Annex F

Explanation of LRIC and the LRIC+ target charge

1 Use of LRIC as the cost base

F.1 As stated in the May consultation, the Director's view is that the most appropriate and economically efficient basis for regulatory charge controls is forward-looking LRIC. The LRIC of voice termination is the additional cost an MNO incurs to provide termination. This can also be seen as the cost that the firm would avoid if it decided not to provide voice termination, taking a long-run perspective. It corresponds more closely to the charges that would prevail in an effectively competitive market than accounting-based measures of cost. It is a fundamental goal of price regulation to mimic the effects of a competitive market and this consideration underpins the use of LRIC.

F.2 LRIC is widely used as a regulatory costing technique, for example by other NRAs in Europe, and by the FCC in the US. It has also been identified as the most appropriate methodology to use for setting interconnection charges by the European Commission in its 1998 Recommendation on Interconnection. For further details, see *The Use of Long Run Incremental Cost (LRIC) as a Costing Methodology in Regulation*, 12 February 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/lric120202.pdf. Furthermore, the Competition Commission (CC) has agreed, as stated in paragraph 2.251 of its December 2002 report[42], with the use of LRIC as the appropriate costing methodology for setting termination charges.

F.3 The Director's view remains unchanged that the only relevant costs for the purposes of setting the charge controls are those relevant to 2G voice termination. This excludes 3G costs which the MNOs can recover through their unregulated 3G charges. The CC took the same view as the Director on this issue as stated in paragraph 2.251 of the CC report.

2 LRIC model

F.4 The purpose of the LRIC model used by the Director is to derive the costs of a reasonably efficient 2G mobile operator in the UK. In April 2002, the Director made available the latest version of the model that considered a voice-only network. The model and supporting documentation are available at http://www.analysys.com/ukmobilelric. Further detailed papers are also available: *Source of algorithms, data, assumptions and estimates,* http://www.oftel.gov.uk/publications/mobile/ctm_2002/analysis300102.pdf; and *Manual for the Oftel LRIC model*, http://www.oftel.gov.uk/publications/mobile/ctm_2002/slides300102.pdf

F.5 In designing the model, the Director considered five key issues, each of which are summarised briefly in the May consultation:

[42] Competition Commission's report on Vodafone, O_2, Orange and T-Mobile, December 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2003/index.htm.

- the length of the **time period** over which cost behaviour would be considered (see also *Network Common Costs*, 19 February 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/network_costs.pdf);
- the definition of the **increment** (see also *Network Common Costs* (referred to above) and *Different Views of Oftel and MNOs on Network Common Costs*, 27 May 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/common_cost0602.pdf);
- the definition of **common costs** and how these should be recovered (see also *Network Common Costs,* and *Different Views of Oftel and MNOs on Network Common Costs* (referred to above));
- the **level of efficiency** to be assumed; and
- the **depreciation method** to be used (see also *Calls to mobile: economic depreciation*, September 2001, http://www.oftel.gov.uk/publications/mobile/depr0901.htm, and *Additional Information Concerning Oftel's LRIC Model*, 12 February 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/lric_more120202.pdf, and *Accounting depreciation cost based estimates*, 3 May 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/account_let0502.pdf).

F.6 In its review of the charges for calls to mobiles, the CC agreed with these general principles and that the April 2002 LRIC model was a suitable starting point for the assessment of the costs of terminating calls on mobile networks (paragraph 2.287 in their report).

3 Adjustments to the LRIC model output

F.7 The charge controls set out in this market review are based on the costs of terminating calls on a 2G mobile network as calculated by the April 2002 LRIC model. However, in the light of the CC's investigation and the CC report, as well as responses received to the May consultation, the Director has considered a number of issues and potential adjustments concerning the output of the April 2002 model. These issues are as follows and are discussed in turn below.

- Cost of capital;
- Amendments to the LRIC model calculation;
- Comparison with MNO data;
- Market share;
- Network common costs; and
- Non-network common costs.

3.1 Cost of capital

F.8 As stated in the May consultation, the appropriate cost of capital in the context of this market review is the cost of capital for a reasonably efficient 2G mobile operator in the UK, and in particular, the cost of capital regarding 2G termination services.

F.9 The model made available in April 2002 calculates the LRIC on the basis of a 12.5% pre-tax real cost of capital in 2003/04 and subsequent years. The Director has updated each of the components of the CAPM used to derive an estimate for the cost of capital in the light of more recent information. On this basis, the Director estimates the pre-tax real cost of capital to be in the range of 10.3% to 14.3% with a mid-point of 12.25%, which is a small increase from the 12% that he proposed in the May consultation, based on the best available information at that time. Further details of the derivation of this range are provided in Annex E.

F.10 The resulting adjustment to the output from the April 2002 LRIC model, in relation to that proposed in the May consultation (based on a lower cost of capital of 12%), is shown in the table below with LRIC+ in 2005/06 just under 1% higher.

Table 1: Adjustment to April 2002 LRIC model output for 12.25% cost of capital

Pence per minute (real 2000/01)	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators					
LRIC+ at 12% CoC (May consultation)	4.86	4.57	3.90	3.70	3.53
LRIC+ at 12.25% CoC	4.84	4.55	3.93	3.74	3.56
Difference	-0.02	-0.03	0.04	0.03	0.03
Percentage	-0.5%	-0.5%	1.0%	0.9%	0.8%
1800MHz operators					
LRIC+ at 12% CoC (May consultation)	6.06	5.67	4.77	4.50	4.27
LRIC+ at 12.25% CoC	6.03	5.64	4.82	4.55	4.31
Difference	-0.03	-0.03	0.05	0.05	0.04
Percentage	-0.5%	-0.5%	1.1%	1.0%	0.9%

3.2 Amendments to the LRIC model calculation

F.11 In response to the proposals set out in the May consultation, the Director received substantial comments from interested parties submitting that amendments to the LRIC model calculation were necessary. The Director has addressed these responses by amending the LRIC model where he believes it to be appropriate. These issues are discussed under the following headings:

- Amend inputs to LRIC model with operator data;
- Correct mechanical error regarding 32Mbit/s links;
- Correct HCA calculation of GBV for removed assets;
- Revise treatment and allocation of location update costs;
- Revise allocation of GSM licence fee and NMS costs;
- Revise asset lifetimes used in the model; and
- Revise asset prices used in the model after 2010.

3.2.1 Amend inputs to LRIC model with operator data

F.12 In paragraphs A.2.2 and A.2.7 to A.2.15 of its response to the May consultation, Vodafone argues that the Director should amend the model inputs and parameters to calibrate against the cost and equipment for Vodafone and data provided by each of the operators separately in order to deduce the fair charge in 2005/06. Vodafone submits that it is inadequate to calibrate an unmodified model

against averaged operator data at a single point in history and then make exogenous adjustments.

F.13 Vodafone's approach necessarily focuses on the micro-detail of the numerous model inputs and, in the Director's view, does not replace the need for a more macro-level reconciliation with operator data to confirm that the model outputs are sensible, which may still result in the need for further adjustment. Indeed, the requirement to compare model results with operator data, even after detailed modification of inputs, appears to be a view shared by Vodafone (paragraph A.2.15). The key requirement of the exercise is to obtain a good estimate for the cost of mobile termination in 2005/06 of an average, reasonably efficient, operator rather than more detailed results for any specific operator. In view of this, the Director believes that his approach is reasonable and fit for purpose.

F.14 Whilst the Director agrees that Vodafone's approach would potentially result in greater fidelity of the model, given that more detailed results are not required for the purpose of setting the charge control, he believes that in present circumstances it would be disproportionate to adopt such an onerous, data intensive and time consuming exercise.

3.2.2 Correct mechanical error regarding 32Mbit/s links

F.15 Vodafone states in paragraph A.2.54 of its response that 32Mbit/s links disappear in the model from 2000/01, falling from 292 to zero. Vodafone also states that this results in a similar problem regarding BSC-MSC ports and MSC-BSC ports.

F.16 The Director agrees that 32Mbit/s BSC-MSC links erroneously disappear from the model in 2000/01. Correcting the model in row 659 of the Network_Design_Full sheet of the Netw_R2.xls file (as suggested by Vodafone) so that more than one 32Mbit/s link can be deployed per BSC site (if required by traffic demand) ensures that 32Mbit/s links remain deployed within the model. Furthermore, the identified error regarding BSC-MSC and MSC-BSC ports resolves itself as these cost elements are driven by BSC-MSC transmission requirements. This correction has the impact of slightly increasing the cost of termination in the model, by around 0.6% in 2005/06 (see Table below).

Table 2: 32Mbit/s link corrected results[43]

Pence per minute (real 00/01)	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators						
Original number of 32Mbit/s hops	292	0	0	0	0	0
Revised number of hops	292	656	680	696	712	744
LRIC+		4.84	4.55	3.93	3.74	3.56
LRIC+ revised		4.86	4.57	3.96	3.76	3.58
Difference		0.02	0.02	0.02	0.02	0.02
Percentage		0.4%	0.4%	0.6%	0.7%	0.7%
1800MHz operators						
Original number of 32Mbit/s hops	292	0	0	0	0	0
Revised number of hops	292	648	656	664	672	696
LRIC+		6.03	5.64	4.82	4.55	4.31

[43] After increasing the cost of capital to 12.25%.

LRIC+ revised	6.05	5.66	4.84	4.57	4.33
Difference	0.02	0.02	0.02	0.02	0.02
Percentage	0.3%	0.3%	0.5%	0.5%	0.5%

F.17 However, as discussed in section 3.3, in order to address concerns over the LRIC model's accuracy, the Director has compared the output of the LRIC model with cost accounting information submitted by the MNOs during the CC's investigations. This process results in an upwards capital cost adjustment and a downwards operating cost adjustment, the former based on a comparison of gross book value (GBV). Note that the amendment to the treatment of 32Mbit/s links results in increased GBV of £11m (approximately 0.5%) and hence the capital cost adjustment required following reconciliation with the MNO accounts is reduced. The impact of this amendment *after* reconciliation with the MNOs' data is therefore much smaller and has a negligible effect on the fair target charge in 2005/06.

3.2.3 Correct HCA calculation of GBV for removed assets

F.18 In paragraphs A.2.29 to A.2.36 of its response to the May consultation, Vodafone submits that the calculation methodology used to derive network GBV on a historic cost accounting (HCA) basis for the purpose of comparing capital costs derived by the model with MNO cost accounting data is flawed as it makes no allowance for decreasing equipment quantities. Vodafone states that the GBV calculation continues to hold the GBV associated with assets that have been eliminated from the network, thus overstating the calculated GBV in relation to the assets actually deployed in the model. As a result, in Vodafone's opinion, the capital cost adjustment factor, which uplifts the model GBV to equate to that of the MNOs accounts, should be significantly higher.

F.19 Orange raises the same point in its response (section 10.4.2.1.5), reaching an identical conclusion and proposed solution.

F.20 The issue raised encompasses three different specific types of behaviour in the calculation of GBV in the model:

- missing equipment (32 Mbit/s links, associated BSC:MSC ports);
- equipment which has been "swapped out" (2 mbit/s microwave links, 16mbit/s microwave links);
- equipment which declines in quantity from a peak around the year 2000, and then recovers in deployment by around 2005/06 (3-sector macro cell sites, 140Mbit/s backbone links).

Missing equipment

F.21 Due to the mechanical error in the model algorithm regarding 32Mbit/s links (acknowledged in the preceding section), the Director agrees with Vodafone's analysis (in paragraph A.2.65 of its response) that correction of this error results in an increase in GBV of 0.6% from £1,879m to £1,891m in 2001/02 for a 900/1800MHz operator, and from £2,044m to £2,055m for a 1800MHz operator.

F.22 Despite the fact that the uncorrected model erroneously removes these links (see preceding section), the issue identified in this section means that the GBV is correctly retained in the HCA model's GBV calculation. Hence, with regards to 32Mbit/s links, the Director does not agree that the GBV is overstated. In fact, since the uncorrected model retains the GBV associated with the missing links, but does not add the GBV of the additional links required, the model actually understates GBV. This is confirmed by the correction to the model algorithm regarding 32Mbit/s links (described in the preceding section), that results in GBV increasing by £12m in 2001/02, as acknowledged by Vodafone.

Swapped out equipment

F.23 The Director acknowledges that the model overstates GBV due to double counting of GBV from both new and swapped out microwave links.

