Ref: PL

Network and 3G information

How mobile phones work – the need for base stations

How calls are made and received

In order to run a network offering mobile services, each operator is granted a licence to broadcast at a particular frequency range within the radio spectrum. All other users of the radio spectrum must be allocated their own part of the spectrum to prevent interference occurring.

Mobile phones work by converting voice into electronic signals and then sending and receiving these signals to and from antennae that are attached to radio transmitters, or radio base stations. They do so by using a part of the allocated frequency range, known as a radio channel.

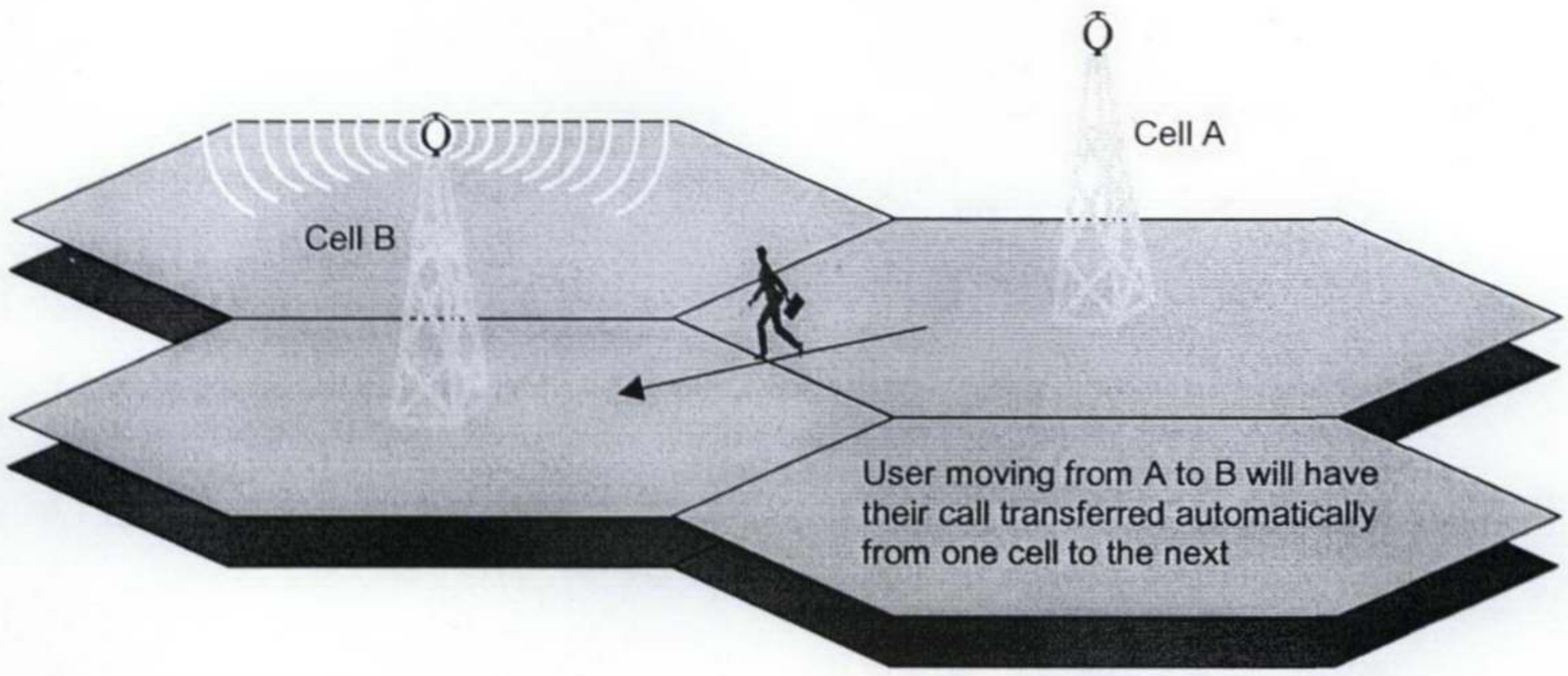
Therefore, in order for a two way conversation to be held without interference from other calls, each call must be allocated a radio channel at which to transmit and a radio channel at which to receive.

