

## **Wireless Broadband: Health & Safety Information**

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### **Introduction**

The increasing use of mobile phones and other wireless technology has been accompanied by public debate about possible adverse effects on health. The concerns have related to the emissions of radio frequency (RF) radiation from the phones (the handsets) and from the base stations that receive and transmit the signals.

This document discusses the health effects of radio emissions and extremely low frequency (ELF) electromagnetic fields generated by wireless equipment such as mobile telephones and wireless access points. In addition, this document aims to explain that the proposed technology for delivering wireless broadband falls well below the recommended levels of radiation and is in fact far less harmful than many devices used in our day to day lives.

### **Background**

Electromagnetic waves are a form of energy that consists of vibrating electric and magnetic fields. Forces of electric charges produce electric fields, and magnetic fields are produced when electric charges are in motion. Man-made sources account for most of the electromagnetic radiation in our environment. When an appliance is plugged in, an electric field is produced around the appliance; when the appliance is turned on and the electrical current is flowing, a magnetic field is produced.

With the proliferation of new technological devices in our home and workplace we are all exposed to electromagnetic radiation daily. Everyday household electrical devices such as hairdryers, electric and microwave ovens, fluorescent lights, stereos, mobile phones, and computers and the transmitters that support these items emit electrical and magnetic fields of varying intensities.

The electromagnetic spectrum is divided into ionising and non-ionising bands based on how the wave interacts with biological tissue. Radio frequencies emitted by mobile phone and WLAN (Wireless Local Area Network) antenna are classed as non-ionising radiation. Although these frequencies can enter the body the levels we are exposed to daily are extremely low and the majority of radiation is absorbed in the first few millimetres i.e. the skin. This prevents any impact on areas such as the brain and internal organs.

This absorption can cause the feeling of warmth if the antenna (i.e. the mobile phone handset) is held close to the head for a considerable length of time. The heat can also be attributed to heat transfer from the battery and the pressure of the object on the skin. It is important to note that the exposure to radio waves diminishes rapidly over distance so in reality an antenna mounted on the roof of a building is unlikely to cause the "thermal effect" experienced with a mobile phone.

Although some research has indicated support of the theory that RF emissions might have adverse effects on the human body, the experiments were unable to be confirmed by repeat experimentation. In addition, those experiments that have indicated the possibility of a negative impact on the public have involved cells or organisms exposed to very high radiation levels, levels that are not found in wireless communications transmissions including point to point links and low-power omni-directional transmissions.

## Wireless Broadband Installation

Radio waves can be radiated in all directions for broadcasts, towards general directions where a moving receiver is likely to be, or toward fixed receivers whose direction is known. The strength of the field can vary, depending upon:

- 1) The total radiated power – higher power produces stronger fields
- 2) The radiation pattern – narrow beams contain stronger fields
- 3) Distance from antenna – field strength reduces as distance increases

The amount of radiation actually received by a person is dependent upon all of these factors, and in addition, the distance between that person and device and anything in the way of the signal (e.g. a car, wall or tree).

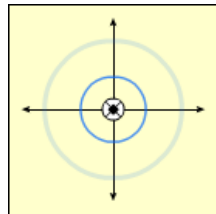
The antenna and wireless access point provided for delivering broadband to the building operates at 2.4GHz (gigahertz) and has a peak power output of 100mW (0.1W).

Either an omni-directional or directional antenna will be used depending upon the topology of the land and location of the building. The antenna will be mounted on a steel pole on the roof of the building with a shielded coaxial cable linking the antenna to the access point found in the network cabinet.



### Omni-Directional Antenna

Length 36cm  
Diameter 5cm  
Weight 1.4kg

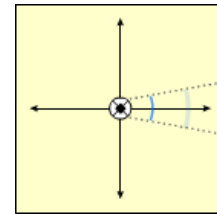


360° coverage.