F.24 Vodafone and Orange suggest that the appropriate correction is to reduce the model GBV associated with the swapped out links which then results in a higher upwards capital adjustment when compared with the GBV from the MNOs' accounts. However, the Director believes that this method is likely to overstate the size of correction required as it gives no consideration to the potential for system upgrades (for example upgrading a 2Mbit/s microwave link to 8Mbit/s). Taking this approach effectively assumes that as traffic demand grows and smaller microwave links no longer have sufficient capacity, these links are thrown away (without realising any residual value) and new larger capacity links are purchased to replace them. The Director believes that it is more realistic to consider that such links would be upgraded, thus the GBV associated with the original smaller link would remain but when capacity is exhausted a smaller capital cost is incurred, being the incremental cost associated with the upgrade. He therefore believes that it is more reasonable to amend the model to reflect this situation than apply the solution suggested by Vodafone and Orange. This can be achieved relatively simply by amending the Netw_R2.xls model file in the following areas:

- Network_deployment sheet, cells F74-Y74: change the named range from "Full.Backhaul.uwaves.2Mbs" to "Full.Backhaul.uwaves.2Mbs+Full.Backhaul.uwaves.8Mbs";
- Network_deployment sheet, cells F87-Y87: change the named range from "Full.Backhaul.uwaves.16Mbs" to "Full.Backhaul.uwaves.16Mbs+Full.Backhaul.uwaves.32Mbs";
- Unit_cost_data, cell C45: change 16,500 to 1,500 (the increment between 2Mbit/s and 8Mbit/s links);
- Unit_cost_data, cell C47: change 19,965 to 1,815 (the increment between 16Mbit/s and 32Mbit/s links).

F.25 The impact of this amendment[44] is a negligible change to the economic cost in 2005/06 as reported by the model, but a decrease in the model GBV in 2001/02 of about 3.5% as expected.

[44] after having increased the cost of capital to 12.25%, and corrected the model for the 32Mbit/s link issue described in section 3.2.2

Equipment that declines in quantity but then recovers

F.26 The number of 3-sector macro cell sites peaks prior to the calibration point in 2001 before declining and then increasing again by 2005/06. This behaviour is due to a period of rapid growth prior to the calibration point followed by slower growth and the properties of the model's look-ahead algorithm. The economic cost calculations in the model assume that the number of sites decreases during this period and hence, whilst operating costs decline with the installed base before increasing again, it also assumes that the initial investments are required to be re-purchased when site numbers increase again. The HCA model calculation also assumes that operating costs decline with the installed base but, in contrast, assumes that the GBV of all assets is retained and so any decrease in asset numbers is double counted as retained GBV. The Director acknowledges that this is an inconsistent treatment and pertinent to the comparison with MNO data given that the reconciliation occurs during the transient dip in site count.

F.27 However, the Director believes that it is unrealistic to assume that an operator would prematurely remove recently installed assets likely to be used a short time in the future, even if there was a transient relaxation of demand growth. Thus he believes that it is more appropriate to reconsider the assumptions underlying the economic cost calculation rather than merely adjusting the HCA model calculation of GBV as Vodafone and Orange suggest. On this basis, the Director has amended the model so that it does not allow removal of such assets. This can be achieved relatively simply by amending the Netw_R2.xls model file in the following way to prevent the relevant equipment from temporarily declining:

- Network_Design_Full, rows 152-162, 386, 710, 727, 740, 749, 767: for each of these rows, change the formulae in columns F to X to equal the maximum of the original formula and the cell immediately to the left (the previous year's value).

F.28 There are two counteracting factors to consider in regards to the economic cost result:

- capital expenditure is reduced as a result of no longer requiring to re-purchase assets;
- operating expenditure is increased over the period due to a greater number of assets and assets which are of older vintage.

F.29 The impact of increased operating costs is greater (after having increased the cost of capital to 12.25%, corrected the model for the 32Mbit/s links and swapped out equipment issues already discussed), resulting in an increase of about 1% in the economic cost of termination in 2005/06. However, these model results are prior to reconciliation with the MNO data in 2001. As a result of modifying the model to retain all previous assets, whilst there is negligible change in the resulting GBV from the HCA model calculation on average[45], there is an increase in the operating costs in the reconciliation year since the installed base no longer decreases. This equates to

[45] GBV in 2000/01 actually increases slightly for 900MHz operators, but decreases slightly for 1800MHz operators

an increase in operating costs of almost 3% in 2001 which results in a larger downwards operating cost adjustment after reconciliation with the operators' accounts and counteracts the small increase in the economic cost in 2005/06 so that the net impact of the amendment to address declining equipment is negligible.

F.30 The overall impact resulting from the two further amendments described in this section are shown below.

Table 3: Swapped out and declining equipment corrected results[46]

Pence per minute (real 00/01)	01/02	02/03	03/04	04/05	05/06	GBV[47] (£m)	Opex[48] (£m)
900/1800MHz operators							
LRIC+	4.86	4.57	3.96	3.76	3.58	1,891	339
LRIC+ revised	4.84	4.56	3.98	3.79	3.62	1,835	348
Difference	-0.02	-0.01	0.02	0.03	0.04	-56	9
Percentage	-0.5%	-0.2%	0.5%	0.7%	1.0%	-3.0%	2.8%
1800MHz operators							
LRIC+	6.05	5.66	4.84	4.57	4.33	2,055	398
LRIC+ revised	6.03	5.65	4.85	4.59	4.36	1,983	410
Difference	-0.02	-0.01	0.01	0.02	0.02	-71	11
Percentage	-0.3%	-0.2%	0.2%	0.4%	0.5%	-3.5%	2.9%

3.2.4 Revise treatment and allocation of location update costs

F.31 Vodafone (paragraph A.2.55), Orange (section 10.4.2.1.1) and T-Mobile (paragraph 4.65) state in their responses that costs associated with HLR location update costs should be allocated to on-net and inbound calls rather than allocated to subscribers, referring to the CC report (paragraphs 2.270-2.271).

F.32 Furthermore, the model uses a value of 1400ms per customer per busy hour year for MSC dimensioning purposes. Vodafone argues (in paragraph A.2.57 of its response) that whilst this value is reasonable, this same value of 1400ms is used as the measure of *total* (rather than busy hour) location update effort per customer per year for the purposes of weighting the economic costs of MSCs. Given that the busy hour to day ratio is assumed to be 10%, this latter figure should be 14,000ms not 1400ms. In section 10.4.2.1.1 of its response, Orange raises the same issue.

F.33 The Director previously stated that it is economically most efficient to recover the cost of location updates by means of a per subscriber charge given that this cost is driven by the number of (active) subscribers within mobile networks regardless of the volume of incoming calls that they generate. However, the Director also recognises that the primary purpose of location updates is to enable an incoming call to reach the intended mobile handset and hence a case can be made for allocating the associated costs to on-net and inbound calls. The Director believes that there is merit in both approaches, but on further consideration of the CC's view has decided that it is reasonable to allocate location update and HLR costs to on-net and inbound calls.

[46] After increasing the cost of capital to 12.25% and correcting for 32Mbit/s links
[47] From HCA model in 2001/02 (real 2000/01)
[48] From HCA model in 2000/01 for 900/1800MHz operators and weighted average of 2000/01 and 2001/02 for 1800MHz operators (real 2000/01)

F.34 Regarding the second point raised, the Director agrees that the model assumes that 1400ms of MSC processing occurs in 250 busy hours for each subscriber per year and hence 14,000ms is the appropriate total processing occurring in 365 days, for each subscriber per year. Whilst total MSC deployments are correctly driven by peak ms, the LRIC model aims to calculate total output (for economic depreciation) of MSCs according to total annual milliseconds output due to traffic and total loading per subscriber per year. Hence the Director agrees that the routeing factor for location updates should be increased by a factor of 10 to 14,000ms[49]. The Director calculates that the amendment increases the total economic cost of location updates in the MSC by approximately a factor of two, since the change in routeing factors increases the proportion of MSC costs being allocated to location updates rather than call minutes.

F.35 In investigating the issue raised by Vodafone and Orange, the Director has identified a further inconsistency regarding the call related routeing factors for MSC ms processing. The LRIC model calculates MSC demand by taking total annual milliseconds output due to traffic (minutes) and annual location update processor loading per subscriber per year. However, the first of these components is calculated in the LRIC model by taking annual traffic in minutes and multiplying by the per call attempt ms factor. This is inconsistent as it results in output in terms of calls not minutes. Hence the Director has applied a further revision to the model, incorporating a '1/call duration' factor into each minute weighted routeing factor[50]. This has the impact of slightly increasing the cost of termination relative to the other traffic types (due to the relatively shorter call duration).

F.36 Amending the routing factors as described above and calculating the impact of reallocating the costs of location updates and HLRs, by dividing the total economic cost of location updates and HLR (previously allocated to subscribers) by the total volume of incoming and on-net minutes, increases the cost of termination in the model by about 0.15 pence per minute in 2005/06.

Table 4: Location update / HLR amended routing factors and allocation[51]

Pence per minute (real 2000/01)	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators					
Original cost of subs due to LU / HLR (£m)	10.93	10.61	9.05	8.28	7.64
Revised cost of subs due to LU / HLR (£m)	25.82	25.32	21.87	20.20	18.81
Location updates + HLR per minute	0.26	0.24	0.21	0.19	0.17
LRIC+	4.84	4.56	3.98	3.79	3.62
LRIC+ revised (routing factors and alloc)[52]	5.07	4.76	4.16	3.95	3.76

[49] This can be achieved by multiplying the original formulae in cells F46-F51 of the Network Element Output sheet in the Netw_R2.xls file by a factor of 10.
[50] This can be achieved by multiplying the original formulae in cells G46-G51, H46-H51, and I46-I51 of the Network Element Output sheet in the Netw_R2.xls file by Calls_per_minute_OLO_mobile, Calls_per_minute_mobile_OLO, and Calls_per_minute_onnet respectively.
[51] After increasing the cost of capital to 12.25%, correcting for missing 32Mbit/s links, swapped out equipment and decline in equipment.
[52] The LRIC+ revised figure for termination is lower than the sum of the original LRIC+ of termination and the cost of location updates and HLR since the amendment in routing factors for MSC costs not only results in an increase in the MSC cost for location updates but a corresponding reduction in the MSC costs for incoming calls.

Difference	0.23	0.20	0.18	0.16	0.15
Percentage	4.7%	4.5%	4.5%	4.3%	4.0%
900/1800MHz operators					
Original cost of subs due to LU / HLR (£m)	10.93	10.61	9.05	8.28	7.64
Revised cost of subs due to LU / HLR (£m)	25.82	25.32	21.87	20.20	18.81
Location updates + HLR per minute	0.26	0.24	0.21	0.19	0.17
LRIC+	6.03	5.65	4.85	4.59	4.36
LRIC+ revised (routing factors and alloc)	6.26	5.85	5.03	4.75	4.50
Difference	0.23	0.20	0.18	0.16	0.15
Percentage	3.8%	3.6%	3.6%	3.5%	3.3%

3.2.5 Revise allocation of GSM licence fee and NMS costs

F.37 In paragraph A.2.63 of its response to the May consultation, Vodafone submits that it is inappropriate to weight the GSM licence fee and the network management system (NMS) costs in the proportions of 1:1:2 between incoming, outgoing and on-net calls (the same allocation rule as used for direct costs in the radio layer). Rather, Vodafone proposes that the costs for both these asset types should be recovered by an equal allocation across all traffic types. However, Vodafone acknowledges that even if its proposed amendment was implemented, the amendment is relatively immaterial and as a consequence Vodafone itself has not included the amendment in its revised calculations.

F.38 The Director believes that the routeing factors used in the model for the GSM licence fee are appropriate. The licence fee is levied for the use of radio spectrum and, as for other costs associated with the radio layer, on-net calls use the air interface twice as much in comparison to incoming or outgoing calls.

F.39 Regarding NMS costs, the Director has treated these costs as common and hence the routeing factors that appear in the model are effectively inconsequential[53].

3.2.6 Revise asset lifetimes used in the model

F.40 Orange submits that the assets lives used within the LRIC model are overstated and hence fail to recover the actual capital investment of operators (section 10.4.2.1.4 and Appendix 5 of Orange's response). Whilst adjustments are made following comparison of operating costs and asset GBV between the LRIC model and MNOs' accounts, Orange expresses concern that no such adjustment is made with regards to capital cost recovery.

