Comments – Possible amendments to the Telecommunications in New Developments Policy – Mobile Connectivity and Other Measures

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1 COMMENTER's DETAILS

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2 ORGANISATIONAL CAPABILITY AND CAPACITY

Powertec is a national wireless technology company established in 1995. The company comprises a team of over 80 permanent staff, supported by a network of over 100 telecommunications field contractors, and over 1000 local distributors, installers, and dealers spanning Australia, New Zealand, Pacific Islands, Thailand, and Bangladesh.

Powertec is the world's largest distributor of Nextivity Cel-Fi repeaters, having sold more than 200,000 units to homes, businesses and mobile operators including first responders. Our expertise is in providing Cellular connectivity to people who have no coverage to which we have connected so many, who without our technology would not have usable phone signals or data.

Powertec's extensive capabilities encompass everything a wireless project requires, including communications towers, solar systems, microwave links, long range antennas, sensors, and modems. Strategic partnerships with wireless vendors, mobile network operators, and IoT providers coupled with its national network of field technicians allows Powertec to deliver truly turn-key wireless and communication systems.

With a company history spanning almost 3 decades, Powertec's engineering success is built on a solid administrative foundation. The company operates an industry-leading Enterprise Resource Planning suite, along with CRM and technical support ticketing systems. Powertec is ISO 9001, ISO 14001, and AS/NZS 4801 certified.

OBSEQUENTIA
QUALITY CERTIFIED
ISO 9001:2015

OBSEQUENTIA
ENVIRONMENT CERTIFIED
ISO 14001:2015

OBSEQUENTIA
SAFETY CERTIFIED
AS/NZS 4801:2001

3 SCOPE

The purpose of this document is to respond to the Department of Infrastructure, Transport, Regional Development, Communications and the Arts' Consultation Paper *"Possible amendments to the Telecommunications in New Developments Policy – Mobile Connectivity and Other Measures"*. The Consultation Paper seeks comments from the industry and interested parties.

Powertec intends to use this Request for Comment to convey our and industry views on various solutions, cascading from the simplest to the more complex.

3.1 EXTERNAL DOCUMENTS & STANDARDS

[1] None

4 DEFINITIONS, SYMBOLS, AND ABBREVIATIONS

4.1.1 Definitions

Not in use.

4.1.2 Symbols

Not in use.

4.1.3 Acronyms and abbreviations

For the purposes of the present document, the following acronyms and abbreviations apply.

ACMA	Australian Communications and Media Authority
CSP	Carriage Service Provider
LEO	Low Earth Orbit
MPN	Mobile Private Network
NCM	National Coverage Map
NTN	Non-Terrestrial Network
RFC	Request for Comment
RSRP	Reference Signal Receive Power
RSSI	Receive Signal Strength Indicator
SDR	Software Defined Radio
VoWiFi	Voice over WiFi

5 OVERVIEW OF CARRIER INDEPENDENT CONNECTIVITY

Cellular connectivity to new developments is a constant challenge. Consumers believe that once they have paid their Mobile subscription, it's up to the carriers to give them usable signals in their homes, cars and offices, however, the Carriers who are faced with increasing competition at ever lowering costs, struggle to maintain the costs of operating towers and the justification in providing new towers in areas with few subscribers.

Telstra is generally the provider of choice for people outside of Metro areas, despite Optus spending billions improving their regional connectivity, TPG is seldom chosen for regional users and the emerging 4th Telco FSG is focussed on regional black spots. Carriers, despite having received substantial amounts for black spot funding have done little to provide further connectivity as the regions are so vast and spending >$1M on a tower plus operating costs to serve a few hundred consumers with a low consumer spend across different carriers does not make economic sense.

Today, both mobile and data connectivity can be provided anywhere and everywhere independent of Carrier Points of Presence.

Below is an overview of the technologies available to developers' selling properties without direct mobile tower coverage.

5.1 CELLULAR REPEATERS

Cellular 4G-5G Repeaters are a technology that has been available in Australia since 2014 when Powertec first introduced the Cel-Fi. Cel-Fi remains the only legal repeater due to its unique mechanism of operation, leading to its approval on all three of Australia's mobile networks. Cel-Fi is a network-aware 'intelligent' repeater capable of self-organising and self-configuring by listening, and responding, to control messages from the mobile network. Its technology is dramatically different to 'wideband' repeaters of yesteryear which blindly boosted an entire frequency band regardless of the networks or sources of interference present between its start and stop frequencies.

Today, Powertec has provided more than 200,000 repeaters to Australian families and businesses.

