSA's, common exchange formats and terminology will be needed to support interoperability in data collections. This field intelligence can also feed predictive models (such as CSIRO's fire propagation model, SPARK) to anticipate the movement of events. Location services are relatively low bandwidth but do require good coverage to be effective, often in remote situations.

Location based commands can also be pushed down to the front line, allowing spatial directions to be given to responders.

2.2 Mapping services

Stepping up from simple location services are mapping systems. Marked up maps can be sent in either direction to support strategic deployment of assets. House plans can be passed to police, fire and ambulance crews. Video and laser scanning systems (such as CSIRO's Zebedee) can create maps of the built environment for either later annotation or, in the future, near real time mapping of environments. Such applications require high bandwidth and low latency connections as the processing is done on remote servers and then fed back to responders in real time.

2.3 The crowd

The crowd can be an important source of information, particularly about the impact of an incident. CSIRO's ESA (Emergency Situation Awareness) system analyses Twitter to discover incidents and collect details about them. It is also important to get information into a crowd to affect its behaviour. Since regular mobile or fixed line broadband can be damaged in incidents it is important that the general public has some access to the PSMB network.

2.4 Remote assistance

First Responders could be provided with remote assistance. This assistance could involve two way video conferencing, augmented with a laser projection such as in CSIRO's Remote Immersive Diagnostic Examination System (RIDES) or gesture overlays as in the Guardian ReMoTe system. These techniques enable a remote specialist to effectively 'reach through' the screen to assess the situation and assist with tasks across large distances. For example in a medical emergency, when the remote medical specialist draws on the video screen, a laser projector at the emergency site can display that sketch directly on the patient's skin or on medical equipment; thereby guiding a First Aider or Paramedic in the precise way to attend to the patient.

The use of live streaming panoramic cameras can also provide context to the remote specialist. Such cameras have been used in CSIRO's telepresence systems (to give guided tours) and telerobotic systems (to provide situational awareness). These applications require high bandwidth (currently around 20MBit/s); both download and upload, with low latency.

2.5 Sensorisation

Assets can be equipped with a variety of sensors (environmental, infra-red, video, spatial, biological) to better understand conditions at the incident. For example water bombing aircraft can be fitted with infrared sensors to identify effects on the fire front. Bandwidth can vary considerably. Collected data can be fed back to responders. For real time feedback low latency is required.

In recent submission to the United States Department of Homeland Security conversations on homeland security technology there was significant focus on first responder video.

http://www.dhs.gov/science-and-technology/join-conversation

A submission by utility.com highlighted the need for high resolution for effective use of the video footage. With a sufficiently high upload bandwidth PSMB network and low latency could provide real time value add such as suspect identification and tracking using cloud services.

http://www.utility.com/perch/resources/generation-2-bodyworn-camera-white-paper.pdf

Cloud based image analysis has been used for a graffiti based gang identification.

http://www.firstresponder.gov/TechnologyDocuments/Gang%20Graffiti%20Automation%20and%20Idenfication%20System.pdf

Finally cloud based technology such as Google's translate can provide audio based language translation.

3 A Public Safety Mobile Broadband network

Given these applications, a picture can be painted of a PSMB network.

3.1 Technology

LTE (Long Term Evolution - 4G, 4GX, 4G plus) is a good candidate for high download bandwidth, good upload bandwidth and relatively low latency. An opportunity also exists to utilise NBN infrastructure:

- Satellite broadband (with high latency) is accessible in remote locations. It could also be made available to aircraft.
- Fixed wireless, is an LTE based technology that could be leveraged in addition to the traditional cellular network.
  http://www.nbnco.com.au/content/dam/nbnco/documents/fixed-wireless-factsheet.pdf
- Fixed. Some cities already provide Wi-Fi mesh networks.
  http://www.computerworld.com.au/article/560750/perth-expands-public-wireless-network-into-northbridge/
  Mesh networks could connect to the NBN fixed network at every Fibre To The Node NBN node. This provides for relatively small cells, increasing resilience.

CSIRO is also partnering with RF Technologies in the development of new technologies (NGARA) targeted at delivering higher data rates and increased efficiencies. (Refer to a separate submission to this inquiry by RF Technology Pty. Ltd identified as No 3 on the Submission web site).

3.2 Public/Private network

If the PSMB network is the only network in operation in an area then the crowd applications are enabled by allowing public access. Public access is also likely to reduce the deployment cost of PSMB infrastructure. Usage could be prioritised to:

1. PSAs
2. 000
3. short messages (sms, twitter)
4. general

Telstra's LANES system is an example of the sort of technology available.

http://www.telstra.com.au/business-enterprise/download/document/business-4g-lte-mobile-broadband-emergency-services.pdf

It would also be advantageous to allow the PSMB infrastructure to be multi operator (i.e. all operators can utilise it). That is particularly useful for wheeled in stations as it allows the crowd to

assist operation with generic devices nominally tied to specific networks. Allowing existing carrier equipment (existing cell towers) to be multi carrier during an incident may also be possible.

