

M2M Connectivity Antenna Guide

Installing a single antenna on a high speed 4G/5G router would be like putting 91 octane fuel in a Porsche.

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When designing an IoT solution, the importance of selecting the correct antenna could inadvertently be overlooked. Whether installing a simple wireless router for your beach house or installing a fleet of vending machines across the nation, the antenna selected could be the point of difference between seamless uninterrupted connectivity or constant downtime (causing countless call outs and support emails/calls). You don't want to make the mistake of underestimating the importance of your antenna.

If you are in the middle of developing your IoT solution, you will most likely have considered your touchpoints in the communication journey. The touchpoint between your device and cell tower may be out of your control but you can maximise the connection to lower the chances of a dropout.



Choosing the right antenna: Factors

There are several factors to consider when you are selecting your antenna and almost all situations are different to the next. Like selecting a car to purchase, everyone has their own needs and wants.

A quick list of factors to consider:

1. Mobile or fixed application?

2. Location/Area deployed?

- What is the signal strength? Rural or populous location?
- Network provider? (Strength may vary depending on provider + location)

3. Installation Application

- How will it be installed? On a desk, control panel, on top of a vehicle etc?
- What is the mount required? Wall mount, mag mount, pole mount?
- Any weather/harsh conditions? Desert? Tropical condition?

4. Cable Type/Length

- What length is required from device to antenna?
- Different type of cables provides different strengths and capabilities.

5. What data is being transferred?

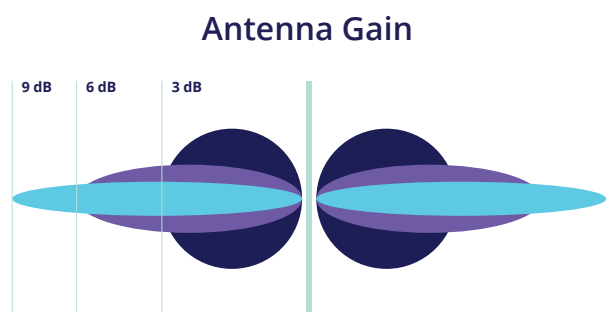
6. Frequency requirements

We will break down these factors a little later in the article.

Antenna Gain

Understanding antenna gain is very important of the ability of your antenna. This is particularly relevant to cellular networks and short range technologies such as WiFi or Zigbee, where the range of emission is limited. (As opposed to satellite networks with global coverage).

The higher the gain, the further away from source of emission, however, higher gain doesn't always mean better. Antenna gain is not the only factor to influence your antenna performance; 3D pattern of reception shape of your antenna is another big factor (*see diagram for abstract representation of the relationship between gain and 3D pattern*). Be sure to always purchase a couple of samples to do some testing before a large deployment. Antenna performance is also extremely dependent on environmental conditions, so best to perform some testing and ask an antenna specialist for some tips.



1. Mobile or Fixed Application



Having a fixed application will reduce the number of variables to consider. Assuming the network provider doesn't amend the network coverage, it's safe to assume the environments won't change besides network congestion.

There is less to consider for fixed application compared to a mobile application. For mobile applications, such as public transport or emergency vehicles or freight etc, your coverage will consistently change depending on location and it's critical for your antenna to adapt to its environments.

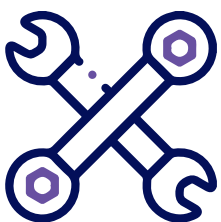
2. Location/Area deployment

What is the signal strength of the area? If developed in a built-up location, you may be able to get away with a small unity (right angle) antennas, many devices come with these antennas in the package or they're low-cost addons. However, many IoT deployments are featured in rurally or low signal areas, it will be beneficial to invest in a high gain antenna with certain features to allow for maximum performance.

Who is your network provider? In Australia, network signal varies depending on the provider. Telstra is known to have wider coverage than Optus and other providers. When deploying in more rural area, please check what network provider is being used or it may be beneficial to switch providers to ensure connectivity. M2M One sim plan utilises the Telstra network and provide failover sims on Optus for devices with dual sim capabilities. For critical applications, investing in dual module or dual sim systems is vital in case of network disruptions.



3. Installation Application



The location (not geographically) is another important factor. Are you installing on a vehicle, a control panel, inside a vending machine, on a work desk?

