SafetyNet

John de Ridder [1]

De Ridder Consulting

Robin Eckermann [2]

University of Canberra

AJTDE - Vol 5, No 3 - August 2017 [3]

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Abstract

This paper proposes a new vehicle, dubbed SafetyNet here, for improving communications in rural and remote Australia. It would be led by the Commonwealth replacing its disparate programmes for the bush with a public-private partnership combining the resources of various operators and governments. Part of the proposed solution is a wholesale mobile network using LTE in the 450 MHz spectrum band. SafetyNet would address any updated Universal Service Obligation, public safety network options and mobile roaming.

Introduction

Rural and remote areas will continue to struggle to keep up with urban telecommunications despite the progress that has been made with initiatives such as the Mobile Black Spot Program (MBSP) and the NBN fixed wireless and satellite. A new approach is needed as we consider updating the Universal Service Obligation, public safety network options and mobile roaming. Instead of seeking more expensive small gains at the margin, or counterproductive roaming arrangements, we should take a large step forward by having the Commonwealth, States and mobile network operators (MNOs) work together to build *SafetyNet*, a collaborative model using shared infrastructure.

The SafetyNet model proposed here would:

1. Resolve the conflict between coverage and competition which is prominent in all rural and remote communications programmes and discussions.
2. Expand the current, narrow view of what 'communications' means for rural and remote customers. In additional to conventional mobile network services, the SafetyNet solution will contribute to making land more productive, providing public benefits (e.g. in education and health) and improving public safety .
3. Reduce the inefficient use of public and private resources to meet the needs of rural and remote customers by taking a cooperative portfolio approach across governments and private operators.
4. Improve the affordability of rural communications and provide more retail choices for end users by using open access where it is uneconomic for any MNO to venture without a significant public subsidy.
5. Alleviate the issue that up to 90,000 satellite users, as estimated in the Productivity Commission?s June 2017 final report on the USO, will have worse quality voice services and no adequate mobile coverage once the existing copper network is decommissioned.
6. Alleviate concerns about the future capacity of the Long Term Satellite Service (LTSS) by providing better broadband service over LTE.

The Commonwealth may baulk at the prospect of supporting a mobile wholesale operator on the grounds that the mobiles market works well. But in fact it doesn?t: not in rural and remote Australia. Such areas account for a large part of our land area and support valuable socio-economic activity. To obtain coverage the economically sensible approach is to address gaps with a natural monopoly. This calls for public intervention. The MBSP programme is worthy. But it is not enough.

The Commonwealth may have no appetite to consider new programmes until the NBN roll-out is complete. Initiatives like the one outlined here will take time to bring to fruition. Australia needs to start planning for it now.

Achievements and Remaining Frontiers

A significant improvement in broadband communications for rural and remote Australia is underway with deployment of the NBN. Most rural and remote residences and businesses will be able to get better fixed broadband ? albeit at a price.

The Universal Service Obligation has successfully delivered a uniformly satisfactory voice service over the copper network. But migration from the existing copper network to the NBN will pose a challenge for customers in the satellite footprint who have no alternative mobile voice service.

Mobile service availability has also improved at the margins with blackspot investment, and more people will be adequately served for mobile access ? even if only when near population centres. But there is a danger that relying only on this approach for improving coverage will come at a significant and growing cost.

Police, fire, ambulance and other public safety agencies (PSAs) currently use their own networks to deliver voice and some data services, such as text messaging. They are reliable, resilient and secure, but they do not support high-speed data and often they are not interoperable across agencies (Productivity Commission, 2015 [6]). Public safety mobile broadband (PSMB) would allow frontline officers to access high-speed video, images, location tracking and much more. In November 2016, the Government accepted the Productivity Commission?s position that commercial mobile networks are the most efficient, effective and economical way of delivering a public safety mobile broadband capability.

Also, new demands for improved communications arise with the IOT (Internet of Things) in rural and remote areas which are needed to make machines and land more productive.

