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ALLIANCE LTD

INDUSTRY GUIDANCE NOTE (IGN 023)

TELECOMMUNICATIONS NETWORK MANAGEMENT – ENERGY SUPPLY

Telecommunications Network Management – Energy Supply Industry Guidance Note IGN 023

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VERSION HISTORY

This document constitutes: Version 1 of Industry Guidance Note IGN 023

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1 BACKGROUND

The Communications Resilience Administration Industry Group within Communications Alliance has developed this Industry Guidance Note to facilitate efficient interactions between the telecommunications industry, energy suppliers and relevant Australian Government agencies regarding the types of energy supplies used within networks for general network management.

This information can also assist in facilitating clearer discussions between Australian Government agencies, energy suppliers and telecommunications providers in the planning, management and response to a disaster or emergency event(s).

In the bushfires of the summer of 2019/2020, by far the greatest cause of loss of mobile service was the loss of mains power supply to either mobile base stations or to transmission hubs supplying backhaul to the base station.

The Australian Communications and Media Authority's review into the impacts of the 2019-2020 bushfires on the telecommunications network found that, of 888 telecommunication outages observed between December 2019 and January 2020, 779 – or 88% – were caused by mains power outages. In comparison, fire damage accounted for only one per cent of telecommunications outages.[1]

During the floods in northern rivers area of New South Wales and in Southeast Queensland in 2022 there was loss of equipment due to flooding, however the largest impact arose from loss of power supply and inability to access sites to provide standby power capability. Usually due to washed away roads and/or bridges and the only access, where possible, being by small boats. In some cases, in metropolitan areas there was no ability to provide standby power as the infrastructure was located on the roof of tall buildings with no ability to have a generator on the roof, and a range of factors limiting an ability to have a generator power supply at ground level.

In times of disaster many factors come into play when assessing the impact of loss of power and how to manage each situation is highly variable.

2 OBJECTIVE OF THIS GUIDANCE NOTE

The objective of this Guideline is to provide interested parties with information relating to the power arrangements in place for supplying telecommunications services. It is not intended to be exhaustive of all power supply arrangements but is to be used as tool to broaden general knowledge about the powering of telecommunications services, and some of the considerations that service providers consider when looking at options for managing the risk of loss of power and practical solutions to remedy loss of power and to improve network resilience against loss of power.

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[1] Royal Commission into National Natural Disaster Arrangements Report 28 October 2020

3 TELECOMMUNICATION DISRUPTIONS ARE USUALLY RELATED TO POWER

Telecommunications networks generally rely on the ready availability of a local mains power supply. Especially with the number of connections in excess of 50,000 across Australia.

During a disaster event the loss of power is often the first casualty, and this loss of power is the principal contributor to loss of telecommunications capability.

Figure 1 below presents a simplified illustration of events that cause telecommunication disruptions, their frequency, and the scale of impact that can be associated with these. As shown, most outages are caused by a failure of supporting infrastructure — primarily mains power —with physical damage from natural disasters also an issue. Sometimes failures with supporting infrastructure overlap with a natural disaster and escalate into a 'mass disruption event' where higher levels of outages and impact occur. The bushfires of the 2019/20 Australian summer are one example of a mass disruption event.

This Industry Guidance Note outlines how the telecommunications industry prepares for service disruptions that are related to power. The topology of telecommunication networks and the power requirements of telecommunications infrastructure are relevant to this undertaking, so these issues are considered before an overview of the industry approach to the provision of back-up power sources.

While back-up power sources can be helpful for mitigating the impacts of short duration power outages, this IGN also highlights the practical limitations of back-up power options and explains why they cannot compensate for all disruption scenarios.