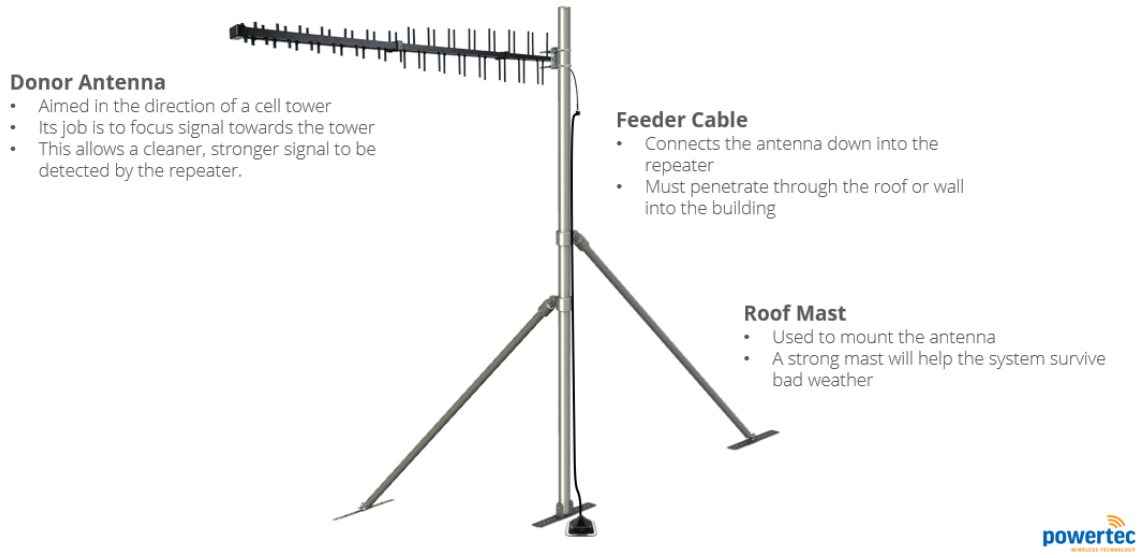

Figure 1 – Equipment on roof

Figure 2 - Equipment inside house

5.1.1 How Cel-Fi works

With a guaranteed interference-free mechanism of operation, Cel-Fi is used across the country to boost Telstra, Optus, and Vodafone signal up to full strength in vehicles, houses, large buildings, and outdoor areas. In order to do so, it requires an input signal from the local cell tower. A signal can be detected to about as weak as about -121 dBm RSRP, which in more familiar terms is a signal level of 'zero bars' on a mobile phone. The repeater is connected to an antenna, called the Donor Antenna, mounted on the roof of a building or vehicle, which aids in improving the strength and quality of the input signal by as much as the stated antenna gain (if correctly aligned) plus about 1 dB per additional metre of height, and adding back any signal that would be absorbed by a building's walls or the vehicle itself. An antenna located inside the building or vehicle, called the Service Antenna, outputs the boosted signal.

Cel-Fi identifies the control messaging from the mobile network and configures itself for the most optimal frequency band. An amplifier then adds up to 100 dB of system gain, up to a maximum downlink RSSI of +20 dBm for the G41 Cel-Fi, or maximum RSSI of +0 dBm for the R41 vehicle repeater. It's an important technical note to clarify the difference between RSSI and RSRP – all values for the Cel-Fi are based on RSSI and not RSRP, as such the conducted RSRP is typically 30 to 35 dB lower than the observed RSSI. Hence the RSRP at the service antenna interface is typically a maximum of -10 to -15 dBm, which is important in understanding the coverage radius of the repeater. When signal quality degrades, the coverage radius will shrink due to a greater difference between the RSSI and RSRP values. Accordingly, correct design is essential in achieving maximum coverage range.

In its ordinary configuration, Cel-Fi can provide enough coverage to service an entire home. When installed as part of an In-Building Coverage system, solutions can be developed to cover buildings as large as four storeys. When installed outdoors coverage can be output between 300 metres and one kilometre, depending on the quality of input signal and shape of service antenna.

5.1.2 How locations are qualified

In order to determine whether a location will benefit from a Cel-Fi, Powertec developed a National Coverage Map (NCM), understood to be the only one of its kind. NCM consists of a high resolution nationwide 3D model of Telstra, Optus, and Vodafone signal strength, data speeds, and best serving tower.

Importantly, this model factors in the most up-to-date available terrain, vegetation, buildings, population data, and cell tower configurations. The propagation models used to determine how well each frequency band travels across land and penetrates vegetation and buildings have been tuned from thousands of kilometres of drive-testing across Australia.

We suggest that the NCM be used by developers, real estate agents and prospective buyers as the NCM will provide real coverage statistics and prove without a site survey the likely signal inside the dwelling not hypothetically floating over the roof of the dwelling which current coverage maps provide. This will also qualify a development as to whether inexpensive individual Cel-Fi carrier switchable repeaters will work, or a more complex whole estate solution is required for Cellular connectivity.