However, the allocated frequency range can only be divided into a limited number of radio channels, which means only a limited number of calls can be made at any particular time. If all radio channels are being used no further calls can be made.

Building a Network – obtaining coverage

Radio base stations transmit and receive signals to and from the mobile handsets and allocate the radio channels to the calls being made. The area over which a single radio base station transmits and receives is generally referred to as 'cell'.

The operator's network therefore is made up of many overlapping cells covering the entire geographical area over which coverage must be achieved.



In order to ensure that a call remains continuous as the user moves around, the cells overlap slightly. When a user nears the edge of a cell and enters the overlap area with the next cell, the network will hand over from one base station to the next once the new base station is providing a stronger signal.

However, radio signals will suffer interference from any obstacles such as buildings, trees, hills and valleys and therefore wherever these obstacles exist a new base station must be erected to provide coverage in the area where signals from existing base stations cannot reach.

Transferring a call

Once a call reaches a radio base station, it must be transferred across the rest of the mobile operator's network and into the fixed line network or to wherever the call is being made.

Depending on where the base station is located the call will be passed either through underground fibre optic cables or via 'point to point' fixed links which transmit a 'torch like' beam from one base station to the next and require a direct line of sight.

By a combination of these methods, the call may travel between several base stations, before entering a main switching centre and then being passed off the mobile operators network through the public switch telephone network.

Increasing capacity

In order to increase the number of calls that can be made, the operator must re-use the same radio channel many times simultaneously. As long as the same radio channel is not being used on more than one call within the same geographical area, interference will not occur and many calls can use the same radio channel without affecting each other.

Each base station uses a certain number of all the radio channels available to the mobile operator in its allocated frequency range. If all the radio channels in a particular cell are being used then greater capacity can be created, enabling more calls to be made, by erecting another base station within the existing cell and creating two smaller cells.

Therefore the way in which radio channels are reused is by increasing the number of radio base stations, which will always have to be multiplied in line with the number of calls made by new customers who buy mobile phones.

As long as the base stations in these adjoining cells are not using the same radio channels; more calls can be made in the same area without causing interference.

Third Generation, 3G – impact on the network

Third Generation, commonly referred to as 3G, represents the next advance in mobile communications technology. The current digital mobile technology is referred to as Second Generation (2G) and the First Generation (1G) was the original analogue systems.

Orange, along with the other 2G operators and an additional new entrant, has been granted a Licence to provide 3G services in the United Kingdom. Orange is currently building the infrastructure to support 3G services in readiness for the expected UK launch date in late 2002.