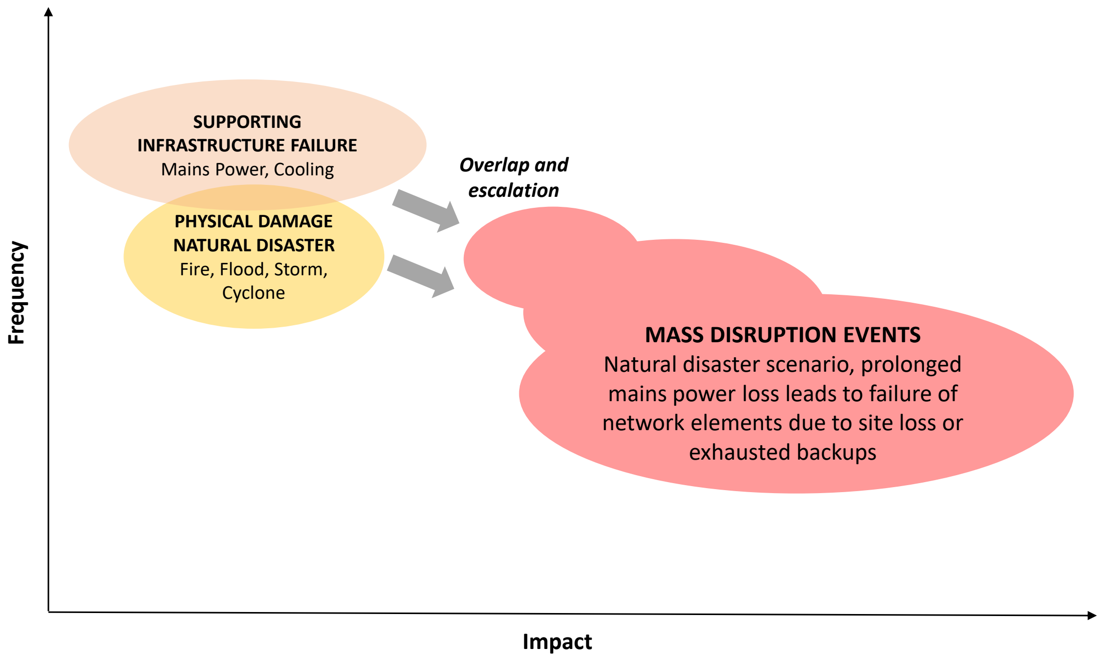

FIGURE 1

Simplified view of events causing telecommunications outages, with frequency and scale of impact

4 FACTORS RELEVANT TO PREPARING FOR, AND MANAGING, POWER OUTAGES

Two factors highly relevant to preparing for, and managing, power outages are network topology and the power requirements of telecommunications infrastructure.

4.1 Network topology

Telecommunication networks — constituting infrastructure such as exchanges, repeaters, optical fibre links and towers (supporting both mobile and fixed wireless) — span much of Australia.

Figure 2 shows the basis topology of a telecommunications network. In general, the infrastructure is similar in metro and regional areas — towers (mobile base stations for example) are connected back to repeaters, then exchanges, which are usually connected to one another via multiple fibre paths for the purposes of redundancy (that is, if one fibre path is disrupted, traffic can be routed around that). These connections are usually optical fibre but can also be via microwave radio hops (or satellite), especially in more remote areas.

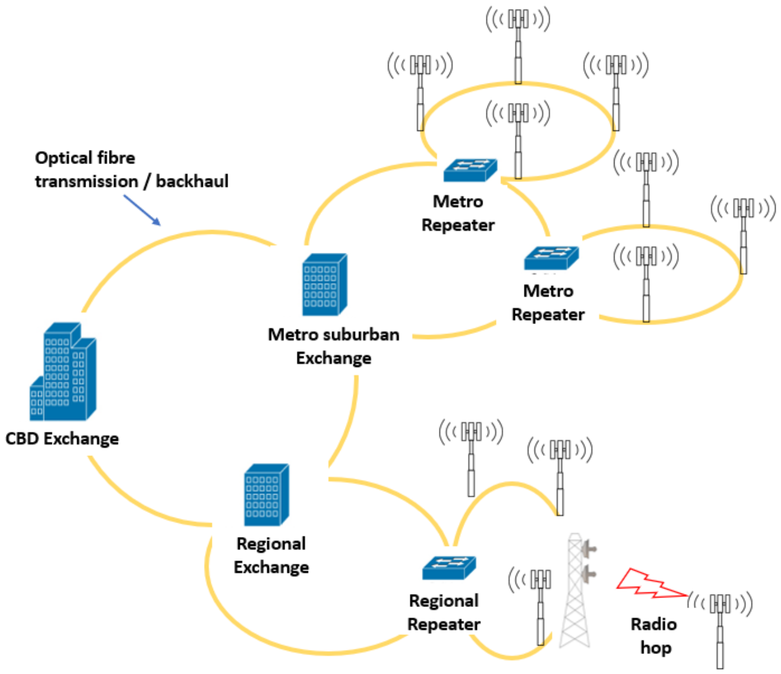

FIGURE 2

Basic topology of a telecommunications network

The two key callouts with respect to Figure 2 are:

- In regional areas, there may not be any backhaul redundancy (i.e., there is only one fibre link, not two on different paths) between a tower and the nearest repeater — such fibre links are called 'spurs' because they branch off the main transmission ring, and in some cases, there may be multiple towers along a given spur; and
- Each type of telecommunication infrastructure shown requires power, preferably mains. While there is often redundancy in the mains power supporting infrastructure in metro areas and regional exchanges, this — due to the topology of power distribution networks, which don't necessarily match the topology of

telecommunication networks — is generally not the case for towers which support service provision in regional areas.

