3G Coverage Obligation Verification Methodology

Statement

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Section 1

Introduction

1.1   Ofcom published a Notice on 2 February 2011 proposing to make a number of variations to the existing 2100 MHz Third Generation Mobile Wireless Telegraphy Act licences.

1.2   Ofcom published a Statement on 20 June 2011 where we stated that we would vary the licences in line with our proposal in the Notice subject to some minor changes to the drafting of the licences. We also said that if the individual licensees choose to consent to these changes then new licences will be issued to them.

1.3   In addition we said that we would carry out further work in conjunction with the mobile network operators to reach a consensus regarding a coverage obligation verification methodology. This work is now complete and the methodology is outlined in this statement.

1.4   The Direction[1] requires Ofcom to revise the coverage obligation specified in the current 3G licences should the Licensee request a variation to the term of their licence. The key requirements of the revised obligation are that by 20 June 2013, the licensee must provide an electronic communications network:

- that is capable of providing mobile telecommunications services to an area within which at least 90% of the population of the UK lives (this represents an increase from the existing 80% population coverage obligation in the current licences); and

- with a 90% probability that users in outdoor locations within that area can receive the service with a sustained downlink speed of not less than 768 kbps in a lightly loaded cell.

1.5   For the purposes of this notice, we interpret 'lightly loaded cell' as follows:

- a 'lightly loaded cell' has a single user demanding service with a sustained downlink speed of not less than 768 kbps and the surrounding cells of the network are loaded to a low level (e.g. the common channels transmitting at 20% of their maximum power).

1.6   Below we summarise our approach to monitor and verify compliance with the revised obligation.

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[1] The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010 (S.I.2010 No. 3024) which can be found at: http://www.legislation.gov.uk/uksi/2010/3024/contents/made

Section 2

Summary of approach

2.1   In order to assess whether a terminal located at any specific location can receive the minimum downlink speed, we consider that the following condition needs to be met:

- the signal to interference plus noise ratio (SINR) of the relevant data channel (i.e. the high speed downlink shared channel (HS-DSCH) for HSDPA systems) needs to be above a certain threshold. We set out below how that threshold is to be calculated.

2.2   Our approach is to calculate the SINR (HS-DSCH) for a hypothetical test terminal located at each population point taking into account signals from the 20 closest base sites.

2.3   The SINR threshold used to verify compliance with the obligation will be -5 dB.

Population distribution model

2.4   On examination of the population weighted output area centroid of the 2001 Census it was decided that the dataset is too coarse a measure of population. As the output areas get bigger, especially in rural areas, the population weighted centroid is not a true representation of where the population lives.

2.5   A dataset based on Ordnance Survey CodePoint® residential delivery point data in conjunction with census data to will be used to create the population distribution.

2.6   Population will be uniformly distributed across residential delivery points within each census output area.

2.7   Ordnance Survey CodePoint® data does not contain residential delivery point data in Northern Ireland, in order to capture the data for all nations the enhanced dataset Geopoint Plus will be used. For the first verification exercise the Geopoint Plus R52 will be used.

2.8   The most up to date full census dataset should be used in any assessment. At the current time and for the first verification exercise this is the 2001 dataset.

2.9   For future coverage verification exercises a 1 year notice period will be given by Ofcom if there is to be a change in the source data for the population distribution used to measure compliance.

Clutter database

2.10   A 50 metre resolution clutter database will be used to identify the dominant clutter designation at the population point. The Ofcom Infoterra clutter dataset has 10 clutter categories that will be mapped to the required Urban, Suburban and Open clutter designations as outlined in Table 2.1.

