3 August 2020

Senator Tim Ayres
Chair
Senate Finance and Public Administration References Committee
PO Box 6100
Parliament House
Canberra ACT 2600

By email: fpa.sen@aph.gov.au

Dear Chair

Inquiry into lessons to be learned in relation to the Australian bushfire season 2019-20

We write further to the Senate Finance and Public Administration Committee's recent invitation to BAI Communications (BAI) to give evidence to the above-mentioned inquiry at a public hearing on 12 August.

We have responded separately to say that BAI would be pleased to appear at the hearing.

In this regard, BAI thought it might be helpful to provide the Committee with a copy of the recent submission it made to the Royal Commission into National Natural Disaster Arrangements.

In this submission, BAI sets out corporate information on the company, its experience as a communications infrastructure and service provider during the 2019-20 bushfire season, learnings from those events, and proposals on building greater resilience in communications networks.

We trust this information is useful and will assist the Committee's deliberations.

Yours sincerely

Peter Lambourne
CEO

Head Office
Level 10, Tower A
799 Pacific Highway
Chatswood NSW
Australia 2067

BAI Communications Pty
ABN 99 086 048 562

Royal Commission into National Natural Disaster Arrangements

Submission by BAI Communications

17 April 2020

bai communications

1. Executive summary

About BAI Communications

BAI Communications (**BAI**) is an Australian-headquartered company that designs, builds and operates communications infrastructure – cellular, Wi-Fi, broadcast, radio and IP networks around the world. In Australia, BAI owns and operates one of the most extensive transmission networks worldwide. We are the broadcast transmission partner of the ABC, SBS and Southern Cross Austereo (SCA), broadcasting ABC, SBS and SCA radio and television services across Australia. In addition, we operate the NSW Government Radio Network (NSW GRN) which serves as a key communications network for NSW emergency services. We also provide services to commercial broadcasters and telecommunications companies across Australia.

Our experience during the 2019/2020 bushfires

Throughout the Black Summer bushfires, BAI teams defended, reinforced and repaired communications networks to ensure the continuity of radio and television broadcast transmissions and the primary NSW emergency services communications network.

Our experience this summer highlighted a number of key learnings related to the resilience of Australia's communications networks during natural disasters:

1. The fundamental role **radio broadcasts** (particularly ABC Local Radio) continue to play in providing real-time information to affected communities during natural disasters - due to the ubiquity and portability of radio receivers in cars and homes, the extremely wide area geographic coverage, and the inherent resilience through overlapping coverage from different broadcast sites.
2. **Diverse and overlapping communications networks** are essential to maintaining communications during a natural disaster.
3. The existence and efficacy of **standby power solutions** at communications sites is the single most critical determinant of whether communications networks remain available during natural disasters.
4. A **failure in telecommunications infrastructure** in an area can impact radio and television broadcasts in situations where those broadcasts are reliant on telecommunications infrastructure to 'feed in' the broadcast content signal to the transmission site.
5. **Asset protection zones** comprising cleared land around transmission site infrastructure are very effective at preventing transmission infrastructure from physical damage.
6. **Priority access to broadcast sites** assists in the rapid repair of broadcast and telecommunications sites and restoration of transmission into affected areas and communities.

Challenges facing Australia's communications networks during natural disasters

The 2019-20 bushfire season demonstrated shortcomings in Australia's existing emergency services and public communications networks. The unique geography of our island continent, combined with the increasing likelihood of natural disasters due to climate change, provides an opportunity for a new approach to communications infrastructure, particularly in regional and rural communities.

BAI has identified three key challenges facing Australia's emergency services communications networks during natural disasters:

1. Each state and territory operates its own separate emergency services communications networks and these networks have major **interoperability issues** which present challenges in state border regions and when emergency services teams are deployed to a location outside their home state.
2. Emergency services **increasingly use data transmissions** for incident management and coordination, but emergency services private radio network devices are currently optimised for voice communications. As such, emergency services personnel often use personal mobile devices for data-based communications, which rely on less resilient commercial mobile networks.
3. **Mobilisation of volunteer forces**, on which agencies such as the State Emergency Services and the Rural Fire Service are heavily dependent, is generally accomplished using less resilient commercial communications networks.

BAI has also identified three key challenges facing Australian public communications networks during natural disasters:

1. In those rare instances where an ABC Local Radio broadcast is temporarily lost, **public knowledge of alternative ABC Local Radio broadcast frequencies is low**.
2. The National Broadband Network (NBN) is now the primary fixed communication network for most Australian households, but the NBN typically does not function when a household loses mains power. As such, **a loss of power to the home** – as frequently occurs during natural disasters – **means the loss of a household's fixed-line connection.**
3. **Commercial mobile network sites** are generally **substantially less resilient** than broadcast sites. Furthermore, commercial mobile network coverage often **lacks any redundancy** in regional and rural areas – the loss of a single site often results in complete loss of network availability in that coverage area.

Recommendations

RECOMMENDATION ONE: BAI recommends the further hardening of broadcast sites used for ABC services across Australia. We propose four near term areas of Government investment to improve the availability of critical broadcast services to local communities during natural disasters:

1. **Site resilience initiatives**: implementation of asset protection zones around sites through the clearance of bush land, significantly reducing the risk of asset damage and service outages from bushfires.
2. **Standby power initiatives**: provide standby power equipment to sites not currently provisioned for this, allowing services to continue in the event of extended power outages.
3. **Service recovery initiatives**: the procurement and strategic distribution of rapidly deployable assets such as trailer based broadcast sites, mobile generators and portable transmission equipment across the country to enable faster recovery of service in the event of asset loss.
4. **Service continuity initiatives:** Redundancy upgrades to on-site equipment and systems (e.g. satellite-based backup systems), allowing services to continue when primary equipment or systems fail.

BAI believes there is a compelling rationale for hardening all sites that broadcast ABC Local Radio across Australia. There is a strong rationale to extend these hardening measures to cover all sites that broadcast ABC and SBS television across Australia. Further details, including an overview of required funding and proposed regulatory reform measures is provided in Section 8.

<u>RECOMMENDATION TWO:</u> BAI recommends the establishment of a new 'Universal Mobile Network' covering regional Australia, primarily using existing broadcast transmission sites. This shared 4G and 5G mobile network would be available to both emergency services and the public in regional and rural areas throughout Australia. The network would be heavily hardened to maintain connectivity during natural disasters.

BAI proposes the new network operate in two distinct modes. During *'normal conditions'*, the 'Universal Mobile Network' would carry emergency services voice and data communications as well as leasing bandwidth to mobile network operators on an as-needed basis - providing additional capacity and extended coverage in regional and rural areas. During *'emergency conditions'*, such as natural disasters, the 'Universal Mobile Network' would prioritise emergency services traffic while also ensuring the highest number of public mobile devices can receive voice and basic data mobile coverage.

Key features of the 'Universal Mobile Network'

- ☑ National mobile overlay network providing two-way communications to mobile devices within ~30 km of transmission sites
- ☑ Connectivity for both emergency services and the public
- ☑ Complementary to existing mobile networks
- ☑ Network hardened to maintain connectivity during natural disasters
- ☑ Connectivity for all Australian mobile phones and devices, regardless of the SIM installed
- ☑ Accessible using current mobile phones and devices
- ☑ Prioritised access for:
  - Emergency services communication
  - 000 calls
  - Delivery of localised emergency warning alerts
  - Emergency information apps (such as 'Fires Near Me')
- ☑ Primarily uses existing broadcast transmission sites to minimise build timeframes and cost
- ☑ Necessary technology is available now to commence build
- ☑ Capable of providing one-way communication (e.g. emergency warning alerts) to mobile devices up to 200km from transmission sites
- ☑ Readily upgradable to accommodate Public Safety Mobile Broadband (PSMB) requirements

The 'Universal Mobile Network' should be built, operated and maintained by a 'neutral host' – i.e. a party who is not also a mobile network operator. A neutral host model is the simplest and most commercially sensible way to share the upfront and ongoing costs of the network between all its users – Australia's emergency services agencies and all mobile network operators. Furthermore, a neutral host model ensures that the network will be able to be used by all mobile phones and devices in Australia, regardless of the SIM installed – this is especially important during a natural disaster.

2. About BAI Communications

Summary

- BAI Communications designs, builds and operates communications infrastructure – cellular, Wi-Fi, broadcast, radio and IP networks around the world.
- In Australia, we own and operate one of the most extensive transmission networks globally.
  - We are the broadcast transmission partner of the ABC, SBS and SCA, broadcasting all ABC, SBS and SCA radio and television services across Australia to 99% of the population.
  - In addition, we operate the NSW Government Radio Network (GRN) which serves as a key communications network for NSW emergency services.
  - We also provide services to a number of commercial broadcasters and telecommunications companies across Australia.

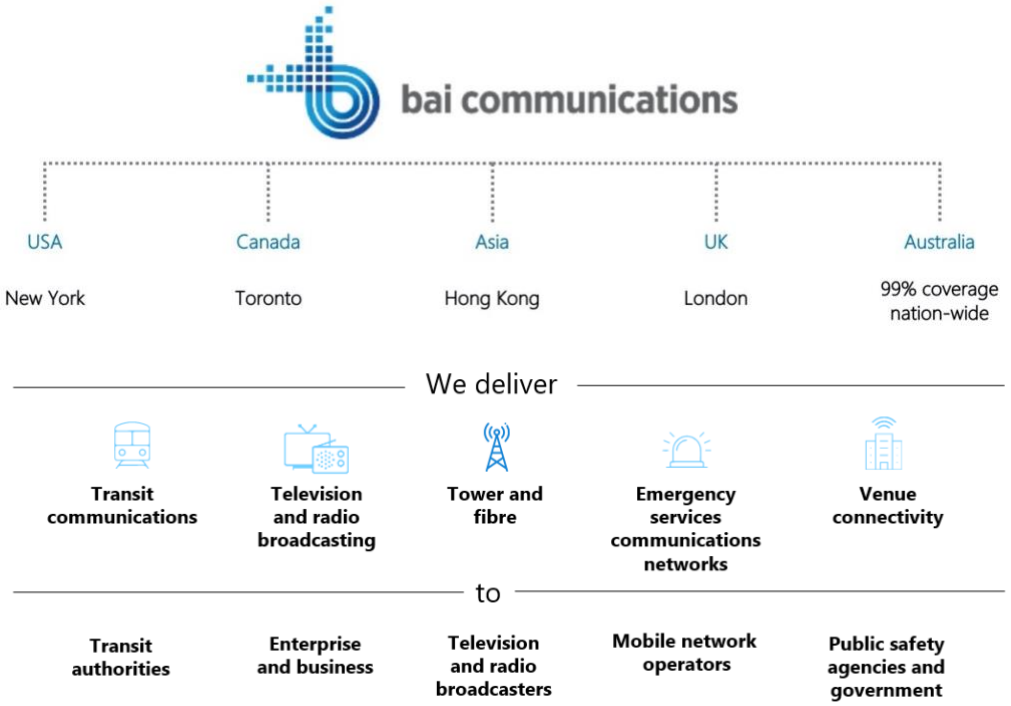

Figure 1: BAI Communications designs, builds and operates communications infrastructure around the world

BAI Communications designs, builds and operates communications infrastructure – cellular, Wi-Fi, broadcast, radio and IP networks – connecting communities around the world. With a heritage of over 90 years, and operations in Australia, Hong Kong, London, New York, and Toronto, BAI creates networks that unlock new services and revenue streams for our customers, enabling them to deliver better connected and enhanced experiences for people, communities and economies every day.

