OFFICE OF COMMUNICATIONS

3G Rollout obligations

Statement

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Contents

Section 1

Executive Summary

1.2 Ofcom expects all 3G licensees to meet the requirements for rollout as stated in their licences by the end of 2007.

1.3 It is important that stakeholders understand the technical basis for any measurement of rollout. Ofcom made proposals for the technical approach it would intend to take in its assessment of compliance in a consultation document dated 28 July 2006. This attracted 8 responses. In general these were supportive of Ofcom's approach, but some valuable suggestions for improvement were also made.

1.4 This document takes these suggestions into account and sets out Ofcom's conclusions about the right technical approach to be adopted in assessing compliance. It also sets out the timetable for doing so.

1.5 Ofcom received additional comments outside the technical questions asked in the consultation document dated 28 July 2006. Ofcom will be addressing these issues separately.

Section 2

Introduction

Background

2.1 An auction of Wireless Telegraphy Act Licences for 3G mobile telephony services was held in the UK in early 2000. Following that auction, five licences were granted to the winning bidders. Those licences are now held by Hutchison 3G (UK) Limited, O2 (UK) Limited, Orange Personal Communications Services Limited T-Mobile (UK) Limited, and Vodafone Limited.

2.2 These licences authorise the establishment, installation and use of apparatus to use the specified frequency assignments until 31 December 2021. These licences contain a condition which requires the licensees to meet certain targets for rollout of their networks. Specifically, paragraph 4(a) of the Schedule to each licence provided:

> "The Licensees shall install, maintain and use Radio Equipment (as specified in paragraph 10 of Schedule 1) in such a way as to enable the provision of, by not later than 31 December 2007, and to maintain thereafter, a telecommunications service by means of the Radio Equipment to an area where at least 80% of the population of the UK live."

This condition is referred to in this document as the "rollout obligation".

2.3 Full details of the 3G licence terms, the 2000 auction process and the information memorandum can be found at:
http://www.ofcom.org.uk/static/archive/spectrumauctions/main.htm

2.4 Since the award of these licences, all licensees have invested in the development of 3G networks, and have launched services that are now commercially available.

2.5 Ofcom set out its proposed approach to ensuring compliance with the obligation in the Spectrum Framework review: Implementation Plan in January 2005. Ofcom published its conclusions about the enforcement of the obligation on 28 July 2006, taking account of the responses received: that document also set out proposals for the technical assessment methodology by which compliance would be measured.

2.6 This document provides a summary of the technical issues raised in response to the consultation of 28 July 2006. Ofcom has taken into account the responses received and has updated its proposals in the light of them.

2.7 How Ofcom intends to measure compliance can be found in section 3. Section 4 provides details of the steps Ofcom intends to take during 2007 and 2008 to measure compliance. Analysis and conclusions of the responses to the 3G Rollout consultation can be found in Annex 1. A revised list of the technical parameters is included in Annex 2. Default antenna patterns are provided in Annex 3.

Section 3

How Ofcom intends to measure compliance

Evaluation of performance against obligation

3.1 This section discusses in detail the methodology Ofcom will use to determine the degree to which licensees meet the obligation to "provide a telecommunications service by means of the Radio Equipment to an area where at least 80% of the population of the UK live".

3.2 The description of the obligation contained within the 3G licences gives Ofcom considerable freedom to choose the methodology and detailed parameters for evaluating compliance. The parameters and the measurement methodology are important for the licensees and will be essential so that all parties can understand what is required to reach compliance with the obligation.

Basic methodology to use

3.3 In its consultation Ofcom proposed four basic methodologies that could be employed:

- Engineering analysis by Ofcom;
- Physical field strength measurement by Ofcom or an agent;
- Combination of the above two approaches; and
- Operator self-declaration (either based on prediction, measurement or a combination).

3.4 Ofcom intends to use a methodology based on engineering analysis, backed up by measurements in the field to verify the results as necessary.

3.5 Ofcom intends to issue a request for tender by an outside organisation to provide an independent verification of Ofcom's own analysis by the use of supplementary field strength measurements. The work to be tendered for will be broken into three parts:

- Develop the field trial methodology;
- Test run to verify the field trial methodology; and
- Carry out the field trials. (The number of which will be defined in the field trial methodology).

The nature of the service

3.6 3G networks can offer a broad range of services, from simple voice and text to advanced video calling and multimedia. Ofcom's proposed approach to measuring the coverage of networks reflects this variety.

3.7 The mix of services available at any location will depend on decisions taken by operators – for example about cell size and the number of simultaneous users supported. The proposed approach measures where a range of basic and advanced services are available under normal conditions, but recognises that this range may not be available there to all users at all times.