These needs underpin the next profound shift in technology. After moving from voice to data and then from fixed to mobile, we need networks that support not only calls, texts or browsing but also the fundamental infrastructure that feeds us, transports us, provides power and water, and keeps us safe. It is foreseeable that these capabilities will be seen as foundational rather than add-ons in the near future, and fundamental to all Australians? way of life.

It is Time to Reassess Our National Needs

The NBN may satisfy many requirements including health and education. While its fixed wire and fixed wireless networks will cover 97% of premises (with satellites covering the rest), it will not meet connectivity requirements on the roads or in the paddocks.

Many needs could of course be met by the mobile operators or, in truly rural and remote areas, by just one mobile operator. There are also other technologies (like LoRa ? see LoRa Alliance, 2017 [7]) that have a role to play, but they are unlikely to obviate the need for wired or (where more practical) wireless interfaces to the wider Internet.

This might indeed look like the inevitable end game given the difficult economics of each new network. But 2017 is a good time to step back and look at how best to meet the complete set of needs for rural and remote Australia. A quite different end game might emerge if the States and Commonwealth looked at the overall portfolio of needs and networks that are being funded in rural and remote areas rather than continuing with the current ad-hoc, uncoordinated and piecemeal approach (e.g. NBN fixed wireless and satellite, USO, MBSP and Public Safety). States and Commonwealth must manage a portfolio of investments as an operator would ? not as a collection of disparate policies overtaken by rapidly evolving requirements.

In both the 2012 and 2015 Regional Telecommunications Independent Reviews, mobile coverage was raised as the dominant issue ? with access to the full range of competition enjoyed by those in urban areas barely rating a mention. Country customers want improved mobile coverage more than they want competition[1] [8]. Because of rural economics, it is difficult to have both ? unless policy makers consider more radical alternatives than the ACCC is able to consider.

A more holistic approach integrating various requirements and pooling resources would work with the demanding economics of the bush and allow retail competition despite coverage challenges.

Mobile Coverage ? the State of Play

The ACCC reported (October 2016 [9]) that retail mobile services in Australia are currently supplied by three MNOs: Telstra, Optus and VHA. On 12 April 2017, TPG acquired 2x10 MHz in the 700 MHz spectrum, and announced that it would build a mobile network that would cover 80 % of the population within three years. TPG?s planned market entry is unlikely to help country areas much.

There are more than 60 mobile virtual network operators (MVNOs) that use one or more of the MNOs. The three existing MNOs each operate national mobile networks and hold a collective market share of 90 percent of the retail market for mobile handset services, with MVNOs accounting for the rest.

[10]

Fig 1 Mobile coverage by carrier by population and geography

Source: ACCC Discussion Paper, October 2016 [9]

Each of the three mobile networks covers over 97 % of the places where people live (with VHA?s population coverage including that provided through roaming agreements with Optus). But customers want coverage even when they are not at home, and Australia is a very big place.

The total area of Australia is 7.7 million km^2. About one third is now covered by commercial mobile operators. While it would be foolish to aim for 100 % geographical coverage by terrestrial means, there are undoubtedly many benefits to be gained by extending mobile coverage beyond what any MNO would do for commercial reasons.

Between 1998 and 2016, Telstra more than doubled the size of its network, but increased population coverage by only 6 percentage points. Telstra?s mobile network now covers a considerably larger geographic area than those of Optus or VHA, such that for over 1 million km^2 Telstra is the only MNO with mobile coverage. Only 0.8 % of the population (approx. 200,000) lives in areas where Telstra is the only MNO with coverage.

Telstra?s superior geographical coverage is rewarded by its market share in regional Australia, which is significantly higher than in the national market. A survey of over 500 farmers across Victoria conducted by the Victorian Farmers Federation found that 88 % used Telstra as their mobile service provider.

Natural Monopoly at the Edges?