Our Australian operations

BAI Australia is the only truly national broadcast transmission provider in Australia. We are a world-class centre of excellence for television and radio broadcasting, specialising in the design, build and operation of highly available networks to meet our customers' needs. As a broadcast network

specialist, our core competencies span all aspects of the planning and delivery of analogue and digital transmission systems. Using our engineering, delivery and operational capability, we act as a neutral host across a range of technologies. We deliver television and radio broadcast services to 99% of the Australian population and provide tower and fibre co-location services for mobile network operators. BAI Australia has longstanding contracts with both national public broadcasters, ABC and SBS, for the transmission of their services throughout Australia. In times of crisis, ABC and SBS rely on us to maintain their connection with Australians and emergency services rely on us to help keep them informed. During 2019, we established long-term agreements with Network 10 (to deliver their free-to-air channels) and with Southern Cross Austereo (to deliver their radio and television free-to-air channels). Across NSW, we operate and maintain the Government Radio Network for the NSW Telco Authority.

Resilience we build into the networks we operate in Australia

BAI is committed to building resilience into our telecommunications and broadcast networks. A key component of this commitment is ensuring there is sufficient redundancy in our facilities, including multiple service inputs, transmitter replacements and satellite inputs. We provision approximately a third of our sites (typically larger, higher-powered sites) with standby power generators or large-scale batteries and solar arrays, providing those sites with 3 - 10 days of power autonomy when mains power is lost. BAI undertakes an extensive program of ground maintenance to reduce the risk of damage to telecommunications and broadcast infrastructure. Architecture is also a key consideration – we extensively use naturally-resilient brick construction.

Enabling connectivity around the globe

Globally, BAI Communications has deployed 'neutral host' communications networks in some of the largest and most complex underground transit systems in the world.

New York City: The Transit Wireless (a majority owned BAI Communications company) network hosts Verizon, AT&T, T-Mobile and Sprint in all 283 subway stations, providing connectivity to roughly 5.3 million commuters each weekday. The network is also the foundation for many critical public safety communications systems, including a 4.9 GHz public safety network.

Toronto: The wireless network BAI has built for the Toronto Transit Commission, called TCONNECT, extends throughout all 75 stations. Commuters log in more than 200,000 times each weekday.

Hong Kong: We design, build and maintain communications infrastructure across Hong Kong's Mass Transit Railway to help commuters stay connected during their ride.

About Canada Pension Plan Investment Board

BAI Communications has been majority owned by Canada Pension Plan Investment Board (CPPIB) since 2009. CPPIB is a trusted long-term investor with ~C$420 billion under management, and actively invests in infrastructure assets around the world. In order to build a diversified portfolio of assets, CPPIB invests in public equities, private equities, real estate, infrastructure and fixed income instruments. Headquartered in Toronto, CPPIB is governed and managed independently of the Canada Pension Plan and at arm's length from governments.

3. Our experience during the 2019/2020 bushfires

Summary

- Our experience this summer highlighted a number of key learnings related to the resilience of Australia's communications networks during natural disasters:
  - radio broadcasts continue to play a fundamental role during natural disasters
  - standby power solutions are of critical importance at transmission sites
  - network diversity and redundancy are vital for the provision of resilient communications
  - asset protection zones (cleared land around transmission sites) are very effective at preventing transmission infrastructure from physical fire damage
  - priority access to sites greatly assists in repairing damaged communications services.

3.1. Key learnings from the 2019/2020 bushfires

Throughout the Black Summer bushfires, BAI defended, reinforced and repaired its communications networks to ensure the continuity of radio and television broadcast transmissions as well as the NSW Government Radio Network (the primary NSW emergency services communications network).

The typical geographical location (setback from tree coverage on elevated landforms such as hills) and hardening of BAI's broadcast sites meant that despite the unprecedented nature of the Black Summer bushfires, major damage to BAI broadcast site infrastructure was relatively limited. Between September 2019 and February 2020, BAI managed fire risk across 27 sites in NSW and Victoria – over 130 individual broadcast services hosted at these sites were at risk. Physical fire damage occurred at just three sites and of these BAI experienced major issues at a single site only – Mt Wandera in the NSW South Coast region. This site experienced damage to antenna systems and other site infrastructure along with a two-month loss of mains power (although temporary power was available throughout). Throughout the summer, broadcast infrastructure overall sustained much less damage than telecommunications infrastructure.

Our experience this summer highlighted a number of key learnings related to the resilience of Australia's communication and broadcast networks during natural disasters.

The fundamental role radio broadcasts continue to play during natural disasters

A key strength of radio broadcasts lies in the ubiquity of receivers in Australia - radio receivers are found in virtually all cars and most homes. Furthermore, most members of the public have access to a radio receiver which is not reliant on mains power. As such, radio broadcasts (including the localised essential information provided by ABC Local Radio in an emergency situation) are able to reach a larger proportion of the Australian population than other forms of communication.

Because radio broadcast transmissions can cover extremely large geographical areas (e.g. a radius of up to 400 km for the largest AM broadcasts in Australia), it is more likely that a radio broadcast site is situated outside the immediate danger of a natural disaster hazard when compared with other communication network alternatives.

The value of radio broadcasts as a reliable way to keep the Australian public informed and up-to-date during a natural disaster is further enhanced by the overlapping coverage of radio broadcasts across Australia. Approximately 97% of Australia's population, for example, can receive both an ABC AM radio service as well as an ABC FM radio service. AM and FM radio services are *always* broadcast

from different sites for technical reasons. Accordingly, should a radio broadcast fail during a natural disaster, the public is almost always able to pick up an alternative radio broadcast from a different broadcast site.

Critical importance of standby power on site

The existence and efficacy of standby power solutions at communications sites is the single most critical determinant of whether communications networks remain available during and following natural disasters. Across BAI's communications infrastructure, we use a combination of mains power, fixed diesel generators, batteries, solar arrays and portable diesel generators to help ensure power supply continuity. Many of our smaller broadcast transmission sites (typically located in regional and rural areas), however, do not currently have permanent standby power solutions. In these cases, broadcast transmissions went down when mains power was lost and was not re-established until we were able to access the site to install a portable generator.

Resilience requires network diversity and redundancy

A number of BAI broadcast sites are reliant on nearby telecommunications infrastructure to 'feed in' the broadcast content signal to the transmission site. Loss of nearby telecommunications infrastructure due to fire damage temporarily took some BAI broadcast transmission sites 'off the air' until we were able to reach the site and install an alternative satellite-based 'feed in' solution.

Furthermore, most of BAI's broadcast sites use telecommunications infrastructure for site monitoring and telemetry (i.e. remote measurement and data collection). We were thus unable to monitor or control a number of our sites in bushfire affected areas when nearby telecommunications facilities were lost. The Mt Elliott case study below illustrates how damage to telecommunications infrastructure can impact broadcast reliability, by preventing BAI staff from monitoring the site remotely.

The value of asset protection zones

Asset protection zones (cleared land approximately 30 metres around transmission site infrastructure) are very effective at preventing transmission infrastructure from being physically damaged by fire. Where possible, BAI has already put this valuable asset protection measure in place. A number of our sites, however, require additional regulatory permissions in order to do this (for example, those located in a National or State Park). The experience at our Mt Wandera transmission site, referred to below, illustrates the need for greater asset protection zones. The extreme weather events of the summer demonstrated even relatively isolated broadcast sites are at risk from radiant heat, ash and smoke and, in some instances, directly from fire. There is an opportunity to promote broadcast site resilience by establishing asset protection zones which increase the distance between the fire edge and essential infrastructure.

Site access permissions

Where damage to broadcast sites occurred, BAI work crews and repair specialists were hindered in some instances due to delays in permission to access sites. BAI's ability to ensure service continuity throughout the summer bushfire period was enhanced where priority was given to BAI crews for service and refuelling broadcast sites that also are part of the NSW GRN transmission network. Our experience at Mt Wandera, discussed below, demonstrated the importance of site access in periods of emergency. If BAI personnel and staff working for other communication providers were granted priority access to transmission sites for service recovery and refuelling emergency backup generators, this would assist in re-establishing services where issues arise during natural disasters.

3.2. Case studies

3.2.1. Mt Nardi

Background

Mt Nardi is a broadcast site servicing the Northern Rivers area in New South Wales, approximately 30 km north of Lismore. The site is in Nightcap National Park and provides broadcast services to approximately 250,000 people in the area, including the ABC Local Radio service.

What happened

Throughout late December 2019 and into early January 2020 the Mt Nardi site was impacted by a bushfire in the Nightcap National Park. During the course of the crisis, the fire edge came close to the Mt Nardi site but did not breach the property itself due to favourable wind conditions. The on-site generator automatically started as required and ensured transmission from the site was uninterrupted. The NSW Rural Fire Service (RFS) secured the site by increasing the size of the asset protection zone and the use of fire retardant to further protect the assets.