F.41 In paragraphs 4.54-4.58 of its response, T-Mobile also raises concern regarding the asset lives used in the LRIC model which it regards as significantly overstated but, unlike Orange, does not attempt to quantify the impact.

F.42 As recognised in Orange's response, the asset lifetimes used in the LRIC model are derived as part of the economic depreciation calculation in the September

[53] In practice there would be a very small impact resulting from a change in the routeing factor for on-net calls from 2 to 1 since the total economic cost of NMS in a given year depends on the unit cost, which in turn is determined by the average growth rate. The average growth rate depends on the routeing factors since the growth rate of each type of traffic differs slightly. However, the discrepancy is negligible, being of the order of 0.002 pence per minute to the economic cost in 2005/06.

2001 version of the model. This calculation derives asset lifetimes recognising, amongst a range of considerations, the trade-off between increased capital costs if assets are replaced more frequently and increased operating costs associated with older assets if they are replaced less frequently. Given this endogenous calculation, appropriate consideration should be given to the need for internal consistency rather than simply changing asset lifetimes without regard to the impact on the 'age on age' operating cost profile. In a similar manner, the need for internal consistency provides some caution against simply reducing lifetimes in response to issues of technological change or obsolescence that are, in any case, ultimately addressed through reconciliation with operator data.

F.43 The Director has attempted to replicate Orange's calculations as set out in its Appendix 5 and has generated similar results, but disagrees with Orange's subsequent use of these results and hence conclusion.

F.44 If the lifetimes of all network elements in the LRIC model are reduced in accordance with those suggested by Orange, the Director obtains the following results:

- capital cost recovery is higher, as suggested by Orange (Appendix 5);
- operating cost recovery is lower;
- the combination of higher capital cost recovery and lower operating cost recovery balances the effects to give an uplift on the cost of termination of around 1% on a pence per minute basis in 2005/06.

F.45 This result is broadly consistent with the result obtained when the Director implemented the same lifetime sensitivity test in December 2001, at the request of Orange, in that:

- capital cost recovery is increased due to the need to recover capital cost over a shorter period of time;
- operating cost recovery is reduced, because operating costs over the (shorter) lifetimes of assets is lower – the increased opex associated with assets in their later years is not incurred as the assets are replaced with a new version before this happens.

F.46 The Director is still therefore of the view that reducing the lifetime of network elements does not have a significant impact on the economic cost of termination as determined by the model in 2005/06. This is the year of interest because the charge control reflects the cost in that year. This suggests that the key model results are not sensitive to asset lifetimes.

F.47 Regarding the capital and operating cost adjustments following comparison with the MNOs' accounts, it is far from clear that any further modification is appropriate. This is due in part to the uncertainty regarding the most appropriate values for the economic lifetime of different network assets since the evidence submitted by the MNOs is mixed. However, even if there was a significantly greater uniformity regarding economic lifetimes, the comparison of capital costs between the model and the MNOs' accounts using GBV figures is a relatively high level process and is sensitive to the particular timing of asset replacement. This is essentially due

to a modelling artefact which simplifies the nature of asset replacement, assuming that complete replacement of equipment of one vintage occurs in a single year, which is highly unlikely in practice. For example, whilst Orange's proposed asset lifetimes result in a slightly higher 2005/06 cost of termination after reconciliation with operator data, best estimates for T-Mobile's asset lifetimes lead to a slightly lower cost of termination resulting from the model, even after reconciliation with operator data. The Director therefore finds no compelling evidence to adopt a different position. He believes that the lifetimes used in the LRIC model produce a reasonable estimate for the cost of termination, and that the results of the model in 2005/06 are not materially influenced by the adoption of shorter asset lifetimes.

3.2.7 Revise asset prices used in the model after 2010

F.48 In paragraphs A.2.70 to A.2.79 of its response, Vodafone submits that the demand and price trends in the LRIC model are unreasonable. The model assumes continued rising traffic demand and frozen asset prices from 2010 onwards. Vodafone believes the model should be amended so that asset prices continue to fall beyond 2010 (treating the model as an approximate surrogate for a combined 2G and 3G network and representing continued development in 3G equipment). Alternatively, Vodafone submits that the volumes of voice traffic in the model should be progressively reduced, reflecting the migration of voice traffic from 2G to 3G.

F.49 The Director does not agree that either of the proposed amendments is appropriate since neither of these is consistent with the underlying modelled scenario. Whilst the Director acknowledges that in reality it is likely that voice traffic on the existing 2G networks will, in the future, partially migrate to 3G networks, the model does not attempt to represent this outcome. Rather, for the purposes of regulating 2G termination charges, the Director has modelled voice traffic *as if* all future voice traffic is carried on a 2G network of a reasonably efficient operator. The Director believes that this represents an appropriate ceiling for the calculation of the costs associated with voice termination. The Director views the timing and rate of migration of voice traffic from 2G to 3G networks as a decision to be made by operators based on cost advantages and other commercial considerations.

F.50 As stated in paragraph 2.317 of the CC report, the CC agreed with the Director that it is more reasonable and conservative to assume that equipment prices would remain constant in real terms rather than continuing to fall after 20 years of cost reductions.

3.2.8 Summary

F.51 The overall impact of the amendments made to the model regarding missing 32Mbit/s links, addressing swapped-out and declining equipment levels, and correcting MSC routing factors for location updates and allocation to incoming and on-net traffic, is summarised in the table below.

Table 5: Summary of impact of amendments on LRIC model results

Pence per minute (real 2000/01)	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators					

LRIC+ at 12.25% CoC	4.84	4.55	3.93	3.74	3.56
LRIC+ revised	5.07	4.76	4.16	3.95	3.76
Difference	0.23	0.21	0.22	0.21	0.21
Percentage	4.7%	4.7%	5.6%	5.7%	5.8%
1800MHz operators					
LRIC+ at 12.25% CoC	6.03	5.64	4.82	4.55	4.31
LRIC+ revised	6.26	5.85	5.03	4.75	4.50
Difference	0.23	0.21	0.21	0.20	0.19
Percentage	3.8%	3.8%	4.4%	4.4%	4.4%

F.52 The revised LRIC model figures for 2005/06, shown in the table above, are 0.23ppm (in real 2000/01 terms) higher than the equivalent figures presented in the May consultation (taking account of both the amendments summarised above as well as the increase in the cost of capital from 12% to 12.25%), for both combined 900/1800MHz operators and 1800MHz operators.

3.3 Comparison with MNO data

F.53 As stated in the May consultation, in order to address concerns over the accuracy of the LRIC model, the Director has undertaken a comparison between the outputs of the model and actual cost accounting data from the mobile operators. The Director has derived adjustments to be applied to the output of the LRIC model following the methodology below, as proposed by the CC in its inquiry:

i. separating network from non-network costs in the MNOs' information;
ii. averaging across the resulting information from the four MNOs;
iii. averaging the outputs of Oftel's LRIC model for the combined 900/1800MHz and 1800MHz operators;
iv. comparing ii. and iii. at the level of total network costs to derive (separately) capital and operating cost adjustments; and
v. comparing the actual equipment deployments of the combined 900/1800MHz and 1800MHz MNOs to derive the 900MHz adjustment.

3.3.1 MNO network cost information

F.54 As the starting point for the analysis, in the May consultation the Director took an average gross book value (GBV) across the four MNOs of £2,680m as at September 2001 (see Table 7.6 of the CC's report) to compare with that calculated by the LRIC model in order to determine the appropriate capital cost adjustment. Similarly, the Director took the average of network operating costs (excluding depreciation) across the four operators of £338m for the year to March or December 2001 (see Table 7.7 of the CC's report) in order to determine the appropriate operating cost adjustment.

GBV cost information misinterpreted

F.55 In section 10.4.2.1.6 of its response, Orange states that in supplying its network costs for 2001 to the CC it had already excluded data specific costs. Orange therefore argues that applying a further data adjustment factor is inappropriate.

F.56 Based on examining further information from Orange requested by the Director in support of its argument, the Director is of the opinion that the figure used by the CC for Orange's total GBV did already exclude Orange's allocation of GBV to data services. Hence, the Director has amended Orange's total GBV figure by multiplying it by a factor of 1/(1-*x*%), where *x*% is the percentage of total network costs that Orange had already excluded, in order to derive an average *total* GBV figure based on appropriate figures from all four operators. This results in an amended GBV across the four MNOs of £2,710m at September 2001, as compared to the figure of £2,680m used in the May consultation.

Operating leases for network equipment

F.57 Orange also states (in section 10.4.2.1.7 of its response) that in order for comparison between the model outputs and the operators' actual GBV to be on a consistent basis, it is necessary to capitalise assets funded through operating leases and make a corresponding adjustment to operating costs.

F.58 The Director's view is that amending his reconciliation exercise to reflect Orange's comments would not be appropriate. His rationale is outlined below.

F.59 Assessing the impact of assets being funded through operating leases is a difficult exercise. For example, were such an adjustment to be made it would be appropriate to make a corresponding adjustment to the gearing level and equity beta in the cost of capital estimation which may be subject to significant potential variation.

F.60 More importantly, the extent to which the MNOs are reliant on leased network assets is unlikely to remain stable over time. The estimates supplied by Orange concerning the scale of this effect are a snapshot and as such only relate to current or recent trends. The proportion of leased assets in the MNOs' network at the time of the calculation of the target charge in 2005/06 is difficult to predict.

F.61 Orange's proposed adjustment effectively involves reclassifying some operating costs in the model as capital costs and hence necessitates an upwards adjustment to the MNOs' GBV figures used by the Director in his reconciliation exercise, as well as a downwards adjustment to the MNOs' operating costs. Orange's analysis suggests that the former effect dominates at the calibration point and that a net upwards adjustment to the fair charge is therefore required. However, it is not clear that the upwards adjustment would dominate in the case of the target charge in 2005/06. The Director's LRIC model predicts that the mix of operating and capital costs in the total economic cost incurred by the MNOs changes over time as shown in the table below (see also paragraphs F.79-F.82).

Table 6: Percentage total economic cost that is capital cost in the model

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators	55%	49%	45%	38%	34%	30%
1800MHz operators	60%	52%	48%	40%	36%	32%

F.62 The remainder of costs are operating costs, for example in 2000/01 40% (calculated as one minus 60%) of the total modelled economic costs of running an 1800MHz network are capital costs.

F.63 As discussed in paragraphs F.79-F.82, the Director believes that a more accurate estimate of the economic cost in 2005/06 can be derived by recognising that the capital / operating proportions do vary over time. Using the forecast operating and capital cost proportions for 2005/06 in calculating a target charge, the net impact of making the adjustments advocated by Orange (assuming that the extent of equipment leasing remained at its current level) would be to *lower* the target charge by approximately 0.4ppm. This is because the impact of the downwards adjustment to operating costs outweighs that of the upwards adjustment to capital costs.

F.64 In the light of the above arguments, the Director's view is that the use of the type of adjustment advocated by Orange is not appropriate due to the considerable amount of uncertainty regarding its implementation which places greater reliance on the accuracy of the relatively high level reconciliation process than is reasonable. Furthermore, the Director notes that the most internally consistent application of this adjustment may well have the impact of lowering the fair charge.

Summary

F.65 In summary, the Director considers an average GBV across the four MNOs of £2,710m as at September 2001, and an average of network operating costs of £338m for the MNOs' 2001 accounting year, as reasonable figures to compare with those calculated by the LRIC model in order to determine the appropriate capital and operating cost adjustments. The Director notes that these figures reflect any current inefficiency of the MNOs rather than the efficient level of costs; however, he has taken a conservative view in not making further adjustments to account for this.

3.3.2 Data adjustment factor

F.66 The LRIC model considers a voice-only network whilst the information submitted by the MNOs to the CC was for their total network including both voice and data services. Thus before comparing with the LRIC model output, a 'data adjustment' factor should be applied to the cost information provided by the MNOs to obtain a figure for the costs incurred by the MNOs relating only to voice services. In the May consultation, the Director proposed using a 5% data adjustment figure based on the proportion of capacity installed to handle existing and forecast data traffic in September 2001 as it would allow one or more traffic channels to be reserved in some areas, and none in other areas where sufficient excess capacity already exists. The Director also noted that this estimate is consistent with that used by the CC in paragraph 7.108 of the CC report.