Head to head infrastructure competition in the more remote areas is neither likely nor efficient, because once the first network is built in a location previously having no coverage there is not sufficient demand to justify a competitor building a rival mobile network.

[11]

Figure 2 Presence of multiple carrier coverage in South Australia

Source: Robin Eckermann

As one moves away from the densely populated areas, the return on investment for MNOs becomes marginal; and the number of networks drops from three to two, then from two to one (mostly Telstra) and finally ? for over 65% of Australia's landmass ? from one to zero. This pattern is very clear if the coverage maps of the three operators are "massaged" graphically and amalgamated in a way that highlights the 3-2-1-0 coverage pattern ? as shown here for South Australia (the darker the shading, the more mobile networks that provide coverage)[2] [12].

The ACCC agrees:

?*the economics of building mobile networks in Australia suggest that in many regional areas, it is likely that a mobile network exhibits natural monopoly characteristics. This means that once there is a mobile network, it may not be efficient for a second MNO to duplicate mobile infrastructure in those areas*? (ACCC, 2016 [9]; p. 30).

The quote immediately above comes from a discussion paper exploring whether regulated mobile roaming is the answer to the natural monopoly. Mobile roaming services are offered in some places on a commercial basis. Neither Telstra nor Optus offers coverage across the entirety of their networks. Optus provides roaming services to VHA in some areas where both Telstra and Optus have coverage. Telstra provides wholesale services to 11 MVNOs which cover 98.8 % of the population, 0.3 % more than Optus (ACCC, 2017 [13]; p 37).

The ACCC has considered the declaration of a mobile roaming service on two previous occasions: 1998 and 2005. In the earlier cases, it concluded that no regulatory intervention was required, as services would be offered through commercial negotiations. Its draft decision in May 2017 is not to declare the service:

The ACCC?s preliminary view is that economic regulation, in the form of declaring a domestic mobile roaming service, will not address the concerns regarding the level of mobile coverage and network quality available in regional areas? (ACCC, 2017 [13]; p. 76).

It remains to be seen whether the draft decision will become final. Declaration would almost certainly chill further private investment by a second or third network operator in marginal areas ? why overbuild the incumbent if you can access its infrastructure or roam over it? It is unlikely that any declaration would help in addressing the real problem ? that is, extending coverage into areas where it is fundamentally uneconomic for any operator to venture.

How Effective is the Mobile Black Spots Programme?

The Coalition Government is subsidising the extension of mobile coverage through the Mobile Black Spots Programme. $220 million in Commonwealth funds has been allocated across three funding rounds ($100 million for Round 1, $60 million for each of Rounds 2 and 3).

The first round was completed in June 2015, with 499 base stations covering 3,000 blackspots (see Figure 3).

[14]

Figure 3 Number of Mobile Black Spots funded

Source: Prime Minister?s Press Release, December 2016 [15]

Round 2, announced in December 2016, will deliver another 266 new and upgraded mobile base stations in regional Australia, covering some 1,400 black spots across 17,700 square kilometres, as well as 1,900 kilometres of major transport routes, and cover some 6,300 homes and businesses. The $60 million investment under Round 2 leveraged a total investment of $213 million, including funding from state and local governments, mobile network operators (Telstra, Optus, VHA), businesses and community organisations.

Rounds 1 and 2 cover 4,400 of the 10,000 black spots nominated by the public. Round 3 commenced in early 2017. It should be emphasised that the 10,000 nominated blackspots include overlaps and by no means represent the entirety of underserved areas when a broader view of needs and opportunities is taken.

The programme has issues. It has been accused of cementing Telstra?s monopoly with public funding and creating islands of alternative mobile operator coverage that require dual SIMs to straddle areas covered by, say, Telstra and Vodafone .

Also, the Auditor General (ANAO) found, that one in five of the mobile phone towers funded in the first round of the programme provided little to no new coverage for consumers:

"*public funding has resulted in substantial consolidation of existing coverage provided by grant applicants, as opposed to extending coverage in new areas?a key objective for the programme?* (**ANAO, 2016** [16]).

