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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.

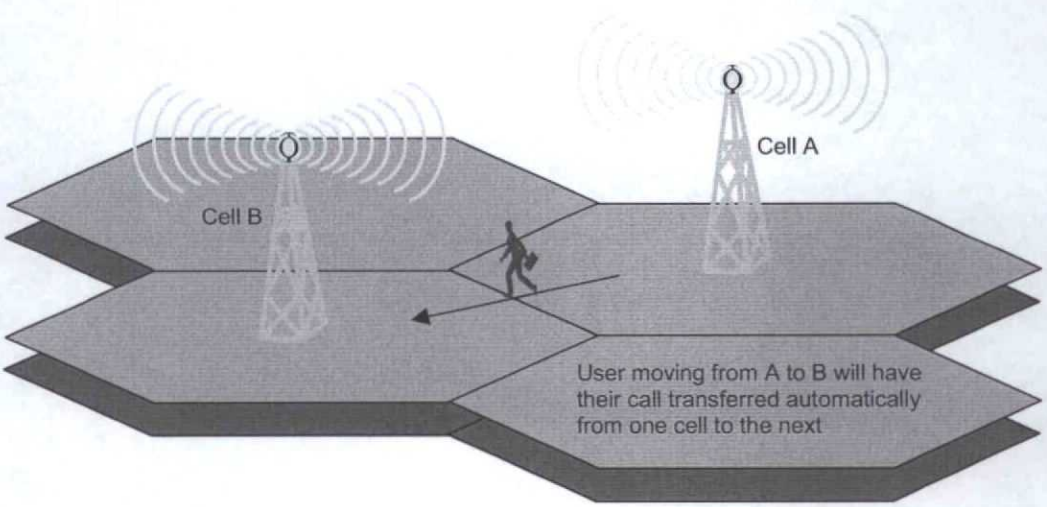
Therefore, in order for a two way conversation to be held without interference from other calls, each call must be allocated a radio channel at which to transmit and a radio channel at which to receive.

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.

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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.

Declaration of Conformity with ICNIRP Public Exposure Guidelines ("ICNIRP Declaration")

Orange PCS Ltd

St James Court
Great Park Road
Almondsbury Park
Bradley Stoke
Bristol
BS32 4QL

Certifies that the proposed equipment and installation as detailed in drawing numbers WSS0172G/10A within the attached planning/GPDO application at:

Highways Verge off Brighton Road, Shoreham by Sea, BN43 5YB.

OPCS Reference (WSS0172)

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)".

* Reference: 1999/519/EC

Date: 23/11/06

Signed: [redacted]

For and on behalf of Orange PCS Ltd

Name: I. McIntosh

Position: Engineer

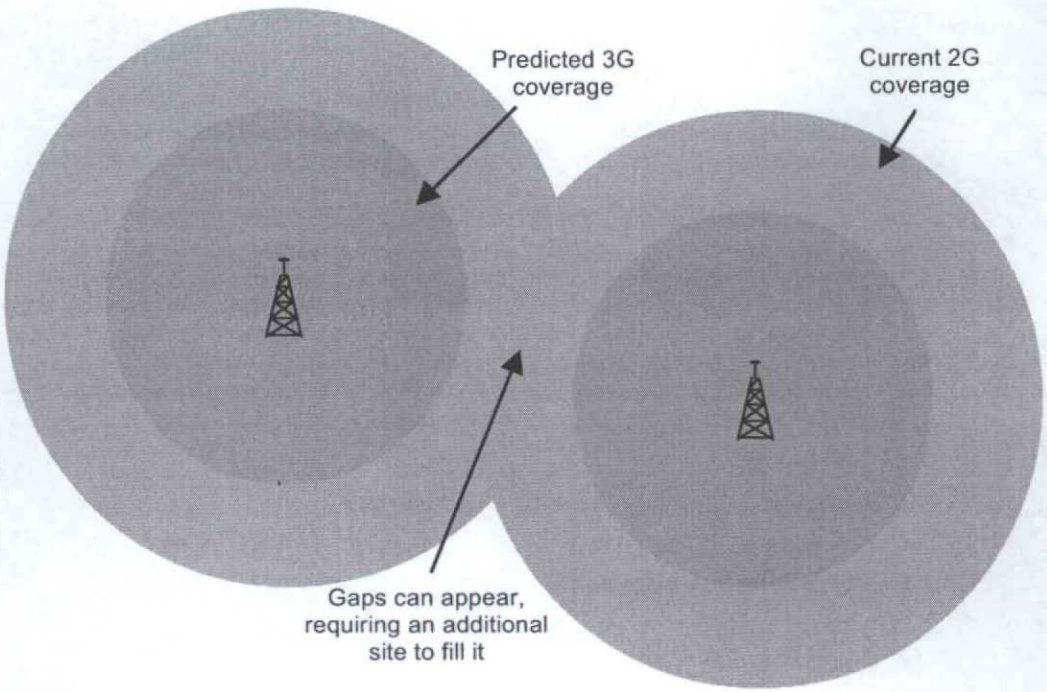
Company: Harlequin (Design) Limited

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.