F.67 In response to the May consultation, Vodafone states that it believes the 5% data adjustment factor applied to actual operator GBV is too high (paragraphs A.2.37 to A.2.45). Vodafone argues that the methodology used by the CC and adopted by the Director to calculate the data adjustment factor is flawed. Vodafone believes it is more appropriate to consider what percentage of total GBV was dedicated to non-

voice services at 30 September 2001 and submits a figure for its own network on this basis. Furthermore, Vodafone believes that the CC drew its conclusions from information submitted by only two operators and on this basis, and Vodafone's interpretation of these figures, submits that a figure of 3.5% is more reasonable for the average data adjustment factor.

F.68 T-Mobile raises a similar point in paragraphs 4.51 to 4.53 of its response, and also submits a revised percentage which it believes is more reasonable, based on its own capital expenditure.

F.69 Orange also argues (in section 10.4.2.1.6 of its response) that a more appropriate approach is to consider the costs associated with the network in the absence of data rather than looking at the proportions of capacity used for voice and used for data. Orange makes similar points to Vodafone that given capacity installed for coverage in significant areas of the country, data services can be supported without additional investment.

F.70 The purpose of the data adjustment factor is to reduce the average operators' total GBV in 2001 to represent the GBV that would be associated with a voice-only network at that point in time. This is then compared to the outputs of the LRIC model, which represent the costs of a voice-only network. In this context, the Director believes that it is likely to be conservative to use information regarding the percentage of total GBV dedicated to non-voice services. The Director observes that the figures submitted by the MNOs in response to the May consultation refer to the incremental costs exclusively associated with data services and as such may represent an understatement of the appropriate data adjustment factor. Whilst additional radio capacity may not have been installed by 2001 for the dedicated use of GPRS data traffic, it may well be the case that additional capacity was installed, at least in part, with the intention of ensuring sufficient provision for future data growth, even if it was not immediately used to carry data traffic. Taking account of this point would potentially lead to a higher data adjustment factor.

F.71 The Director also notes that GBV figures relating to non-voice services can be subject to significant variations due to differences in cost allocation methodologies. In this respect he believes that his previous methodology of estimating the data adjustment factor based on the capacity dedicated to non-voice services is relevant. The capacity proportion is likely to provide a reasonable estimate of the effect on cost given that the economies of scale at the relevant traffic volumes are very small (especially in the case of 900MHz operators).

F.72 Nevertheless, the Director has taken the figures submitted in response to the May consultation to derive a revised average data adjustment factor based on information from all four MNOs. Furthermore, in the interests of applying a conservative data adjustment factor, the Director has then rounded-down this average to 4.5%. A lower data adjustment factor results in a higher cost figure to compare to the LRIC model outputs and thus ultimately a higher adjustment factor to be applied to those outputs. The Director believes that the figures resulting from these adjustments are more likely to overstate efficiently incurred costs than understate them due to the below average data adjustment factor and the fact that

the data underpinning the adjustments reflect the average of any current inefficiency of the MNOs rather than the efficient level of costs.

F.73 The resulting impact on the cost of termination in 2005/06 of reducing the data adjustment factor from the 5% in the May consultation to 4.5% is small (an increase of less than 0.5%).

F.74 As a final remark, Vodafone's assumption that the CC's conclusion was based on only two operator submissions is incorrect, as acknowledged in Vodafone's further submission of 27 October 2003. However, this supplemental submission engages in further speculation regarding the submission of other operators, and as these assumptions are in fact incorrect, adds nothing further to the argument.

3.3.3 Capital and operating cost adjustments

F.75 In order to determine the capital cost adjustment, the Director has compared the average GBV of the four MNOs at September 2001, reduced by the data adjustment factor of 4.5%, with the average output (across combined 900/1800MHz and 1800MHz operators) from the LRIC model for 2001/02. The amended LRIC model[54] calculates a nominal GBV for combined 900/1800MHz operators of £1,835m and for 1800MHz operators of £1,983m in 2001/02. This results in an average of £1,909m. These figures are about 3% lower than those in the May consultation of £1,879m and £2,044m for combined 900/1800MHz and 1800MHz operators respectively giving an average of £1,962m. Comparing this model average with the average of £2,710m[55] submitted by the MNOs reduced by 4.5% implies that an upward adjustment factor should be applied to the capital costs in the LRIC model of 35.6% in 2001/02. This compares with the capital adjustment factor of 29.8% stated in the May consultation and the CC's value of 31% (paragraph 7.121 of the CC report), based on their comparison of GBV and the number of items of equipment.

F.76 The Director has also undertaken a comparison of the average MNO network operating cost with the output of the LRIC model. The LRIC model calculates nominal operating costs for combined 900/1800MHz operators to be £348m in 2000/01 – the appropriate year to compare for accounts ending in March 2001. Similarly, the model calculates nominal operating costs for 1800MHz operators to be £376m and £421m in 2000/01 and 2001/02 respectively, which gives a weighted average of £410m as an estimate for the calendar year 2001 to compare with the accounts of the 1800MHz operators. The average of the combined 900/1800MHz and 1800MHz figures results in an average LRIC model figure of £379m. This compares with an overall average of £367m as stated in the May consultation. Comparing this model average with the average of £338m submitted by the MNOs reduced by 4.5%, the Director believes that it is appropriate to apply a downward adjustment to operating costs in the LRIC model by 14.9% in 2001/02. This compares to an adjustment of -12.5% stated in the May consultation and the adjustment of -11% used by the CC in paragraph 7.122 of the CC report.

Incorrect operating cost figure from the LRIC model

[54] After increasing the cost of capital to 12.25%, correcting for missing 32Mbit/s links, swapped out equipment and declining equipment, and correcting MSC location update routing factors.
[55] After adjustment as a result of Orange's submission.

F.77 In paragraph 2.46 of its response, Vodafone states that the Director quotes the incorrect figure for 1800MHz operating costs in 2001/02 as predicted by the model. As a result, Vodafone believes that the Director has overstated the operating cost adjustment factor.

F.78 The model amendments discussed in section 3.2 result in minor changes to the figures presented in the May consultation document, leading to the reassessment of the appropriate operating cost figure generated by the LRIC model as highlighted above. Nevertheless the Director disagrees with Vodafone. The Director suspects that Vodafone's assertion that the figure of £403m should have been £394m is an error resulting from a misinterpretation of the model output. The appropriate model output to use for comparison with operator data is the nominal operating cost in 2001/02. Before applying the amendments discussed in section 3.2, for 1800MHz operators, this is £403m, whilst the real operating cost (in 2000/01 prices) is the figure stated by Vodafone of £394m.

Varying capital / operating cost proportions over time

F.79 In order to apply these adjustments to equipment costs and operating costs separately, a split of total costs between capital and operating costs must be derived. In the May consultation, the Director applied proportions of 57% and 43% for capital and operating costs respectively for a combined 900/1800MHz operator, and 53% and 47% for capital and operating costs respectively for a 1800MHz operator in order to align the model to the cost accounting data in 2001/02.

F.80 However, in Annex E of the May consultation, the Director also recognised that there is a case for varying the capital / operating cost proportions over time in calculating the adjustments for subsequent years, as the LRIC model indicates that these proportions do vary year by year, with operating costs growing in importance relative to capital costs. At that time, the Director took the more conservative approach of establishing the correct base year of costs and using the overall model forecast trend to determine the appropriate adjustment in 2005/06. However, on further examination of this issue, the Director is of the view that a more accurate estimate of the economic cost in 2005/06, after comparison with the MNOs' data, can be derived by recognising that the capital / operating cost proportions do vary over time.

F.81 Deriving the capital / operating cost proportions from the LRIC model in 2005/06 (after implementing the revisions described in section 3.2), the appropriate split becomes 30% and 70% for capital and operating costs respectively for a combined 900/1800MHz operator, and 32% and 68% for capital and operating costs respectively for a 1800MHz operator.

F.82 The overall impact on adjustments following comparison with the MNOs' data (implementing an increase in the capital cost adjustment to 35.6%, a decrease in the operating cost adjustment to -14.9%, and the amendment to the capital / operating cost proportions), is a reduction in 2005/06 of about 0.4ppm (in real 2000/01 terms) when compared to the adjustments proposed in the May consultation.

Structural bias in the model requires termination-specific adjustment

F.83 Vodafone states that it is unrealistic to assume that the discrepancy between the LRIC model and the MNO accounts at a total network level in 2001 will apply in equal proportions to the cost of individual services (paragraphs A.2.103 – A.2.120 of Vodafone's response). Vodafone believes that the LRIC model exhibits a structural bias that results in a greater underestimation of the cost of termination than for the network as a whole. As a result, Vodafone argues that a further, termination-specific upwards adjustment is appropriate. Vodafone supports this assertion by a comparison of the proportion of total cost allocated to call termination by the MNOs in their FAC-based service cost estimates with the (smaller) proportion of total cost allocated to call termination in the Director's LRIC model.

F.84 Specifically, Vodafone suggests that the bias arises due to the LRIC model's overstatement of the proportion of cost that resides in the radio layer in an MNO's network, as opposed to the switching layer. Vodafone suggests that this difference may be due to, for example, inappropriate equipment unit prices. Since a greater proportion of costs in the switch layer are allocated to incoming traffic than in the radio layer, corrections to the switch layer have a greater impact on the cost of termination. Furthermore, Vodafone states that volume mix and allocation mix, as well as unit prices, contribute towards the bias.

F.85 The Director's view is that making a correction for "structural bias" such as that proposed by Vodafone is not appropriate. His supporting rationale is outlined below.

F.86 The Director is minded not to place a significant degree of weight on a detailed comparison between the outputs of his LRIC model and the top down FAC estimates submitted to the CC by the MNOs for the reasons outlined in section 3.3.5. Given these arguments, the Director is not persuaded that a comparison of the incoming proportion of total voice network costs allocated to call termination in the LRIC model and the MNOs' FAC data is likely to result in a significant improvement in the Director's results.

F.87 The Director's view is that an appropriate approach to comparing network costs implied by the LRIC model and MNO data is a high level reconciliation based on the GBV, and operating costs, of *all* network equipment in total (as adopted by the CC). As outlined by Vodafone, this exercise differs from a reconciliation with the MNOs' top-down service cost estimates in that it does not reflect, for example, any differences in the allocation of network costs to individual services. The Director's view is that attempting to perform a reconciliation exercise at a more granular level, e.g. that of high level network component categories such as radio layer, BSC, switch layer, and "others" (as undertaken by Vodafone), is unlikely to improve his analysis since doing so carries the risk of achieving results that may be *less* accurate due to issues of consistency between data supplied by the MNOs, as evidenced by Vodafone having the highest top-down FAC estimate for termination despite evidence suggesting that it is the most efficient operator (see section 3.3.5). Furthermore, it would be necessary to examine the costs of all MNOs at this greater level of granularity – for example, not just capital costs, but also operating costs – which would involve significantly greater effort.

F.88 The Director therefore believes that conducting a more granular model reconciliation exercise would be inappropriate. However, in order to examine the cause of the observations made by Vodafone he has conducted a short analysis of information that was submitted by the MNOs during the CC's review. This information concerns the proportion of total network depreciation associated with distinct network asset classes in 2001 (Appendix 7.2 to Appendix 7.5 of the CC's report). As outlined by Vodafone in paragraph A.2.110 of its response, its own proportionate splits, derived from revising unit prices in the model, differ significantly from those implied by the Director's LRIC model. Such differences can have a significant impact on the proportion of total cost that is allocated to call termination since, as stated by Vodafone, "…whilst in the radio layer costs are allocated between incoming, outgoing and on-net traffic in the ratio 1:1:2 per unit of volume, in the switch layer a greater proportion of costs is allocated to incoming." (paragraph A.2.111). Based on the figures available to the Director, which were supplied by the MNOs to the CC, the Director has calculated a split of total network depreciation into the four categories considered in Vodafone's analysis: namely the radio layer, BSC, switch layer, and "others". A comparison of these splits for the different MNOs shows that Vodafone's estimates differ substantially from those of the other MNOs in the Director's analysis. For example, deriving an average for other MNOs to compare with Vodafone results in an average proportion of total network depreciation accounted for by the radio layer that is more than 50% greater than the comparable figure accounted for by Vodafone. Furthermore, the averaged network depreciation results for other MNOs reveals splits that are broadly in line with comparable values in the Director's model.