The need for 3G base stations

Coverage

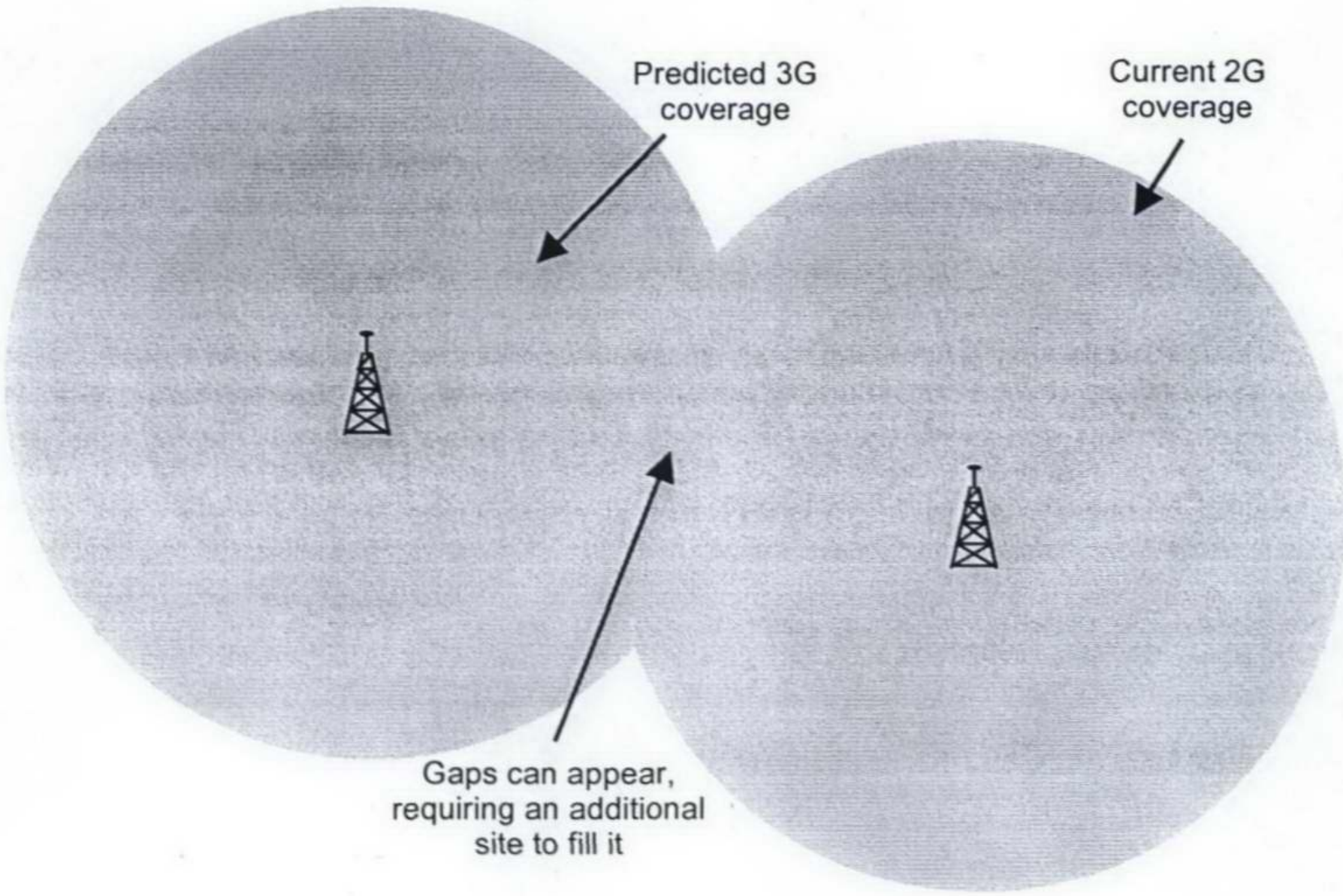
The existing Orange network will be used as the base upon which the new 3G network will be built. Where possible, existing 2G sites will be upgraded to allow them to offer both 2G and 3G services from a single base station. This is intended to minimise the number of additional sites required.

In most cases, this will involve swapping existing 2G antennas with new ones that are able to send and receive current 2G radio signals as well as the 3G signals. Equipment cabins will also be replaced.

The 3G system operates in another part of the electromagnetic spectrum, adjacent to the existing 2G part (1800 MHz) at slightly higher frequencies (2100MHz). The main impact on the Orange network of these different frequencies will be on geographical coverage. The radio waves transmitted at these higher do not travel as far through the air as 2G radio waves.

This means that the area that a 3G base station is able to cover will be smaller than a 2G base station at the same location currently covers. In some areas this will mean that 'holes' may appear in the 3G network.

Therefore, in these areas it will become necessary to build additional sites to fill these gaps so we can provide the same level of coverage for 3G as is currently available for 2G.



In – building services

Another consideration is the need for good quality signal. As 3G will involve increased use of data services, as well as voice calls, it is important that there is no disruption to the signal as important information could be missed. Consequently, it is vital to improve the quality of coverage above that acceptable for 2G services.

This is becoming more important as mobile communications move beyond simple voice calls and more data services are developed. Improving the coverage in built-up areas will allow better signal quality in buildings allowing many more people to access these services, both at the home and in the office.

Capacity demand

The growth of mobile phone usage has been exponential and there are more than 45 million users of mobile phones in the UK representing over 70% of the population. It is anticipated that 3G services will prove to be as popular as the current services available.

If demand keeps growing there will be a requirement for additional sites to support it, as each base station can only handle a certain number of calls. Some of the new 3G services such as videophones use more capacity than voice calls, further increasing the need for more capacity.

Building the 3G network

It is difficult to estimate the number of new sites required for 3G services. Orange's preference is always to use existing structures to accommodate transmitter equipment, wherever possible, whether they are buildings or existing radio masts.