What went well

The measures adopted by BAI and the NSW RFS helped protect the Mt Nardi site. Specifically, the combination of ground maintenance and the provision of fire retardant prevented fire embers from generating spot fires on the property. This meant BAI and its commercial broadcast partners ensured radio and television services remained on air throughout the entire period and residents in the Northern Rivers region were kept up to date about bushfires across the region.

What could have been better

The Mt Nardi case study demonstrates the necessity of asset protection zones in ensuring broadcast continuity. Had the fire edge reached the property, it is likely the result would have been more substantial asset damage, and, potentially, the loss of vital broadcast services. The increase to the asset protection zone helped protect the Mt Nardi site.

3.2.2. Mt Wandera

Background

Mt Wandera is a broadcast site which provides broadcast services to communities in the New South Wales South Coast region, including Batemans Bay and Moruya. The site provides radio and television broadcast services to approximately 55,000 residents in the area.

What happened

The Mt Wandera site was directly affected by bushfires on the 31st December 2019, causing substantial damage to BAI infrastructure. This included heat damage to both the antenna and electrical feeder systems. Mt Wandera also suffered from a loss of mains power at that time. BAI restored some services through establishing a Local Radio transmission from a temporary site and operated part of the Mt Wandera site using the on-site generator whilst waiting for mains power to be repaired.

What went well

The Mt Wandera case study demonstrates, once again, the importance of standby power to ensure continuity of broadcast transmission during natural disasters. BAI was also aided by its comprehensive transmission site network architecture which enabled it to rapidly bring online an alternative broadcast solution from a nearby site. In addition, BAI temporarily utilised antenna systems from our commercial broadcaster partners to ensure service continuity. While the damage to the Mt Wandera site was substantial, the site also benefited from the resilience of its design, with vital facilities surviving the fires because they were housed in brick buildings. Due to BAI involvement as the operator of the NSW Government Radio Network (NSW GRN), our teams were given priority access to the site. This enabled us to resolve issues more rapidly than at other sites where access issues were encountered.

What could have been better

The Mt Wandera case study demonstrates that asset protection zones are essential for protecting broadcast assets. The damage to the site might have been avoided altogether, if not for the proximity of the tree line to the broadcast tower. Also, the long period without mains power represented a substantial obstacle and required BAI to rely on a backup generator for two months.

3.2.3. Mt Elliot

Background

Mt Elliot is a broadcast site which provides broadcast services to the community of Corryong in Victoria, which is located near the New South Wales border. The site broadcasts radio and television to approximately 2,000 residents in Corryong and surrounds.

What happened

The Mt Elliot site was affected by bushfires throughout late December 2019 and into mid-January 2020. The bushfires resulted in a loss of mains power to the site, along with telemetry services. Due to the location and ongoing risk from the bushfires, BAI was not able to access the site for some time. Subsequently, when our teams reached the site, a portable generator was installed to provide temporary power.

What went well

BAI benefited from a Tesla Powerwall battery which had previously been installed at the site. This battery provided 27 hours of standby power at the peak of the bushfire event, keeping critical information available to residents through the ABC Local Radio service. Subsequently, BAI deployed a portable generator to site to allow continuation of the service after the battery had exhausted.

What could have been better

As a result of damage to a non-BAI telecommunications site located nearby, BAI was unable to monitor the site remotely. The loss of remote monitoring meant it was difficult for our team to determine if broadcast transmissions were still available to the local community. Due to the local transmitter failing and the absence of redundancy replacements, broadcast from Mt Elliot was offline for approximately 8 hours during a time when local residents needed up to date news. Furthermore, as the diesel generator required daily refuelling, our teams had to keep returning to site in difficult conditions.

4. Current challenges facing Australia's communications networks during natural disasters

Summary

- Key communications challenges for Australia's emergency services during natural disasters:
  - Interoperability issues between separate state emergency communications networks;
  - Rising use of data increasing reliance on less resilient commercial mobile networks;
  - Mobilisation of volunteer forces reliant on less resilient commercial communications networks.
- Key communications challenges facing the Australian public during natural disasters:
  - Low public knowledge of alternative ABC Local Radio broadcast frequencies;
  - Loss of household mains power generally results in the loss of National Broadband Network fixed-line phone and internet connections;
  - Current mobile networks lack resilience and often are unavailable during natural disasters.

4.1. Challenges for emergency services

The 2019-20 Bushfire Season demonstrated shortcomings in Australia's existing communications networks. The unique geography of our island continent, combined with the increasing likelihood of natural disasters due to climate change, provides the opportunity to invest in reliable and efficient communications infrastructure, particularly for regional and rural communities.

4.1.1. Interoperability challenges between separate state/territory based emergency services communications networks

In Australia, critical communications for emergency services agencies are primarily managed by State and Territory Governments. Historically, critical communications generally evolved naturally on an agency based level. Each agency, within each State or Territory Government, tended to establish its own networks as needed. A recent trend in communications has seen the development of unified critical communications networks, with every emergency service on a single network. In South Australia, a single network (the SA GRN) has been established, while New South Wales, Queensland and Tasmania are migrating services to a single network.

While the creation of unified critical communications networks within each state is welcome, issues remain for inter-state coordination. This is particularly pronounced in border communities, where interoperability remains a live issue, particularly during periods of natural disasters. The 2019-20 Black Summer bushfires provided several examples of the real-world implications of these interoperability issues. For example, Queensland firefighters deployed in New South Wales were unable to use Queensland issued private radio network handsets in New South Wales, while firefighters defending communities along the Victoria and New South Wales border experienced real difficulty in coordinating their efforts. In this instance, firefighters in Victoria had difficulty communicating with their state based colleagues where they had to cross into New South Wales, while NSW Firefighters had the same issues in Victoria.

The various State and Territory networks use a single communications standard for critical communications networks (called 'P25'). However, as the upgrade cycles for the different networks

are not aligned and funding is provided on a State level, there has not been a strong momentum for reform. The formation of a national critical communications network would resolve these interoperability challenges.

4.1.2. Rising use of data increasing reliance on commercial mobile networks

The current private radio networks are optimised for the communications traditionally used by emergency services, namely voice communications. Furthermore, many of the handheld devices issued to emergency service workers are only able to be used for voice calls. However, emergency services are increasingly using data transmissions to manage and coordinate their teams on the ground. One example of the application of this capability is the transmission of map details or directions to firefighters during a bushfire. Emergency service agencies have begun relying on commercial mobile networks to send data transmissions to workers in the field to fill this capability gap. This capability is limited by the lack of mobile coverage in remote and rural areas. Also, as has previously been noted, existing mobile networks lack the resilience commonly found in hardened, critical communications networks. During periods of natural disaster, commercial mobile networks are more likely to experience service disruption due to the lack of site resilience, insufficient redundancy and their reliance on mains power, without appropriate backup power. Presently, Governments are exploring the potential to enhance existing critical communications networks with mobile broadband services, however, these upgraded networks have yet to be procured from the market.

4.1.3. Mobilisation of volunteer forces reliant on commercial communications networks

Prominent emergency services agencies in Australia, including State Emergency Services and the Rural Fire Service, rely predominantly on volunteers. During natural disasters, these agencies are typically at the forefront of the Government's response. However, due to budgetary constraints, private radio handsets are not necessarily available to all volunteers, but provided on an as-needs basis. Due to these restraints, volunteers typically rely on a combination of low-cost pagers or even volunteers' mobile phones. These communication devices rely on commercial communications networks, which generally lack the resilience of critical communications networks. This results in potential communications challenges in mobilising volunteer staff during natural disasters.

4.2. Challenges for the Australian public

Public communication networks consist of broadcasting, mobile and fixed communications networks. The technical separation and lack of interoperability of these communication types during periods of natural disaster can create information gaps for the Australian public.

4.2.1. Broadcast communications

The content provided by broadcasters is one of the most trusted sources of information in Australia. The loss of services from a site – such as the incident which occurred at Mt Wandera on the NSW South Coast – caused the loss of this trusted source of information when local residents had the greatest need for up-to-date, accurate information. In the case of Mt Wandera, residents were unable to access a number of broadcast services including the ABC FM Local Radio service; while ABC Local Radio broadcast continued to be available from nearby AM stations at Nowra and Bega, coverage in Moruya and the Batemans Bay area for these transmissions is relatively low and the public may not have been aware of their presence. As such, the challenge to be addressed is communicating with the public during periods of natural disaster where a local transmission site has

been damaged or power disruptions cause sites without backup power to be offline, and local residents may not be aware of alternate sources of information.

4.2.2. Fixed connections

The primary fixed communication source for Australian households is now the National Broadband Network (NBN) provided by NBN Co. While the fibre system used by the NBN has many advantages over the traditional copper wire Plain Old Telephone Service (POTS), there is also a significant disadvantage. The POTS handsets still present in some Australian homes are powered from the telephone exchange through the copper line, while the NBN system usually relies on household mains power. As such, a loss of power to the home – as frequently occurs during bushfires and other natural disasters – typically means the loss of a fixed-line connection. In an environment where households are increasingly opting not to install POTS handsets, the resilience of Australian fixed connections has decreased, even as their capability has increased.

4.2.3. Mobile connections

In Australia, there are three mobile network operators (MNOs) – Telstra, Optus and Vodafone. Other mobile service providers (Virtual MNOs) have commercial arrangements with these three networks. The three MNOs have different coverage areas and the Virtual MNOs which lease capacity from their networks do not necessarily pay for access to the entire network. As a result, there is a patchwork of different effective mobile network coverage areas in use depending on the SIM a user has installed in their mobile phone or device. This means that, during a natural disaster, the Australian public is not able to be kept informed about current developments on a uniform basis.

Furthermore, mobile communications sites are generally much less resilient than broadcast sites. They are more likely to be damaged in natural disasters due to their typical location and less likely to have significant backup power capability on site. On average, MNO transmission sites have 6 to 8 hours of power autonomy available, after which they will require a separate generator to provide coverage. In remote and regional areas there are generally only a smaller number of MNOs present (potentially only one) and sharing arrangements, even in times of crises, are rarely available. As a result of these conditions, the loss of a single MNO transmission site during a natural disaster can result in large numbers of mobile phone users without the ability to communicate using their mobile phone.

