# Annex 22 – economies of scale from the coverage network.

## Summary

1.  This annex considers evidence from Ofcom's March 2015 Statement on Mobile Call Termination[1] on the existence of fixed costs and economies of scale for UK mobile network operators of differing markets shares.

2.  Ofcom's modelling of network operating and capital costs shows that there are significant fixed network costs of around €800m a year for a UK operator, regardless of that operator's market share. This is primarily because the cost of the cell site network in rural areas is largely fixed, regardless of operator market share.

3.  Ofcom's approach to non-network administrative costs of nearly €800m a year implies that a large but unquantifiable proportion of those costs are also fixed, regardless of operator market share.

4.  In total therefore, Ofcom's Statement indicates that there are very significant fixed costs for a UK mobile operator, regardless of its market share. If two smaller operators were to merge, Ofcom's own analysis implies that this would enable cost savings of over €1,000m a year.

---

[1] *Mobile call termination market review 2015-18: Statement*, Ofcom, 17 March 2015

# Network costs
## Ofcom's mobile operator model

5.    In March 2015, Ofcom identified a number of separate markets for voice call termination services provided by mobile operators, and designated each operator as having Significant Market Power with respect to the termination of calls to numbers allocated by to that operator.  For each operator, Ofcom imposed a charge control covering the period 1 April 2015 to 31 March 2018, limiting the maximum permitted charge for Mobile Call Termination ("MCT") to an estimate of cost based on the LRIC standard[2], in line with the 2009 EC Recommendation on termination rates ("the EC Recommendation")[3].

6.    In order to arrive at its estimate of MCT LRIC, Ofcom relied on a Bottom-Up LRIC ("BU-LRIC") model that it had developed, adapted from an earlier version of a BU-LRIC model of similar form that it had used in setting the previous charge controls in 2011, also on the basis of LRIC[4].  Both BU-LRIC models are consistent with the approach set out in the 2009 EC Recommendation.

7.    Ofcom's BU-LRIC modelling has been thoroughly tested over the years:

   a)   Ofcom consulted on its 2011 BU-LRIC model extensively during the period 2009 to 2011.  It received detailed comments on a draft version of the model from operators and other stakeholders, before publishing a finalised version of the model in support of its March 2011 final decision on the charge controls[5].

---

[2]  Section 1,*Mobile call termination market review 2015-18:  Statement*, Ofcom, 17 March 2015
[3]  *Commission Recommendation of 7 May 2009 on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU* (2009/396/EC)
[4]  A copy of Ofcom's BU-LRIC model can be downloaded from its website at http://stakeholders.ofcom.org.uk/consultations/mobile-call-termination-14/statement/
[5]  Annexes 6 to 10, *Wholesale mobile voice call termination:  Statement*, Ofcom, 15 March 2011

b) Some operators appealed Ofcom's 2011 decision, claiming that the approach adopted by the BU-LRIC model was flawed and not capable of generating a reasonable estimate of LRIC. Following a detailed investigation, the Competition Commission rejected those claims. While it supported some minor amendments to specific modelling assumptions, it supported Ofcom's modelling approach[6].

c) Ofcom again consulted on its 2015 BU-LRIC model extensively during the period 2013 to 2015[7].

d) No stakeholder has appealed Ofcom's decision to rely on its 2015 BU-LRIC model in setting the charge controls.

8. Ofcom's BU-LRIC model estimates the scale and cost of the network that a hypothetical efficient UK operator would have to deploy in order to carry an assumed level and pattern of network traffic:

a) traffic includes voice, data and messaging services, and is split between 2G, 3G and 4G technologies;

b) the scale of the network required to carry this traffic is estimated through a series of network dimensioning engineering assumptions, including coverage requirements and the traffic capacity of different elements of the network; and

c) unit capital and operating cost assumptions for the various network elements are then applied in order to generate a total network cost.