Currently 60% of existing Orange sites are located on existing towers, masts or existing structures and within buildings, or accommodate other mobile operators' equipment.

Under the terms of the Licence granted by the Government, Orange has an obligation to provide and maintain a 3G UMTS telecommunications service to an area where at least 80% of the population of the UK live by 31 December 2007.

HEALTH AND SAFETY STATEMENT

As you are aware, technical information relating to health and safety has already been provided in the Supplementary Information Template which is enclosed with this application.

PPG8 states that it is not for the local planning authority to seek to replicate through the planning system controls under the health and safety regime as enforcement of this legislation is a matter for the Health and Safety Executive

However, Orange recognises the concerns of members of the public over perceived health effects and considers that detailed supplementary information would be beneficial for all parties concerned.

Independent Expert Group on Mobile Phones – 2000

As a result of concern over mobile phones and base stations the Minister for Public Health set up the Independent Group on Mobile Phones in the UK in 1999, under the chairmanship of Professor Sir William Stewart. Its report (The Stewart Report) was published in May 2000 and is the first genuinely independent and comprehensive review of mobile communications technology in the UK. A copy of the report can be found at www.iegmp.org.uk It concluded that:

- "the balance of evidence indicates that there is no general risk to the health of people living near base stations on the basis that exposures are expected to be small fractions of the guidelines;

- However there can be indirect adverse effects on their well being in some cases;

- There is now scientific evidence, however, which suggests that there may be biological effects occurring at exposures below these guidelines;

- We recommend that a precautionary approach of the use of mobile phone technology be adopted until much more detailed and scientifically robust information on any health effects becomes available".

Advisory Group on Non-ionising Radiation (AGNIR) - 2004

Following one of the recommendations made in the Stewart Report to review the possible health effects from mobile phone technology in three years time (paragraph 1.60) AGNIR was reconstituted in 1999 as an independent body that now reports directly to the Board of NRPB.

Their report issued 'Health Effects from Radiofrequency Electromagnetic Fields' was issued on 14th January 2004 and looked at the studies conducted since the review by the Independent Expert Group in 2000. Their conclusion is as follows:

> "In aggregate the research published since the IEGMP report does not give cause for concern. The weight of evidence now available does not suggest that there are adverse health effects to RF fields below guideline levels, but the published research on RF exposures and health has limitations, and mobile phones have only been in widespread use for a relatively short time. The possibility therefore remains open that there could be health effects from exposure to RF fields below guideline levels; hence continued research is required." (Paragraph 21, Chapter 8)
>
> "Exposure levels from living near to mobile phone base stations are extremely low, and the overall evidence indicates that they are unlikely to pose a risk to health". (Paragraph 20, Chapter 8).

A copy of the report can be found on the NRPB website: www.nrpb.org.

Mobile Phones and Health 2004: Report by the Board of NRPB

This report follows the earlier Independent Expert Group on Mobile Phones (Stewart Report) published in 2000. This report specifically revisits (and reiterates) many of the recommendations made in the original Stewart Report.

Paragraph 9 of the Summary states "Since then, the widespread development in the use of mobile phones world-wide has not been accompanied by associated, clearly established increases in adverse health effects. Within the UK, there is a lack of hard information showing that mobile phone systems in use are damaging to health. It is important to emphasise this important point.

The report can be viewed on the NRPB's web site: http://www.nrpb.org/news/index.htm

World Health Organisation Report (July 2000)

The World Health Organisation updated its Fact Sheet No 193, Electromagnetic Fields and Public Health. It urges regulatory authorities not to undermine the science base of (health based) guidelines by incorporating arbitrary additional safety factors. The fact sheet also states that the ICNIRP guidelines offer protection against all identified hazards of RF energy with large safety margins.

The fact sheet concludes

> 'RF fields around base stations are not considered a health risk'.

Further Research

Having considered research issues, AGNIR also made a number of specific recommendations that aim to improve the quality and interpretability of future health-related research and current health research programmes. These should be seen in context of the substantial programme of ongoing research in the UK funded jointly by the government and industry. The research is being carried out under the management of an independent Programme Management Committee. Full details can be found on www.mthr.org.uk.