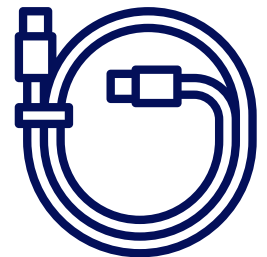
There are several variables when considering the environmental factors. For example, you may be in a metropolitan area but your device will be located in the basement of a building with 10 levels or the control panel is completely blocking out all the signal to your device. It will be necessary to install an antenna with a long cable (or extension cable) to move the antenna to a better location.

Security is also another factor to consider. You wouldn't want to put an easily removable antenna in a public area. It could be left vulnerable to theft or vandalism/tampering. Especially for unattended applications such as a vending or bottle collection machines. A low antenna with a through hole mount and bolted internally would be the best option for those applications.

Weather is another factor, if your antenna will be installed outside, then be sure to understand the likely (or unlikely) weather the antenna will endure. Whether it is located in a tropical weather or in the middle of a desert, make sure the material of the antenna is equipped to handle the conditions.

4. Cable Type/Length/Connector

The longer the cable, the more potential loss of gain. Antennas come either with a fixed cable length or a connector/short pigtail for an extension cable. You need to factor in the cable length required for your application.



Generally, any requirement over 5m cable, you might want to consider a low loss cable to minimise the loss of gain. Think about installing an antenna on a roof, your device is almost 10m away but also factoring bends and wiring, you could require 15m. A low loss cable and very high gain antenna is required to minimize the loss created.

Another critical part is the connector, many devices and antennas have different connectors, and it doesn't always pair. You could purchase a device with SMA but then accidentally purchase an antenna with a FME connector. Or have the same connectors (eg female side on cable and then male side on the device), so ensure the two pair together.

5. Data transferred.



If you have critical application or high-capacity data being transferred, it is very important your antenna is capable of providing the speeds with the circumstances above factored in. For less critical and low data, you could accept random signal dropouts and lower speeds (think small usage such as noncritical sensor readings such as gas/electrical metered readings).

6. Frequency

Antennas have different frequency ranges, you'll hear 3G, 4G and 5G antennas in descriptions but how do you know if the antenna is the correct one?

Different bands broadcast at different frequencies, it's best to check specifically the band your network is operating on in your area.



Generally 4G antennas cover between 698-960, 1719-2700mhz but generally whip 4G antennas cover 700-960-2170mhz, so frequencies between 2170-2700 won't be accepted.

Increasingly 5G antennas are becoming standard, many of them go up to 3800mhz or full 5G range up to 6000mhz. If you are planning to install a 4G device but then upgrading to a 5G device soon, it might be beneficial to purchase a 5G ready antenna to future proof your antenna and only upgrading your device from 4G to 5G.

Certifications

If you are installing for a specific application that requires MANY certifications and regulation approvals for the install, this would most likely include the antenna as well. For example, locomotive/train industry will have an extensive list of certification requirements on devices installed including the antennas, it must hold certain industry standards and approvals before being approved for train install. For example, the Maxtena Maxwave is built purposely for train applications and feature an extensive list of approvals.

Omni directional and Directional Antennas.

At M2M Connectivity, we generally categorise our antennas into two types, omni directional and directional antennas. Directional antennas are optimised to direct it's aim towards a certain section of the area to optimise connection. Whilst Omni is design to emit in all directions to connect in all directions, hence the term "omni".

For example, if you are installing on a farm and have minimal reception, a directional antenna would be required to direct to the nearest cellular tower. A clear line of sight would be required, and a maximum distance would need to be established.



Right Angle/Unity antennas

Great low cost option for deployment in well signalled areas. Simple install and sometimes may come included in device package.



Whip Antennas

Classic antenna that can be installed with a mag base or certain mount for standard connectivity.



Low Profile Antennas



Small visibility with low height for small areas. Great for security using minimal space. Great to install on vending machines, outside of control panels, on top of vehicles etc.

Wall mount

Installing on a side of a building or alongside a control panel, anything with a flat side.



Mag base antennas

Great for secured locations (private property), inside server rooms and portable applications, eg inside a pelican case for pop up sites etc. Also, great when no physical permanent alterations are allowed for the location (no screws or bolts).



Pole mount

Suitable for large antennas and directional antennas to swivel the required directional for best available signal. Professional install is recommended to ensure antenna is installed correctly.