F.89 Whilst the Director's view is that an analysis of depreciation figures in isolation is not conclusive, he believes that it highlights, at the very least, the substantial difficulties in attempting to conduct a more granular reconciliation process given the likely inconsistency of approach to asset group classification taken by the different MNOs. Therefore the Director has not modified his reconciliation analysis since:

- such an analysis is subject to a number of practical difficulties, in particular consistency of allocation between the MNOs, as outlined above; and
- the information available to him suggests that the data supplied by Vodafone is unrepresentative when considered in the context of that that supplied by the other MNOs.

3.3.4 Combined 900/1800MHz and 1800MHz operator cost differential

F.90 The Director has not received compelling evidence to deviate from his view stated in the May consultation, that he accepts the CC's conclusion that, at current traffic levels of the MNOs, combined 900/1800MHz and 1800MHz operators employ a similar amount of network equipment and so have similar costs (see paragraphs 2.301-2.307 of the CC report). As stated in the May consultation, since the LRIC model derives a higher cost figure for 1800MHz operators, the Director believes that a further adjustment to the final pence per minute cost is appropriate to realign the costs of the two types of operator. There are, however, two sources of this difference and it is only appropriate to adjust for the first one. The first source of the difference reflects the fact that, on an accounting depreciation basis, the LRIC model estimates

that the cost of 1800MHz operators is higher by about 0.2p per minute for terminating calls when compared to the combined 900/1800MHz operators in 2005/06. The second source of the difference, which is quantitatively more important, derives from the use of economic depreciation to obtain the path of costs over time. Under economic depreciation cost recovery is deferred from earlier years, in which utilisation was lower, to later years, in which higher levels of utilisation are experienced. However, this effect is more pronounced for 1800MHz networks, because the characteristics of their spectrum imply that such operators have a smaller maximum cell radius and so experience lower site utilisation in the earlier years of their operation than the combined 900/1800MHz operators. The conclusion that, currently, combined 900/1800MHz and 1800MHz operators employ a similar amount of network equipment and so have similar costs does not imply any need to adjust for the second source of difference, but only to remove the difference in the first case.

F.91 Taking account of the first point raised in the previous paragraph implies that the gap between the estimated costs for the two types of operators should be reduced by 0.2ppm. However, the operating and capital cost adjustments discussed above already bring the *average* total network cost in the LRIC model in line with the MNOs' accounting data and so any further adjustment should ensure that the average across both types of operator remains unchanged. Hence, as in the May consultation, the Director believes a reasonable adjustment is to add 0.1ppm to the costs of the combined 900/1800MHz operators, and subtract 0.1ppm from the costs of the 1800MHz operators so that the average adjustment across all MNOs for this effect is zero.

1800MHz operator cost disadvantage underestimated

F.92 In paragraphs 4.38 to 4.50 of its response to the May consultation, T-Mobile states that by following the CC's approach to reconciling the LRIC model outputs with operator data, the Director has ignored T-Mobile's significant improvements in network coverage and quality since 2001. T-Mobile submits that failure to recognise that 1800MHz operators were incurring similar costs to provide networks of inferior coverage and quality in 2001 has led to an underestimation of the appropriate costs for 1800MHz networks. Hence the Director should apply a further upwards adjustment to 1800MHz operator costs to take account of T-Mobile's extensive roll-out of cell sites since 2001 and the corresponding investment in network infrastructure. T-Mobile has provided supporting evidence regarding its increased network roll-out and improved customer satisfaction to support its view.

F.93 Furthermore, T-Mobile argues that ignoring the differences in quality and coverage between 900/1800MHz and 1800MHz operators in 2001 has led the Director to infer incorrectly that there is no cost disadvantage suffered by 1800MHz operators. Similarly, Orange (section 10.4.2.1.8 of its response) raises a concern that the approach of averaging data from the two types of operators before comparison with the LRIC model has incorrectly led to the conclusion that similar levels of equipment are required for both operators, failing to take account of T-Mobile's lower than average coverage and hence lower number of cell sites.

F.94 The CC's reconciliation exercise was carried out based on data made available at a single point in time, recognising that *all* the MNOs would continue to invest further in network equipment after this date as voice and data traffic capacity requirements increased over time. One of the reasons for choosing its calibration date of comparison in 2001, rather than using newer data, was to minimise the extent to which its information (e.g. GBV) was influenced by network roll-out relating to (either dedicated or shared) data services, notably 2.5G and 3G services. As acknowledged by T-Mobile in the material it supplied to the Director, one of the drivers of its continued network roll-out is the need to serve data applications, e.g. GPRS services, which were launched in 2002, and its 3G services which had been scheduled for launch in 2003. The cost of such network equipment is not relevant to the calculation of the cost of 2G voice call termination.

F.95 Information available to the Director suggests that network roll-out since 2001 has primarily been driven by a requirement to improve call quality, rather than to increase network coverage. In the context of the model, coverage areas are regarded as areas in which a mobile signal can be obtained, however weak, and improved service is treated as a question of call quality. Following examination of T-Mobile's detailed information regarding network roll-out after 2001 and improvements in customer satisfaction, the Director is still of the view that the LRIC model includes a reasonable quality of service. It is unclear to the Director that callers to mobiles should be obliged to pay more because of a higher quality of service that has been chosen by call recipients.

F.96 Although the Director does not believe such an amendment is appropriate, in order to estimate the potential impact of increasing quality, he has modelled a scenario in which voice call quality in the LRIC model increases after the point of comparison with the MNOs' data. Call quality in the LRIC model is modelled by means of a blocking probability[56] percentage (the model's *Blocking_prob* variable). A blocking probability of 2% means that 98% of calls are set up successfully. In the April 2002 version of the model used to inform the proposed charge control, the blocking probability is set at a constant level of 2% throughout the modelled period[57]. The Director has modelled the impact on cost trends and levels of increasing the voice call quality in the LRIC model, specifically achieving a blocking probability of 2% in the time period up to and including 2001/02, and then a lower blocking probability of 1% (higher service quality) from the beginning of 2002/03 onwards. Making this amendment to the model increases the LRIC model output in 2005/06 by about 0.07ppm, however, it also results in an increase in GBV in 2001/02 of about £50m due to the LRIC model's look-ahead algorithm, which reduces the size of the capital cost adjustment after reconciliation with the MNOs' data. The overall impact of this sensitivity, after reconciliation with the MNOs' data, is an increase in the fair charge in 2005/06 of only 0.04ppm and 0.02ppm (in real 2000/01 terms) for combined 900/1800MHz and 1800MHz operators respectively.

[56] The term "blocking probability" describes the statistical probability that a telephone connection cannot be established due to insufficient transmission resources in the network. It is usually expressed as a percentage or a decimal equivalent of calls blocked by network congestion during the busy hour. The lower the blocking probability is, the higher the quality of service will be.
[57] It is worth noting that the average percentage of successful call set-ups in 2000 was 98%, see http://www.oftel.gov.uk/publications/research/mble0500.htm

F.97 However, given the Director's view that it is unclear that callers to mobile should pay for a higher quality of service chosen by call recipients, and that even incorporating the model amendment described above has a small impact (especially for an 1800MHz operator), the Director has no compelling reason to revise his approach in the light of T-Mobile's argument.

F.98 Regarding T-Mobile's argument that the Director has underestimated the cost disadvantage suffered by 1800MHz operators, the Director has carefully considered the confidential figures relating to network size (e.g. cell sites and TRXs) and network costs (e.g. GBV and operating costs) submitted to the CC by each of the four MNOs, in light of T-Mobile's concern regarding inferior 1800MHz network quality. After weighing-up different pieces of evidence, and taking account of arguments advanced by Vodafone that the cost disadvantages for 1800MHz operators is *overestimated* (see following section), the Director finds no compelling reason to revise his position or make further adjustments.

1800MHz operator cost disadvantage overestimated

F.99 In response to the May consultation, Vodafone argues (in paragraphs A.2.123 to A.2.127 of its response) that the Director has still overestimated the difference in cost between the two types of operators. Vodafone claims that 1800MHz operators have a significant cost advantage in areas where there is high demand for capacity given that the 1800MHz operators have been allocated more spectrum than combined 900/1800MHz operators and can therefore deploy more capacity (TRXs) on existing cell sites. In contrast Vodafone states that a combined 900/1800MHz operator would have to cell-split requiring additional costs of a new base station as well as transceivers. Vodafone submits that the LRIC model does not adequately take account of this since it imposes a physical constraint on the number of TRXs that prevents 1800MHz operators fully exploiting their greater spectral resource.

F.100 The Director has examined Vodafone's argument in detail and considers that Vodafone's view of the differential parameters concerning capacity per cell is extreme, as reflected in its endogenously modified version of the LRIC model dated March 2002, which leads to an overstatement of the spectral advantage to 1800MHz operators in areas of high demand.

F.101 Vodafone's amendments indicate that it believes 1800MHz operators can deploy substantially more capacity per cell than combined 900/1800MHz operators. Whilst this may represent a theoretical upper limit, the Director is of the view that, on average, such strongly differing parameters are unlikely to occur in practice. Given information provided by 1800MHz operators and several counter arguments made in the responses of the 1800MHz operators, the Director believes that Vodafone's proposed parameters are unlikely to reflect reality for the following reasons:

- installing as many TRXs in macro base stations as Vodafone implicitly suggests would require additional investment in cabinets, power and housings. The Director believes that such upgrades may be physically impossible in a significant number of 'space-limited' sites, particularly in urban areas where sites are located on rooftops, buildings, etc. In addition, Vodafone recognises that there will be additional costs for such site

expansion in paragraph A.2.125 (without including these costs in its argument);

- installing a few sites with very high capacity is unlikely to provide the same quality of reception as more sites and less capacity per site (but the same overall TRX deployment and overall capacity). The1800MHz operators may need to deploy more sites (cell-splitting) rather than increase capacity on existing sites in order to address black-spots which are likely to occur in building-cluttered city centres;
- 1800MHz operators are significantly disadvantaged in areas of low demand where sites have been deployed for coverage. If the LRIC model understates the proportion of sites falling into this category (as claimed by the 1800MHz operators) the model will underestimate the disadvantage to 1800MHz in this respect.

F.102 Taking account of all the views submitted, in particular the counter arguments proposed by the 1800MHz operators and the absence of new information with which to quantify the effect with greater certainty, the Director believes that the current model and results are appropriate and finds no compelling reason to make further adjustments.

F.103 In paragraphs A.2.128 to A.2.141 of its response, Vodafone further argues that given the model incorrectly predicts the GBV differential between the two operator types at the point of comparison with the MNOs' data, there can be no confidence that the model correctly assesses the difference in network size at any other point. Vodafone believes that the differential is overstated in all years and in particular in years prior to the comparison with the MNOs' data in 2001 which influence the economic cost during the period of the proposed charge control. Vodafone's proposed solution is to conduct the calibration for the two operator types separately.

F.104 The key objective in undertaking the bottom-up modelling exercise is to establish a reasonable estimate for the economic cost of termination in 2005/06. The Director is of the opinion that a bottom-up model more accurately captures the relevant cost structure and cost drivers required to predict the economic cost in 2005/06 than can be derived from top-down accounting information. The Director is of the opinion that the parameters and cost trends used in the bottom-up model are reasonable and hence a single point of comparison with top-down operator information is an appropriate approach to calibration. To require calibration in multiple earlier years would be to place a greater reliance on the trends as implied by the top-down information, which the Director believes would be less appropriate to inform a forecast of the future.

F.105 The Director does not believe that the model overestimates the economic cost differential materially, after taking account of the further adjustment that reduces the difference implied by the model by 0.2ppm. Vodafone's assertion that the difference is significantly overstated arises largely from its own analysis which assumes that 1800MHz operators are afforded a much greater spectral advantage than the Director believes is realistic, for the reasons discussed above. Together with the counter arguments advanced by the 1800MHz operators that the differential is

underestimated, the Director finds no compelling reason to make further adjustments.

F.106 In response to Vodafone's belief that an appropriate remedy to its concern is to compare results from the model with MNO data for the two types of operators separately, it is unclear to the Director that this approach actually addresses the original concern. Furthermore, in undertaking his own sensitivity analysis, the Director finds that the difference resulting from taking this approach is minimal.

Appropriate basis for cost recovery

F.107 In its response to the May consultation (paragraphs 5.11 to 5.16), O2 argues that the adoption of economic depreciation discriminates in favour of the 1800MHz operators and that the Director should instead base his calculations on accounting depreciation. The MNOs fund their activities on the basis of their performance reflected in accounts compiled using accounting depreciation, and O2 believes that regulation imposed by the Director should be determined on a consistent basis. However, by determining the charge control using economic depreciation, O2 states that a distortion is introduced resulting in an unfair revenue advantage for 1800MHz operators.