Considerations for engineering analysis by Ofcom

3.8 There are certain factors that need to be considered when deciding the analytical approach that Ofcom takes in assessing an operator's coverage. One such factor is the metric on which to base any prediction, i.e. some estimate of power received to enable the provision of a telecommunications service. Another such factor is the assumption on cell loading.

3.9 An assessment of coverage based on total power received would not give a true indication of whether a telecommunication service was available, as not all of the total power is used in providing a telecommunications service. This approach would tend to overestimate coverage.

3.10 The effects of cell breathing (the cell range effectively shrinks when a cell is heavily loaded) mean that the service level achieved at the edge of the coverage area changes as traffic changes. It is possible that the available coverage area could be different at different times of day due to changes in traffic levels/cell loading.

3.11 The primary common pilot channel (Primary CPICH) is used for cell selection, reselection and handover. The handset must be able to receive sufficient Primary CPICH power in order to initiate a 3G call. Ofcom considers that reception of the Primary CPICH is a suitable proxy for the provision of a telecommunication service.

3.12 The percentage of total downlink power that operators devote to the Primary CPICH is a configurable variable under the control of the operator. The literature suggests that it is normally chosen to be within the range 5–15 % of the total downlink power. This choice allows a trade-off to be made in areas where coverage is more important than capacity and vice versa. If coverage is more important (say in rural areas) the proportion of the total power allocated to the Primary CPICH is set as high as possible, which leaves less power available to telecommunications services. If capacity is more important (say in urban/suburban areas) the cells will be smaller therefore not requiring as much power for the Primary CPICH thus leaving more power available to devote to capacity and higher data rate services.

3.13 Analysis conducted by Ofcom indicates that, with Primary CPICH power set within the range 5 – 15%, telecommunications services up to data rates of 384 kbits/s should be available at the edge of a cell (at least for a lightly loaded cell).

3.14 Ofcom assumes that Primary CPICH power of 10% of the maximum transmit power in our analysis is likely to be indicative of urban/suburban deployment and therefore a value within this range is appropriate for our analysis of coverage of 80% of the population. Higher Primary CPICH powers of 10% and above are more likely to be used in less densely populated areas outside the 80% coverage area.

Signal level

3.15 As indicated above, Ofcom proposes to use reception of the Primary CPICH as a proxy for the provision of a telecommunication service. In order to conduct this analysis the minimum signal strength that constitutes reliable reception of the

Primary CPICH needs to be established. Ofcom will use Recommendation ITU-R P.1546-2 as the propagation model in its calculation of the received Primary CPICH signal strength. This International Telecommunications Union (ITU) recommendation provides a methodology for point-to-area predictions for terrestrial services such as 3G services.

3.16 Ofcom intends to use service availability as a guide in the selection of the slow fade margin. This margin is used to define the minimum receive signal level at the cell edge.

3.17 If the fade margin is selected such that the service availability at the cell edge is at least 90%, then it can be shown that the service availability over the entire cell should theoretically be greater than 97%. If there are neighbouring cells and handover is possible then the service availability over the entire coverage area should rise to better than 99%.

3.18 If the service availability at the cell edge is to be 90% then the fade margin must be 1.3 times the standard deviation of slow fading (assuming a normal distribution).

3.19 The mobile receiver sensitivity given in the 3G specifications (3GPP TS 25.101) is -117dBm.

3.20 ITU-R P.1546-1 quotes a standard deviation for slow fading of 5.5 dB for channels wider than 1 MHz. Therefore the minimum received signal level is calculated using a slow fading margin of 5.5 dB x 1.3.

3.21 The minimum signal level required to be received by the handset in order that it can "see" the Primary CPICH across the whole coverage area to better than 99% probability is therefore -117 + (5.5 x 1.3) = -110 dBm.

3.22 Ofcom will use a Primary CPICH signal level of -110 dBm for the purpose of assessing the edge of the 3G coverage[1].

3.23 If coverage was to be assessed for indoor use then an additional margin would need to be included in the calculation for the minimum receive signal level to take account of propagation losses through walls, etc. However, the rollout obligation does not specify that coverage must be indoors, and therefore Ofcom will not include such a margin.

Population data

3.24 In order to assess coverage to the population it is necessary to have a database of the population against location for the UK (i.e. where people live).

3.25 Ofcom will use the 2001 census data. For specific detail of assessing the population coverage percentage, please see Annex 2.

[1] -110 dBm is relative to an isotropic antenna.