The two callouts above mean the risk of telecommunication service disruptions is greater in regional areas compared to metro areas, because there is comparatively less redundancy coupled with the very long distances over which power lines traverse in the power infrastructure which supports regional areas.

4.2 Power requirements of telecommunications infrastructure

Telecommunications infrastructure requires a lot of power to operate.

In general, the various types of infrastructure shown in Figure 2 will have mains power.

The average power consumption at regional mobile base stations ranges between 5 and 12.5 kW, covering the radio equipment (3G/4G/5G), cooling equipment and local transmission equipment. This upper level of power draw is equal to 300kW hours a day, when the average home uses 20 kW hours a day — put another way, running a regional mobile base station is equivalent to running 15 family homes or running 62 large family refrigerators 24/7 (~200W each).

At larger sites, where there could be exchange equipment or major microwave radio links, the power needs will be above the average listed above.

In regional areas there is rarely diversity in the mains power supply, so operators install power backups such as batteries and generators to support continued operation of the site and local transmission equipment should the mains power be interrupted. While back-up power options are also used metro areas, these mainly cater for short duration outages, noting natural disasters and mass disruption events tend to be more prevalent in regional areas.

5 INDUSTRY APPROACH TO BACK-UP POWER PROVISION

There are several considerations which network operators consider in the provision of back-up power options.

The main options for back-up power supply to telecommunications network infrastructure are batteries and generators.

Batteries are typically the most cost-effective approach, but beyond certain levels of reserve — site dependent — generators can become more cost-effective. It is important to note, however, that all back-up power options have their limitations, and none are a perfect solution for outages to the mains power network.

5.1 Batteries

Key points:

- Batteries are intended to cover short-duration outages of mains power, with most batteries having a reserve of between 1 and 12 hours.
- The large power requirements of mobile network base stations limit the practical amount of battery reserve.
- Batteries are expensive, and their installation or expansion can require the establishment of additional huts or shelters, which adds further costs.
- In some circumstances, such as a regional site in a natural disaster-prone location, the use of a 12-hour battery is appropriate but exceeding this is generally impractical.
- In addition to the cost of batteries and associated structures, other factors limit the extent and efficacy of battery backup deployed, including:
    - Space – at some locations there is no extra space available, due to topological factors or the sensitivity of the location (i.e., National Parks).
    - Short lifecycles – batteries have a relatively short lifetime of 7-10 years. This means there are continual battery replacement program already, and with increasing demand the number of batteries required at a site to sustain target levels of reserve also trends upwards with time.
    - Battery requirements can vary by site – larger sites and/or the presence of additional equipment means greater power needs, and therefore require more batteries than smaller sites for any target level of battery reserve.
    - Wider network dependencies – loss of an upstream repeater or exchange due to physical damage (fire, flood) disrupting transmission back to the core network.
    - An Extended battery may provide extended DC power, but some site cooling solutions are only AC power so there is a risk of equipment failing due to temperatures increasing in equipment shelters.
- If battery backup were to be increased to 24 hours, an additional equipment hut would often be required to accommodate batteries – see Figure 3. In most cases, the additional hut would require a major site redesign, and in many locations, there would simply be insufficient space to accommodate an extra hut.

FIGURE 3

Conceptual Regional Mobile Base Station with additional Equipment Hut to house extra batteries for 24 hours of backup power

- Even when battery back-ups are installed, they may be of little or no use (irrespective of how long their reserve is) if there is either:
  - A power outage which impacts upstream infrastructure such as a repeater – due to Australia's large geography it is not uncommon for fibre spurs to branch off main transmission rings in regional areas for considerable distances, connecting a line of towers. If an upstream repeater loses power and exhausts its backup, all sites downstream will be impacted irrespective of whether they have back-up, and the reserve of any back-ups. See Figure 4 for an illustration of this scenario.