Category	Description	Clutter Designation
1	Dense Urban	Urban
2	Urban	Urban
3	Industry	Suburban
4	Suburban	Suburban
5	Village	Suburban
6	Parks/Recreation	Open
7	Open	Open
8	Open in Urban	Open
9	Forest	Open
10	Water	Open

Table 2.1 Infoterra clutter code mapping

Propagation Model

2.11   A median path loss will be calculated using the Extended Hata[2] Model.

2.12   Location variation can be considered to be approximately a lognormal distribution with zero mean. 90% location probability will be included in the calculation using a standard deviation σ_L derived from equation 32 in Annex 5 of Recommendation ITU-R P.1546-4.

$$\sigma_L = K + 1.3log_{10}(f) \qquad \text{dB}$$

with a value of K = 4.2 dB for Urban clutter and K = 3.5 dB otherwise. Frequency, f, is in MHz.

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[2] ERC Report 68 and ECO Seamcat User Manual at
http://tractool.seamcat.org/wiki/Manual/PropagationModels/ExtendedHata.

Section 3

Key parameters to be used in the SINR calculation

3.1 Table 3.1 contains the key parameters to be used in the SINR calculation, these are given for 2100 and 900 MHz. Ofcom does not anticipate 1800 MHz being used for HSPA services at this time, should assessment including 1800 MHz be required suitable parameters will be set.

Parameter	Unit	2100 MHz	900 MHz
UE Noise figure	dB	8	10
UE Antenna gain	dB	0	0
HS-DSCH Power	%	60	60
Pilot power	%	10	10
Other common CH	%	10	10
Lightly loaded neighbour	%	20	20
Body/orientation loss	dB	2.5	2.5

Table 3.1 Key parameters for 2100 and 900 MHz

3.2 Theoretical radiation patterns taken from 3GPP TR36.814 tuned to the supplied antenna beamwidths will be applied in the SINR calculation.

Azimuth pattern: $A_H(\varphi) = -min\left[12\left(\frac{\varphi}{\varphi_{3dB}}\right)^2, A_m\right]$

Elevation pattern: $A_V(\theta) = -min\left[12\left(\frac{\theta - \theta_{tilt}}{\theta_{3dB}}\right)^2, SLA_v\right]$

The values of φ_{3dB}, θ_{3dB} and θ_{tilt} are supplied inputs, A_m = 25 dB and SLA_v = 20 dB.

Section 4

Overview of the calculation method

4.1   For each operator the calculation would proceed along the following lines, illustrated in figure 4.1:

- the operator supplies data for each 3G site in its network. This data could include all or some of the following - supplemented (for certain, non critical, parameters) by default values if necessary:

    o location (6 figure NGR);

    o height above ground level (metres);

    o number of sectors;

    o for each sector;

        ▪ frequency carrier(s)

        ▪ boresight direction (degrees east of north);

        ▪ boresight gain (dBi);

        ▪ horizontal 3 dB beamwidth (degrees);

        ▪ vertical 3 dB beamwidth (degrees);

        ▪ combined mechanical and electrical downtilt (degrees);

        ▪ maximum transmit power (into antenna) or EIRP (dBm);

- for each population data point:

    o the nearest 20 base stations to the population point are identified;

    o for each sector of the nearest base stations identified in the previous step, the downlink power that would be received by a terminal 1.5 metres above ground level at the population point location is calculated;

    o a theoretical antenna radiation pattern tuned to the beamwidths provided in the input data is applied to each sector;

    o the base station sector providing the highest received power is designated as the serving sector;

    o non-serving sectors are assumed to be transmitting at 20% of their maximum power (i.e. they are lightly loaded);

    o a SINR of HS-DSCH distribution is created using a Monte Carlo process calculated by assuming 0.5 location variability cross-correlation between the serving and non-serving sites;

- o if the 90% percentile of the resultant SINR distribution is calculated to be greater than or equal to the -5dB threshold the population point is deemed to be served.

- o if the first carrier does not serve the point the next and subsequent carriers (until all provided carriers are exhausted) will be assessed in turn. If one of them meets the criteria in the points above the population point is deemed to be served.