Section 4

Next steps

During 2007

Feb 07:	Publish the definitive technical methodology and set out the timetable for the process during 2007 and 2008. (i.e. this document).
March 07:	In conjunction with the 3G licensees, agree a sample area (e.g. 100 x 100 km) in which to apply the methodology for benchmarking purposes. Request site and coverage data for this sample area. Compare Ofcom and licensee results.
mid-April 07:	Drive test within the sample area to confirm the methodology and share results with the licensees.
end-Oct 07:	Ofcom requests licensees to provide a snapshot of their site data as at 14 November 2007 to assess compliance.
16 November 07	Ofcom receives 14 November 2007 snapshot from all licensees.
mid-Dec 07:	Ofcom will: • Inform licensees whether it believes they are compliant; • Issue formal request to licensees, who may not already be compliant, to provide a snapshot of their site data as at 1 January 2008.

During 2008

early-Jan 08:	Assess data, undertake drive tests as necessary.

Annex 1

Analysis and conclusions from the responses to the 3G Rollout consultation

A1.1 This Annex provides a summary of the technical issues raised in responses to Ofcom's consultation on 3G Rollout obligations dated 28 July 2006.A revised list of technical parameters is included in Annex 2.

A1.2 The 3G licences authorise the establishment, installation and use of apparatus to use the specified frequency assignments until 31 December 2021. These licences contain a condition which requires the licensees to meet certain targets for rollout of their networks. Specifically, paragraph 4(a) of the Schedule to each licence provided:

> "The Licensees shall install, maintain and use Radio Equipment (as specified in paragraph 10 of Schedule 1) in such a way as to enable the provision of, by not later than 31 December 2007, and to maintain thereafter, a telecommunications service by means of the Radio Equipment to an area where at least 80% of the population of the UK live."

A1.3 The consultation put forward a proposed methodology to measure compliance with the license condition and sought views from interested parties on the following questions:

- Do you have any comments on Ofcom's proposed basic methodology?
- Do you agree that this is an appropriate basis for measurement?
- Do you have any comments on this assessment criterion?
- Do you have any comments on Ofcom's proposals in relation to population data?

A1.4 Ofcom received eight responses to the consultation, the majority of which were supportive of Ofcom's general methodology. This can be summarised as follows:

- Ofcom will assess coverage on the basis of data about base stations supplied by the licensees and population data from the 2001 Census;
- It will use industry standard planning tools to perform an engineering analysis of the signal strength receivable at outdoor locations; and
- This will be supported by sample measurements around the UK to verify the results.

A1.5 The responders did however raise a number of technical issues for clarification and correction based on the questions put forward in the consultation. These issues are summarised below and are formatted in the same structure as Section 7 of the consultation. Where appropriate Ofcom has altered its methodology and technical parameters to enhance its approach based on the comments received.

A1.6 Question 1: Do you have any comments on Ofcom's proposed basic methodology?

- The majority of the respondents agreed with the combination of engineering analysis by Ofcom backed up by physical field strength measurements by Ofcom or an agent.

- Comments raised in the responses were:

  - Information was requested about the engineering tool to be used by Ofcom.

    - Ofcom will be running its simulations on software from LS Telecom called xG-Planner. The digital terrain data is sourced from Ordinance Survey (OS).

  - Clarification was sought on the intended procedure to obtain sample of field strength measurements to verify the engineering analysis.

    - Ofcom is in the process of drafting a tender for a third party to develop a test methodology. See section 3.5.

A1.7 Question 2: Do you agree that this is an appropriate basis for measurement?

- Comments raised regarding the Primary CPICH Percentage.

  - The majority of the responses agreed to the level of 10% of the maximum transmitted power as an appropriate level for primary CPICH power.

    - There were requests for a more flexible approach in setting different levels of CPICH power for the different environments; Ofcom did not see this as a practical approach to assign different levels depending on their location.
    - Ofcom believes that there should be consistency with the required data submitted by each operator. Ofcom requires the maximum transmitted power from each 3G operator to fulfil our proposal to use 10% of the maximum transmitted power for Primary CPICH power in our analysis. Ofcom does not envisage there to be problems for an operator to provide the maximum power transmitted from each base station.
    - The level of CPICH power actually used by the operators could be captured during the field measurement campaign this may be compared with the 10% value chosen to check for consistency.

- Comments raised regarding antenna down tilt.

  - The unit in the table A6.2 from the consultation has been corrected to degrees.

- Comments raised regarding High sites.

  - A modification was requested to the basic methodology to limit the cell sizes of high sites in population centres.

    - Ofcom recognises that the mix of services available at any location will depend on decisions taken by operators including cell size. If an operator forecasts that the service take up in any area will be low then that operator may decide to install a high site. Ofcom does not intend to modify its basic methodology for specifically assessing the coverage of high sites.

