Improving Your Mobile Phone and Internet Reception in Regional Australia

Summary

This article applies to any vehicle or building in a regional area with weak mobile phone signals. My personal experience is with a 'blue tick' phone that receives a weak ground-level outdoor signal of about -120 dBm (RSRP) on the Telstra wholesale network (luckily across several frequency bands). Installation of a repeater system (CEL-FI R41 with roof-top LPDA ‘donor’ and indoor dome ‘server’ antennas) increased my indoor signal strength to about -90dBm, and indoor download data speed increased from zero to >10 Mb/s. The instructions with the system and on-line from suppliers are clear, so it was a DIY job in which the biggest challenges were setting the donor antenna, choosing a location with power for the repeater unit, and running the cables. No harder overall than installing an outdoor TV antenna. If desired, the same repeater unit can be moved to a vehicle, with different antennas, for use on the move. There are a few tricks to get the best data speeds at home, as explained below.

The Problem

If you live or travel outside of a major ‘population centre’(city) you have probably experienced poor mobile phone reception and data (internet) speeds. Phone network (carrier) companies boast that they serve a high percentage of the population, but this is a much smaller percentage of the land area in Australia. Reception sometimes got worse as companies turned off older transmission technologies such as 3G that phones still used in many regional areas, and as barriers such as trees continued to grow. Reception gets worse inside a house or vehicle. So what can you do? Unfortunately all of the potential solutions cost money.

Potential Solutions

One thing that can help is to use a new phone with improved reception capability for newer (4G and 5G) transmission technologies. Prefer phone models that have been found better in regional areas (eg Telstra ‘Blue Tick’ designated models) and be sure that the phone can use all of the bands (frequencies) used for phone signal transmission in Australia. Sleek modern phones rarely have an external antenna port. Though mobile phones vary in internal antenna strength, all use small omni-directional antennas, which inevitably have much lower gain than the best outdoor antennas used with home repeater systems (see below).

Check which phone company provides best service in your area. The full Telstra network provides the widest cover, but other carriers such as Optus may be better in specific areas depending on transmitter locations. Ask your neighbors. MVNO Boost uses the full Telstra network but others (such as Belong) access the lesser ‘Telstra wholesale network’ or the networks of other carriers.

If you have a land-line (NBN) connection that drives a Wi-Fi modem, be sure that both your phone and your phone service subscription (plan) include Wi-Fi calling. Then you should be able to use your mobile phone within the limited range of your Wi-Fi modem. But what if you have no hard-wired NBN? One option is to explore NBN fixed wireless or satellite services / plans.

Alternatively, if you receive a fair outdoor phone signal and want simultaneous use of multiple Wi-Fi devices inside, your best option may be a 4/5G modem/router with high-gain outdoor antenna/s (all MIMO if such signals reach you). Some are designed for use in vehicles. Setting of the outdoor antenna/s can be critical for data speed. You would need a SIM card and data plan for the modem, as well as the phone. You would still need Wi-Fi calling. I have not tried this.

If you get poor phone reception outside as well as inside buildings (or vehicles) you will probably have to install (and subscribe to) a satellite phone service such as Starlink.

If you get a low but reliable phone signal outside, and little or nothing inside, you are likely to benefit from installation of a repeater (often mistakenly called a signal booster, which technically uses a wired connection to a single phone, illegal in Australia). An outside antenna and inductive phone cradle (without repeater) may be enough in a small vehicle such as a car. A repeater can provide more gain, and does not need a separate SIM card or data plan, but there are a few pitfalls.

If you use a search engine to look for mobile phone repeaters the top hits are probably devices that are illegal to install in Australia. Poorly designed repeaters are likely to interfere with the phone network, causing problems for all users, so you can be fined and/or forced to cease use of devices that are illegal. The cheaper units typically work on only one or a few frequencies, which may not match the phone signal at your location. Be sure to use a device that is legal in Australia and approved by the owner of the phone network that you intend to use. At present this means Nextivity CEL-FI devices. They may be more expensive than some of the illegal devices, but they work better as they are designed and tested for compatibility with Australian phone networks.

At present there is a model (R41) designed for vehicles that works well (with a suitable 12V power supply) for some smaller houses (with direct line of sight and no more than 7 m from the service antenna to phone use areas). There is a more powerful model (G41) with enough amplifier oomph for average to larger homes, two-band amplification, and the option of band 28U. Be careful that the repeater matches your phone company in band 28 coverage. Some overseas countries split this band between TV and phone use, whereas in Australia it is split between companies (with Telstra and Optus using 28A≡L whereas Vodaphone and TPG use 28B≡U). IF your phone and your carrier support LTE inter-band aggregation (one type of confusingly named 'carrier aggregation') two-band amplification may be a real benefit for data speed. One way to check is to look for 4G+, LTE+ or LTE-A at the top of your mobile phone screen, during data transfer. Aggregation may also work in 5G with some (typically more expensive) phones and plans.

