



About mobile phone networks

How does a mobile phone network operate?

A mobile phone network consists of a system of adjoining zones called 'cells'. Cells vary in size with the radius generally between 2 and 10 kilometres. Each cell has its own base station which sends and receives radio signals throughout its specified zone. Base stations produce very weak radiofrequency (RF) electromagnetic energy (EME) exposure levels.

*For information on potential health effects see fact sheet 1
'Electromagnetic energy and its effects'.*

Mobile phone base stations must be carefully located in relation to each other, so each cell in the network functions efficiently to ensure minimum network congestion and good signal quality.

When a call is made in Australia from a mobile phone, the network allocates the call to an available RF channel (or carrier frequency) within each cell. Unless the call is to another mobile phone within the same cell, the call is then "switched" to a conventional phone line. If the mobile phone user is travelling, the network will pass the call on to the base station that can provide the best available signal. Multiple cells are required because of the finite nature of the number of calls each base station can accommodate at any given point in time.

There are a number of networks that operate in Australia. The Global System for Mobile communication (GSM), which operates in the 900 and 1800 MHz band, the Code Division Multiple Access (CDMA) network, which operates in the 800 MHz band, the Universal Mobile Telecommunications System (UMTS) also known as 3G, which operates in the 2100 MHz band and Bluetooth, which operates in the 2400 MHz band.

Mobile phone antennas need to be mounted clear of surrounding obstructions like trees and buildings, to reduce 'dead spots' in coverage and allow the mobile phone base station to cover its intended cells with a minimum of transmitter power. They must also be sited where they will not interfere with neighbouring cells.

The more base stations of a particular carrier there are in an area, the smaller the cells, which means the power and energy levels of each are lower.

In areas of high mobile phone use, where there are many small cells to meet traffic demands, antennas do not need to be very high and can be installed on building roofs or small poles. These antenna configurations are called *low impact facilities*. In low usage areas, however, the cells are larger and the antennas are mounted on taller masts and towers.

In an area of increasing mobile phone use the number of cells needed to maintain service quality increases. Often this means an additional base station(s) is needed, even in areas where mobile network coverage already exists. If this is not done the mobile network will not operate properly and, as a result, mobile phone users may not be able to connect to their network (congestion).

What are the RF EME levels from mobile phone antennas?

Base stations transmit power levels from a few watts to 100 watts or more, depending on the size of the region or "cell" that they are designed to service. Base station antennas are typically about 20-30 cm in width and one to two metres in length, mounted on buildings or towers at a height of from 15 to 50 metres above ground. These antennas emit RF beams that are typically very narrow in the vertical direction but quite broad in the horizontal direction. Because of the narrow vertical spread of the beam, the RF field intensity at the ground directly below the antenna is low. The RF field intensity increases slightly up to distances of several hundred metres (the analogy of a water sprinkler is often used to describe the beam from a base station).

Rooftop antennas have restricted access in order to keep the public away from locations where the RF fields may exceed exposure limits. Since antennas direct their power outward, and do not radiate significant amounts of energy from their back surfaces or towards the top or bottom of the antenna, the levels of RF energy inside or to the sides of the building are normally very low.

ARPANSA conducted measurements of RF EME levels at 14 locations near GSM mobile phone base stations during 1997-99. ARPANSA found that emissions from these antennas were usually many orders of magnitude below the limit of $450 \mu\text{W}/\text{cm}^2$ set by the ARPANSA Radiation Protection Standard "Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz" for general public exposure. The levels measured were comparable to television and FM radio transmitters and considerably lower than those from AM radio transmitters, all measured at the same time. A comparison of RF EME levels between a mobile base station and other sources of RF EME at Highbury Park, Burwood, Victoria is shown in Figure 1.



A further study of 60 base stations, including CDMA, GSM and 3G technologies, in 2003 confirmed that RF EME levels were well below general public exposure limits.

For further information see fact sheet 4 'The ARPANSA RF exposure standard'.

Are mobile phone base stations a health risk?

The weight of national and international scientific opinion is that there is no substantiated evidence that living near a mobile phone antenna causes adverse health effects.

For further information see fact sheet 1 'Electromagnetic energy and its effects'.