A1.8 Question 3: Do you have any comments on this assessment criteria?

- Comments raised regarding the Primary CPICH signal level.
  - The majority of the responses agreed with the proposed Primary CPICH signal level of - 110dBm for the purposes of assessing the edge of coverage.
  - The minimum received signal level is calculated using a slow fading margin of 5.5dB. Ofcom obtained the figure of 5.5dB for slow fading for channels with a bandwidth of greater than 1MHz from propagation model ITU-R P.1546-1. Ofcom considers that this is an appropriate value.
- Comments raised regarding the propagation model
  - The validity of choosing ITU-R P.1546-2 propagation model over a proprietary model was questioned.
    - Ofcom recognises that each operator has invested in drive tests to calibrate their own proprietary models. However Ofcom believes that there should be a consistent basis for measuring all operators' rollout and therefore intends to use a single universal propagation model for its coverage assessment for all operators. The propagation model ITU-R P.1546-2 is the recommended model by the International Telecommunications Union for this type of application.
    - The parameters to be used for the settings of ITU-R P.1546-2 are listed in Annex 2.
  - Frequency Range
    - ITU-R P.1546-2 is applicable between 30MHz to 3000MHz. It has propagation curves reflecting the nominal frequencies of 100, 600 and 2000MHz. Interpolation or extrapolation of the values obtained for these nominal frequency values should be used to obtain field strength for any given required frequency.
    - Extrapolation above 2000MHz is inherent within the methodology of ITU-R P.1546-2, so Ofcom does not consider that this needs verification.
  - In the responses it was noted that ITU-R P.1546-2 model is valid only for ranges above 1km.
    - The implementation of propagation model ITU-R P.1546-2 within Ofcom's engineering tool uses an interpolation calculation for ITU-R P.1546-2 for distances below 1km.
    - Ofcom considers that this factor only matters if the coverage area from a base station has a radius of less than 1km. The propagation assumptions made up to 1km do not impact of the signal levels calculated at the edge of the coverage area from each base station with a radius of greater than 1km. Ofcom considers that base stations with coverage of less than 1km in radius will not be at the extremities of coverage area. Ofcom considers that the method chosen to define coverage up to 1km is

not a significant assumption in estimating the total population coverage percentage.

- It was highlighted that the value for the path loss exponent is not stated in the consultation document.
    - Ofcom can confirm that it intends to use the values provided by ITU-R P.1546-2.
- It was highlighted that the building height had not been defined.
    - A clutter height of 10m will be Ofcom's default for all clutter types. This value is given in ITU-R P.1546-2 for suburban clutter and the recommendation ITU-R P.1546-2 is subject to a minimum ground cover surrounding the receiving mobile of a height of 10m.
- It was requested that a single resolution of 100m pixel is used for all of the data and the calculations, as separate resolutions of data will make modelling overly complex.
    - Ofcom agrees that it is sensible to use a single resolution of 100m pixels for all of the data and calculations.
- Ofcom's statement of service availability was questioned.
    - Ofcom has not imposed a requirement to achieve service availability.
    - However Ofcom has used service availability as a guide in the selection of the slow fade margin. This margin is used to define the minimum receive signal level at the cell edge. The slow fade margin used should be expected to yield a call success of 90% at the cell edge. This represents on average a service availability of the entire cell of greater than 97% call success. Using Monte Carlo analysis and assuming that there are both neighbouring cells and handover is possible, the average service availability over the entire coverage area is calculated as approximately 99%.

A1.9 Question 4: Do you have any comments on Ofcom's proposals in relation to population data?

- Comments raised regarding the request for postcode data
    - Ofcom proposes to use the National Grid Reference in Eastings and Northings to reflect the position of transmitter. The postcode data is requested as a cross-check for the National Grid References, but is not essential.
- Comments raised regarding the population data
    - The use of 2001 census data was supported by the majority of responses.
    - How the data will be apportioned across census Output Areas was questioned. Specifically the accuracy of evenly distributing the population within each Output Area, particularly in larger rural Output Areas where the population can be clustered in a small percentage of the area.

        - Ofcom considers that it is appropriate to have a uniform approach and considers that the method chosen offers this.
        - Ofcom considers that this approach taken should not underestimate the actual population totals when considered over a large area.

- However, Ofcom has revised the suggested approach. The differences in the total population captured by the approach originally suggested by Ofcom and this new approach are insignificant over a large selection area.