5. International Approaches to Emergency and Public Networks in Regional Areas

Summary

- There are a number of key lessons for Australia from international experience:
  - Emergency services will continue to rely on digital private radio networks for the foreseeable future given their reliability and ubiquity of coverage, particularly in regional areas
  - Broadcast services, particularly localised radio services, will continue as important sources of information for the public during times of disaster due to their resilience, localisation and ubiquity.
  - The sharing of mobile broadband networks is driven by the need to cost effectively supply broadband services in regional areas to both emergency workers and the public. This in-turn enables higher population coverage by these regional networks.
  - Technology developments such as 5G are significantly increasing the ability to share networks and prioritise emergency services on common network infrastructure.
  - Shared regional public and emergency networks are driven by national governments, not state or local governments, even in federal systems of government like the US.

5.1. International approaches to regional communications networks for emergency services

During the bushfire emergency there was a critical need for emergency workers in regional areas to have reliable communications as the situation changed rapidly across Queensland, New South Wales and Victoria. Given the dynamic nature and vast areas of the fires, the need for ubiquitous, resilient and diverse networks has become increasingly obvious. Though the geographies of other countries differ from that of Australia, the needs of emergency workers are very similar. It is therefore instructive to examine the different network models being adopted in comparable jurisdictions such as New Zealand, UK and USA.

In each of these countries there are two tiers of communication networks for emergency services:

- Digital private radio networks for voice and low bandwidth data communications typically based on the 'P25' standard utilising dedicated networks and receivers;
- Emerging mobile broadband networks for emergency service communications, typically 4G based, sharing infrastructure to some degree with commercial mobile networks.

Digital Private Radio Networks

Emergency services agencies around the world are expected to increasingly utilise the new emerging mobile broadband networks. However, it appears unlikely in the near to medium term that the current digital private radio networks will be totally de-commissioned due to their reliability and ubiquity of coverage. Recent outages in Australian mobile networks due to bushfires and operational issues tend to strengthen the view that it is wise to retain a robust, ubiquitous communication network for emergency communications. The UK government does intend to close their emergency digital private radio network, given its age, but due to significant delays in the rollout of their

emergency mobile broadband network (ESN) there appears to be uncertainty as to when (and if) this will now occur in the short to medium term.

Mobile Broadband Networks

The approaches utilised for the rollout of emergency (private) mobile broadband networks in New Zealand, UK and USA all involve the sharing of infrastructure with public mobile broadband networks, particularly in regional areas.

In New Zealand, the emergency services intend to utilise a fully shared regional network that is being rolled out for the delivery of public mobile broadband communications in regional areas. This shared public broadband network is described further in Section 5.2 below. Currently New Zealand Police Search and Rescue has commenced use of this new network and other agencies are expected to start utilising it as the network rollout completes in 2024.

In the UK, the British government has provided over GB£6bn in funding and commissioned one of the carriers, EE, to rollout a dedicated emergency services mobile broadband network (ESN) across the country. The new network will share passive infrastructure (i.e. tower structure and power) with the public networks but will largely be operated separately.

In the US, an emergency services mobile broadband network, 'FirstNet', is being rolled out by AT&T, who will also operate the network. AT&T received a combination of spectrum and funds from the Federal Government in exchange for building and running the network. Firstnet fully shares the AT&T public mobile network infrastructure, including spectrum. 'Quality of Service' commitments for the emergency services are delivered by AT&T utilising network traffic prioritisation of emergency services traffic.

In summary, the current approach for the delivery of emergency services networks in these different geographies is for dedicated emergency digital private radio networks to operate alongside emergency mobile broadband networks that share infrastructure, to varying degrees, with public mobile broadband networks.

5.2. International approaches to regional communications networks for public services

The bushfire disaster also demonstrated the need for the public to be able to obtain local, relevant information in order to plan appropriately. In some of the worst affected areas the mobile networks were rendered inoperable at critical times, necessitating the public to rely on broadcast television and radio networks for information and guidance.

Broadcast Services

As a result of issues with the mobile networks during the bushfire disaster, many of the most affected people needed to rely on broadcast services, particularly radio, for information about the local fire situation. In other jurisdictions the reliance on broadcast services is similarly evident. Many countries across the world, including New Zealand, UK and USA all have extensive public and private broadcast TV and radio networks that are utilised during disasters to supply up-to-the-minute information about the local situation, as in Australia.

Broadcast radio is a priority service in all these geographies during natural disasters due to the ability to receive it even when someone may have lost mains power at their home (as often occurs in these situations), as well as its localisation of the information for the public. The local broadcast radio

services have the additional advantages of ubiquitous coverage and listeners being able to receive the services both in their home and vehicles.

Mobile Broadband Services

Different approaches to the provision of public mobile broadband network services in regional areas have been taken around the world.

In **New Zealand**, the national government has co-funded a fully shared model for the deployment of new public mobile infrastructure in regional areas. The network is co-funded by the Rural Broadband Initiative Phase 2/Mobile Blackspot government programs as well as the three mobile operators. The mobile operators have formed a joint venture, the Rural Connectivity Group (RCG), to build, own and operate the new network. All three networks will share backhaul, network equipment, antennae, and spectrum on each of the towers. As mentioned above in Section 5.1, the Police Search and Rescue service is utilising the service and the intent is for the network to be utilised by other emergency services as the network is completed in 2024.

In the **UK**, the national government has co-funded the rollout of a 4G Shared Rural Network (SRN), across new and existing mobile infrastructure sites with the four main mobile operators. The mobile operators have formed a joint venture, Digital Mobile Spectrum LTD, to build, own and operate the SRN. The operators will share backhaul and tower infrastructure but will utilise their own equipment on the towers as well as their own spectrum. Some of the tower infrastructure will be shared by the SRN with the emergency services network currently being rolled out by EE, however the networks will be separate.

In the **USA**, there is no significant government funding of the public mobile broadband networks. However, FirstNet, the new emergency mobile broadband network as described in Section 5.1, is effectively funded by the federal government. Furthermore, the four major carriers do share passive mobile tower infrastructure in some regions.

Due to Australia's size and low population densities in regional areas, BAI believes the imperative for a shared regional mobile broadband network is even greater than the international examples above. Given Australia's federated structure of government there is a clear necessity for Federal Government involvement in driving a national network approach that will deliver the best network outcomes for the most Australians.

6. Communications network technology options

Summary

- Australian emergency services communications networks generally use a combination of P25 digital private radio and pager technology today.
- A number of countries are progressively evolving their emergency services communications networks to 4G mobile technology; none, however, have yet shut down P25 digital private radio networks to date.
- Whilst the Australian public increasingly communicates using mobile networks, television and radio broadcast networks will remain critical sources of information during crises.

6.1. Network technology options for emergency services communications networks

P25 Private Mobile Radio networks

'P25' is a suite of standards for digital private radio communications designed for use by emergency services. 'P25' private radio networks can transfer encrypted voice and data transmissions, although most handsets in use today typically can only make and receive voice transmissions. These P25 networks are used by almost every emergency services agency in Australia as their primary private radio communication network. Historically each state agency set up its own communications network, but most states are now moving to a model with a single unified state emergency services communications network used by all agencies in that jurisdiction. There are two broad implementations of 'P25' networks in Australia today – the older 'Phase 1' implementation (currently used in NSW), and the newer 'Phase 2' implementation (currently used in Queensland). The different implementations of 'P25' networks across Australia present inter-operability challenges between the states. 'P25' private radio networks are typically used in Australia for group calls involving all private radio network handsets in a 'talk group' receiving every transmission made by anyone in that talk group. They can also be used for one-to-one calls, but this functionality is rarely used in practice.

Pager networks

Emergency service agencies in some states rely on pager networks, especially for volunteer communications. Various emergency service agencies in Victoria, for example, use the 'EAS Paging network' to mobilise volunteer first responders. The 'EAS Paging network' is a managed service dedicated for use by Victorian emergency service agencies. South Australia has just deployed a new pager system for use by emergency service agencies in that state, utilising an existing commercial wide-area pager network.

4G mobile networks

A number of countries are progressively evolving their emergency services communication networks to networks based on 4G mobile technology. Typically, these new 4G mobile based emergency services networks share some, or all, transmission infrastructure with commercial mobile networks. In some cases, they also use the same radiofrequency spectrum bands as commercial mobile networks. When sharing both transmission infrastructure and spectrum bands, emergency services network traffic will typically be prioritised above commercial network traffic through 'Quality of Service' rules. New Zealand, the UK and the USA are all starting to utilise 4G mobile based networks

for emergency services communications. Section 5.1 above provides further details on the new networks in each of these countries.

6.2. Network technology options for public communications networks

4G and 5G mobile networks

Mobile Network Operators (MNOs) currently use a combination of 3G and 4G (LTE) networks in Australian cities and are currently rolling out 5G infrastructure. The limited reach of mobile networks, due to device return path limitations, means that the mobile network base stations tend to be located within or near communities. The lack of infrastructure sharing between the MNOs means that there are significant differences in overall reach, coverage and capacity. Historically, the technology to efficiently share Radio Access Networks (RAN) had not been available, but with the introduction of 'Virtualised RAN' and the ability to provide 'Network Slicing' within the upcoming 5G specification, these technical limitations are being removed.

In densely populated areas, there may still be a commercial rationale in the future for two or three MNOs to build their own networks and rely on this 'technical differentiation' as a marketing and commercial advantage. In regional and rural Australia, however, there is real opportunity for a new hardened 4G and 5G mobile network - which provides coverage to all Australians and all their devices (irrespective of the SIM card in their mobile devices) and maintains connectivity during natural disasters. This new network could provide dedicated capacity to emergency services agencies through the use of network slicing. The new network could further provide exceptionally wide area coverage for one-way communications through functionality in the 5G specification called '5G Broadcast'. Using this technology, the network can deliver data (e.g. an emergency warning alert) to mobile devices up to 200 km away (in comparison, the typical range of a conventional mobile transmission site is up to 30 km).

Two distinct commercial and technical approaches are possible to establishing this new hardened mobile network for regional and rural Australia:

- A **'Shared Mobile Network'** could be built, where all three MNOs share all extensions of existing mobile network infrastructure in regional and rural areas. Sharing of network infrastructure in this way enables greater mobile coverage and higher resilience to natural disasters than any individual MNO network would be able to achieve on a commercially viable basis.
- Alternatively, a **'Universal Mobile Network'** could be built by a 'neutral host' to complement existing and future MNO mobile networks in regional and rural areas. This network would provide additional capacity and extended coverage to all MNOs in regional areas. As it is hardened to withstand natural disasters, it can be relied upon by emergency services and the Australian public to maintain mobile connectivity even when less resilient existing mobile networks fail.