The auditor found 89 base stations received $28 million in funding despite providing minimal benefits to consumers in areas without any coverage. It also found that 39 of the 499 base stations would have been built anyway by private operators without needing public funding:

?*The department did not assess whether an applicant?s proposed base station location was listed on the work plan of another applicant?the department should review applicant proposals against the network expansion plans of other operators as an indicator of whether the programme is funding additional outcomes to normal commercial investment.?* (**ANAO, 2016** [16]).

As the programme continues and pushes into even more marginal areas, carrier returns will become more and more elusive. As a result, the MNOs' own appetite for contributing will progressively diminish and the level of community and public subsidy will have to increase.

While small incremental benefits have been achieved at the margins, it is proposed that the money could be better spent on a more comprehensive solution. SafetyNet could eliminate more blackspots cost effectively (especially if 450 MHz is used).

Public Safety Needs and Opportunities

The network options for public safety remain controversial despite the ACMA allocating 800MHz spectrum and the Productivity Commission coming down on the side of commercial operator networks. The main issues are the poor coverage relative to existing (mostly voice) legacy networks and a lack of trust that the commercial networks would deliver.

SafetyNet could deliver a very effective solution for the truly rural and remote areas if existing mobile coverage could be augmented with the 450MHz desired by police and emergency services. The low frequency of 450MHz is well suited to vast areas where base stations are few and far apart. As shown below, one 450MHz base station can cover twice the area of an 800MHz base station, and 20 times that of a single 2.6GHz node.

Table 1: Spectrum Efficiencies for Coverage

Frequency (MHz)	Cell radius (km)	Cell area (km^2)	Relative cell count
450	48.9	7512	1
850	29.4	2712	2.8
950	26.9	2269	3.3
1800	14.0	618	12.2
1900	13.3	553	13.6
2500	10.0	312	24.1

Source: Bright, Julian at OVUM (Bright, 2014 [17])

Notes: Theoretical comparison of base station coverage at different spectrum bands. This performance is based on flat terrain, tower mounted amplifier with radio 60 metres above ground and no interference.

The 450 MHz band was chosen in Finland in 2014. With a relatively low population of 5.4 million, Finland, which spans about 1,000 kilometres from south to north and a total of 340,000 square kilometres, is certainly an ideal kind of country for this sort of technology (*telecoms.com*, 2014 [18]).

In Australia, some States may build their own urban core LTE networks for public safety needs, perhaps leveraging transport LTE networks. Operators could then support the surrounding annulus on normal commercial networks and be benchmarked against both SafetyNet and the urban core safety networks.

What is to be done?

What rural and remote Australia needs is open access together with improved mobile coverage. This requires a coordinated response across Federal, State and Local Governments who each manage important pieces of the puzzle for various purposes.

Since the Commonwealth is spending more on rural and remote communications than Telstra and the other MNOs combined, it should take the lead in developing the concept. With a coherent portfolio approach, millions of dollars could be saved.

The cross-government portfolio of telecommunications resources could include:

? Public Safety Mobile Broadband ? with Land Mobile Radio for safety already very extensive in regional areas, we could replace existing 450MHz radio systems with national LTE infrastructure ? ideally 450-470MHz, (subject to ACMA 400MHz band plan and LTE terminal availability), add 700 or 800MHz Public Safety spectrum managed by State public safety entities, but with an expectation of high availability of this spectrum for non-Public Safety applications.

? Spectrum ? the 450MHz LTE available to current Land Mobile Radio footprint plus any available lower band, wider reach 700 or 800MHz spectrum.

? Black Spot funding ? where a SafetyNet can have more regard to public interest requirements in improving land productivity through the internet of things, public safety and communications access and affordability.

? USO and payphones funding.