_____

[6] _Reference under section 193 of the Communications Act 2003: British Telecommunications plc v Office of Communications (Case 1180/3/3/11); Everything Everywhere Limited v Office of Communications (Case 1181/3/3/11); Hutchison 3G UK Limited v Office of Communications (Case 1182/3/3/11); Vodafone Limited v Office of Communications (Case 1183/3/3/11); and Telefónica UK Limited - Determination_, Competition Commission, 9 February 2012

[7] Annexes 7 to 12, _Mobile call termination market review 2015-18: Statement_, Ofcom, 17 March 2015

9. The model is calibrated against actual data from UK operators, in order to make its results as robust as possible:

   a) the level and pattern of traffic assumed in the model is based on total actual and forecast traffic for the whole of the UK;

   b) a market share of approximately 25% is adopted as an input assumption into the model;

   c) the model then estimates the total scale and cost of the network for the 25% UK operator; and

   d) these results are compared against actual asset and accounting data from UK operators, taking into account their relative market shares[8].

10. The model generates a LRIC for MCT by:

    a) using the assumptions above to estimate the scale and cost of the network required to carry all assumed traffic;

    b) using the same assumptions to estimate the scale and cost of the network required to carry all assumed traffic except for MCT; and

    c) calculating the difference between the estimated network costs under the two scenarios, i.e. the LRIC of MCT.

11. As investigated in depth by the Competition Commission, a crucial requirement of this approach is that the model should be capable of estimating the scale and cost of the network over a range of alternative and hypothetical traffic levels, not just those observed for the 25% modelled operator. The Competition Commission concluded that Ofcom's modelling approach has such capability.

12. The significance of this observation is that in addition to generating a robust estimate of network costs at the level of all traffic implied by a 25% market share, the model is also capable of generating robust estimates of network costs at the levels of all traffic implied by other market shares.

---

[8] Annex 9, *Mobile call termination market review 2015-18: Statement*, Ofcom, 17 March 2015

13. The design of Ofcom's own well tested BU-LRIC model therefore means that it can directly and robustly estimate total network costs for UK operators of differing market shares, calibrated against UK traffic, geography, engineering and cost data.

**Network costs implied by Ofcom's mobile operator model**

14. Ofcom's model generates a total annual cost in 2016/17 for the hypothetical modelled operator of €1,727m. That cost is calculated in Current Cost Accounting (CCA) terms, including operating expenditure, capital expenditure and an allowance for a regulated return on capital[9].

15. As noted above, this is based on a UK operator with a market share of approximately 25%. We have amended the market share input assumptions in that model[10] to generate the following total cost figures for a range of market shares in 5% increments, from 0%[11] to 50%. The results are set out in the table below:

| Market share | 2016/17 cost (€m) |
|---|---|
| 0% | 869 |
| 5% | 1,014 |
| 10% | 1,212 |
| 15% | 1,391 |
| 20% | 1,587 |
| 25% | 1,790 |
| 30% | 1,996 |
| 35% | 2,204 |
| 40% | 2,422 |
| 45% | 2,647 |
| 50% | 2,865 |

---

[9] Total cost figures are sourced from rows 2324 to 2473 of the "CCA" sheet in the "HCACCA" module of Ofcom's model. As published by Ofcom, that part of the model appears to work correctly up to 2013/14 but not beyond as the inflation calculations at rows 30 to 35 of the "Parameters" sheet in the "Cost" module have not all been extended beyond this date. We have extended the calculation assumptions to subsequent years, assuming CPI inflation of 2.0%.

The cost figures in Ofcom's model are expressed in real terms in 2012/13 prices, in GBP. The cost figures in this paper are expressed in 2015/16 prices in Euros. We have multiplied 2012/13 prices by a factor of 1.036 to convert them into 2015/16 prices, reflecting the ratio of 2015/16 CPI (estimated at 128.2 based on June 2015 CPI) to 2012/13 CPI (an average of 123.8 over 12 months). CPI figures have been sourced from the Office of National Statistics. We have multiplied the resulting GBP figures by 1.41 to convert them into Euro figures (sourced from Reuters on 09.08.15).

[10] At row 129 of the "Inputs" sheet and row 141 of the "Subscribers" sheet in the "Traffic" module of Ofcom's model.

[11] The model becomes unstable at 0% market share due to the impact of zero values in formulae not designed to accommodate them. We have therefore estimated cost at 0% market share by adopting a market share input assumption of 0.0001%.