BAI recommends that the second of these approaches, a 'Universal Mobile Network', is adopted by Australia for use by both emergency services and the public. The timeframe required to deliver a functional 'Universal Mobile Network' is anticipated to be significantly shorter than the timeframe required for a 'Shared Mobile Network'. Section 9 provides further details on this recommendation.

Television broadcast networks

The Australian digital television network commenced operation in capital cities in January 2001. It was subsequently rolled-out across the country with the last analogue television services being turned off in December 2013. Digital television technology has progressed significantly in the last twenty years including both the channel and video coding. These improvements have given rise to the next generation of television suitable for the Australian market – a combination of DVB-T2 and High Efficiency Video Codec (HEVC) technologies. Both technologies are included in many television sets imported into Australia in the last few years. The DVB-T2 technology includes an Emergency Warning System functionality which should be included in any future transmission and receiver standards. The combination of DVB-T2 and HEVC would provide broadcasters with a choice to either increase the picture quality, increase the number of programs, reduce the spectrum required in an area or any combination of the three. Should broadcasters in regional areas choose to reduce the amount of spectrum required for the provision of their services, the high end of the broadcast spectrum in these areas would be ideally suited for the provision of a wide area 5G network for a neutral host provider (i.e. a 'Universal Mobile Network') including a requirement to provide emergency warning and emergency services capacity.

AM / FM / DAB+ / DRM radio broadcast networks

Currently, digital radio broadcasting in Australia is based on DAB+ technology using VHF Band III spectrum (circa 200 MHz), which has a smaller footprint when compared to the AM and FM services which were its forerunners. DAB+ provides additional audio programs in the metropolitan markets of Sydney, Melbourne, Brisbane, Adelaide and Perth where it was launched in 2009-2010. In three other cities – Canberra, Darwin and Hobart – where it was more recently launched, there are also additional audio channels being made available.

The Australian Communications and Media Authority recently found that[1]:

1. AM will continue to play an important role in regional and remote areas – particularly for emergency warnings – in the medium to long term
2. FM will remain strong and viable for the foreseeable future
3. FM and DAB+ cannot economically replicate the coverage provided by high power AM services.
4. Digital Radio Mondiale (DRM) has the potential to replicate FM and AM coverage.

The importance of AM radio reach in regional and remote Australia is undeniable. However, the reach of these services depends on both the coverage provided by the transmission network and the reception equipment in use by the Australian population. There has been a shift away from AM reception being included in some radio receivers – most notably FM / DAB+ 'clock-radio' style devices – which is currently impacting some of the audience's ability to receive these important services in regional and remote Australia. Within the important car market, the ACMA found "There are no current plans to phase out AM in non-electric vehicles in Australia."

BAI notes that digital radio systems (both DAB+ and DRM) have the capability to include Emergency Warning Functionality. This would 'wake-up' receivers in standby mode and replace normal content with emergency warning information. Consideration should be given as to whether this should be mandated in all future digital receiver standards.

[1] Australian Communications and Media Authority, *'The Future Delivery of Radio'* (Final Report), March 2020

7. Enhancing Australia's communications network architecture to effectively manage future natural disasters

Summary

- BAI has two key recommendations to enhance and augment Australia's current communications networks:
  - Further harden ABC broadcast sites across Australia
  - Build a new 'Universal Mobile Network' in regional and rural areas across Australia for use by both emergency services and the public

BAI has two key recommendations to enhance and augment Australia's current communications networks so that both Australia's emergency services and the Australian public are better equipped and informed to overcome the challenges faced during future natural disasters.

Recommendation One: Further harden ABC broadcast sites across Australia

Whilst many of BAI's transmission sites that broadcast ABC radio and television are already heavily hardened to ensure broadcasts continue during natural disasters, a substantial number of smaller transmission sites (typically those which serve smaller regional communities around Australia) are not hardened to withstand natural disasters to the same degree. BAI believes there is a compelling rationale for hardening all sites that broadcast ABC Local Radio across Australia. There is also a strong rationale to extend these hardening measures to cover all sites that broadcast ABC and SBS television across Australia. Four near term areas of investment to effectively harden broadcast sites against natural disasters are proposed in Section 8.

Recommendation Two: Build a 'Universal Mobile Network' covering regional Australia

BAI recommends a new 'Universal Mobile Network' is built in regional and rural areas across Australia for use by both emergency services and the public. New network infrastructure is proposed to be co-located on ~600 existing broadcast transmission sites, with these sites to be heavily hardened to maintain connectivity during natural disasters. BAI proposes the new network operate in two distinct modes. During *'normal conditions'*, the 'Universal Mobile Network' would carry emergency services voice and data communications as well as leasing bandwidth to mobile network operators on an as-needed basis - providing additional capacity and extended coverage in regional and rural areas. During *'emergency conditions'*, such as natural disasters, the 'Universal Mobile Network' would prioritise emergency services traffic while also ensuring the highest number of public mobile devices can receive voice and basic data mobile coverage. Further details on this proposed new 'Universal Mobile Network' may be found in Section 9.

Figure 2 below illustrates the current state of emergency services and public communications networks in regional and rural Australia. Figure 3 below illustrates the future state of the same networks in regional and rural Australia if both of our recommendations are implemented.

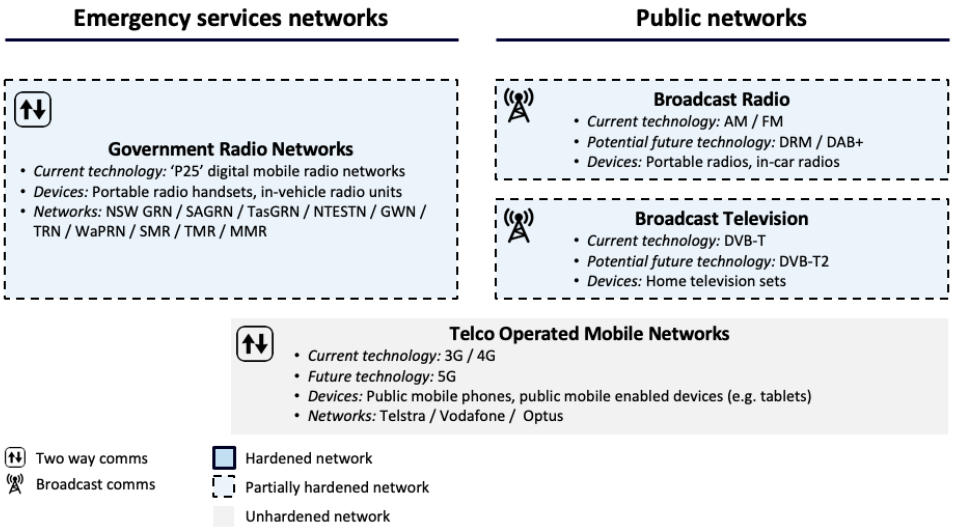

Figure 2: **Current state** of emergency services and public communications networks in regional Australia

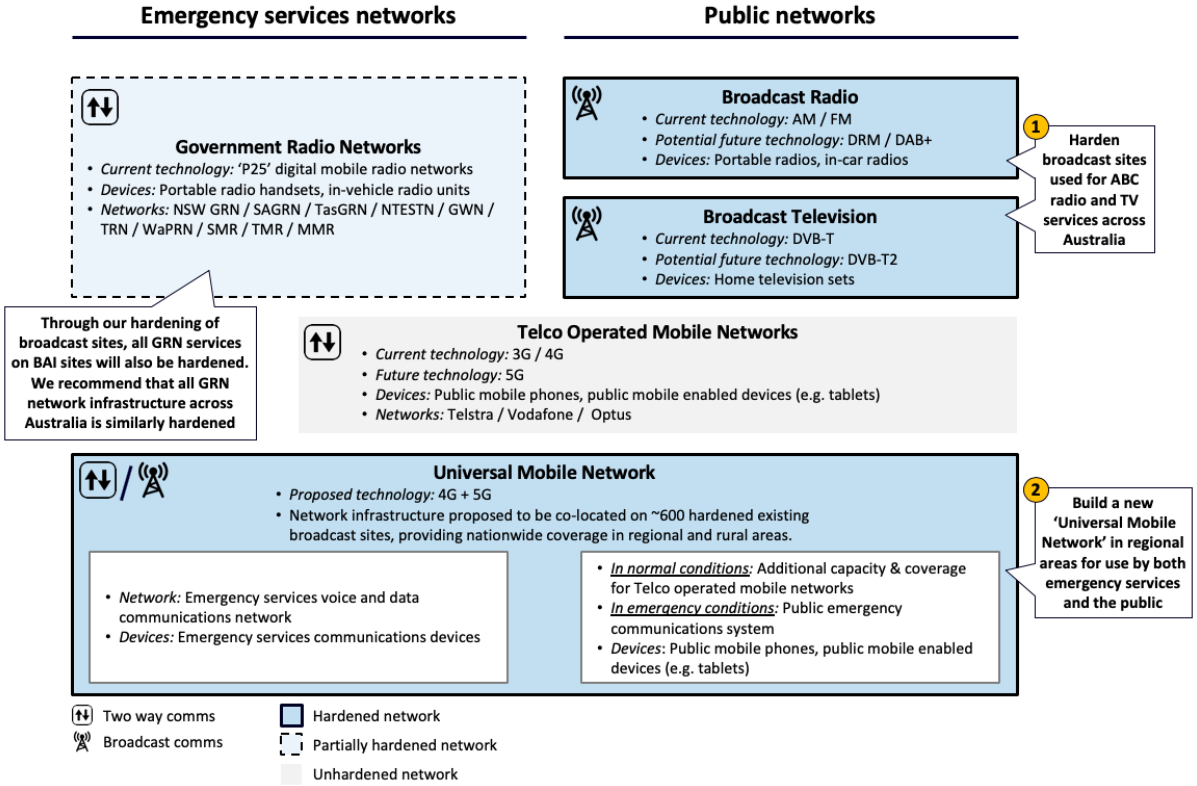

Figure 3: **Proposed future state** of emergency services and public communications networks in regional Australia

8. Recommendation One: Further harden ABC broadcast sites across Australia

Summary

- BAI recommends the further hardening of broadcast sites used for ABC services across Australia. We propose four near term areas of investment to improve the availability of critical broadcast services to local communities during natural disasters: site resilience, standby power, service recovery, and service continuity initiatives.
- BAI recommends, at a minimum, hardening all sites that broadcast ABC Local Radio across Australia. If appetite exists, hardening measures could be further extended to cover all sites that broadcast ABC and SBS television across Australia.