        - Census data has population grouped within an area defined as an Output Area. Each Output Area represents the residential population of around 300 people. An Output Area is given a centroid position that is representative of the location of where most population falls within the Output Area.
        - For our analysis, it is now proposed to use the 2001 census data unaltered as provided. The total population calculated with coverage is the total number of inhabitants summed from the Output Area centroid position within the coverage level of -110dBm.

Annex 2

Revised details of technical parameters

Format of required data

A2.1 The table below gives the site data required and the format required for the engineering analysis.

Item	Format	Units
Operator		
Site Name/Id		
Sector Number		
Site grid system	British National or Irish National Grid	
Easting	123456 (to six figures)	
Northing	123456 (to six figures)	
Postcode	A12 3CD	
Antenna Azimuth	Degrees East of North	Degrees
Antenna Height	Metres above local ground measured to the radiation centre of the antenna	Metres
Antenna Type	The total azimuth 3dB beamwidth	Degrees
Transmit power out of the antenna	The EiRP of the sector	dBm
Down tilt	Total electrical and mechanical down tilt	Degrees

Data Assumptions

A2.2 The table below provides details of the assumptions Ofcom will make in relation to the required information.

Parameter	Value
Centre Frequency	2100MHz.
Primary CPICH transmitted power	10% of total power transmitted from each sector, Ofcom will therefore need to know the maximum total power transmitted from each sector.
Minimum Primary CPICH received signal level [2]	-110 dBm
Antenna Type	We intend to have a set of rules that govern the choice of 5 default antennas for the sector. The default antennas have an approximate 3dB beamwidth of 33°, 65°, 90°, 110° and Omni. The antenna patterns of these defaults can be viewed in Annex 3.
Antenna down tilt	If this value is not given an estimate of 2 degrees will be assumed.

[2] -110 dBm is relative to an isotropic antenna.

Calculation assumptions

Propagation model

A2.3 Propagation models use transmitter information with topographic data to calculate the field strength at a particular location.

A2.4 ITU-R P.1546-2 is a recommended propagation model from the International Telecommunications Union for point-to-area predictions for terrestrial services in the frequency range 30 MHz to 3 000 MHz.

Assumptions in using ITU-R P.1546-2

A2.5 The following assumptions will be made when using ITU-R P.1546-2:

- The frequency will be assumed to be 2100MHz;
- The receive height will be assumed to be 1.5m;
- The propagation curves intended to be used are for 50% locations, 50% time;
- Ofcom intends to use the correction for receiving antenna height;
- Ofcom intends to use the terrain clearance angle correction;
- A clutter of 10m will be Ofcom's default for all clutter types.

Topographic data

A2.6 The propagation model requires terrain and clutter data to calculate the field strength of the radio signal. It is proposed to use 100m pixel resolution data.

Composite coverage

A2.7 The composite coverage represents the field strength from every transmitter. If coverage from two or more transmitters overlaps, the largest signal value is chosen from the overlapping coverage areas. The composite coverage will be calculated to a 100m pixel resolution.

Population data

A2.8 It is proposed that the 2001 census data is used to analyse the coverage requirements.

A2.9 Census data has population grouped within an area defined as an Output Area. . Each Output Area represents the residential population of around 300 people. An Output Area is given a centroid position that is representative of the location of where most population falls within the Output Area.

A2.10 The total population calculated with 3G coverage is the total number of inhabitants summed from the Output Area centroids within the coverage level of -110dBm.

A2.11 The total percentage population coverage will be calculated by (Calculated total population with coverage / total UK population as defined in the 2001 census data) x 100.

The population data is freely available from the following websites:

Northern Ireland Statistics and Research Agency
http://www.nisranew.nisra.gov.uk/census/Start.html

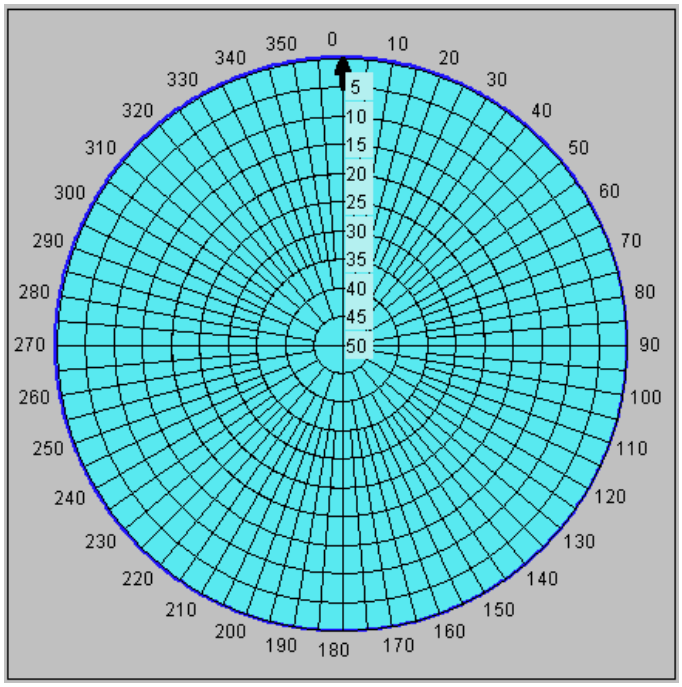
General Register Office for Scotland
http://www.gro-scotland.gov.uk/census/censushm/index.html