ICNIRP Compliance

One of the recommendations of the Stewart Report was to adopt ICNIRP (International Commission on Non-Ionising Radiation Protection) guidelines to limit public exposure from transmitter sites. The Government has adopted this recommendation.

Before going into further detail, we would like to confirm that the proposed installation as detailed in the enclosed numbers is designed to be in full compliance with the requirements of the radio frequency (RF) public exposure guidelines of the International Commission on Non-Ionising Radiation Protection (ICNIRP), as expressed in EU Council recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz). A Certificate is enclosed to this effect.

The site has been designed so that no member of the public can be expected to be exposed to electromagnetic fields in excess of ICNIRP general public guidelines. For Orange installations this equates to safety distances of typically 10 metres between the front of the antenna and anywhere the general public may have access.

Government Policy on Public perception of concern about harm to health

The government's position relating to health and safety is reasonably clear and set out in paragraphs 29 – 31 of PPG8.

> 'Health considerations and public concern can in principle be material considerations in determining applications for planning permission and prior approval. [2]It is for the decision-maker (usually the local planning authority) to determine what weight to attach to such considerations in any particular case.' (Para 29 of Appendix)

> 'However, it is the Government's firm view that the planning system is not the place for determining what measures are necessary to protect public health. In the Governments view, if a proposed mobile phone base station meets the ICNIRP guidelines for public exposure it should not be necessary for the local planning authority to consider further the health effects and concerns about them.' (Para 30 of Note)

Furthermore in the Supporting Guidance it states that

> *'It is not for the local planning authority to seek to replicate through the planning* system controls under the health and safety regime. Enforcement of health and safety legislation is a matter for the Health and Safety Executive and not the local planing authority.' (Para 94)

This policy has been tested in numerous appeals (many at public inquiry) and in the High Court. To date no appeals by operators have been dismissed where perceived health effects was the main issue. Although the application of this policy has been subject to challenge in the High Court, no decision granting planning permission for a mast has been quashed by the High Court where this policy has been applied.

Since PPG8 was re-issued in August 2001 there have been seven public inquiries where health and safety was considered a main issue. In each case the Inspector allowed the appeal. On five occasions, costs were awarded against the Council. Details can be found on the Mobile Operator's Association (MOA) web site;
http://www.mobilemastinfo.com/planning/policy/intro.htm

Although the application of this policy has been subject to challenge in the High Court and the Court Of Appeal no decision granting permission for a mast has been quashed by either Court where this policy has been applied. Two cases are Trevett –v- Secretary of State DTLR and others [2002] EWHC 2696 Admin [2002] and T Mobile and others-v-First Secretary of STATE AND Harrogate Borough Council [2004] EWCA Civ 1763. Details can be found on the MOA web site.

Precautionary Approach

Much has been made of the term 'Precautionary Approach' and the Government has given guidance on what this constitutes.

> 'The Government's acceptance of the precautionary approach recommended by the Stewart Group's report "mobile phones and health" is limited to the specific recommendations in the Group's report and the Government's response to them. The report does not provide any basis for precautionary actions beyond those already proposed. In the Governments view, local planning authorities should not implement their own precautionary policies e.g. by way of imposing a ban or moratorium on new telecommunications development or insisting on minimum distances between new telecommunications development and existing development.' (Para 31 of Note)

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[2] Newport B.C. v S.S. for Wales and Browning Ferris Environmental Services Ltd (1998)

As a precautionary approach the Government has adopted the ICNIRP general public guidelines in preference to the previously used NRPB guidelines. The ICNIRP standards are founded on the same scientific basis as NRPB but have, by including the precautionary approach, increased the safety standards by five.

Beam of Greatest Intensity

The Stewart Report referred to a 'Beam of Greatest Intensity' and this has been picked up on by local planning authorities and the public. Although the Stewart Report defines this beam it is our feeling that the purpose of this calculation has been misunderstood and consequently misused.

The Stewart Report defines the Beam of Greatest Intensity as the area at whose boundary the intensity falls to a half (Paragraph 4.32). So the region of greatest intensity lies between the points where the centre of the main beam hits the ground and where the nearest edge of the beam hits the ground.

The Stewart report points out whether the radio signal from a given site falls on a particular location is dependent on the height of antennas and their direction and tilt. Based on typical down-tilt for antennas on say a 15m mast the Beam would fall on a large area typically 180m to 400m for a macro cell.