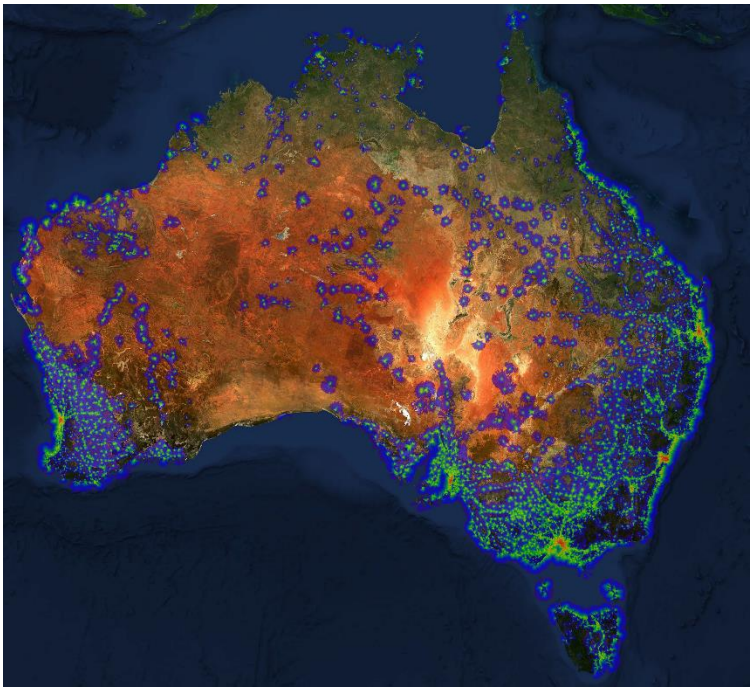

Figure 3 - Nationwide Telstra RSRP

This tool allows Powertec staff and its licenced users to log in and perform address searches to determine the cause of poor 4G and 5G signal facing a user, and what type of cellular solution would be most appropriate.