UK National Statistics
http://www.statistics.gov.uk/census2001/ordering.asp

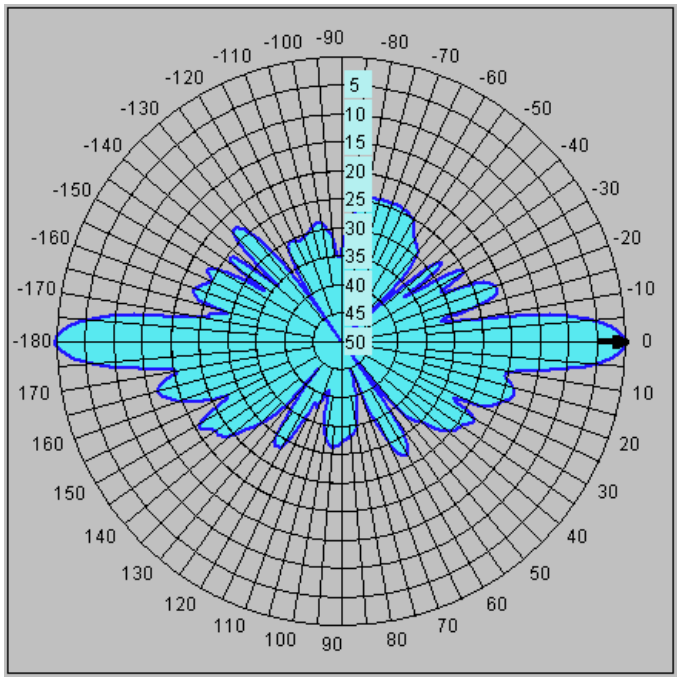
Annex 3

Default antenna patterns

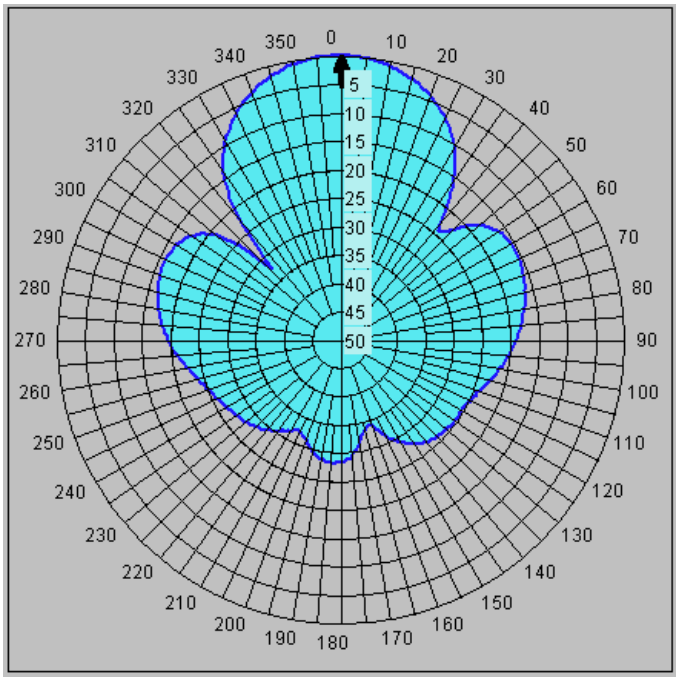
Omni antenna – horizontal pattern