### Directional Antenna

Length: 45cm  
Width: 25cm  
Weight: 1.3kg



Focused beam

### Different types of antenna used

The access point and antenna equipment operates within the guidelines found in radio frequency safety standards and recommendations and has been built to IEEE and FCC standards which reflect the consensus of the scientific community and are therefore deemed to be safe and not harmful to the human body.

## Specific Absorption Range

The amount of radio energy that penetrates the human body and is absorbed depends on several factors including frequency, power output, position of use, and antenna type. This exposure is characterized by the Specific Absorption Range, or SAR, in the tissues and has a peak value near the body surface and closest to the radiating antenna. Guidelines expect SAR to be averaged over various different tissue masses and time periods before comparison with the basic restrictions. The most stringent basic restrictions are those for low-power radio transmissions localized near the head over an averaging mass of 10 grams and averaging time of 6 minutes. In this situation, the ICNIRP guidelines for the general public recommend that SAR should not exceed 2 W/kg. Given the maximum radiated power levels emitted by 2.4 GHz WLAN technologies is 100 milliwatts (0.1W), reaching maximum exposure levels is impossible.

## Wireless LAN vs. Mobile Telephones

The increasing use of wireless systems, in particular mobile phones, has generated public safety concerns relating both to the placement of transmitter base station and the use of handheld receivers. Concerns have focused on:

- Human exposure to radio frequency fields emanating from base stations among people living or working close to wireless base stations.
- Possible biological effects arising from the use of mobile phone handsets resulting from energy absorption by the head and neck.

### Mobile Phones

To investigate these concerns, the Independent Expert Working Group on Mobile Phones (IEGMP) published The Stewart Report<sup>1</sup> in May 2000. The main conclusions are:

- The balance of evidence does not suggest mobile phone technologies put the health of the general population of the UK at risk.
- The balance of evidence suggests that exposures to RF (radio frequencies) radiation below NRPB and ICNIRP guidelines do not cause adverse health effects to the general population.
- Overall, the report proposes that a precautionary approach be adopted until more robust scientific information becomes available and that the subject be reviewed again in three years time.

One of the precautionary approaches recommended was to ensure that where mobile phone base stations were sited at or near schools, that the beam of greatest intensity should not be permitted to fall on any part of the schools grounds or buildings without agreement from the school or parents.

Since The Stewart Report, the RA (Radiocommunications Agency) has undertaken a series of field strength measurements on mobile telephone base stations near schools and other sensitive sites such as hospitals. The results of this study have demonstrated that mobile phone base station emissions are **significantly lower** than the ICNIRP guidelines; the highest recorded level of radiation was 1/731<sup>st</sup> of the recommended limit and the lowest was just over one ten-millionth of the limit<sup>2</sup>. ICNIRP guidelines incorporate a safety factor to protect possible hypersensitive or vulnerable subjects in the population such as young children.

Wireless Technology	Power output (Peak EIRP per channel) Remote / customer unit	Power output (Peak EIRP per channel) Central base station / Access point
2.4GHz WLAN (802.11b)	100mW	100mW
Two way Satellite (1.8 metre antenna)	Variable. Can be 100kW	(not relevant: on satellite)
Mobile Handset	1-2W	Variable. Typically 100W, Max 1kW
5.8GHz WLAN Band A	200mW	200mW
5.8GHz WLAN Band B	1W	1W
5.8GHz Band C	2W	2W
Fixed Wireless (3.5GHz/10GHz/28GHz/40GHz)	Variable. Typically 30-40W	Variable. Typically 30-40W
Car remote lock	10mW	(typically receive only)
Terrestrial TV transmitter	(receive only)	Variable. 1-5MW for largest sites

**Power output of wireless devices (source: Analysys 2003)**

<sup>1</sup> The full report is available at <http://www.iegmp.org.uk/report/text.htm>.

<sup>2</sup> Complete report: [http://www.radio.gov.uk/topics/\[safety/school-audit/summary2003.htm](http://www.radio.gov.uk/topics/[safety/school-audit/summary2003.htm).