F.108 The Director considers that the relevant question to address, in the context of this review, is the appropriate basis of cost recovery for regulation.

F.109 It is for the MNOs and their investors to decide upon the most appropriate basis for accounting and performance measurement for commercial purposes. However, the Director believes that this choice should not determine the accounting basis for regulatory purposes. For example, statutory accounts of companies are typically based on historical cost accounting (HCA), but it is generally more appropriate for regulated charges to reflect a more economic approach to costs, such as current cost accounting (CCA) or economic depreciation.

F.110 Economic depreciation provides the Director's best view of the appropriate path of cost recovery over time for the purpose of setting regulated charges, being the path of costs that would prevail in a competitive market.

3.3.5 Comparison with MNOs' FAC of termination

F.111 In its response to the May consultation, Vodafone argues (paragraphs A.2.21 to A.2.25) that the Director should undertake a comparison of the model output regarding termination costs with the cost of termination derived from FAC. As it stands, Vodafone believes that the Director's approach does not constitute a reasonable method of model calibration.

F.112 The Director has not attempted to derive termination costs from FAC information because it is unclear to the Director that there are substantial benefits to be gained from undertaking such a resource-intensive exercise and he is confident that his estimate of the cost of termination in 2005/06 is reasonable on the basis of the significant work already undertaken.

F.113 It is far from evident that the significant effort required in undertaking an examination and reconciliation of FAC data necessarily leads to more accurate results. In particular, there are considerable difficulties associated with deriving reliable FAC estimates due to differences in cost allocation. For example, as acknowledged by Vodafone (paragraph A.2.117), the CC's FAC calculations resulted in concluding that Vodafone had the highest network cost of termination despite evidence that shows Vodafone is the most efficient operator[58]. This observation casts serious doubt on the reliability of FAC estimates. Indeed, as again acknowledged by Vodafone (paragraph A.2.24), the CC's results were not derived on the basis of the FAC estimates, but merely used them as a cross-check for the LRIC result.

F.114 Vodafone's key concern in raising the issue of a comparison with FAC derived costs appears to be the concern that the universally applied adjustments following reconciliation with the MNOs' accounts may be inappropriate to the specific costs of termination. This is a question of whether a further termination-specific adjustment is necessary and is addressed separately in paragraphs F.83-F.89.

F.115 The Director maintains his belief that the approach taken to deriving the cost of termination is fit for purpose. He believes that his bottom-up LRIC model gives sufficient understanding of the cost structures and relationships for the basis of determining termination costs, and indeed, greater understanding than can typically be gained from top-down information. Furthermore, the Director is of the opinion that the parameters and cost trends implied by the bottom-up model are reasonable and in this context, his single point of comparison with top-down operator information is entirely reasonable and constitutes a conventional approach.

3.3.6 Summary of net adjustments following comparison with MNO data

F.116 The derivation of the net adjustment to be made for combined 900/1800MHz operators and 1800MHz operators in the years up to 2005/06 is shown in the table below.

Table 7: Net adjustments following comparison with MNO data

Pence per minute (real 2000/01)	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators					
Revised model LRIC+ (12.25% CoC)	5.07	4.76	4.16	3.95	3.76
Capital cost adjustment (ppm)	0.83	0.72	0.53	0.45	0.39
Operating cost adjustment (ppm)	-0.37	-0.37	-0.37	-0.37	-0.37
900MHz / 1800MHz adjustment	0.10	0.10	0.10	0.10	0.10
Net adjustment	0.57	0.45	0.26	0.18	0.11
Resulting LRIC+	5.64	5.21	4.42	4.13	3.88
1800MHz operators					
Revised model LRIC+ (12.25% CoC)	6.26	5.85	5.03	4.75	4.50
Capital cost adjustment (ppm)	1.11	0.96	0.68	0.58	0.49
Operating cost adjustment (ppm)	-0.43	-0.43	-0.43	-0.43	-0.44
900MHz / 1800MHz adjustment	-0.10	-0.10	-0.10	-0.10	-0.10

[58] See http://www.oftel.gov.uk/publications/mobile/neracover0901.htm

Net adjustment	0.58	0.42	0.15	0.05	-0.05
Resulting LRIC+	6.84	6.27	5.18	4.80	4.46

F.117 The net adjustments of +0.11ppm and -0.05ppm (in real 2000/01 terms) for combined 900/1800MHz operators and 1800MHz operators respectively are approximately 0.4ppm lower than those proposed in the May consultation (net adjustments of +0.51ppm and +0.32ppm for combined 900/1800MHz operators and 1800MHz operators respectively).

3.4 Market share

F.118 The output of the LRIC model is based on the costs of an average operator with a 25% market share in 2001, declining to 20% by 2010 following the entrance of the fifth operator, "3".

F.119 As described in the May consultation, there is a question whether the fair charge should be adjusted to take into account the position of an MNO with a market share of total traffic lower than the average. Points in favour of implementing an adjustment are as set out by the CC in paragraphs 2.275-2.280 of the CC report: that is, in the short term the fair charge should take into account the extra cost of an MNO with a market share of traffic lower than the average to ensure that it is not unduly disadvantaged by its smaller scale. In contrast, it can be argued that a market share adjustment is inappropriate, as determining the fair charge based on an average operator with average market share is the most competitively neutral position to adopt rather than modelling specific operators.

F.120 In the context of this market review the key cost figure is the fair charge in 2005/06. Therefore, in the May consultation the Director concluded that the point is academic. Even in the case that a market share adjustment were implemented, as proposed by the CC, then this adjustment would diminish to zero by 2005/06 by design. Thus either approach results in no adjustment to the fair charge in 2005/06.

F.121 T-Mobile argues, in paragraphs 4.60 to 4.64 and 4.66 to 4.67 of its response to the May consultation, that operators must be allowed to achieve a reasonable rate of return on adequate capital employed and even a relatively small MNO should receive sufficient income to finance its termination business. Hence T-Mobile believes that it is inadequate to consider that a smaller player has the possibility of capturing a higher market share in the future, and the Director should estimate the likely market share of the smallest 2G operator in 2005/06 rather than the market share of an average operator in 2005/06.

F.122 The Director emphasises that his primary approach in determining a fair charge for the cost of termination in 2005/06 has been to base his calculation on an achievable, competitively neutral, and internally consistent market share, rather than to attempt to predict any particular operator's market share in 2005/06.

F.123 All four 2G mobile operators in the UK have a comparatively similar position (in contrast to most other European countries) and hence the Director believes that considering an average operator is a reasonable and competitively neutral approach.

The market share assumed in the LRIC model by the end of 2005/06 is 21.8%, which is in fact lower than the current market share by call minutes of 21.9%[59] of the smallest 2G operator, as quoted by T-Mobile. The Director therefore believes that this is not only an achievable market share for all 2G operators by 2005/06 but is entirely appropriate, enabling operators to achieve a reasonable rate of return. The CC agreed, in paragraph 2.278 of the CC report, that "By 2006, the appropriate cost for all operators would be based on the DGT's original estimate of the share for that year of an average existing MNO following the launch of Hutchison 3G, being a 22 per cent market share." To the extent that a mobile operator increases in efficiency (for example, through cost reductions) over and above the model of an average, reasonably efficient operator used to determine the charge control, the Director believes that such an operator should gain the appropriate benefits from its increased efficiency.

F.124 T-Mobile also argues that the Director's proposals do not have full regard to the particular costs of each operator and that the glidepath is developed in relation to the combined 900/1800MHz operators. The Director disagrees, as discussed more fully in Annex H, and emphasises that his proposals apply a steeper initial cut to 1800MHz operators not due to a failure to take account of the costs of 1800MHz operators but because 1800MHz operators' current charges are higher above cost than the charges of combined 900/1800MHz operators.

F.125 In any case, given that few economies of scale exist for traffic volumes around 20-25% market share, the difference to the unit cost of termination resulting from a slight decrease in market share is very small. T-Mobile erroneously suggests that the cost for 1800MHz operators should be increased by 0.75ppm calculated as an uplift of 16.4% (equal to 22%/18.9%). However, this is an incorrect approach to determining the increase in cost per minute due to lower call volumes. The Director estimates, by reducing the volumes in the LRIC model, that even if the market share in 2005/06 was reduced to 19% (an assumption which he regards as inappropriate), it would result in an increase in the network cost of termination of only 0.1ppm[60].

F.126 T-Mobile quotes from paragraph 2.277 of the CC report expressing the view that even a relatively small MNO should receive sufficient income to finance its termination business. However, T-Mobile only considers part of the CC's opinion as expressed in that paragraph. As summarised in the May consultation, the CC expresses this view in relation to the *short term*[61], and goes on to state in the same paragraph: "However, over a period of two to three years we think that an MNO with a lower than average market share has the opportunity to capture at least an average share of the market. Therefore, by 2006, we would expect there to be no need for any extra cost due to low market share and the extent to which any extra cost would be relevant in the earlier years of any price control would depend on decisions taken on the glide path between current prices and the cost projection for 2006." As stated in the May consultation, even in the case that a market share

[59] Oftel, Market Information – Mobile update June 2003.
[60] Obtained by reducing the market share assumption at the end of 2005/06 to 18.9%, continuing to maintain 25% up until the end of 2001 and applying a simple linear decline in between.
[61] T-Mobile also cites a press release from the Austrian regulator (TKK Press release, 15 April 2003) asserting that it recognises the need to set differentiated termination charge controls for each operator, however, this is once again in the context of a short term consideration.

adjustment were implemented, as proposed by the CC, then this adjustment would diminish to zero by 2005/06 and have no impact on the cost of termination in 2005/06 and hence the proposed charge control.

F.127 Finally, T-Mobile highlights that the Dutch regulator, OPTA, took account of "advantages of scale" [62]. However, OPTA did not propose to treat each of the five operators in the Netherlands separately, but rather to distinguish between two groups where there are significant differences, namely between 900MHz operators (KPN Mobile and Vodafone) and 1800MHz operators (Duchtone, Telfort and Ben) as a result of the earlier deployment of 900MHz networks and the persistence of a greater number of subscribers for these networks, which is not relevant to the situation in the UK.

3.5 Network common costs

3.5.1 Minimum coverage network costs

F.128 In response to the May consultation, Vodafone submits that there are substantial common network and non-network costs that should be recovered via call termination charges (paragraph 2.32 and Annexes 2A, 2B and 2E of its response). In particular, Vodafone believes that the Director has significantly understated the level of common network costs (comprised of network coverage costs and indirect network costs) because it argues that the costs of equipment used to provide traffic capacity on the minimum coverage network in the UK, and not just the costs incurred in providing physical coverage (the 'minimum coverage presence'), ought to be treated as a common cost rather than included in the LRIC calculation.

F.129 The Director, however, considers his approach to be entirely correct[63]. In his view, treating minimum coverage network costs relating to traffic capacity as a common cost is incorrect: it leads to an understatement of the average incremental costs and a corresponding overstatement of common costs[64].

F.130 The Director's approach adopts a consistent long-run perspective on costs. This recognises that use of traffic capacity involves an "opportunity cost": when the initial capacity deployment is used to supply a unit of traffic, the use of that amount of the capacity is denied to other units of traffic. The existence of an opportunity cost means that the cost incurred to provide the initial site is not truly fixed or common, since these would not involve an opportunity cost of traffic. Under this long-run perspective on costs, the costs of traffic capacity are part of the incremental costs and not the common costs.

[62] OPTA, *Policy Rules regarding the regulation of mobile terminating tariffs*, paragraph 32, http://www.opta.nl/download/mta_policyrules_300902.pdf
[63] His approach is described in *Network Common Costs,* Oftel, 19 February 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/network_costs.pdf
[64] Further details are set out in *Different Views of Oftel and MNOs on Network Common Costs*, Oftel, 27 May 2002, http://www.oftel.gov.uk/publications/mobile/ctm_2002/common_cost0602.pdf

F.131 Vodafone's approach ignores the opportunity cost of use of the initial capacity deployment, presuming it to be zero. In effect, Vodafone is assuming that the initial site provides "free" capacity (from the point of view of traffic-related costs). Furthermore, by failing to smooth the modularity of capacity,[65] and so treating the equipment costs of the minimum coverage network as being fixed, Vodafone's approach effectively adopts a short-run view of the costs of the initial site in each area. However, in this context, pricing based on short-run marginal costs is impractical and economically undesirable. First, short-run marginal cost is volatile depending on whether traffic is close to site capacity (when close to capacity, short-run marginal cost is high, but with excess capacity, it is zero or close to zero). Secondly, since averaging of prices across base stations occurs, it is not clear that the price signals would promote efficient usage by consumers. Thirdly, prices based on short-run marginal cost might result in under-recovery or over-recovery of costs by the MNOs.