8.1. Proposed near-term initiatives to harden broadcast sites

Drawing upon the Black Summer bushfires and BAI's extensive experience managing critical communications and broadcast networks for almost one hundred years, we have proposed simple solutions to improve communications in times of natural disaster. BAI has proposed four near term areas of investment to improve the availability of critical broadcast services to local communities during natural disasters, such as bushfires. These relate to: Site Resilience; Service Continuity; Standby Power; and Service Recovery.

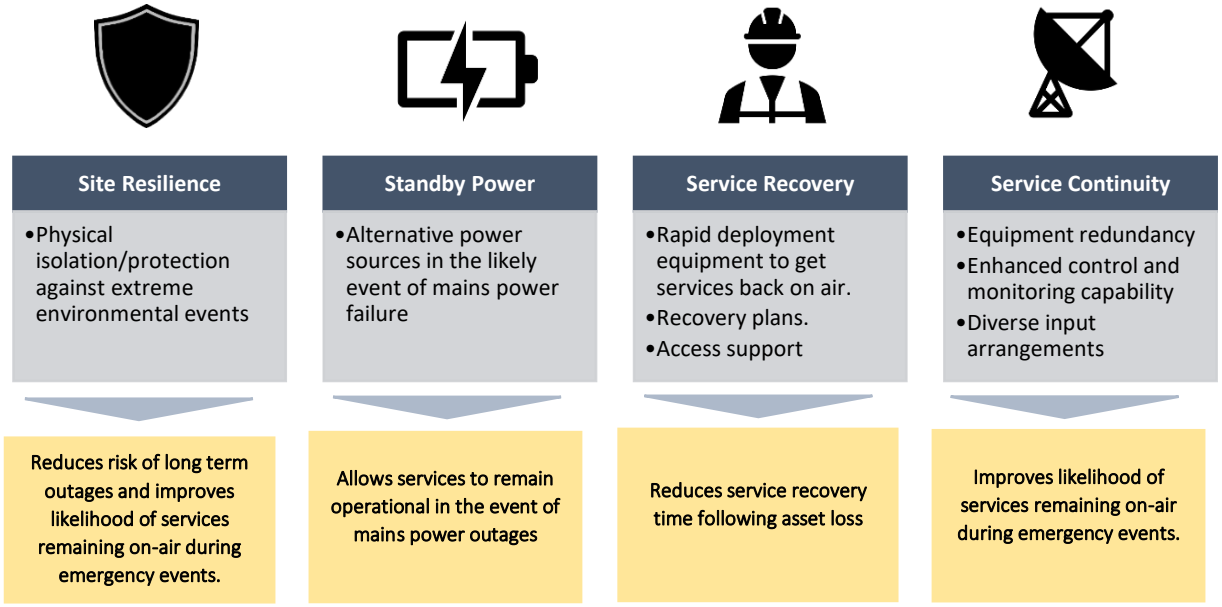

Figure 4: Near term areas of investment to improve the availability of critical broadcast services to local communities during natural disasters

8.1.1. Site resilience enhancement initiatives

Site resilience enhancements improve the physical isolation between the natural event and the facility. In this context, site resilience relates to the implementation of asset protection zones around sites through the clearance of bush land. Effective asset protection zones significantly reduce the risk of asset damage and service outages from bushfires.

The aerial images in Figures 5 and 6 below show the difference between a site with an effective asset protection zone and one without. Many of BAI's sites already utilise effective asset protection zones. However, BAI has repeatedly encountered difficulty in securing approval to establish asset protection zones.

Recommended initiatives will harden up to approximately **3,880** broadcast radio, broadcast television, government radio network and commercial mobile network services at up to **184** transmission sites across Australia. Government assistance will be required for the upfront cost, ongoing maintenance costs and relevant approvals to complete the works.

Figure 5: Mt Cenn Cruaich prior to asset protection zone implementation

Figure 6: Mt Cenn Cruaich post asset protection zone implementation

8.1.2. Standby power enhancement initiatives

Standby power upgrades provide standby power equipment to site, allowing services to continue in the event of power outages. Proposed standby power solutions will typically comprise either a fixed diesel generator or a battery and solar array solution. All services on site will be supported by this standby power facility where possible, resulting in a significant uplift of the number of communications services supported by backup power systems nationwide. The initiatives recommended in this area will provide standby power to up to approximately **3,640** broadcast radio, broadcast television, government radio network and commercial mobile network services at up to **291** transmission sites across Australia.

Figure 7: Diesel generator, or solar and battery solutions provide effective standby power in the event of mains power outages.

8.1.3. Service recovery enhancement initiatives

Service Recovery is the procurement and strategic distribution of rapidly deployable assets across the country. BAI proposes the roll out of trailer-based broadcast sites, mobile generators, portable transmission equipment and portable satellite equipment. Investment in this area will allow faster recovery of service in the event of asset loss. Initiatives proposed by BAI will enable faster service recovery across ABC FM Local Radio services and ABC and SBS television services across Australia. Government assistance will be required in securing access and meeting the cost of new deployment equipment.

Figure 8: High power density light weight equipment is essential for rapid restoration

Figure 9: Trailer based solutions allow temporary broadcasts to rapidly deployed

8.1.4. Service continuity enhancement initiatives

In this context, establishing service resilience requires redundancy upgrades to on-site equipment to prevent failure during times that facility access is not possible. This includes engineering back-ups and, wherever possible, avoiding reliance on nearby, vulnerable terrestrial communications sites. Investments in this area will help keep services on air in the event of equipment failure. Examples include:

- Satellite backup systems to provide an alternate way to get broadcast programming to site without relying on nearby terrestrial facilities that may have been compromised; and
- The addition of automated backup equipment to provide redundancy, which allows the service to readily recover in the event of an on-site equipment fault.

These initiatives will provide service resilience upgrades to **239** ABC Local Radio services across Australia. The investments proposed are primarily focussed on smaller sites, which cover smaller population areas and currently lack enhanced resilience features.

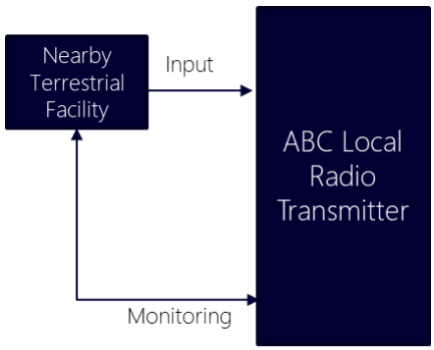

Figure 10: Many ABC Local Radio services rely upon nearby terrestrial facilities for input and monitoring. In many cases these facilities are not operational during natural disaster events.

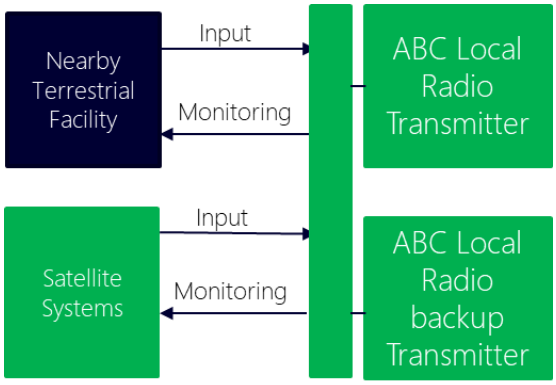

Figure 11: Satellite systems provide backup systems that are independent of local terrestrial facilities, improving service reliability.

8.2. Estimated funding support required

The table below outlines the estimated funding support required for the recommended resilience initiatives. Two options have been considered:

- **Option 1:** Resilience measures extended to all sites that broadcast ABC Local Radio nationally and sites that are controlled by BAI Communications which support a government emergency service network anywhere in Australia
- **Option 2:** Resilience measures extended to sites that broadcast ABC and SBS television nationally

All cost estimates have been represented as total cost figures over 15 years of operation, with ongoing operating costs indexed to increase by 2% per annum. All costs have been estimated on a cost recovery basis – no margin has been included within these figures.

Investment Area *(all cost estimates 15yr total A$m)*	**Option 1** *ABC Local Radio sites + BAI sites with emergency services*	**Option 2** *Extension to cover ABC & SBS TV sites*	**Option 1 + Option 2**
Site Resilience 	$18m ~2380 Services hardened[2] 95 Sites	$14m ~1500 Services hardened[2] 89 Sites	$32m ~3880 Services hardened[2] 184 Sites
Standby Power 	$35m ~1580 Services Supported[2] 122 Sites	$47m ~2060 Services Supported[2] 169 Sites	$82m ~3640 Services Supported[2] 291 Sites
Service Recovery 	$1m Geographic coverage for FM services	$1m Geographic coverage for FM + TV services	$2m Geographic coverage for FM + TV services
Service Continuity 	$25m 239 Services Enhanced	N/A[3]	$25m 239 Services Enhanced 239 Sites
Total	**~$79m**	**Additional ~$62m**	**~$141m**

Please refer to Appendix 10.2 for further detail on these funding support estimates.

[2] Minimum number of services covered, data based on ACMA site ID, in many cases multiple ACMA sites are present within a single physical site

[3] Service continuity upgrades have been recommended for ABC Local Radio only

8.3. Regulatory permissions requested

There are two regulatory changes required for the recommended resilience initiatives:

1. **Priority Access**: For diesel standby power generators to remain effective during natural disaster events involving extended power outages, it is critical site operators such as BAI have access to site to refuel the generator. Broadcast sites, particularly those broadcasting ABC Local Radio (i.e. providing the public with critical information), should be given equivalent priority access and escort to site for refuelling and service restoration purposes as the emergency service communication networks. Broadcast sites should be placed on the critical refuelling list.
2. **Streamlining environmental approvals**: Asset protection zones often require a range of approvals that are often very challenging to obtain and highly time consuming. Examples of environmental approvals typically required include:
    - environmental assessments and local, state and/or federal government approvals (for flora and/or fauna);
    - approval from land owner (private, National Parks & Wildlife, State Forests etc);
    - approval from local fire captain.