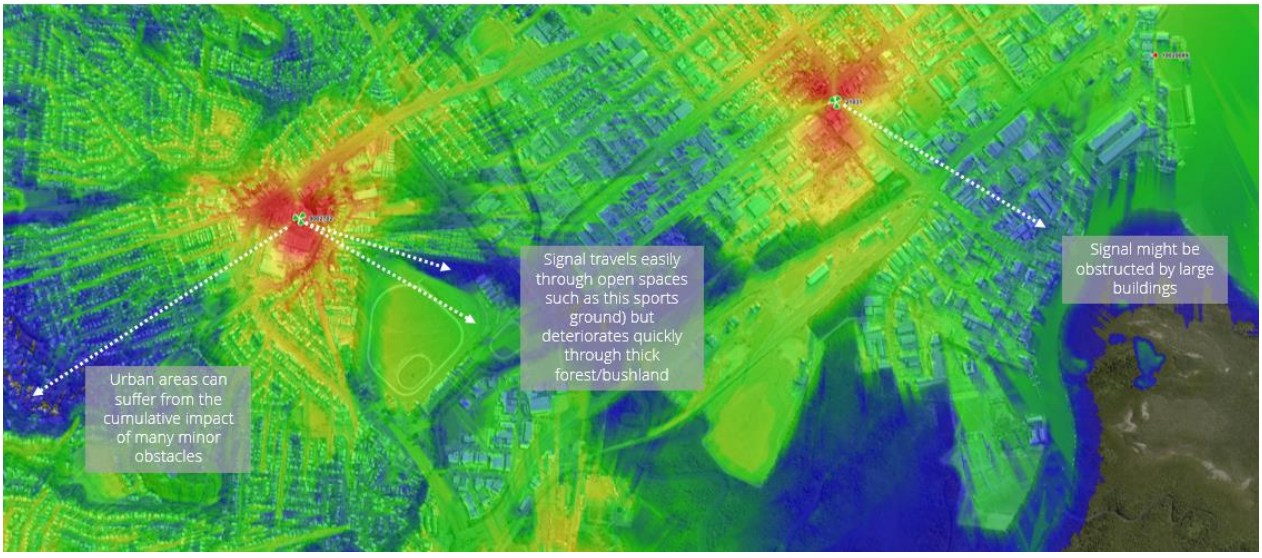

Figure 4 - Causes of poor 5G signal in Cairns urban environment

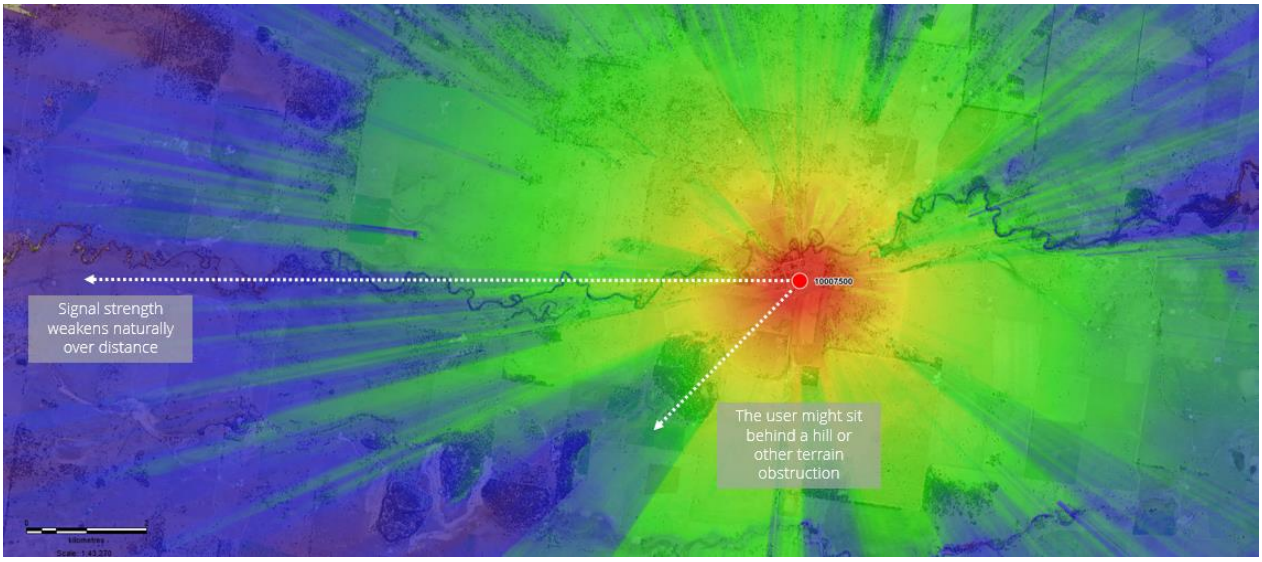

Figure 5 - Causes of poor Telstra 700 MHz in a regional town

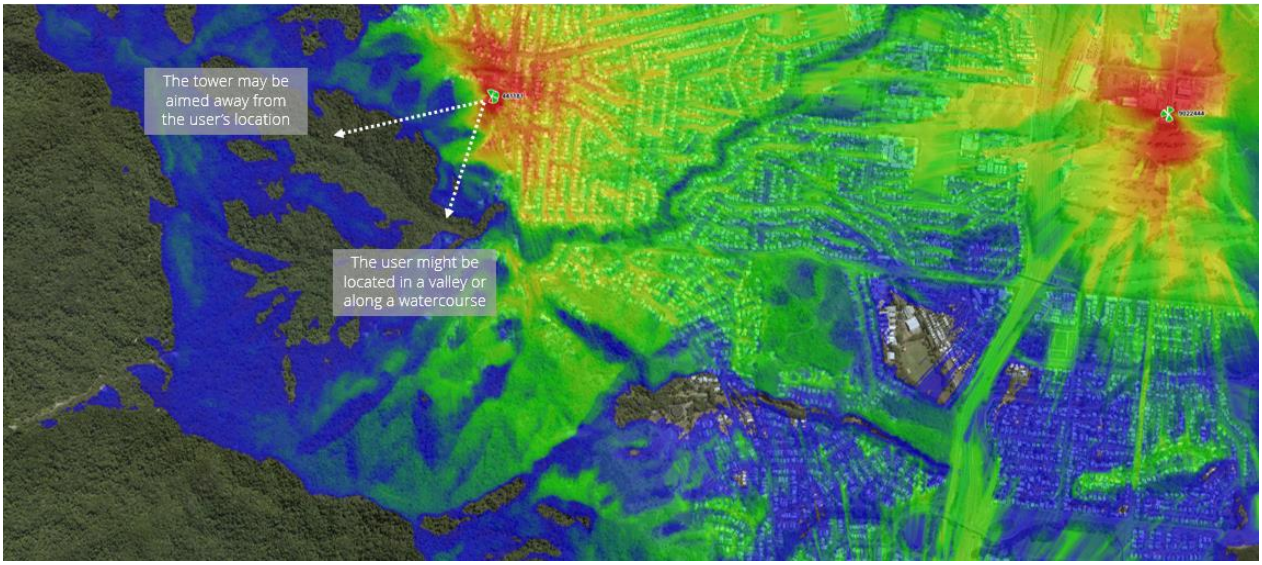

Figure 6 - Causes of poor 5G signal in hilly and forested areas

Once the root cause of the issue is identified, determining the correct solution is straight forward. This is of course on the basis that sufficient input signal is available. In the below case, a reliable solution may not be possible at this location without considerable effort and complexity, all which carries a cost. Accordingly, it is necessary to explore alternative technologies to service the location.