You will also need to install a 'donor' antenna (probably outside, *eg* on the mast for your roof-top TV antenna) and an inside 'server' (='service', ='broadcast') antenna (or several of these in a large or multi-story home); along with appropriate connecting cables. If you do not want to do the research to choose between omni-directional vs Yagi vs open or enclosed (radome) LPDA donor antennas (or even multiple donor antennas in special cases), and (one or more) dome vs panel server antennas, it may be best to get help from a professional installer who should make the decisions based on your specific circumstances. For DIY types, the entire (basic) system can be purchased for about $1,200 (including R41) when some components are on special. Use a reputable supplier (such as Powertec, RFI, Redfleet or The Antenna Company), who can also give helpful advice about antennas and cables.

If you want to know which phone tower your device is using (to help aim your directional donor antenna), the best site I have found for Australia is *Cellmapper*. This gives eNB codes for phone towers and PCI codes for their antennas as well as ECI codes for corresponding cell sectors. You can compare these with the codes in the *Network Cell Info Lite* app to determine which tower (or towers) and antennas your phone is selecting for strongest reception (as well as the band of the transmission and the cell sector being used). Do this with your phone (with wi-fi off) before installation of the repeater. Be aware that in areas with signal blockages due to topography, vegetation or buildings, you may be receiving a reflected signal from a direction other than the phone tower. If you are in an area served by multiple towers (or if you are on the move), your phone may switch between towers over time. This can be important if you need to select a tower and band for highest available data speed at home, as described below.

An advantage of the CEL-FI repeaters is that they will lock onto a single network (which you can alter if needed) and amplify a signal from any 4G band (or 2 bands for the G41) in that network. Signal strength, quality and stability are important for voice calls. But if speed of data download

and/or upload is more important to you, antenna position score (in the CEL-FI *Wave* app) and signal strength (bars on your phone, or dBm in your phone SIM status or an app like *Network Cell Info Lite*) can be misleading.

Depending on factors including user load and wavelength, data speeds can be unrelated to apparent signal strength. This can be a problem for mobile phone data users, as the phone (and the repeater) seem to select the strongest signal; perhaps taking account of signal quality but without testing data speed. You can test speed in *Network Cell Info Lite* (or a dedicated app). In general, distance covered for reliable voice calls increases at low frequency, but data speed at the same signal strength decreases (table below). Commonly, because Band 28 covers the largest area it has many users and can suffer congestion that slows speed even further. This depends on bandwidth available at the phone tower, and the problem varies with user load (time of day etc).

A repeater can amplify the signal from a phone tower. While selecting a band to boost, it may take interference from other towers into account. How this is weighted against signal strength is unclear; it probably varies between repeaters. Interference lowers signal quality and thus data speed. With a high-gain directional antenna, there may be an increase in signal quality. But neither repeater nor donor antenna can relieve congestion in any particular band at the tower. An important advantage of the CEL-FI repeaters over a mobile phone, if you receive multiple bands at the donor antenna, is that you can disable any band that is slow, so that the device uses a faster band (even if it is not the strongest signal). Once it has chosen a band to boost, my repeater seems far less aggressive than my phone in switching bands to chase a stronger signal. Indoors, the phone then stays locked onto the signal boosted by the repeater.

Carriers can give data speed priority to selected customers, typically those who pay more. New technology like 5G can increase data speeds (and use more battery power), but when 5G is implemented in the frequency range used for 3G and 4G (as in most of Australia: low-band and lower mid-band, DSS / NSA 5G) it is not much faster. The CEL-FI repeaters mentioned above boost DSS 5G (though they do not say so). Different repeaters (and different antennas) will be needed for higher-frequency 5G bands, if these are ever implemented in Australian areas of low population density. MIMO is mostly used at high signal strength, so it is less relevant where repeaters are needed. Even if your carrier uses MIMO, any advantage requires multiple donor antenna inputs, but repeaters that are legal in Australia currently have only one. Get advice from a trusted mobile phone professional experienced in your region before going down this path.

Reliability takes longer to discern. It is affected by signal strength and quality, which can vary over time. If you experience drop-outs or upload problems with a fast but weak band, you may be able to improve this by adjusting the donor antenna. Alternatively, enable a band with a stronger signal, even if it is slower. The good news is that data speeds above 5 Mb/s are fine for most users (even 1.5 Mb/s is sufficient to avoid frustration in most tasks). Streamers of 4K HD videos and multi-user households may want more.

Australian 4G (and DSS 5G) Mobile Phone Bands

Band	(Carrier)*	Frequency (MHz)	Area Covered	Data Speed
28	(T,O,V)	700	++++	+/-
5 / 26	(T, V)	850	+++	++
8	(O)	900	+++	++
3	(T,O,V)	1800	++	+++
1	(T,O,V)	2100	+	++++
40	(O)	2300	+	++++
7	(T,O)	2600	+	++++

* Carriers Telstra, Optus, Vodaphone
5G may also be provided in some areas on higher frequency bands *eg* n78 (3500MHz), n258 (26GHz)