In our opinion, the reference to the Beam has caused undue concern to residents and schools located near to a proposed telecommunications installation. The concept of anyone living in a beam is obviously likely to cause alarm particularly if they do not understand the technology and safety guidelines introduced by the Government. In reality, however as you will see from the diagrams below the theoretical maximum power levels are significantly below ICNIRP guidelines.

Due to the complexity of calculating where the Beam falls and possible concerns that could be raised by residents or schools located within it the Government have distanced themselves from the Beam of Greatest Intensity. None of the recent planning guidance such as PPG8 and the Town and Country Planning (General Permitted Development) (Amendment) (England) (Order) 2001 refers to it once.

We would, therefore, in light of the above propose a more pragmatic approach to such desktop calculation namely based on the theoretical power levels at various distances. We have also show the point at which the highest power level falls. These are also shown in terms of percentage of ICNIRP guidelines.

Power Levels

Orange have developed a desk top calculator that provides theoretical power level on a site specific basis expressed in terms of ICNIRP general public guidelines which for Orange is 9 W/m^2 (Watts per metres square) for GSM and 10 W/m^2 for UMTS.

Diagram 1 (overleaf) shows the theoretical maximum readings from the antenna of a typical macrocell type installation[1]. The calculations are based on a 15m tower and readings are given at set distances of 50, 100, 200, 300, 400 and 500 metres. The diagram also shows the distance at which the power level is highest.

[1] The definition of Macrocells as given in PPG8 is they provide the main structure for the base station network. The base stations for macrocells have power outputs of tens of watts and communicate with phones up to about 35 kilometres (22 miles distant).

The signal levels are given in power flux density[2] and expressed in terms of factors and percentages of ICNIRP public guidelines.

The theoretical model is based on optimum propagation and, therefore, cannot take account of normal terrain features such as trees and buildings that would degrade the received signal. It also does not allow for building penetration losses.

Based on a theoretical model the greatest power level would fall at a distance of 127m. At this point, however, it would only be 0.0725 W/m^2 and only 0.79 per cent of ICNIRP public guidelines.

The diagram also shows how the power level rapidly decreases with distance.