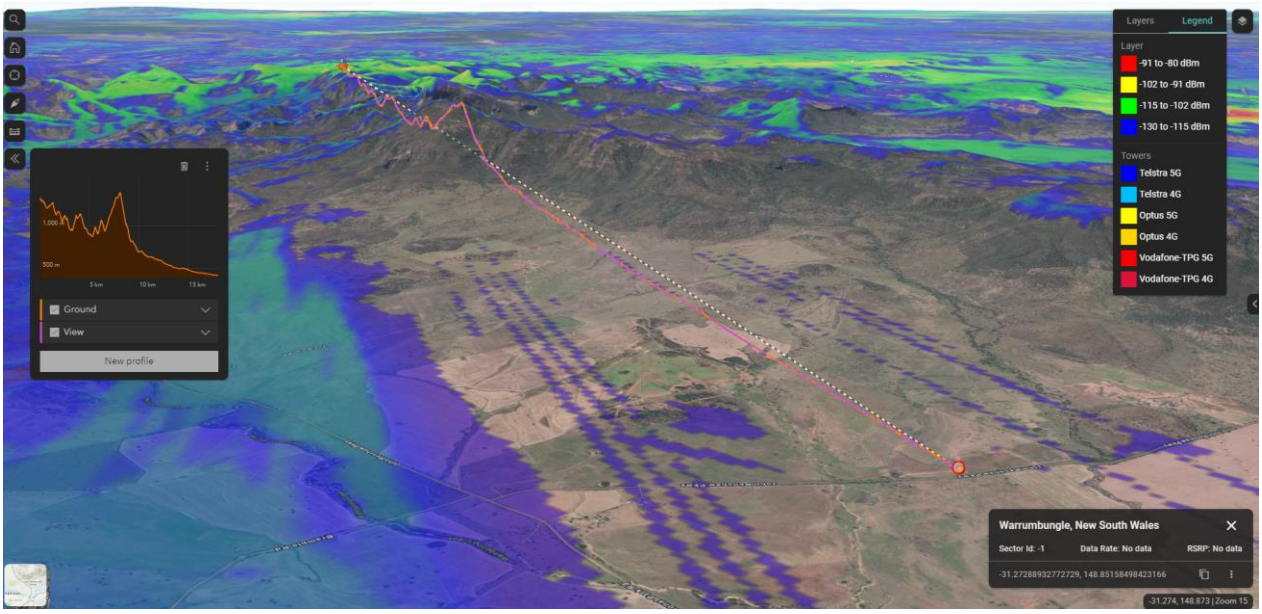

Figure 7 - Location where sufficient signal is unavailable due to terrain and vegetation obstruction

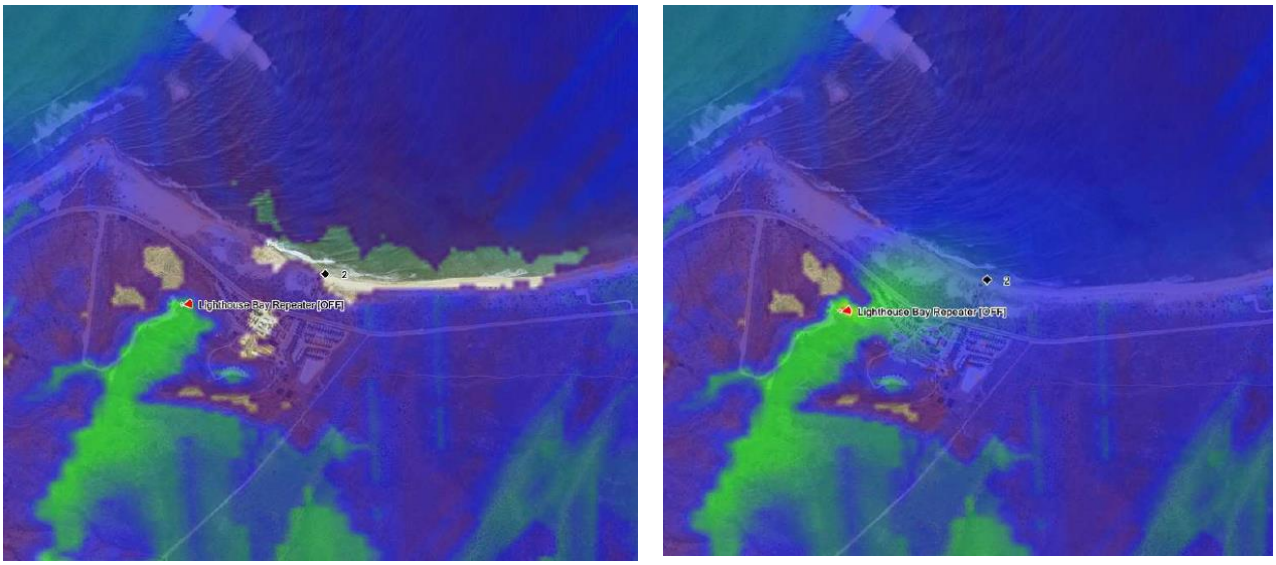

Figure 8 - Before and after using Cel-Fi to infill blackspot caused by sand dunes