F.132 The incorrectness of Vodafone's approach is further shown by the following observations:

- Even in an example in which, by construction, there are no common costs and marginal cost pricing leads to full cost recovery, its approach would still misleadingly suggest that common costs existed.
- It implies diseconomies of scale, which is not an accurate representation of the cost function for radio base stations and indeed is inconsistent with the claim that there are large fixed or common costs, which would suggest that economies of scale exist.
- It involves an entirely different treatment of the cost of the initial deployment of traffic capacity from all subsequent deployments, even though all deployments involve the same modularity of capacity.
- It applies diseconomies of scope, which is in direct contradiction to the proposition that there are large common costs, i.e. economies of scope.

F.133 Given that the Director believes that it is more appropriate to recover a portion of common costs from call termination charges using equal proportionate mark-ups (EPMU) rather than Ramsey pricing (see Annex K for further discussion), he notes that treating minimum coverage network costs relating to traffic capacity as common to traffic services, rather than incremental to traffic, would not change his results regarding the cost of termination.

3.5.2 Modularity of capacity

F.134 In Annex 2E of its response to the May consultation, Vodafone also states that rather than recognising coverage capacity costs as fixed and common across all services, the Director incorrectly considers these costs to reflect the modularity of the network. This issue reflects the fact that capacity cannot be installed smoothly but in minimum indivisible units that results in spare capacity, most evident in the case of the first unit when demand is smooth. T-Mobile also raises this issue in paragraphs

[65] Capacity is added in discrete additional (or modular) amounts given by the available equipment sizes.

4.68 to 4.71 of its response, arguing that such spare capacity should be treated as a fixed and common cost.

F.135 The Director has previously considered, and discussed, the question of modularity of capacity in paragraphs 9-15 of *Different Views of Oftel and MNOs on Network Common Costs*, Oftel, 27 May 2002. As the Director has previously acknowledged, if increases in traffic lead to increases in average utilisation, economies of scale exist. If so, long-run average incremental cost (LRAIC) falls with increases in traffic volumes and the long-run marginal cost (LRMC) is below the LRAIC. In some circumstances, rising average utilisation with volume may well occur since the under-utilised final unit becomes an ever decreasing part of the whole, as the number of units increases. However, this simplistic analysis assumes that the number of sites over which such units are distributed is constant (simplistically one).

F.136 However, in reality there is a limited amount of capacity that can be deployed per site, after which an operator must employ cell-splitting in order to increase capacity. In this case, deployment of additional sites leads to additional under-utilised final units. Thus the under-utilised final units are not an ever decreasing part of the total number of units and hence utilisation does not continue to rise indefinitely towards 100%, but rather, utilisation stabilises.

F.137 The LRIC model addresses the question through the network provisioning algorithms and the deployment of capacity which takes account of modularities. The model derives utilisation rates and assesses how they rise with volume. As previously noted,[66] the Director's view is that, at current traffic levels, utilisation is stable when traffic volume is increased, in which case economies of scale have largely been exhausted and there are few fixed or common costs, rather than the view that utilisation is still rising with traffic volumes. This is reflected, for example, in sensitivity analysis previously undertaken by the Director.

F.138 It is worth noting that the Director's view that utilisation is stable when traffic volume is increased is independent from the use of economic depreciation. As described in paragraph 11 of *Different Views of Oftel and MNOs on Network Common Costs*, Oftel, 27 May 2002, the use of economic depreciation results in the smoothing of modularities between years, however, this is independent of the conclusion that utilisation is stable at current traffic levels.

F.139 As in the discussion of minimum coverage network costs, it should be noted that even if any costs arising from modularity were regarded as common costs to traffic services, rather than incremental to traffic, this would not change the cost of termination given that the Director uses EPMU to recover common costs.

3.5.3 Indirect network costs

F.140 In Annex 2E of Vodafone's response to the May consultation, Vodafone discusses indirect network costs and believes that these costs are common and should be recovered through a Ramsey pricing mark-up.

[66] paragraph 14, *Different Views of Oftel and MNOs on Network Common Costs*, Oftel, 27 May 2002.

F.141 Vodafone identifies indirect network costs comprising of various network staff related expenditure. In its earlier response of September 2002[67], included as Annex 2B of its current response, Vodafone appears to believe that the LRIC model only considers IT for the network business and omits other costs associated with network vehicles and general-purpose network staff property and equipment, thus recognising only a portion of the relevant costs. This is not the case. Issue 11 of Oftel's response[68], whilst specifically entitled "network IT investment", states that the model's unit costs already intend to cover all direct and indirect investments relevant to the network including those listed by Vodafone above. Furthermore, the reconciliation with MNOs' accounts ensures that the level of costs, used to determine the results, appropriately takes account of the relevant costs.

F.142 Regarding allocation of these costs, as above, the Director believes that EPMU is more appropriate than Ramsey pricing for the reasons stated in Annex K. In the context of EPMU, the identification of these costs as incremental to traffic rather than as common has no impact on the economic cost of termination.

3.6 Non-network common costs

F.143 In addition to the LRIC for network costs of incoming calls, two further additions are appropriate in determining the total cost of the incoming calls service: a mark-up for any appropriate share of non-network costs and a mark-up to take account of network externalities. The first issue is addressed here, the second in Annex G.

F.144 In general, costs caused by the caller are already included in the LRIC costs. Furthermore, any costs associated with benefits to the caller are not relevant here but are captured by the mark-up for network externalities. As stated in the May consultation, potentially relevant non-network costs can be grouped into two categories:

(a) customer acquisition, retention and service costs – including advertising and marketing, handset costs, discounts, customer care, and billing;
(b) and administrative costs – general overheads.

F.145 The Director continues to believe that there are no exceptional items that can be causally related to termination services. In particular, amortisation of 3G licence costs are causally related to 3G services only, and not to 2G voice termination.

3.6.1 Treatment of customer acquisition, retention and service (CARS) costs

F.146 Regarding the first category, as stated in the May consultation, the Director's view is that customer acquisition costs are not causally related to the terminating calls service. The operators choose to acquire retail customers, and the fact that calls are then made to those customers does not result in any additional customer acquisition costs. The number of retail subscribers drives customer acquisition costs

[67] Vodafone's response to Oftel's response to operators' comments on Oftel's LRIC model (of 9 July 2002), September 2002.
[68] Table 7, Oftel's response to operators' comments on Oftel's LRIC model, 9 July 2002.

and not the volume of wholesale terminating minutes supplied. Similarly, other non-network costs in this category are caused by services other than voice call termination and hence it is inappropriate to recover any of the costs under (a) in either the LRIC of termination or the mark-up for common costs.

Approach for recovery of CARS costs

F.147 In paragraphs 4.6 to 4.14 of its response to the May consultation, T-Mobile holds that termination services should contribute to the recovery of CARS costs. T-Mobile argues that if origination services were not provided, it would still incur CARS costs in order to acquire, retain and service customers to whom it provides termination services. Thus T-Mobile concludes that CARS costs are common to termination and origination: "The cost of acquiring customers are caused just as much by the MNO's desire to earn termination revenues as by the MNO's desire to earn origination and subscription revenues" (paragraph 4.11). T-Mobile continues to argue that whilst the Director has stated that calls to mobiles do not result in additional customer acquisition costs, this is also true of other services such as origination which demonstrates that "acquisition costs are not incremental to any one service but are common costs" (paragraph 4.11).

F.148 CARS costs consist of:

- *Customer acquisition costs* - marketing, handset subsidies, incentives and discounts to retailers - which are driven by the number of subscribers;
- *Customer retention costs* - marketing, handset subsidies, incentives and discounts to retailers - which are also driven by the number of subscribers;
- *Billing and bad debts costs*, which are driven by the number of subscribers and by the level of outgoing traffic; and
- *Customer centre costs*, which are driven by the number of subscribers and by the level of outgoing traffic. (A very small part of these costs is also related to incoming traffic - see below for further discussion).

F.149 As stated in the May consultation, CARS costs do not vary with incoming traffic, therefore, the Director considers that CARS costs are neither incremental nor common to termination. These costs are incremental to the provision of retail services, specifically subscription and mobile-originated calls. Hence CARS costs should be recovered from the prices for these retail services.

F.150 In the specific case of customer acquisition costs, these are driven only by the number of subscribers and are, thus, incremental to the provision of subscription services and would not be incurred if an MNO did not offer subscription services (see below for further discussion). This is why the level of these costs is not affected if the MNO ceases to provide origination services. T-Mobile appears to ignore that there is a second increment and service (see paragraphs F.152-F.153), in addition to traffic, that drives costs: the number of subscribers.

F.151 T-Mobile also claims (paragraph 4.7) that the Director had originally included the cost of subscription in the mark-up for common costs in his Review of the Charge Control on Calls to Mobiles, 26 September 2001. In the September 2001 review, the Director did not state that handset subsidies should be included in the mark-up for

common costs. Rather, the costs were allocated using two increments: subscribers and traffic, as is the case in the current review. The current proposals are consistent with the Director's previous treatment of handsets costs which were attributed to the subscriber increment and a mark-up for common costs then added.

F.152 T-Mobile, in paragraphs 4.15 to 4.18 of its response, claims that the Director is mistaken in considering customer acquisition and retention costs to be incremental to the provision of access services and explains that subscription is not a service in its own right, but is provided to allow consumers to make and receive calls. It argues that the existence of a subscription charge reflects an optimal two-part tariff structure rather than the existence of a subscription service separate from voice services.

F.153 An economic service exists when there is a distinct demand and / or when there is an identifiable cost. In the case of subscription there is a distinct demand because of the option value of subscription (i.e. the option of being contactable and of contacting other telephone users). There is also a specific cost associated with acquiring and retaining subscribers. Hence, the Director considers subscription to be a service in its own right with a demand, a cost and a price; treated in this way in all of the Ramsey price models prepared by or on behalf of the MNOs and in the Rholfs model for Oftel. Indeed, acquisition and retention costs are driven by the number of subscribers, but not by the level of incoming traffic or outgoing traffic. The Director therefore considers that these costs should not be recovered through the charge for the provision of wholesale termination services. It is then an MNO's commercial choice how to recover these costs from the prices of its unregulated retail services (i.e. whether to recover all of them through a subscription price or through the charges for outgoing calls (as it happens for pre-pay customers) or through a combination of the two). As the prices of retail mobile services are unregulated, the MNOs are free to recover these retail costs using the pricing structure they wish.

F.154 The Director believes that contribution to the recovery of acquisition and retention costs is relevant to the termination charge only through the network externality surcharge.

F.155 T-Mobile (paragraph 4.14 of its response) states that the CC accepted that a small component of CARS costs are common costs, but did not quantify it nor include it in the common costs to be reflected in the mark-up over the LRIC of termination.

F.156 In the May consultation, the Director acknowledged that a very small element of customer service costs may be described as common across traffic (in particular, customer call centre costs incurred in helping to resolve technical problems that affect incoming calls). The CC expressed this view in paragraph 2.330 of the CC report, also stating that this component is very small, as most customer service costs vary with incoming traffic volumes or number of subscribers rather than with incoming traffic.

F.157 The Director agrees with the CC that these costs can be expected to be very small. Due to the absence of any robust calculation of the size of these costs and their likely immateriality, the Director sees no compelling case for adjusting his cost calculations.

CARS and the network externality surcharge

F.158 The Director stated in the May consultation that the benefit that callers to mobile derive from CARS costs, in terms of acquisition and retention of additional subscribers, is captured in the externality surcharge. To include such costs in the LRIC or common costs as well would amount to double counting.

F.159 T-Mobile (paragraph 4.19 of its response) argues that there is no double counting if the cost of CARS is included both as part of the recovery of common non-network costs and in the network externality adjustment. T-Mobile argues that the network externality adjustment is an adjustment to the structure of prices, but does not increase the pool of common costs being recovered. Ramsey mark-ups based only on relative elasticities determine how much of the common costs should be recovered from each service to whose provision they contribute (e.g. *x*% termination services and 1-*x*% outgoing services). If the network externality is also accounted for, it is only the proportion of common costs to be recovered from each service that changes, but not the total amount of costs (e.g. *x*+*y*% of common costs should be recovered from termination services and 1-*x*-*y*% from outgoing services).