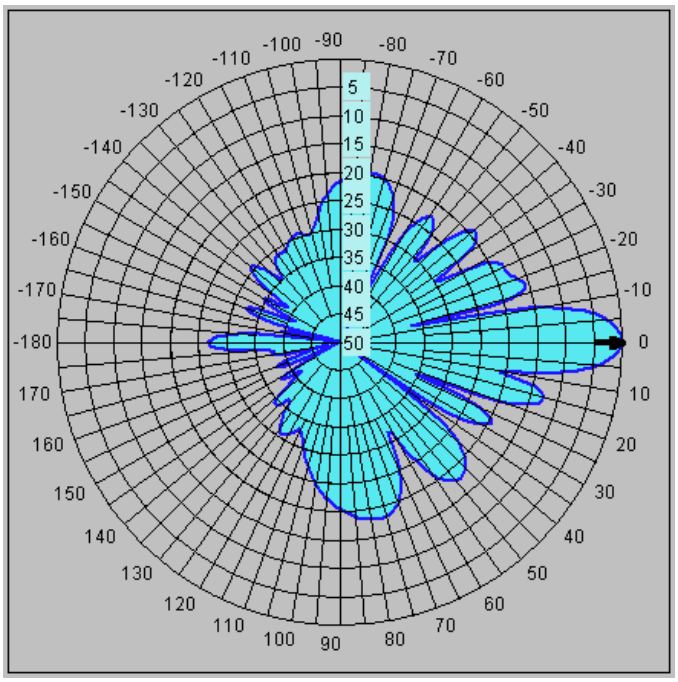
Omni antenna – vertical pattern



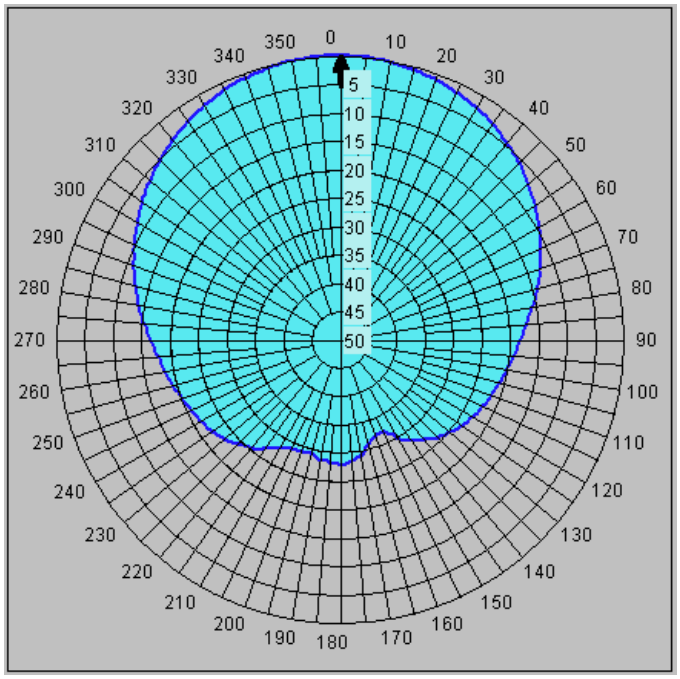
33° beamwidth antenna – horizontal pattern



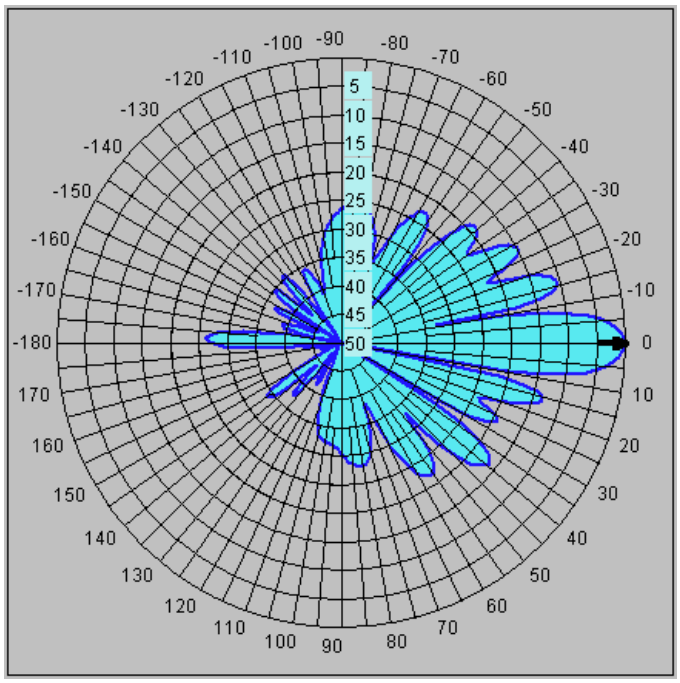
33° beamwidth antenna – vertical pattern