Repeater technology cannot be used to solve connectivity challenges in all situations. Cel-Fi requires an input signal, where no input signal is available the technology is of no use. The natural question to be explored is how can an input signal be provided in areas with no existing coverage. With the availability of global internet connectivity through Low Earth Orbit, an opportunity is present to create new coverage which will be discussed further in Mobile Private Networks.

Repeaters and associated antennas should be considered highly valuable to the TIND Policy as they represent the most common means of improving residential connectivity due to their modest pricing. A portfolio of Carrier switchable repeater and antenna products, or pre-defined ‘packages’ could be made available for simple deployment by developers and/or their clients.

5.2 LOW EARTH ORBIT

Low Earth Orbit (LEO) are a class of wireless technologies which make use of non-stationary satellite constellations which provide faster connectivity and lower latency (delay) due to their much closer proximity to the earth. LEO constellations typically operate between 500 and 2000 km from the earth's surface. Contrasted to geostationary services like NBN Satellite which operate at around 36,000 km, leading to performance being capped by the fundamental laws of physics.

LEO constellations are able to provide a wide range of technology solutions, including broadband internet popularised by Starlink, IoT sensor connectivity, and even 4G-5G mobile voice, text, and data to users who have line of sight (I.E. outdoors), meaning that a repeater is still required in a structure with a roof to receive signal or another Open RAN style of broadcasting in the vicinity to radiate mobile signals into premises.

5.2.1 LEO Broadband

Starlink has revolutionised connectivity to the broader remote/regional communities. As far as Powertec is concerned, the remote internet connectivity challenge is solved. High speed data connectivity can be achieved anywhere, both stationary and vehicular assets, and to a level comparable to that of most urban areas.

Currently, Starlink provides internet access using a mmWave frequency band (Ku and Ka, 12 and 18 GHz respectively) to communicate with fixed User Terminals (UTs). These UTs require clear unobstructed view of the sky and use phased-array antennas to track multiple Starlink satellites simultaneously without motorised adjustment.

The UT is set up simply by placing it outside with a view of the sky. No installation or configuration is required. Starlink is the simplest and lowest cost means of providing high speed internet to areas with not terrestrial connection.

Starlink has announced its intentions to expand connectivity to ordinary mobile handsets by provision of a 2 GHz cellular network operated from its constellation. This will be discussed further in LEO NTN section.

Presently however, mobile voice and text services are still available anywhere in Australia courtesy of VoWiFi technology enabled by the country's mobile network operators. VoWiFi allows any compatible handset to operate as though it were connected to a 4G network except using the phone's WiFi connection.

Combining Starlink with a WiFi Mesh Network is a simple means of extending mobile voice and high-speed data across Houses. VoWiFi mobile services can be propagated across even complex point to multipoint networks, allowing the creation of even very large networks across large geographical areas.

Figure 9 – Starlink + WiFi covering 250 m radius with voice, text, and data services

In the above example, Starlink provided Telstra/Optus/Vodafone voice, text, and data services using VoWiFi, by connecting through a central highpoint which using a Cambium multipoint radio distributed connectivity down to each paddock where a receiving dish and WiFi access point provided coverage within about a 250 metre radius from the station. A 12 Vdc solar system was used to power the equipment.

The limit of this technology however is that establishing large scale networks is a fundamentally complex process. While lower cost from an OPEX perspective, the steep learning curve may lead the clients in areas with no NBN to bypass the construction of multipoint networks and simply deploy a large quantity of Starlink units.

5.2.2 LEO Non-Terrestrial Networks

One of the most exciting advances in LEO technology is the development of cellular Non-Terrestrial Networks. These networks can be thought simply of a constellation of cell towers in orbit providing ordinary 4G-5G connectivity to ordinary smartphones and modems.

While there are several LEO companies developing these networks, the two more advanced of which are Starlink and AST SpaceMobile.

Starlink intends on using its existing Gen2 satellite design to provide 4G mobile voice and text services over the 2 GHz band (currently LTE Band 25 in USA during its initial test phase). Starlink expect to provide global voice and text messaging services, data speeds however will be extremely limited with the technology only capable of providing a maximum of 4.4 Mb/s DL & 3.0 Mb/s UL for areas with a 1.4 MHz channel, and 18.3 Mb/s DL & 7.2 Mb/s UL for areas with a 5 MHz channel. These data speeds however are shared between all users within the cell radius, which is currently estimated to be about 20 km from FCC filings.