? Remote Indigenous Telecommunications programmes

? Wholesale network infrastructure for rural and remote areas:

o NBN Fixed Wireless which is inherently a mobile technology, currently adapted to support fixed connections only. With appropriate engineering, the same base station electronics may be able to support both fixed and mobile connectivity. At worst, a separate set of base station electronics could be deployed on NBN Co FW sites ? sharing access, tower, power and backhaul. Integrating FW and mobile coverage would thus boost the return on investment of the nbn's FW sites, and/or

o Inviting MNOs to provide NBN Fixed Wireless over their LTE infrastructure on an open access basis through the NBN for profit.

- NBN Satellite ? Traffic quotas are being imposed to stretch the life of limited satellite capacity, but if satellite users were liberated to use the network as freely as their urban cousins, the long term satellite service (LTSS) would very quickly become as saturated as the interim service. Expanding the mobile and/or FW footprint in the underserved area would provide an alternative for displaced satellite users (giving them improved performance as a bonus) and avoid or at least defer the need to invest in additional satellite capacity.

Taken together, a common LTE wireless infrastructure could be used to meet a range of needs that individually have a poor business case. This solution needs the Commonwealth and States to manage their communications portfolios as a pooled resource and possibly add them to relevant commercial infrastructure.

Let us call the common infrastructure Australia?s SafetyNet: a single fit-for-purpose LTE network for rural and remote areas. A single, open access network has better economics and would go a long way to meeting the aspirations of rural customers with greater coverage, capacity and scope. Just as the creation of NBN recognised that the fixed network broadband network is a natural monopoly outside metro areas, the pooling of resources in SafetyNet would recognise that in rural and remote areas fixed broadband networks are not viable and an LTE network is a natural monopoly.

Precedents

In 2013 the Rwanda Government together with Korea Telecom established a 4G LTE wholesale operator, Kt Rwanda, aiming to cover 95% of the population of 11.5m. By June 2016, it covered just 29%, compared with over 90% on the incumbent?s mobile networks (see Rwanda regulator?s annual report, 2016 [19]; Table 11). Kt Rwanda?s customers are the three mobile operators (MTN, Tigo and Airtel) and a dozen ISPs. In April 2016, it launched 4G LTE Advanced Carrier Aggregation providing data speeds up to 250Mbps.

In Mexico, two universal access projects are under way ? a shared mobile network (Red Compartida) and a fixed network program (Mexico Conectado, improving connectivity in schools, hospitals and other public areas on a municipal, provincial and federal level).

Mexico is the largest country in Central America, with a population of about 120 million people, of whom 22% are living in rural areas. The three major players are AT&T, Telef?nica and Telcel. Telcel has more than 70% of the MNO market and belongs to America M?viles, which also owns the incumbent fixed line operator Telmex. Since 2007, fourteen MVNOs have entered into the market but have a combined market share under 1% (Detecon, 2016 [20]).

Red Compartida (RC) will create a wholesale-only operator providing services that are unbundled and non-discriminatory because ?*Doing business as usual, mobile services will not reach unprofitable markets. RC?s model will allow coverage in otherwise unserved or underserved areas?* (Minister of Transport and Communications, cited in Detecon, 2016). [20]

RC will be implemented as a Private Public Partnership (PPP) with the State represented by Telecomm and a new entity OPRITEL which obtained cheap spectrum. The selection in November 2016 of a private consortium called Alt?n, backed by the Morgan Stanley Investment Bank and the World Bank and supported by a number of Mexican cable and telecoms companies, is being contested by Rivada Networks, an Irish company (Capacity Media, 2017 [21]).

Although RC will have a monopoly in one spectrum area (unencumbered contiguous spectrum on the 700 MHz band), all other MNOs are able to compete in the LTE wholesale markets using other spectrum.

Governance

An obvious candidate to operate SafetyNet is the nbn, given its role as the existing government owned, wholesale communications supplier. But to this point it has not shown much inclination to sub-contract greenfield infrastructure where it was also subject to complaints about unfair competition (Productivity Commission, 2011 [22]) and some of its choices have been questionable (witness the choice of frequency given the high cost and bias towards capacity rather than coverage for Fixed Wireless[3] [23]) .

