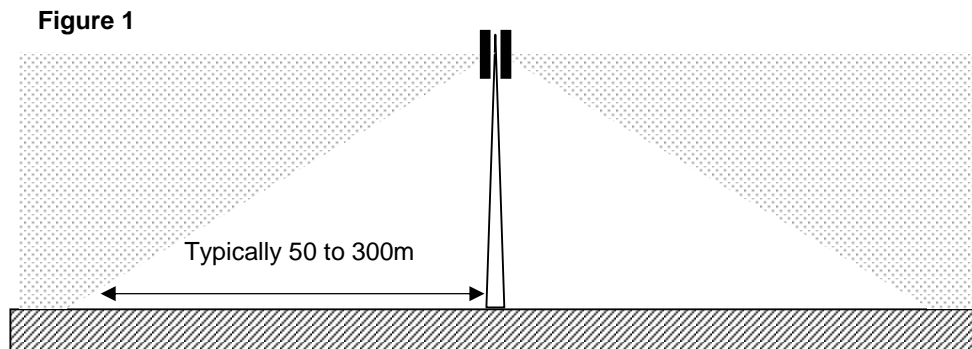


Background Information on Wireless Systems

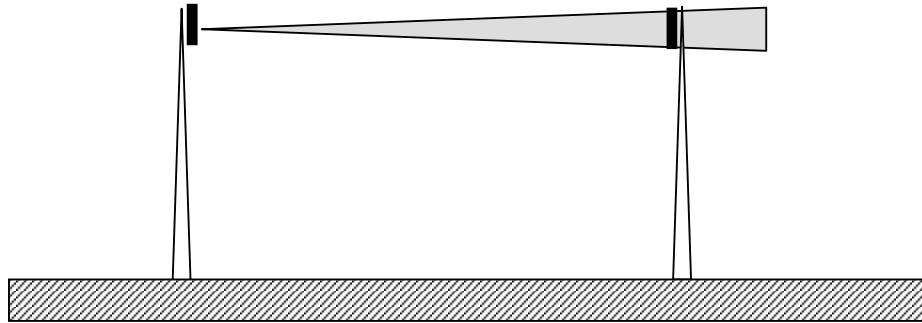
Wireless systems are used in every day situations. The idea of broadcasting radio and television and signals into our homes is something that most people take for granted. Another type of wireless system is when two or more radio transmitters pass signals to one another enabling communication between them.

Modern mobile phone systems have a handset communicating with a 'base station' transmitter and vice versa. Because mobile phone handsets (and even the base stations themselves) transmit a relatively low power signal it is necessary to have a large number of base stations to ensure that the handset always has a base station within range.

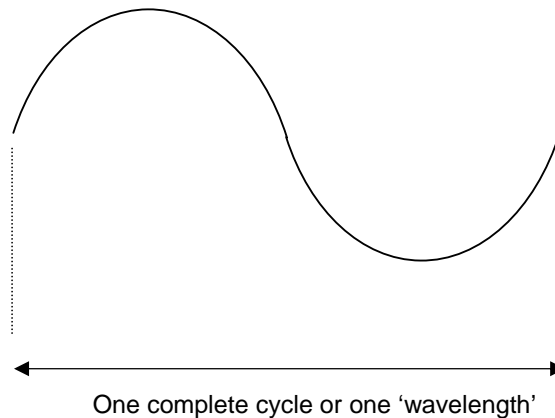
The base stations transmit their signals to the ground via an antenna system mounted on masts or buildings. Depending on the design of the antenna there may be a number of antennas located on the mast to ensure the signals are transmitted in all required directions (often 360°). The most typical configuration is for each antenna to have a reflector that shapes the radio signals to cover a specific 'sector'. The antennas are positioned in such a way to broadcast the signal towards the ground within a certain distance. This distance will depend on local topography. Figure 1 shows a simplified picture of this, real radiation patterns do not have such well defined edges. It is important to note that very little power is directed directly beneath the antenna.



Each base station covers a particular area or 'cell', typically a few kilometres in size. Lower power base stations used to cover smaller areas in cities have a much smaller range. To enable telephone calls to be transferred to other cells (as the caller may be travelling and moving into another area) it is necessary for the base stations to be able to communicate with each other. This is often done via a 'microwave link'. These microwave links use dish type antennas often seen as a small white drum attached to a radio mast. They invariably transmit what is a relatively low power signal in a narrow beam well above ground level (see Figure 2).

Figure 2 – Microwave Links

The term microwave purely refers to the frequency at which the link operates (frequencies above 1000 MHz are often referred to as microwave). To explain this further, 'radio waves' can be thought of as cycles and frequency refers to how many of these cycles occur in one second. The units of measurement are Hertz (Hz) and 1Hz is equal to 1 cycle per second (see figure 3). Different wireless systems work at different frequencies. FM radio such as BBC Radio 1 is broadcast over the VHF band (Very High Frequency, 30 to 300 MHz) at a frequency around 100 MHz. The prefix 'M' or Mega simply means one million, i.e. 100MHz is equal to 100 million cycles per second. Mobile phone systems currently work at around 900MHz, 1800 MHz or 2100MHz.

Figure 3

As mentioned previously, as well as a frequency, radio signals have a power level associated with them. Power is measured in Watts (W). The easiest analogy is an electric light bulb; a 100W bulb is brighter than a 60W bulb and will cast light further. The same applies to radio waves, given the same conditions a more powerful signal will travel further. With regard to safety guidelines power is measured over a given area so the unit of measurement is Watts per square meter (W/m^2). A key point is that the power level falls very rapidly with distance from the antenna. A distance of even a few metres, certainly a few tens of metres, from base station antennas will bring power levels inside safety guideline levels. Often power levels from nearby base station antennas will be broadly similar to radio and television signals broadcast at higher powers from a mast much further away.