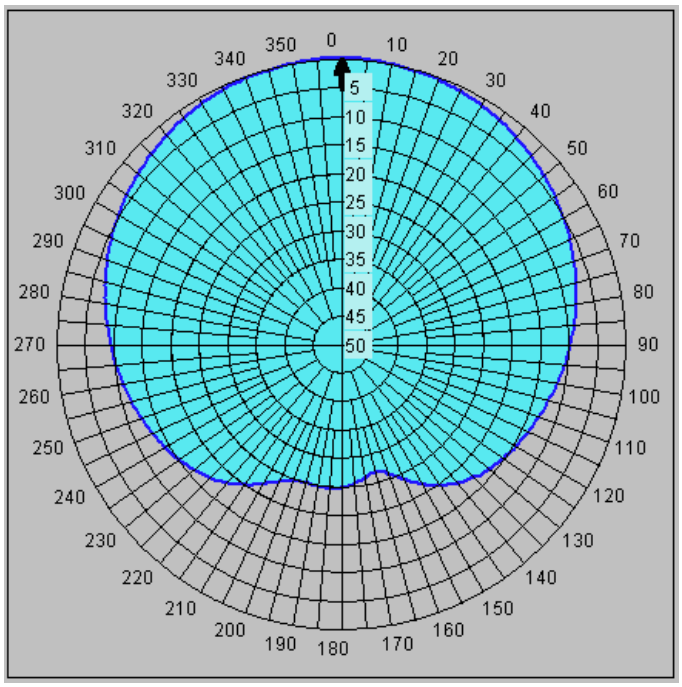
65° beamwidth antenna – horizontal pattern



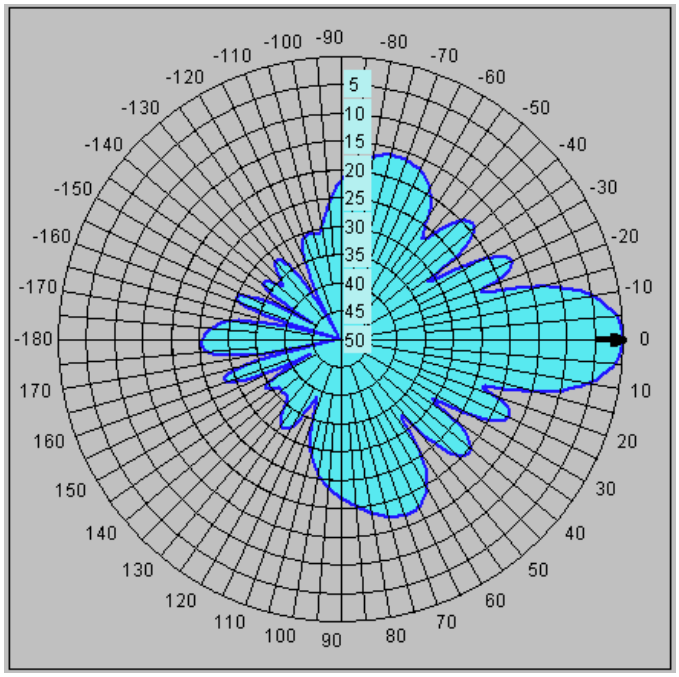
65° beamwidth antenna – vertical pattern



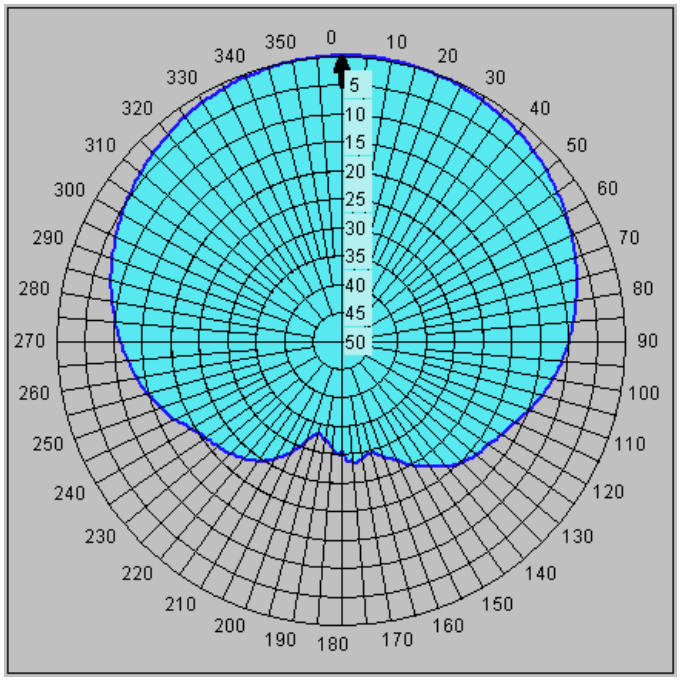
90° beamwidth antenna – horizontal pattern



90° beamwidth antenna – vertical pattern



110° beamwidth antenna – horizontal pattern



110° beamwidth antenna – vertical pattern