The next generation of MVNOs may offer multi-carrier plans. Software systems for Mobile Virtual Network Operators (MVNO) are available to manage wholesale capacity from multiple carriers. For example from emveno in the USA.

http://www.emveno.com/wholesale-mobile-access/

The technology is viable if the carriers are willing to offer wholesale services. A requirement of any new PSMB hardware, especially in remote locations could be to offer wholesale services.

Agreements could also be in place to open up network access from competitor locked devices during incidents. Many new devices can be swapped, with a new SIM, to different carriers. The existing agreements for the any network 112 calls shows it is physically possible to use any network. Carriers need to agree on how this could be extended.

http://www.triplezero.gov.au/Pages/Usingotheremergencynumbers.aspx#mob112

In a 2011 submission to the US House of Representatives the International Fire Chiefs association asked for a dedicated PSMB network that was "under public safefy control". This is not necessary as long as the capacity is there when required. Any shared public/private network must be able to provide a service when it is needed. The article also mentioned that it must be "mission critical", that is be always available. By having the agreements in place to use all commercial infrastructure, NBN and whatever else is suitable mean there is capacity in layers. Should one fail others will be there to back them up.

http://www.iafc.org/files/1GR/gr_testimonyParowPublicSafetyComm110330.pdf

3.3 Interoperability

PSAs rely on Common Operating Picture (COP) systems to assimilate information from the field. A PSMB network will make COP systems critical pieces of infrastructure. As a PSMB network is rolled out the interoperability of COP systems will need to be enhanced. This would allow responder information to be shared across jurisdictions; making it easier to fully utilise interstate resources. CSIRO has significant experience in message, geospatial and standards space andcan apply a system of systems approach to COP interoperability.

3.4 Coverage

Incidents occurring in remote areas are often out of mobile coverage. Focusing PSMB infrastructure in incident prone but remote areas while utilising existing networks in built up areas will reduce the initial cost. Coverage is extended if devices can work across multiple carriers (see public/private).

3.5 Capacity

Near real time applications have high bandwidth and low latency requirements (up to 20MBit/s). These speeds within the capability of LTE services, however speeds degrade as the number of users increase.

Total bandwidth can be increased by making use of the multiple frequencies that devices support. Current devices such as those supporting Telstra 4GX or Optus 4G plus can operate across multiple frequencies. Potentially PSA devices may operate over PSMB network frequencies and commercial carrier frequencies, increasing bandwidth. If a PSMB network also operated across multiple carriers (i.e. towers) then bandwidth, coverage and/or reliability would be enhanced.

Capacity can also be prioritised (see public/private). Ability to tap into the NBN would further increase capacity.

3.6 Resilience and continuity

A multi carrier model supports greater resilience and continuity as the network is not reliant on single cells from one carrier.

3.7 Devices

Over a five year time frame off the shelf devices could start to support a PSMB network. The challenge with devices is, with so many options in emergency situation, to prioritise the use broadband option based on the cost and effectiveness of the services available.

4 Conclusion

A Public Safety Mobile Broadband network ideally:

- has high bandwidth, both upload and download with low latency
- has good and dynamic spatial coverage
- utilises existing networks, including commercial cellular and NBN
- provides broader utility to the community during incidents while prioritising emergency and low demand uses
- is not limited to a single telecommunication carrier

Some applications will work on lesser infrastructure.

In the fixed line telecommunication industry, limited access to the last leg of copper led to the sharing of telephone exchange facilities. Perhaps the scarcity and utility of radio spectrum could lead to an innovative use of mobile broadband infrastructure.

References

ERIC: Emergency Response Intelligence Capability http://eric.csiro.au

ESA: Emergency Situation Awareness http://esa.csiro.au

Telepresence http://www.csiro.au/en/Research/DPF/Areas/Autonomous-systems/Telepresence

RIDES: Remote Immersive Diagnostic Examination System
http://doi.acm.org/10.1145/1324892.1324911

Guardian ReMoTe http://www.csiro.au/en/Research/DPF/Areas/Autonomous-systems/Guardian/ReMoTe

Zebedee http://www.csiro.au/en/Research/DPF/Areas/Autonomous-systems/Mapping/Zebedee

Standards https://www.seegrid.csiro.au

SPARK: Bushfire modelling http://www.csiro.au/en/Research/DPF/Areas/The-digital-economy/Disaster-management/Spark

Sense-T http://www.sense-t.org.au/