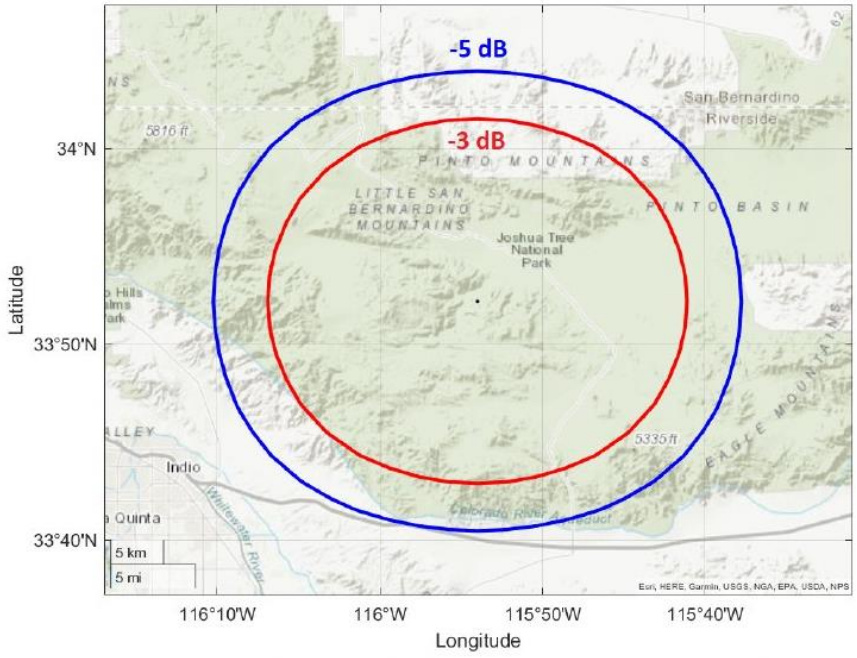

Figure 10 - Starlink 2 GHz Cell Radius

Accordingly, Starlink is expected to provide global 4G voice and text services, internet services however are expected to be of equivalent quality to 2G and early 3G networks. The timeline for coverage from +58 to -58 degrees (i.e., excluding the earth's most northern and southern regions) is reported to be mid-2024.

By establishing a roaming agreement, Starlink's 4G NTN enables network operators to provide near 100% geographical coverage while simultaneously divesting from poor performing regional infrastructure such as towers operated at a financial loss. Accordingly, it is expected that Australian mobile networks will establish agreements whereby users moving beyond the range of the ordinary Telstra/Optus/Vodafone network will automatically connect to Starlink's network.

A potential competitor to Starlink is AST SpaceMobile who intend on creating global internet connectivity direct to handset through the use of large Massive MIMO arrays. AST's prototype BlueWalker 3, launched in September 2022, is a 64 m^2 (10 metre diameter) satellite which expects to provide speeds as high as 30 Mb/s DL and 3 Mb/s UL direct to ordinary 4G mobile phones and modems using a combination of low and mid-band frequencies.

While AST's technology has the capability of providing superior performance, there are concerns about the company's ability to execute given their reliance on SpaceX to conduct launches on its behalf. With Starlink conducting a continuous stream of generation upgrades and launches it is also unclear whether at some point Starlink may evolve quicker than AST can build a full constellation.

While the future cannot be known, it is clear that ubiquitous mobile voice and data connectivity is well on its way and expected to revolutionise connectivity for regional Australians in a few short years. Accordingly, any recommendations or TIND Policy changes by the Department needs to focus on immediately available technology to address the requirements of new developments rather than awaiting these long-term solutions which will still have many issues including handset power if reaching satellites directly and a clear line of sight being required to function (I.E. No indoor coverage).

5.3 MOBILE PRIVATE NETWORKS (MPN)

Mobile Private Networks are commonly referred to as Private LTE networks. Implementing an MPN involves obtaining a spectrum licence and operating a small-scale mobile network by installing a set of servers which operate as a core network and then one or more 'cell towers' which can be incorporated into "smart poles" in new developments.

MPNs can be built both small and large, which when assessing its suitability for developers Powertec loosely divides into Local MPN and Multi-site MPN based on available budget.

Connection to these networks can be a simple as scanning a QR code to connect an e SIM for local phone connections whilst keeping a physical SIM of your preferred provider for connections outside of the residence.

5.3.1 Multi-site MPN

Multi-site MPN refers to a traditional Private LTE network whereby a core network is built and then several cell towers are deployed. The typical cost to deploy a 4G-5G core network is upwards of $500,000, with the cost per cell tower starting at $150,000. Accordingly, this is largely unaffordable for small developments and as such is a solution more appropriate for larger developments which can share the deployment cost of the core network across a greater number of properties.