Another complication which needs to be considered is the possible future privatisation of nbn?s fixed wireless and/or satellite assets. This sale might be an opportunity to establish the nucleus of a commercially operated SafetyNet.

A possible alternative is to franchise the operation of a wholesale SafetyNet to an existing MNO or consortium of MNOs. In the area of public safety, capabilities such as Telstra?s LANES technology have growing potential to support existing and emerging new needs of public safety agencies on the same infrastructure as provides mobile coverage.

It is in the interests of the MNOs to cooperate regardless of who runs SafetyNet, because cooperation would be a condition of access to unique, additional coverage.

To respect the MNOs? investments and to ensure that public investment in SafetyNet does not stifle private investment, the mobile operators should be given the opportunity to put forward in confidence their committed plans for expanding coverage over, say, the next three years[4] [24]. Based on these plans, identify the residual area (let?s call it "the underserved area") that has no prospect of achieving coverage through the operation of free market forces. This area is fair game for public investment and SafetyNet. If the MNO plans for expanding coverage do not materialise within the specified period, the boundaries of the underserved area could be expanded accordingly.

Governments and operators could become equity partners in SafetyNet based on the MNOs? contributions of infrastructure and the Commonwealth?s contributions around the USO and/or public safety assets.

Conclusion

Australia?s SafetyNet would provide network infrastructure for the rural and remote areas of Australia that would otherwise miss out on the availability of competitive mobile communications infrastructure and up-to-date public safety infrastructure. It would provide additional support for the Internet of Things in rural and remote areas to ensure the optimum use of Australia?s natural resources. SafetyNet would reduce the costs to the Commonwealth, the States and customers through building just one coherent infrastructure capable of providing for diverse applications.

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Endnotes

[1] [38] One of the authors, Robin Eckermann, was on the 2012 and 2015 Regional Telecommunications Reviews and has heard these sentiments expressed many times. Also, ?*Many agricultural representative groups emphasised the importance of mobile coverage in regional Australia and submitted that the promotion of competition should not be sought at the expense of investment in mobile coverage or networks in regional areas?* (ACCC Draft Decision, May 2017 [13]; p. 67).

[2] [39] This diagram was prepared in mid-2015 using published coverage maps by the three MNOs. It does not necessarily reflect coverage at the present time, nor does it attempt to take into consideration differences between coverage using a superior antenna, 2G/3G/4G differences etc. Despite these limitations, the reality it highlights is clear.

[3] [40] We acknowledge that by using higher frequencies necessitating smaller cells, the nbn achieves more capacity per cell (useful in the context of delivering fixed broadband), and the shorter reach facilitates spectrum re-use in nearby cells. Also, requirements (and the suitability of spectrum) will vary depending on location - with higher frequencies and smaller cell sizes suited to some of the nbn?s deployment scenarios on urban fringes, and lower frequencies and longer reach ideal for the more remote areas. Ideally, nbn should conscript other frequencies if and when it targets the more remote areas.

[4] [41] The ACCC sought such information for its mobile domestic roaming inquiry from all three MNOs on their historical investments and planned investments and found their focus is on improved quality, not improved coverage: ?*Based on current information, the ACCC?s preliminary view is that there is evidence that coverage-based competition may continue. Such competition is not focused on the size of geographic coverage, but rather on improving the quality of networks in areas where coverage exists*? (ACCC Draft Decision, 2017 [13]; p. 46).

Article PDF:

112-1052-2-pb.pdf [42]

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Cite this article as:

John de Ridder, Robin Eckermann. 2017. *SafetyNet*. ajtde, Vol 5, No 3, Article 112. http://doi.org/10.18080/ajtde.v5n3.112 [44]. Published by Telecommunications Association Inc. ABN 34 732 327 053. https://telsoc.org [45]

Satellite	safetynet	Mobile	mobile black spots	rural	public policy
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