RF source	Power density $\mu\text{W}/\text{cm}^2$
AM radio	0.0464
FM radio	0.0024
GSM base station	0.0007
UHF TV	0.0006
VHF TV	0.0005
Paging	0.0001

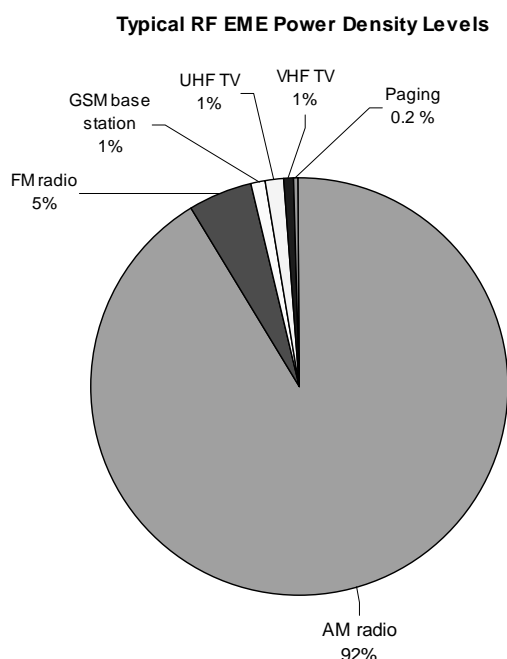


Figure 1. The pie chart shows a typical example of the relationship of the GSM system with other broadcasters using radio frequency transmission. Television and FM radio use frequencies of about 100MHz and AM radio uses frequencies near 1MHz. The pie chart gives the relative amount of RF EME emitted by various sources measured 0.1km from a typical base station. Measurements of power density levels (in microwatts per square centimetre) are made at a position which maximises the exposure from the mobile phone base station. It can be seen that exposure levels are less than those from FM radio stations and significantly less than levels from AM radio stations (measurements were taken at Highbury Park, Burwood, Victoria).

What are the current arrangements in relation to siting of mobile phone base stations?

Regulations to protect the public from RF EME exposure from telecommunications facilities established by the Australian Communications and Media Authority (ACMA) do not set any distance requirements between the facility and other land uses such as residences, schools or hospitals.

Similarly, the ACIF Code (see below) does not specify arbitrary distances at which infrastructure must be sited from community sensitive locations, because arbitrary distances do not necessarily reflect a precautionary approach. In fact, infrastructure sited further from a community sensitive area may need to operate at a higher power and may result in higher EME exposures in that sensitive area. Furthermore, it must be remembered that evidence gathered by ARPANSA suggests that exposure levels in public areas are so far below the exposure limit set by ACMA, that EME emissions from mobile phone base stations have no implications for health.

Telecommunications carriers' responsibilities relating to siting of base stations and consultation are set out in the *Telecommunications Act 1997* and its subordinate legislation, *The Telecommunications (Low Impact Facilities) Determination 1997* (amended 1999) and *the Telecommunications Code of Practice 1997*.

Carriers have the right to install low-impact facilities under conditions that are outlined in the publication *Accessing and Installing Telecommunications facilities - a Guide*. This publication is available from any ACMA office, and may also be downloaded via the ACMA website at:

http://www.acma.gov.au/ACMAINTER:STANDARD::pc=PC_569

Facilities that are not low-impact fall under the jurisdiction of state planning laws.

The Act recognises the trade off between encouraging the construction of telecommunications networks for the benefit of consumers and the broader economy, and accommodating aesthetic and environmental concerns of the community.

The ACIF Code

In addition to State and Federal regulations there is an ACMA registered industry code established by the Australian Communications Industry Forum (ACIF) called *Industry Code for the Deployment of Mobile Phone Network C564* (the "ACIF Code").

The Code supplements the requirements already imposed on carriers under the existing legislative scheme by requiring them to better inform and consult with the local community and to adopt a precautionary approach in planning, installing and operating telecommunications infrastructure. The ACIF Code is also available from the ACMA website at:

<http://emr.acma.gov.au>

With carriers subject to State and Territory planning laws and the ACIF Code, the local community and council are able to provide input into telecommunications network roll out.

(Revised: March 2006)

Fact sheets in the EME series are:

- Fact sheet 1: *Electromagnetic energy and its effects*
- Fact sheet 2: *Government action on electromagnetic energy public health issues*
- Fact sheet 3: *Australian research into EME*
- Fact sheet 4: *The ARPANSA RF Exposure Standard*
- Fact sheet 5: *About mobile phones*
- Fact sheet 6: *About mobile phone networks*
- Fact sheet 7: *What about using a mobile phone while driving*
- Fact sheet 8: *Potential interference of mobile phones with pacemakers, hearing aids and other devices*
- Fact sheet 9: *What about base stations and telecommunications towers - are there any health effects?*
- Fact sheet 10: *What about broadcast towers - are there any health effects?*
- Fact sheet 11: *Mobile phones and children*

For further information you can visit the ARPANSA web site at:

<http://www.arpansa.gov.au>