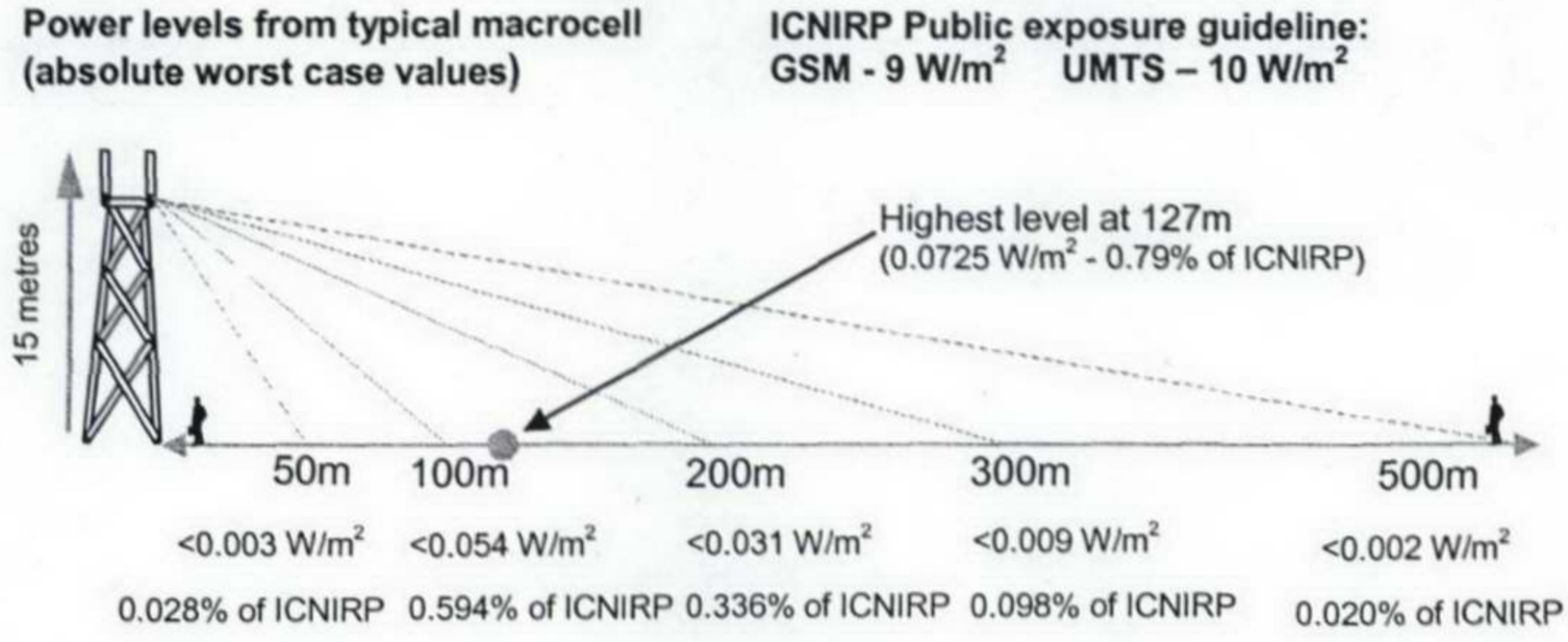

Diagram 1

Diagram 2 shows the power levels in graph form (i.e. the signal along the ground). Note the point at which the level is highest and how rapidly this decreases with distance from the base station.