Historically, due to unavailability of high speed backhaul this technology was out of reach to areas without NBN. The launch of Starlink's business grade internet services allow cell towers to now be deployed at any arbitrary location, particularly in combination with off-grid power when required.

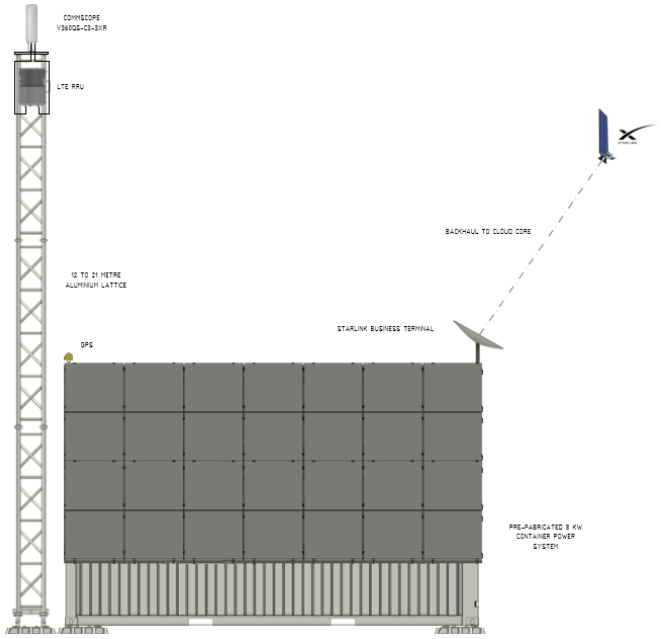

Figure 11 - Typical off-grid MPN site

While the challenges of remote voice and data connectivity are likely to be solved by LEO NTNs in the coming few years, data speeds and latencies will however be restricted by the limitations inherent to communicating with satellites 500 to 2000 km away. As such applications which require higher throughputs are likely to continue requiring MPNs and the technology will grow in relevance to future-focused regional digital consumers and businesses.

As the technology matures MPNs are expected to trend lower in cost over time and demand for mobile data to continue its rapid acceleration, making the technology more in reach of developers over time.

5.3.2 Place-based networks

The third option open to Developers is engaging a partner who has already undertaken the expense of deploying a network core. Companies such as Powertec's partner Field Solutions Group (FSG) specialise in the construction of place-based mobile networks. Under this type of arrangement Powertec and FSG arrange all licencing and construct one or more cell towers (or smart poles) on the developer's property which are connected back to a core network which FSG operates centrally.

This approach allows the Developer to trade-off the ~$500,000 spend on deploying and managing their own core, for more manageable monthly access fees per device. As a licenced Carriage Service Provider (CSP) FSG can also provide interconnectivity, allowing inbound/outbound calling beyond the network itself which is unavailable with Multi-Site and Local MPNs. It is also likely that full roaming will be available for these networks going forward so a developer may be able to offer a national plan via the MNO or other carriers services may be able to simply roam onto the developer's network.

5.3.3 Neutral Hosting

Neutral Hosting is where others build telecommunication infrastructure and connect to the carrier's core as a node for a fee. Worldwide this is believed to be the future in cellular transmission to address coverage where carriers cannot justify the cost of transmission (regional and in buildings). In new developments where an individual telco serves only a few customers per node, brings a high cost-to-customer ratio and ultimately makes it uneconomic to provide services in regions where the population density is low. Under traditional operating models, telcos must construct and manage their own infrastructure to serve customers, so when they pursue operationally and financially challenging network sharing arrangements, they waste resources by creating too many access points for a low number of customers.

The neutral host model potentially addresses both the densification and the rural issue by allowing telcos to use the infrastructure they need from a neutral host with neither having to provide the initial investment to deploy, nor shoulder much of the ongoing operating expense. Today in many countries, over 80% of carrier mobile traffic comes from in-building and rural users. Powertec understands that current ACMA Legislation and carrier reluctance are the obstacles in the immediate deployment of these technologies, however, as MPNs share the same topology and technology, utilising MPN for the immediate at least has an evolution path to neutral hosting in the future.

6 Summary and Recommendations

Mobile phones are ubiquitous in todays connected world, besides the convenience of general communication and the vast array of Apps supporting our lives, they are essential for accessing emergency services for health and safety of people. When consumers unknowingly rent, occupy or purchase a property without cellular connectivity they begrudgingly either do without or purchase a repeater at their cost, that's if they are aware of the existence of repeaters.

Developers do have a duty of care to connect their estates to the NBN but should have the same duty to provide devices such as repeaters in each house that does not have signal and/or be developing estates with poles provisioned for Private LTE, which will lead to Neutral Hosting as technology and regulations ease and carriers progress their thinking.

End of document.