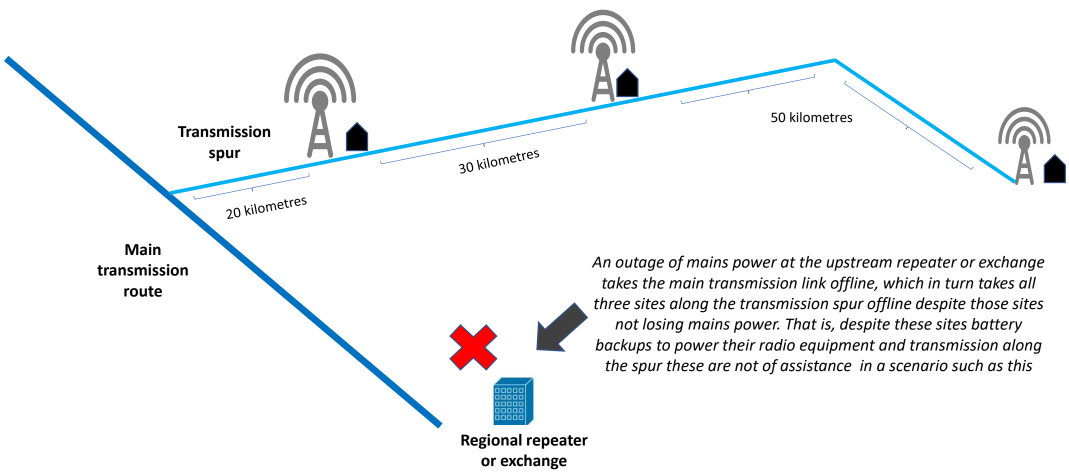

FIGURE 4

Illustrative example of an upstream power outage impacting sites many kilometres away

- A natural disaster, such as an intense bushfire, that significantly damages mobile network infrastructure — where this occurs, that infrastructure will not work irrespective of how much back up power may have been installed – see Figure 5.

FIGURE 5

Fire damaged mobile network equipment (left - Mt Torrens SA, right – Surf Beach NSW)

- Floods can also damage network infrastructure, with water ingress very damaging for electronic equipment. Slippages caused by heavy rain and floods can also expose below-ground fibre assets and in some cases break the fibre links which support mobile connectivity in a given area – see Figure 6.

FIGURE 6

Flood damaged mobile network equipment (left – Fairfield Gardens Brisbane, right – damaged fibre lines alongside a washed-out bridge (white pipes), NSW/QLD border region)

- A Mass Disruption event – the outcome of most natural disasters, almost always involves the loss of the mains power, which progressively overwhelms telecommunication network infrastructure and creates snowballing problems. Where backup options are depleted network elements fail, and this can bring additional delays in recovery due to an increasing number of hardware replacements and/or physical onsite resets in order to bring some equipment back online, and complete mains power recovery. Mass Disruption / Emergency events are often also impacted by the HS&E considerations, with field staff not being permitted any physical access to sites until emergency conditions subside. For example, the flood events of early 2022 prevented site access at some locations for more than a week, with access often informing the requirements for replacement parts, which in turn need to be sourced and transported.

5.2 Generators

- Permanent (on-site) generators are typically more expensive to install, maintain and operate than batteries, especially where outage durations tend to be short term in nature.
- Portable generators are often used as temporary backups during power outages when battery reserves become depleted due to cost and other practical considerations around their use.
- Some of the practical considerations around the use of generators (permanent and portable) include:
  - They are difficult to test properly, as this requires a load (which generally means no mains power);
  - Generators require periodic maintenance, whereas batteries are more ‘light touch’ once installed;
  - They have limited fuel storage, meaning they can only operate a given period of time before they need re-fuelling;
  - If a permanent generator is called upon for a short-term outage, this will reduce the fuel available for the next outage unless a re-fuel occurs — indeed, it can be difficult to know exactly how much fuel is in generator (and therefore how long it will last) unless a site visit occurs and the generator is checked;
  - In some cases, refuelling may not be possible during or immediately after an emergency event/natural disaster;
  - For permanent generators, fuel storage increases the fire risk-rating for a site. and can be accompanied by environmental spill concerns, and a carbon footprint; and
  - Both portable and permanent generators create a significant threat to the availability of the network outside of an emergency event as they can be a target for theft (the actual units themselves), as can the fuel stored with them.
  - Not all sites are suitable for generator installation (e.g., rooftops) and similarly it is not always possible to have power supply generation at street level to a rooftop site due to a number of safety considerations.
- One initiative currently being trialled is the use of an external ‘Auto Transfer Switch’. These allow for generators, usually as a supplementary backup, to be

plugged into the asset and started straightaway to prolong the operation of that site in the absence of mains power restoration - see Figure 7.

FIGURE 7
An Auto Transfer Switch installed in Victoria

- Another initiative that is being deployed is the Hybrid Power Cubes (HPCs) which are solutions utilising solar, battery and fossil fuel to supply up to six months of backup power for critical fixed wireless sites – see Figure 8.