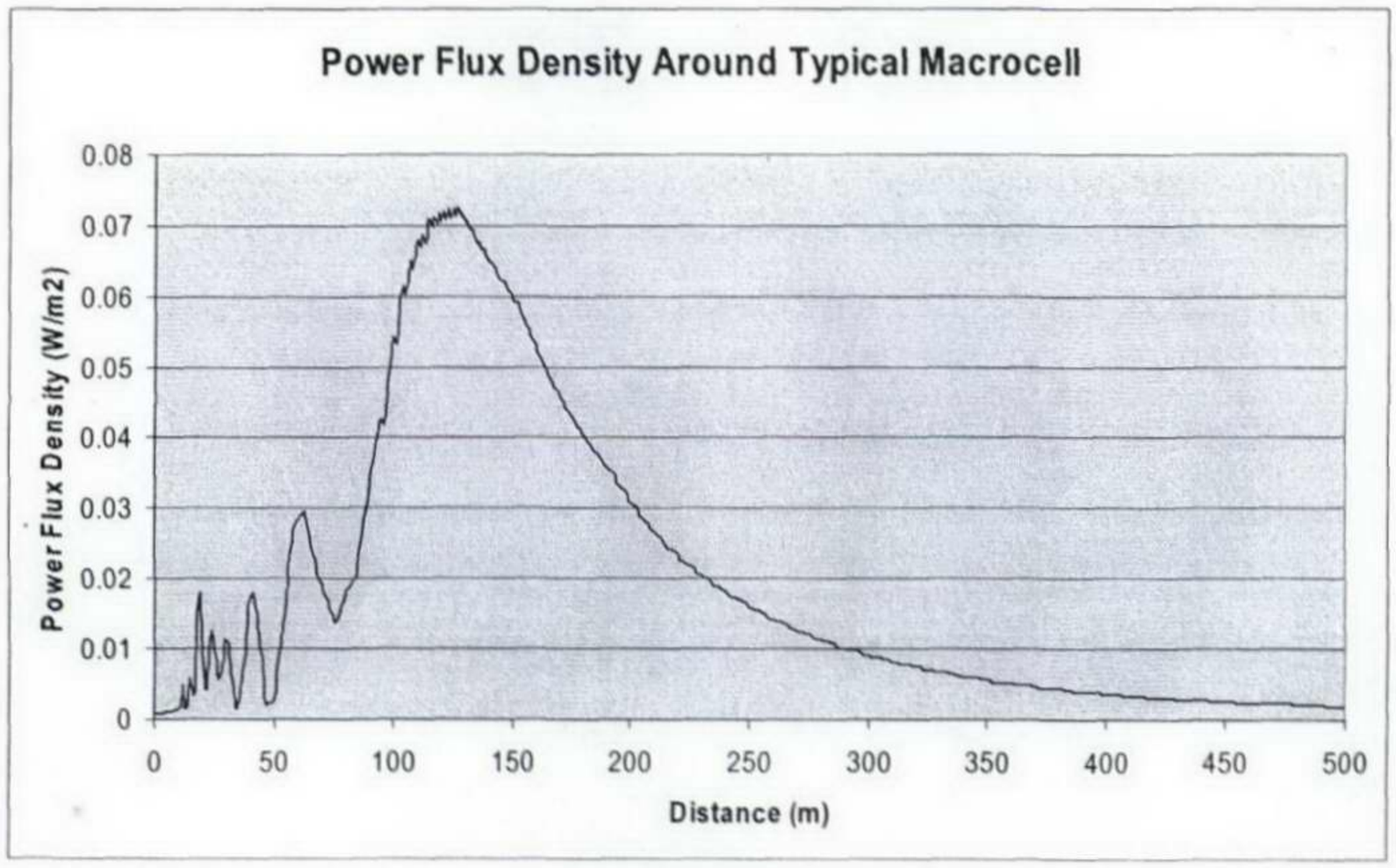

Diagram 2

[2] This is an industry standard way of expressing the strength of a radio signal relative to a surface area. For example, a power flux density of 1 W/m^2 represents 1 watt of RF power spread evenly over 1m^2. Ofcom uses this method of measurement in their schools audit. (see below)

The table below shows the figures for the theoretical model above.

Distance	Power Flux Density W/m^2	Electric field strength V/m	Percentage of ICNIRP (Power levels)	Factor Less than ICNIRP (Power levels)
50m	0.00261	0.9914	0.0280	3571
100m	0.05448	4.5321	0.5941	168
127m	0.07253	5.2291	0.7902	127
200m	0.03082	3.4088	0.3365	297
300m	0.00892	1.8333	0.0976	1025
400m	0.00367	1.1766	0.0403	2481
500m	0.00186	0.8378	0.0204	4902
1000m	0.00026	0.3121	0.0028	35714

Independent RF Surveys

In reality though, a number of independent surveys have confirmed that the actual emissions are well below the theoretical levels outlined above.

As a result of one of the recommendations of the Stewart Report, the Government commissioned the Radiocommunications Agency (now Ofcom) to implement a programme of surveys to ensure emissions from base stations do not exceed guidelines. Reflecting public concern, the initial focus of the audit was directed towards schools with base stations on or close to their premises. In the last couple of years the remit has widened to include other sensitive sites such as hospitals, residential areas and places of work.

The audit results indicated in every case, levels of radiation far below those specified in the guidelines of the ICNIRP.

A summary of the results year by year are as follows:

2001
100 surveys completed.
Lowest recorded level was 1/825,764 (0.000012%)
Highest recorded level was 1/279th (0.358%)

2002
82 surveys completed.
Lowest recorded level was 1/19,907,515 (0.000005%)
Highest recorded level was 1/731 (0.137%)

2003
93 surveys completed.
Lowest recorded level was 1/10,843,598 (0.0000092%).
Highest recorded level was 1/619 (0.16%).

2004
67 surveys completed.
Lowest recorded level was 1/94,875,996 (0.0000011)
Highest recorded level was 1/772 (0.13%).

(Figures given are percentage of and number factor below the ICNIRP maximum guideline reference level for public exposure).

All of the audit reports can be found in the RA archive of the Ofcom website - www.ofcom.org.uk

The mobile phone base station audit programme is continuing to include houses, places of work and public utilities such as water towers and reservoirs.

Ofcom also undertook some surveys of multi-user sites which can also be found in the RA archive. (These are aimed to give a more complete picture of emission levels across a wider range of radio frequencies).

As well as the Ofcom programme of surveys the National Radiological Protection Board are carrying out their own and the results can be found on the NRPB website can be found on (http://www.nrpb.org/radiation_topics/emf/index.htm)

The surveys include measurements near schools, homes and apartments, hospitals, public utilities, offices and other workplaces and show that exposures from mobile phone base stations are usually small fractions of international guidelines, typically less than 0.01% at most locations accessible to the public. The surveys also show that radio and TV transmitters can produce exposures that are comparable with those from mobile phone base stations.