- o the population associated with the served population point is added to the 'cumulative population served'. Once the value of 'cumulative population served' is greater than or equal to 90% of the UK population, the licence condition will be deemed to have been met and the verification process is stopped

Inputs:

Population point data:
- Location (NGR)
- Population
- Clutter

Transmitter data:
- Frequency carrier(s)
- Location (NGR)
- Height
- Number of Sectors
- EIRP
- Antenna parameters
  - Horizontal beamwidth
  - Vertical beamwidth
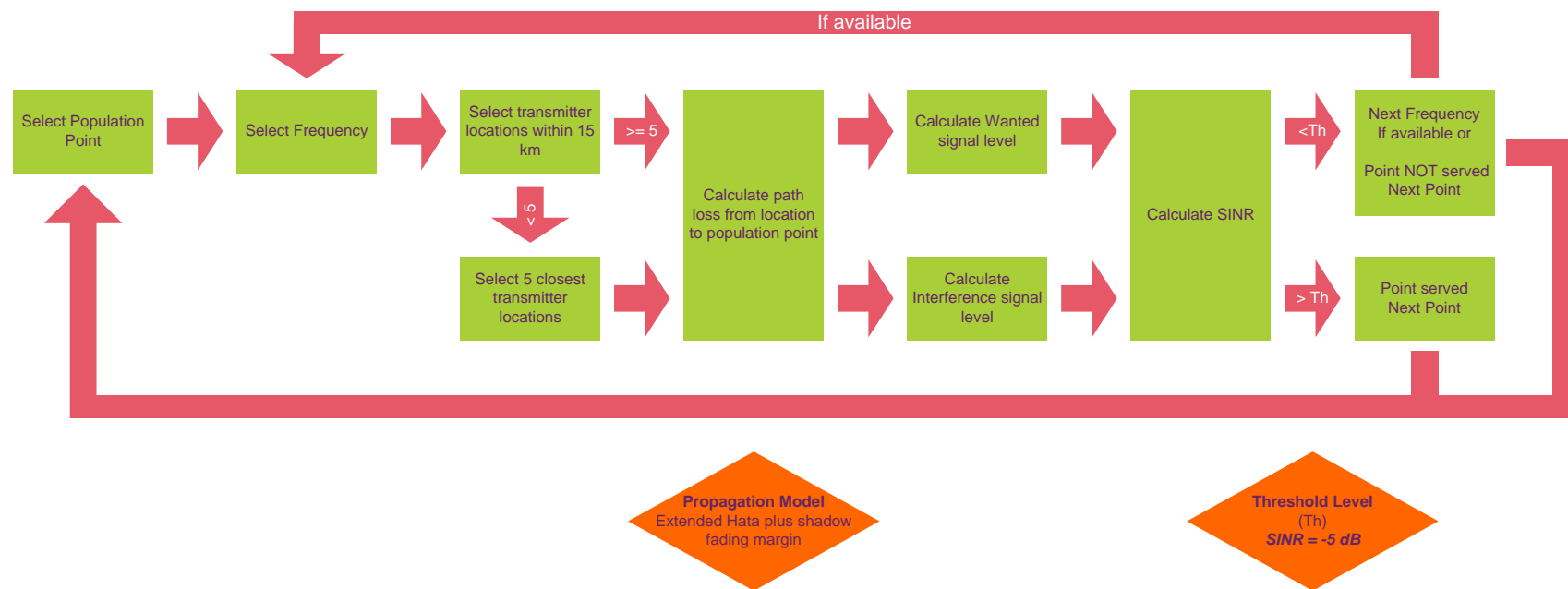 - Azimuth
  - Tilt

Process:

If available

Select Population Point → Select Frequency → Select transmitter locations within 15 km

>= 5 → Calculate path loss from location to population point → Calculate Wanted signal level → Calculate SINR → <Th → Next Frequency If available or Point NOT served Next Point

< 5 → Select 5 closest transmitter locations → Calculate Interference signal level → > Th → Point served Next Point

Propagation Model
Extended Hata plus shadow fading margin

Threshold Level
(Th)
SINR = -5 dB

Figure 4.1 Process overview