8.4. Roadmap for delivery of initiatives

An indicative timeline to deliver the initiatives proposed is depicted in Figure 12 below. This timeline has been structured around delivering tangible improvements in preparation for each of the next four forthcoming bushfire seasons.

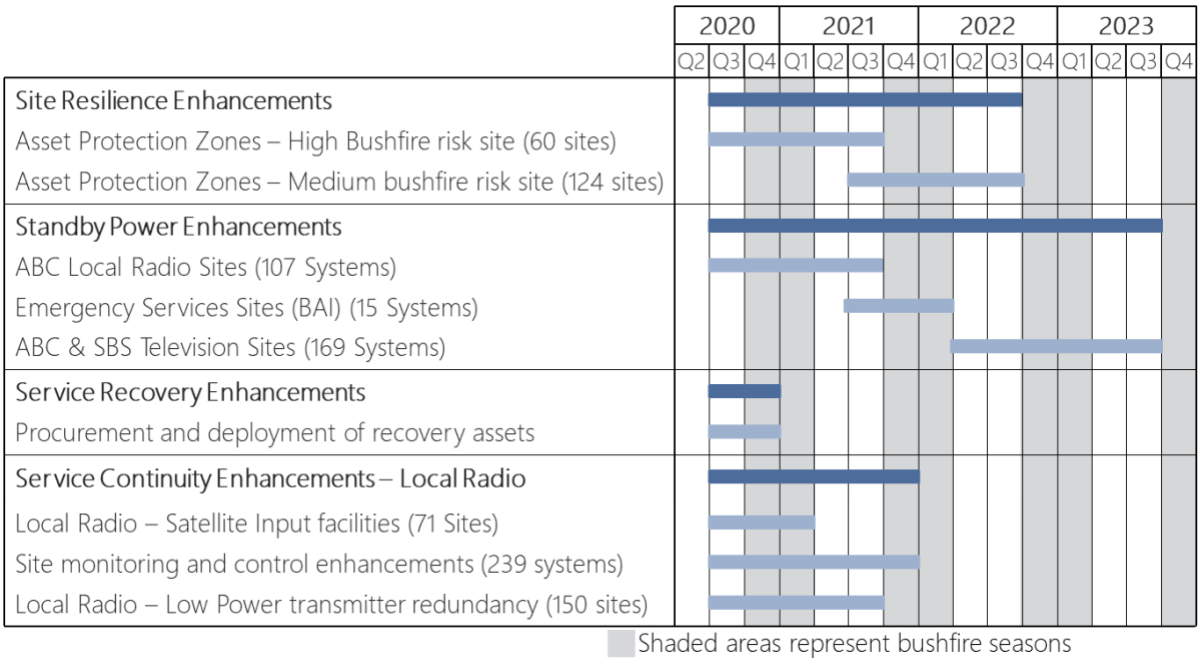

Figure 12: Indicative timeline to deliver resilience initiatives

9. Recommendation Two: A new 'Universal Mobile Network'

Summary

- BAI recommends a new 'Universal Mobile Network' is built, operated and maintained in regional and rural areas for use by both emergency services and the public.
- Key features of the proposed 'Universal Mobile Network':
  - National mobile overlay network providing two-way communications to mobile devices within ~30 km of transmission sites
  - Connectivity for both emergency services and the public
  - Complementary to existing mobile networks
  - Network hardened to maintain connectivity during natural disasters
  - Connectivity for all Australian mobile phones and devices, regardless of the SIM installed
  - Accessible using current mobile phones and devices
  - Prioritised access for emergency services communication, 000 calls, delivery of localised emergency warning alerts, emergency information apps
  - Primarily uses existing broadcast transmission sites to minimise build timeframes and cost
  - Necessary technology is available now to commence build
  - Capable of providing one-way communication (e.g. emergency warning alerts) to mobile devices up to 200km from transmission sites
  - Readily upgradable to accommodate Public Safety Mobile Broadband requirements

9.1. Our vision for a new 'Universal Mobile Network'

BAI recommends a new 'Universal Mobile Network' is built in regional and rural areas across Australia for use by both emergency services and the public. We propose this new network infrastructure primarily be co-located on ~600 existing broadcast transmission sites, providing extensive coverage in regional and rural areas. The high towers and typically elevated site locations of broadcast transmission sites make them highly suitable for the new 'Universal Mobile Network'. This new network is envisaged to operate in parallel and be complementary to existing 4G and future 5G telco operated mobile networks.

Hardened network to maintain connectivity during natural disasters

We propose that the network infrastructure making up this new network would be heavily hardened to maintain connectivity during natural disasters. Hardening the ~600 broadcast transmission sites of this new network is substantially more cost effective than hardening the more than 20,000 existing mobile network transmission towers across Australia. Furthermore, the costs of this hardening are covered in Recommendation One - this investment is being leveraged to provide improved and more resilient mobile coverage to both emergency services and the public. The cost to harden these ~600 sites is quantified above as 'Option 2' in Section 8.2.

Proposed use by emergency services

The new 'Universal Mobile Network' would carry emergency services voice and data communications across Australia. This IP-based network will be fully interoperable across emergency service agencies and across each state of Australia. Emergency services traffic on the shared network will always be prioritised above public traffic through 'Quality of Service' priority rules embedded

into the network. The network would be readily upgradable to accommodate Public Safety Mobile Broadband (PSMB) requirements.

The 'Universal Mobile Network' will soon be capable of providing one-way 'broadcast' communication. This will enable emergency service agencies the ability to communicate to all personnel in an area at higher data rates without facing network congestion. Furthermore, one-way 'broadcast' communication also enables a massively extended coverage range – one-way communications can be made to devices up to 200km from the transmission site *(in comparison, the typical range of a conventional two-way mobile transmission is up to 30 km from the site).* This functionality will be available once the network is upgraded to include 5G capability.

Proposed use by the public

BAI proposes the new 'Universal Mobile Network' operate in two distinct 'modes' to serve the Australian public:

- During *'normal conditions'*, the 'Universal Mobile Network' leases bandwidth to mobile network operators on an as-needed basis, providing mobile network operators and other communications / content providers with additional capacity and extended coverage in regional and rural areas.
- During *'emergency conditions'*, such as during a natural disaster, the 'Universal Mobile Network' prioritises emergency services traffic whilst also ensuring the highest number of public devices can receive voice and basic data mobile coverage simultaneously - by enforcing strict 'Quality of Service' rules and data-rate device caps. 'Quality of Service' rules embedded into the network would prioritise emergency services communication, 000 calls by the public, delivery of localised emergency warning alerts to the public and public access to emergency information apps (such as 'Fires Near Me').

The one-way 'broadcast' communication capability of the 'Universal Mobile Network', as discussed above, can also be used to send emergency warning alerts to the public via every active mobile device in a defined geographic area. The massively extended coverage range of this one-way 'broadcast' communication capability (up to 200km from the transmission site) will greatly assist in reaching as many people as possible in the defined area.

Necessary technology available today

The necessary technology is available now to commence building this network - network infrastructure equipment installed will operate on 4G specifications today and be cost-effectively upgradable to 5G once the global 5G specifications are rolled out by mobile device manufacturers in the next 2 to 3 years.

Built, operated, and maintained by a neutral host

We recommend that this new 'Universal Mobile Network' is built, operated and maintained by a neutral host. A neutral host is the simplest and most commercially sensible way to share the upfront and ongoing costs of the network between all its users – the emergency services agencies and all mobile network operators. Furthermore, a neutral host ensures that the network will be able to be used by all mobile phones in Australia, regardless of the SIM installed – especially important during a natural disaster.

A joint venture approach, similar to what is used in New Zealand and the United Kingdom, would be very challenging to implement in Australia due to the commercial dynamics between Australia's

three mobile network operators (Telstra, Optus and Vodafone). These three Australian mobile network operators have historically been unwilling to share mobile network infrastructure with each other on a network-wide level for commercial and marketing reasons, although some ad-hoc infrastructure sharing has occurred.

A neutral host model has been successfully deployed internationally by BAI in New York by our Transit Wireless subsidiary. Transit Wireless provides six points of interconnection ('base station hotels') for Mobile Network Operators, Mobile Virtual Network Operators and the Metropolitan Transit Agency. From these locations, BAI provides fibre carriage to 280 New York subway stations and operates all mobile network, emergency services and Wi-Fi services within these stations. The model proposed herein is very similar to this New York City transit system example.

9.2. Indicative roadmap for construction of new network

An indicative roadmap for the planning, design and construction of a new 'Universal Mobile Network' across Australia is depicted in Figure 13 below. It is proposed that regions with a higher risk of natural disasters are prioritised so that the new network is operational in those areas first.

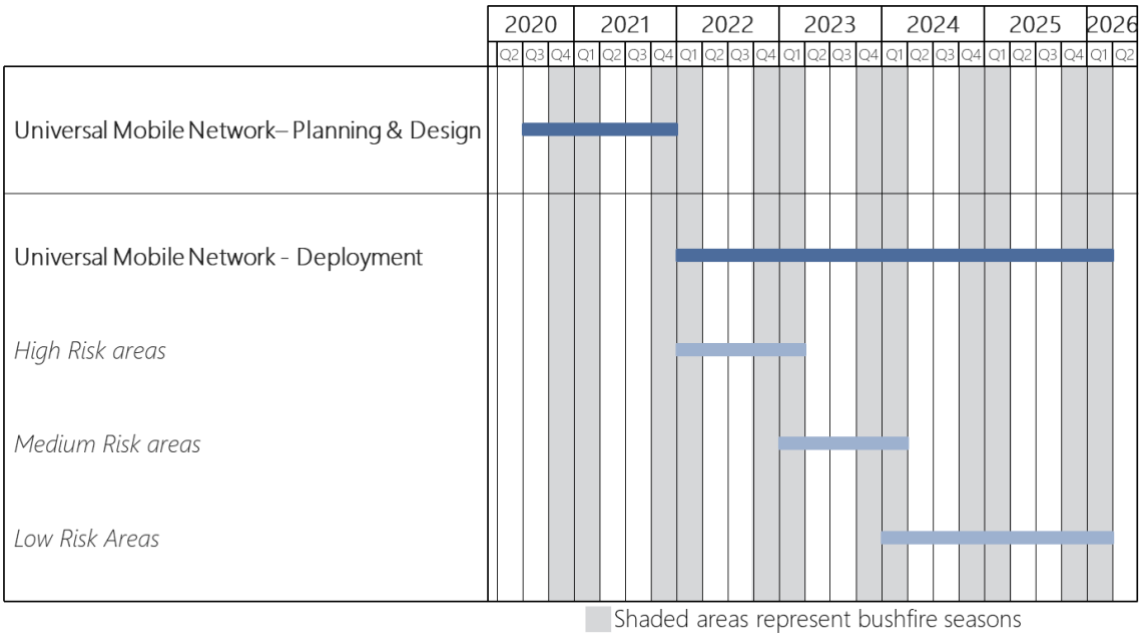

Figure 13: Indicative roadmap for the planning, design and construction of a new 'Universal Mobile Network'

10. Appendices

10.1. Further detail on BAI Communications' operations in Australia

BAI Communications Australia is a neutral host broadcast and telecommunications service provider. Our nation-wide network, paired with our engineering, delivery and operational capability, makes us a trusted partner to deliver high-quality connectivity solutions. With our ability to scale and adapt, we also plan for our customers' future by applying technology innovation in an ever-evolving industry.