## Wireless LAN

As public Wireless LAN systems have only recently emerged in the UK, the voicing of concerns with regards to the possible associated health risks have been limited.

The output power of 2.4 GHz WLAN access points (IEEE 802.11x compliant) can typically range up to 100mW (see table above). This is 200 times less than a mobile phone base station and up to 20 times less than a mobile phone handset.

As the output power of WLANs is very low and since the equipment is not held directly against the head of the user, there will be very little exposure to radio wave energy. This was verified in a study undertaken by the National Radiological Protection Board (NRPB) for Office of Government Commerce (OGC), which found that at certain locations there was greater background radio intrusion from television and radio transmission than from the access points. However, it is advisable that all WLAN equipment is kept at least 30cm away from the head of the user<sup>3</sup>. As the proposed antenna will be mounted on the roof of the building, there is an extremely small chance that anyone would be able to get that close.

The WLAN Association (WLANA), a non-profit educational trade association, has published a research paper entitled "Do Wireless LAN's Pose a Health Risk to the Consumer?". The research paper concludes:

"The interpretation of over four decades of research in this area has led to a scientific consensus on the safety of exposure to radio frequency electromagnetic fields. This consensus is reflected in the recommendations and standards developed by expert committees such as NCRP Scientific Committee 53, IEEE Standards Coordinating Committee 28, IRPA/INIRC and NRPB. Manufacturers of Wireless Networking products design their products to operate within the guidelines of these standards and recommendations and, therefore, are considered safe."<sup>4</sup>

## Guidelines to schools

The UK Government's Spectrum Advisory Group recommends that wireless networks, such as WLAN systems, be used with the same precautions as recommended for mobile phones in the Stewart Report.

The key recommendation for mobile phone base stations at or near schools in this report is that the beam of greatest intensity should not be permitted to fall on any part of the school's grounds or buildings without agreement from the school and parents.

As the WLAN equipment is not designed or deployed in the same way as mobile phone base stations nor does it have the same intensity (by a factor of 200) the concerns about the beam intensity falling on the schools grounds or buildings does not arise.

## Conclusions

### **2.4 GHz WLAN technology:**

1. Emits low frequency radio waves, and the power emitted is no more than 100 milliwatts (0.1W) - 200 times less than a mobile phone base station and up to 20 times less than a mobile phone handset;
2. Is considered safe for use at schools or any other similar place;

<sup>3</sup> Wireless networking in schools: [http://www.becta.org.uk/news/wireless\\_networks/wdocs/wire.pdf](http://www.becta.org.uk/news/wireless_networks/wdocs/wire.pdf).

<sup>4</sup> To view the WLANA paper in full please visit <http://www.wlana.org>.

## Radio Frequency Safety Standards

The following organizations have independently issued similar recommendations for exposure to radio frequency electromagnetic energy.

- Standards Coordinating Committee 28 of the Institute of Electrical and Electronics Engineers (IEEE)
- National Council on Radiation Protection and Measurements (NCRP)
- National Radiological Protection Boards (NRPB) in the United Kingdom.
- International Radiation Protection Association's International Non-Ionizing Radiation Committee (IRPA/INIRC) (under World Health Organization sponsorship)

## References

For further information regarding radio frequencies emitted by mobile phones and Wireless LAN equipment.

World Health Organisation – EMF Project  
<http://www.who.int/peh-emf/about/en/>

National Radiological Protection Board (NRPB)  
<http://www.nrpb.org/>

Independent Expert Group on Mobile Phones (IEGMP)  
<http://www.iegmp.org.uk/>

Institute of Electrical and Electronics Engineers  
<http://www.ieee.org/>

National Council on Radiation Protection and Measurements  
<http://www.ncrp.com/>

International Radiation Protection Association  
<http://www.irpa.net/>

Wireless LAN Association  
<http://www.wlana.org/>

Radiocommunications Agency  
<http://www.radio.gov.uk/>