FIGURE 8
Hybrid Power Cubes

6 OFF GRID, STAND-ALONE POWER SUPPLY SYSTEMS

An off-grid, or stand-alone power system (SPS), may be deployed for telecommunications infrastructure where:

- The site is very remote or within a location such as a National Park – for example, see the Mt Terrible site shown in Figure 9.

FIGURE 9
Solar panels at Telstra's off-grid Mt Terrible (Vic) site

- Local mains power infrastructure has known reliability issues, and instead of maintaining that and responding to outages as they arise it is more cost effective to have a stand-alone power system – for example, see the Mt Ney off-grid mobile site with stand-alone power solution, as shown in Figure 10, which was funded by the WA government through Horizon Power.
- The site is suitable for this type of solution*.

While some type of back up will usually exist at sites with stand-alone power systems these — as per section 5 — are never capable of being a full replacement for the primary power supply.

*Factors for site suitability include physical location, local topography, heritage or other sensitivity considerations for that location, security arrangements to protect against vandalism and/or theft, etc.

FIGURE 10
Close up of off-grid Mobile Base Station at Mt Ney, east of Esperance in WA

- Sufficient physical space at a given site is often the primary constraint in most locations. 330 W solar panels are ~2 x 1 m (2m^2) each. 24 panels at 45° inclination has a minimum footprint[2] of 24 x 1.4m — at the Mt Terrible site above for example, all of the space available for the site has been fully utilised and there is no room for any additional back-up to be installed.
- The regional mobile base station at Mt Ney[3] is powered by 8 kW of solar panels (24 panels @330W ea.), a 16.8kW hour battery and a 26kW back-up generator.

Edge and Regional Data Centres

The emergence of Edge and regional Data Centres will need to be considered in any planning to enable the critical digital infrastructure to continue to operate throughout any disaster. They are providing the ability to locally process data in a secure and resilient manner to further support the growth of regional environments.

The edge sites remain just as important, given they will be in support of business operations such as manufacturing, remote mining, Autonomous Vehicles, 5G, LTE, Critical Comms Networks, cloud access.

When major incidents occur, these assets are what will provide support to the communications industry and enable the emergency services and other agencies to support our communities during times of disaster. This has been evident during the recent Global Pandemic and the role that data centres played supporting the ability for remote work to keep the economy functioning.

For the remote sites there is an ongoing program of work on several sustainable power options, with solar and battery storage one of the main provider lead solutions we are looking at.

Whilst most environments will have off grid, stand-alone power supply systems in the case of an emergency, the overall ongoing sustainability of communities during a disaster is access to regulated fuel supplies. There may be fuel supplies on site, however, should

these be diminished for whatever reason, access to centralised depots could continue to ensure critical communication networks remain active.

2 Panels cannot be placed *immediately* behind each other (to prevent shading), such that a gap of a metre or more is required between consecutive rows of panels.

3 https://www.horizonpower.com.au/about-us/news--announcements/horizon-power-bolsters-telstra-network-resiliency/

7 SUMMARY - TELECOMMUNICATIONS INDUSTRY RESPONSE IN TIMES OF NATURAL DISASTER

The telecommunications industry understands how indispensable communications services are during natural disasters and at times of crisis. We continue to work closely with emergency service operations centres at all such times, to closely monitor and manage telecommunications networks to the best extent possible under the situation.

As this IGN demonstrates, mains power supply to the entire path of telecommunications is critical for telecommunication providers to operate their networks – backup power including batteries and generators can only assist in certain cases and for limited time periods. Information flows between energy providers and telecommunications providers allows telecommunications providers to better manage and predict disruptions to their networks, and to coordinate the deployment of limited resources across their networks.

For example, timely access to information regarding power status, plans to de-energise parts of the power network, or power restoration priorities during bushfire events can avoid wasted effort transporting and connecting a generator at a site just as power resumes, including avoiding tying up emergency service organisation resources in providing escorts into affected areas.

The telecommunications industry stands ready to respond to natural disasters and crises, and we look forward to working closely with emergency service organisations and energy suppliers to share information concerning telecommunications networks and electricity mains-supply during incidents, to closely coordinate resilience and restoration activities.

Communications Alliance was formed in 1997 to provide a unified voice for the Australian communications industry and to lead it into the next generation of converging networks, technologies and services.

In pursuing its goals, Communications Alliance offers a forum for the industry to make coherent and constructive contributions to policy development and debate.

Communications Alliance seeks to facilitate open, effective and ethical competition between service providers while ensuring efficient, safe operation of networks, the provision of innovative services and the enhancement of consumer outcomes.

It is committed to the achievement of the policy objective of the *Telecommunications Act 1997* - the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry.

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