16. The scatter graph below shows that same data in graphical form. It can clearly be seen that there is a strong virtually linear correlation between total cost and market share, and that an element of fixed costs remains even at a 0% market share:
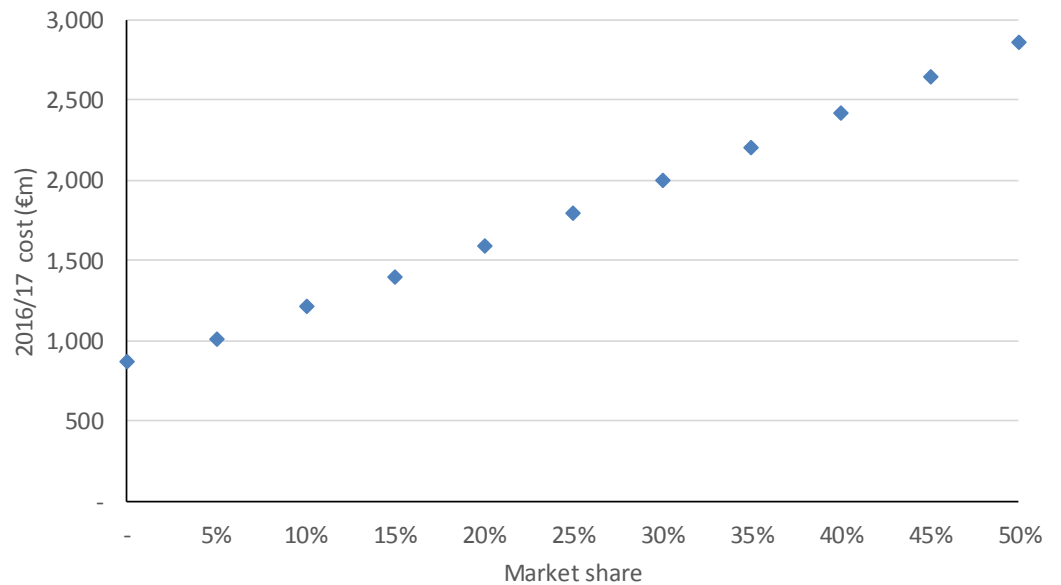


17. The graph is repeated below, with a linear regression line of best fit. The R-squared coefficient of determination is very high, at 0.9981, with a y-axis intercept, i.e. a level of fixed costs, of around €800m a year:



$y = 4032.1x + 809.94$
$R^2 = 0.9981$
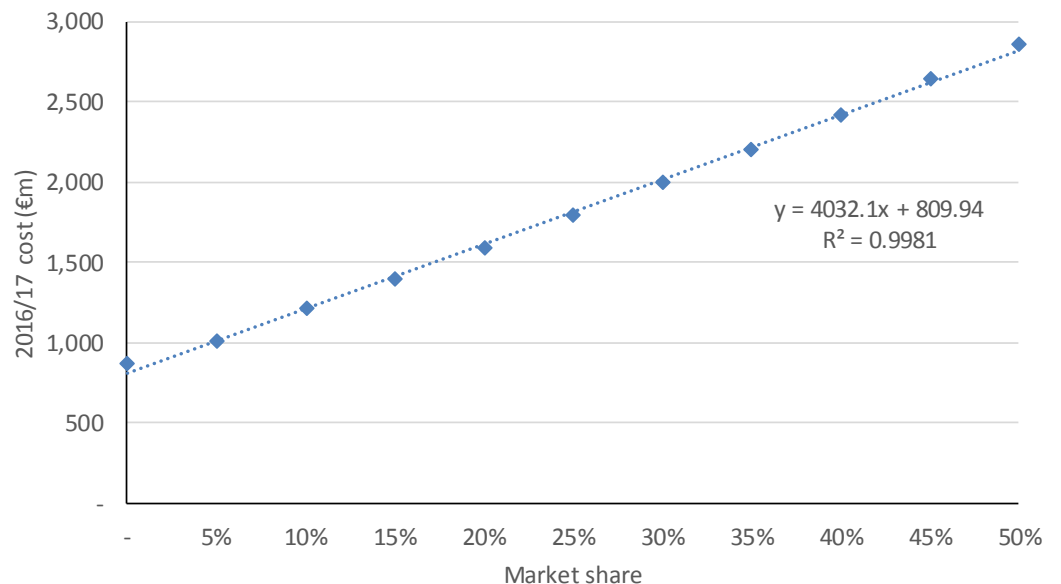
18. An examination of the model reveals the main cause of these fixed costs. Ofcom's model shows that the majority of costs are driven by the number of cell sites required by an operator, and that the total number of cell sites vary with market share in a manner that is broadly similar to the variation in total costs[12]:

● Total

_____
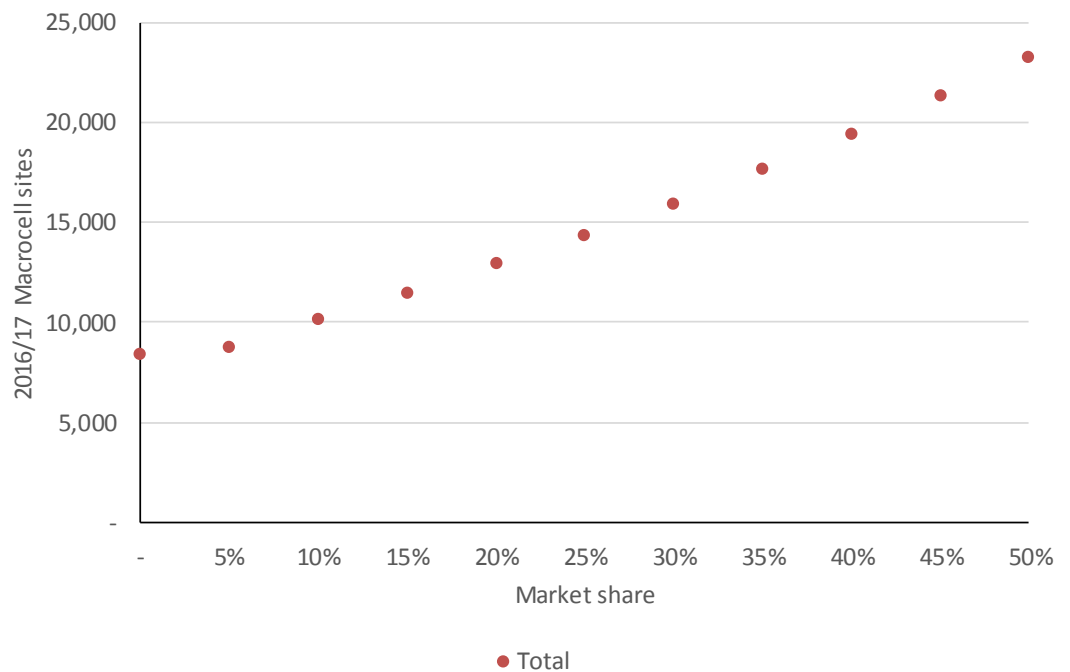
[12] The graph shows macrocell sites, which account for the majority of site costs.

19. Ofcom's model also shows that the variation shown above reflects two distinct components:

    a) a broadly proportional relationship between the number of sites and market share in the denser Urban and Suburban geotypes, where even a small operator has to add new sites to meet traffic demands; and

    b) a broadly fixed relationship between the number of sites and market share in Rural geotypes, where the number of sites required for coverage by any operator, large or small, provides sufficient capacity for even a very large operator[13]:



● Urban and Suburban     ● Rural
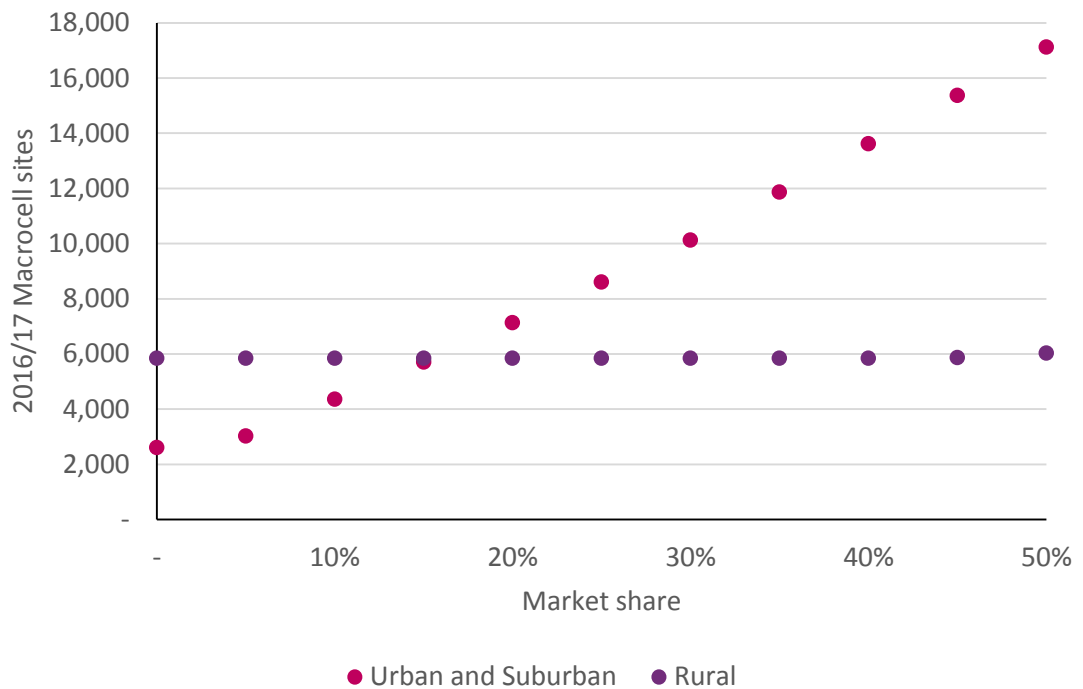
20. In summary, Ofcom's own model shows that there are significant fixed network costs of around €800m a year for a UK operator, regardless of that operator's market share. This is primarily because the cost of the cell site network in rural areas is largely fixed, regardless of operator market share.