Our heritage

The organisation now known as BAI Communications Australia stands at the forefront of broadcast transmission in this country, responsible for delivering Australia's television and radio services for Australia's national broadcasters since 1928. BAI Communications Australia (previously Broadcast Australia) was created following the privatisation of the government-owned and managed National Transmission Agency in 1999. Since its inception, BAI Australia has been primarily focused on linear television and radio broadcasting and has remained consistent in its commitment to excellence in design, build and operation of highly available networks to meet our customers' stringent needs.

Extensive network

Our network consists of 752 transmission sites in metropolitan, regional and remote locations, delivering 59 million broadcasting hours, reaching 99% of the Australian population. We are also responsible for 1,529 managed transmission services. Our Network Operations Centre (NOC) is at the core of providing high service availability, monitoring our sites across the country.

Network Operations Centre

Our Network Operations Centre (NOC), located in Gore Hill, Sydney, is the backbone of our network, providing real-time remote monitoring and control of the network 24 hours a day. A combination of advanced telemetry systems, IP connectivity and software management systems connect ~10,000 devices at 752 sites supported by a team of experienced control room engineers and technicians. In addition to NOC Operators and systems engineers, the NOC has dedicated teams to manage customer reporting and planned outages.

Field services capability

BAI Australia's Service Integrity Team supports our Networks Operations team in the field. This team has built a well-earned reputation from our customers for their quality, capability and dedication, especially in times of major incidents such as bushfires, floods and other natural disasters. Our role as the ABC's National Emergency Broadcasting Partner means that our network can be the last resort for communicating with people in disaster affected areas. BAI employs the largest team of broadcast trained field resources in the country supported by 360 contracted 'First in Maintainers' who are strategically deployed across Australia in 24 maintenance points of presence. We have Australia's largest pool of broadcast transmission equipment spare parts strategically located at maintenance bases around the country. This is further supported by the availability of spare transmitter and antenna systems.

Range of network technologies

BAI Communications Australia is at the forefront of broadcast transmission. We continuously invest in our people, network, and technology to ensure we are providing exceptional service and anticipating customers' needs. We have the assets, expertise and reach to make communications networks of the future more resilient and effective. Services currently provided in Australia include:

- **Broadcast terrestrial television:** We deliver television services nationally on behalf of ABC, SBS and SCA as well as provide services to commercial broadcasters for the transmission of their services. Our digital terrestrial television network is engineered for performance. Designed and built in-house using best-of-breed technologies it comprises seamlessly integrated digital transmission and RF broadcast equipment operated by a national team.
- **Broadcast radio:** We operate and maintain AM and FM radio services for ABC, SBS and commercial broadcasters across the country
- **Digital broadcast radio:** We deliver ABC and SBS Digital Audio Broadcast (DAB) radio services to the country's major capital cities.
- **Other services:** In addition, we provide site sharing, co-hosting and infrastructure services to the telecommunications, utilities, emergency services and broadcasting industries as well as network design and build capabilities.

Industry leadership – leading the way in Broadcast

BAI Communications Australia has always been at the forefront of embracing the latest trends and generating innovative solutions. For example, in 2001 we were one of the first countries in the world to launch digital terrestrial television broadcast services. We were also at the forefront of global DTV deployments in the early 2000's and pioneered the design of wide area single-frequency networks. Additionally, we worked with industry to specify the ETSI-ratified DAB+ standard for digital radio broadcasting. We then launched on behalf of ABC and SBS a world first DAB+ national broadcaster system in Australia's five largest capital cities. We have also been actively involved in field trials of emerging technologies including datacasting, digital radio, mobile TV and 3D TV. A more recent example of innovation and collaboration is the successful completion of the television industry's next generation DVB-T2 trials that were conducted over a six-month period in 2019. The trials were undertaken to assess the performance and potential of DVB-T2 technology as a possible replacement for the DVB-T standard for digital terrestrial television delivery.

10.2. Additional detail on estimated funding support required for initiatives to harden broadcast sites

10.2.1. Site resilience enhancement initiatives – estimated funding support required

Recommendation	**Dimension**	**Option 1** (ABC Local Radio Sites + BAI sites with emergency services)	**Option 2** (Extension to cover ABC & SBS TV sites)
Asset Protection Zones – High bushfire risk sites Clearance of flora around sites to significantly reduce the likelihood of damage to assets and associated loss of service. Government support required to allow clearance in national parks, third party land etc.	**Scope**	28 Sites	32 sites
	Capital expenditure (A$m)	$2.4m	$1.6m
	Annualised operating expenses (A$m)	$0.2 - $0.3m	$0.2 – $0.3m
	Total funding required over 15 years period (A$m)	**$6.1**	**$4.7m**
Asset Protection Zones – Medium bushfire risk sites Clearance of flora around sites to significantly reduce the likelihood of damage to assets and associated loss of service. Government support required to allow clearance in national parks, third party land etc.	**Scope**	67 Sites	57 Sites
	Capital expenditure (A$m)	$4.4m	$3.1m
	Annualised operating expenses (A$m)	$0.4m - $0.5m	$0.3m - $0.4m
	Total funding required over 15 years period (A$m)	**$11.9m**	**$8.9m**

10.2.2. Standby power enhancement initiatives – estimated funding support required

Recommendation	**Dimension**	**Option 1** (ABC Local Radio Sites + BAI sites with emergency services)	**Option 2** (Extension to cover ABC & SBS TV sites)
Permanent Standby Generators – Diesel/Battery Solutions Deploy standby generators or battery solutions to support on site services without current standby power provisions, allowing services to continue to operate in the event of power failure.	**Scope**	122 Sites	169 Sites
	Capital expenditure (A$m)	$24.4	$33.0
	Annualised operating expenses (A$m)	$0.6m - $0.7m	$0.8 - $0.9m
	Total funding required over 15 years period (A$m)	**$35.0m**	**$47.3m**

10.2.3. Service recovery enhancement initiatives – estimated funding support required

Recommendation	**Dimension**	**Option 1** (ABC Local Radio Sites + BAI sites with emergency services)	**Option 2** (Extension to cover ABC & SBS TV sites)
Rapid Deployment Broadcast Trailers Design, construct and strategically deploy rapid deployment trailers that allow recovery of broadcast services (ABC Local Radio as priority)	**Scope**	4 Trailers	4 Trailers
	Capital expenditure (A$m)	$0.8m	$0.8m
	Annualised operating expenses (A$m)	-	-
	Total funding required over 15 years period (A$m)	**$0.8m**	**$0.8m**
Mobile Generators Procure and strategically locate portable generators across the network that can be deployed to power rapid deployment trailers	**Scope**	2 mobile generators	2 mobile generators
	Capital expenditure (A$m)	$0.1m	$0.1m
	Annualised operating expenses (A$m)	-	-
	Total funding required over 15 years period (A$m)	**$0.1m**	**$0.1m**
Rapid restoration transmitters Procure modern high density compact high power transmitters (FM & TV) and travel cases to allow rapid restoration of services	**Scope**	8 Transmitters	8 Transmitters
	Capital expenditure (A$m)	$0.2	$0.2
	Annualised operating expenses (A$m)	-	-
	Total funding required over 15 years period (A$m)	**$0.2m**	**$0.2m**
Portable Telemetry kit Procurement of satellite system to allow restoration of telemetry services during emergency events – allowing monitoring and control	**Scope**	2 kits	2 kits
	Capital expenditure (A$m)	$0.1	$0.1m
	Annualised operating expenses (A$m)	-	-
	Total funding required over 15 years period (A$m)	**$0.1m**	**$0.1m**

10.2.4. Service continuity enhancement initiatives – estimated funding support required

Recommendation	**Dimension**	**Option 1** (ABC Local Radio Sites + BAI sites with emergency services)	**Option 2** (Extension to cover ABC & SBS TV sites)
Service input diversity - Local Radio Satellite Facilities Deploy fixed low cost satellite receive equipment to support local radio services via emergency satellite feed when terrestrial inputs fail (where not already present)	**Scope**	71 Systems	N/A
	Capital expenditure (A$m)	$1.3m	N/A
	Annualised operating expenses (A$m)	-	N/A
	Total funding required over 15 years period (A$m)	**$1.3m**	N/A
Site Monitoring Diversity – Local Radio Satellite Facilities Where possible, provide satellite redundancy capability for service monitoring connections to site to retain ability to confirm services to air, and retain control of site	**Scope**	239 Systems	N/A
	Capital expenditure (A$m)	$4.8m	N/A
	Annualised operating expenses (A$m)	$0.5 - $0.6m	N/A
	Total funding required over 15 years period (A$m)	**$14.7m**	N/A
FM Transmitter Redundancy – Low Power Local Radio Deploy 1+1 transmitter systems for all FM Local Radio services without automatic or remote N+1 capability to allow automatic recovery of service in the event of primary transmitter failure	**Scope**	150 Systems	N/A
	Capital expenditure (A$m)	$9.3	N/A
	Annualised operating expenses (A$m)	-	N/A
	Total funding required over 15 years period (A$m)	**$9.3m**	N/A