---

[13] The "Railway" geotype behaves like a dense geotype and is included within the Urban and Suburban geotypes, whereas the "Highways" geotype behaves like a Rural geotype and is included within that category.

21. The impact of this can be illustrated by using the outputs of Ofcom's model to compare:

    a) network costs for two operators, operator A with 10% market share and operator B with 25% market share; with

    b) network costs for a single operator C with 35% market share.

22. As summarised in the table below, this comparison shows that, relative to a single operator C, two operators A and B would generate:

    a) additional total costs of €800m a year; and

    b) average unit costs that were 36% higher (92% for operator A and 14% for operator B).

| Operator | Market share | 2016/17 cost (€m) | Average cost compared with Operator C |
|---|---|---|---|
| A | 10% | 1,212 | 192% |
| B | 25% | 1,790 | 114% |
| A + B | 35% | 3,002 | 136% |
| C | 35% | 2,204 | 100% |
| A + B v C | | 798 | 36% |

# Non-network costs

23. Ofcom's BU-LRIC model considers only network operating and capital costs. In addition to network costs, Ofcom identifies two other cost categories as related to the running of a UK mobile operator's network:

    a) administrative costs, i.e. general overheads, including overheads for non-network depreciation (IT, furniture and office equipment), property costs, human resources, finance and legal costs, and IT overheads, of €778m a year; and

   b) customer acquisition, retention and service costs ("CARS costs"), i.e. advertising and marketing, discounts and incentives, customer care, billing and bad debts, of €2,441m a year[14].

24. Under Ofcom's approach to MCT, the level of CARS costs does not affect the charge control, so Ofcom only examines the cost behaviour of administrative costs.

25. Unlike network costs, Ofcom does not model the behaviour of administrative costs over a broad range of aggregate traffic levels. Instead, as part of its LRIC approach, Ofcom only considers the degree to which these costs are avoidable in response to the loss of voice call termination traffic. Ofcom concludes that, over this range of traffic levels, administrative costs are fixed, as they are "*common costs that are not sensitive to termination traffic*".

26. The implication of Ofcom's conclusion is that a large proportion of administrative costs of €778m are also fixed, regardless of operator market share, and therefore give rise to economies of scale for larger operators. However, it is not possible to quantify this proportion on the basis of Ofcom's analysis.

---

[14] Paragraphs A11.71 to A11.82, *Mobile call termination market review 2015-18: Statement*, Ofcom, 17 March 2015. Ofcom also identifies a third category of non-network costs, "Other costs", but explains that these do not relate to the running of the UK network.

The cost figures in Ofcom's Statement are expressed in real terms in calendar year 2013 prices, in GBP. The cost figures in this paper are expressed in 2015/16 prices in Euros. I have multiplied 2013 prices by a factor of 1.012 to convert them into 2015/16 prices, reflecting the ratio of 2015/16 CPI (estimated at 128.2 based on June 2015 CPI) to 2013 CPI (an average of 126.1 over 12 months). CPI figures have been sourced from the Office of National Statistics. I have multiplied the resulting GBP figures by 1.41 to convert them into Euro figures (sourced from Reuters on 09.08.15)