F.160 As discussed in detail in Annex K, the Director does not intend to set mark-ups on the basis of Ramsey pricing, but rather proposes to use equal proportional mark-ups (EPMU). If CARS costs were to be included both in the EPMU and in the externality adjustment this would lead to double recovery because the externality adjustment does not alter the percentages by which the total level of common costs is recovered through the various services. Hence, it would be necessary to introduce an appropriate adjustment to avoid double counting. In any case, as discussed above, the Director considers that CARS costs are not common costs and therefore should not be included in the mark-up.

F.161 In paragraphs 4.20 to 4.23 of its response, T-Mobile rejects the Director's argument that CARS should not be allocated to termination because callers to mobile do not benefit from these activities, except in relation for the effect, relative to marginal subscribers, captured by the externality. T-Mobile believes that to allocate costs on the basis of accrued benefits is too subjective a criterion. In many cases some costs are recovered from consumers who, whilst not benefiting directly from the relevant activity, benefit from the firm's other operations which might not exist in the absence of the relevant activity. Hence, it argues that CARS are necessary for an MNO to have a customer base, hence indirectly benefiting callers to mobile. On this basis, T-Mobile argues that it is incorrect to assume that callers only derive benefit from the marginal subscriber being on the network (which is captured by the externality) but that they benefit from being able to call all mobile subscribers of an MNO.

F.162 O2 makes a similar point in paragraph 5.3 of its response stating that a proportion of CARS costs should be recovered through voice call termination charges since callers to mobile derive benefit from being able to make such calls.

F.163 In addition, T-Mobile holds that callers also benefit from churn because it generates competition on coverage, call quality and cost of termination. For these

reasons it concludes that CARS costs should be recovered from termination services.

F.164 T-Mobile is correct in stating that the externality surcharge only recovers the costs of keeping / attracting marginal consumers on the network. The externality surcharge is intended to allow MNOs to recover the subsidies that are used to attract consumers that do not value their mobile subscription sufficiently to be willing to pay its full price, but for whom it would be economically efficient to be mobile subscribers. Infra-marginal consumers are willing to pay in full for the cost of subscribing to a mobile network (or another party has internalised the externality generated by their presence on the network and has paid the full price on their behalf). Hence, there is no economic efficiency reason for callers to contribute for infra-marginal subscribers.

F.165 With regard to churn, as discussed in Chapter 4, the Director considers that T-Mobile's comments are based on a misunderstanding of the desirability of high levels of switching. The elimination of barriers to switching allows consumers to change providers easily and at no cost in order to get the best deal in terms of quality of service and value for money. The risk of losing a customer to a competitor, thus, generates incentives for the MNOs to increase their coverage, reduce their costs (so they can lower charges and prices) and improve the quality and variety of their services. A high level of switching, however, does not generate any downward pressure on termination charges because of the calling party pays (CPP) principle, as discussed in Chapter 2. When switching is artificially induced by a distorted pricing structure (in this case by large subsidies in handset prices, financed by a share of the excessive profits earned from termination services), it can be wasteful and inefficient. Callers to mobile do not derive any benefits from the churn induced through large subscription subsidies, whereas they suffer from the high termination charges necessary to finance these subsidies.

CARS and the level of termination charges

F.166 T-Mobile (paragraphs 4.24 to 4.26 of its response) refers to the Director's argument (made during the Judicial Review) that CARS costs are artificially high because part of the excessive profits earned on termination are spent in these activities. T-Mobile submits that this is not supported by any empirical evidence of a positive correlation between termination charges and acquisition costs, and provides data comparing termination charges and handset subsidies for five EU countries to support its claim. T-Mobile also holds that this argument, even if correct, may justify a reduction in the amount of CARS costs recovered via the common costs mark-up on termination charges, but not for its complete exclusion.

F.167 The Director's point is that when termination charges are set excessively, one of the ways in which this profit is (partially) dissipated or competed away in the retail market is by spending more on CARS (instead of setting lower retail prices). So the observed level of CARS is not an appropriate figure to use – because termination charges have been excessive, the observed level of CARS will be inflated. Just because CARS increase if the termination charge is excessive, this is not a valid reason for setting a regulated termination charge including CARS. Hence it is incorrect to argue that CARS costs are truly causally related or incremental to termination.

F.168 As to empirical evidence, the Director considers that simplistic international comparisons are not conclusive. The Director also notes that the MNOs themselves have indicated that a reduction in termination charges is likely to result in reduced handset subsidies[69].

3.6.2 Treatment of non-network administration costs

F.169 As stated in the May consultation, administration costs comprise the costs that should be recovered across all areas of the business, including both network and retail services. These consist of overheads for non-network depreciation (IT, furniture and office equipment), property costs, human resources, finance and legal costs, and IT overheads. Based on information on administration costs for 2001 submitted by the MNOs to the CC during its investigation (see paragraph 2.329 of the CC report), in the May consultation the Director took the CC's figure of £130m a year as an estimate of the reasonably efficient administration overheads incurred by a mobile operator.

Magnitude of non-network administration costs

F.170 In section 10.4.2.1.2 of its response to the May consultation, Orange states that it believes that the CC incorrectly treated the figure it submitted for non-network overhead costs as the value of its total overheads (both network and non-network), thus leading to an artificially low figure for average non-network administration costs attributable to the cost of termination. By adopting the same approach, Orange submits that the Director's calculations are also subject to this error.

F.171 Having reviewed the CC's treatment of Orange's submitted figures, as well as further information submitted by Orange, the Director is of the opinion that the CC did not make a mistake in using Orange's figure to determine its benchmark for average non-network administration costs.

F.172 Orange's concern appears to arise from a misunderstanding of the appropriate inputs into the CC's calculation of an average figure for non-network administration costs which is then attributable to network functions and CARS functions. The CC's intention was to include only *non-network* related costs in deriving its total figure of £130m of common administration costs. As stated in paragraph 7.159 of the CC report, administration costs are defined to be the residual figure derived after costs have first been allocated to a number of other categories including network costs. Any amount that related to pure network costs should have been removed before determining this residual administration cost.

F.173 Further, the Director understands from paragraph 19 of Annex 7(4)12 of the CC report that Orange had appropriately reallocated all costs that were attributable to network services before arriving at the administration cost figures which the CC then used to derive its estimate of non-network administration costs as used in its report. This figure comprised the non-network overheads, other carrier services

[69] For example, see Response to the Competition Commission's recommendations regarding mobile termination charges, mmO2, 22 January 2003, http://www.mmo2.com/docs/media/pr_030121a.html

which were transferred from network overhead costs, and exceptional items. Appropriately, it did not include further network overhead costs (which together with Orange's non-network overheads gives the total figure which Orange asserts should have been used). Finally, as confirmation that all costs have been appropriately accounted for, the Director notes that Table 7 of Appendix 7.4 of the CC report includes a figure for the balance of network costs under the heading of "Network office and related costs".

F.174 In their responses to the May consultation, Vodafone (paragraph A.2.153 to A.2.154), T-Mobile (paragraph 4.27 to 4.32) and Orange (section 10.4.2.1.2) state that the CC's approach to deriving a benchmark for administration costs by taking the average after excluding the highest figure as an outlier is inequitable. They argue that given that the high outlier is likely to be due to inconsistent cost allocation, exclusion is unjustifiable as it results in removing some of the total costs from the equation.

F.175 In the May consultation, the Director had, like the CC, excluded the outlier. However, on detailed examination of this treatment of administration costs, the Director believes that it is more appropriate to include all four figures in deriving an average non-network administration cost. In analysing the accounting-based network costs of the MNOs, the Director has (like the CC) taken an average across all four operators. The Director is inclined to agree that it would be more consistent to include all data points, including the outlier, in this particular case as well. Hence, the Director has revised his view of the average non-network administration costs to be equal to the simple average of £159m.

F.176 As with the network cost information submitted by the MNOs, the Director notes that the non-network administration figures have the potential to include inefficiencies and it can therefore be argued that these figures lead to an overstatement of the appropriate non-network mark-up for a reasonably efficient average operator. However, the Director has conservatively decided not to adjust these figures to reflect this issue.

F.177 T-Mobile has suggested that the Director should establish standard definitions of cost categories (administration costs as well as others) and reallocate costs accordingly. In response, the Director notes the inherent difficulty and variability in ensuring complete consistency in definitions and cost allocation. The figures he has used reflect the substantial effort already employed by the CC. Moreover, by using the cost information from all four operators, including the outlier on administration costs, the Director considers that all relevant costs have been taken into account.

F.178 Furthermore, Vodafone estimates in Annex 2E of its response to the May consultation that its non-network common costs (direct and indirect) in 2001/02 were significantly greater than the figure used for Vodafone by the CC in deriving the average non-network common costs of the MNOs.

F.179 The Director has analysed the cost categories submitted by Vodafone regarding non-network common costs and classified each of these costs as either:

- retail cost associated with access and origination – retail incremental costs;

- common between network and retail costs; or
- termination incremental costs.

F.180 The conclusion of this examination is that none of the cost categories submitted by Vodafone are incremental to termination, and the majority of the costs are retail costs associated with access and origination. The Director notes that the remaining costs, which he believes should be regarded as common costs between network and retail, are significantly less than the figure used by the CC to reflect Vodafone's non-network administration costs in the derivation of the non-network mark-up.

Allocation of non-network administration costs

F.181 Given that these non-network administration costs are common to the supply of termination and other services they should be allocated across all the services concerned. This requires identifying the total costs of the average MNO. Consistent with the approach adopted in the May consultation, using average information for the four MNOs submitted to the CC, the Director has taken average network costs in 2001 to equal £607m, and retail costs - customer acquisition, retention and service costs (before handset revenues) - to average £1,276m. Adopting an equal proportionate mark-up, 32% (£607m / (£607m + £1,276m)) of the £159m administrative overheads can be attributed to network activities. Dividing the resulting administrative cost attributable to network by the average total minutes for the year (comprising incoming, outgoing and on-net voice minutes) of 15.5 billion[70] results in a non-network common cost mark-up to the LRIC of voice call termination of 0.33ppm (in real 2000/01 terms). This compares with a non-network common cost mark-up of 0.30ppm proposed in the May consultation.

F.182 Regarding the allocation of non-network common costs, in response to the May consultation, Vodafone (paragraphs A.2.155 to A.2.158) and T-Mobile (paragraphs 4.33 to 4.36) hold that the Director's use of EPMU is incorrect and that these costs should be recovered from call termination services using a Ramsey pricing mark-up.

F.183 More specifically, Vodafone argues that even if EPMU was used, the Director has failed to allocate administrative costs based on his own cost-causation principle since he has inflated the non-network cost component by incorrectly including handset subsidies, incentives and discounts which are not a business function in themselves. Similarly, Orange (section 10.4.2.1.3 of its response) claims that handset subsides should be excluded because their costs are also shown within revenues and thus net out (i.e. it is a passthrough item). It also argues that there is no valid cost driver to justify allocating overheads to discount and incentives.

F.184 T-Mobile goes further and holds that the Director's treatment of administrative costs is wrong because these costs should be not be allocated to CARS at all.

F.185 As described above, the Director agrees that an element of administrative costs should be allocated to termination services, because these costs are common

[70] Based on information provided to the CC by the MNOs – see Table 7.14 of the CC report.

to all areas of an MNO's business and are not incremental to any specific activity. By definition, the size of common costs does not vary with the volume of, or price of, any specific activity. Hence the MNOs' comments on the lack of relationship between these common costs and handset prices do not provide a relevant distinction. However, the Director considers that Ramsey mark-ups are not the appropriate way to recover common costs in the voice call termination markets, for the reasons stated in Annex K. He therefore maintains his view of allocation on the basis of the relative proportion of network costs to the total of network and non-network costs (as the CC also did as stated in paragraph 2.335 of the CC report).

F.186 The Director believes that common costs should be recovered from all the activities that these costs help to support, which includes the provision of retail services. Therefore, the Director considers that it is appropriate to add a mark-up for administrative costs on the retail activities, which include the costs incurred in acquiring subscribers (ie handset subsidies, discounts and incentives and marketing). He is also of the view that acquisition costs should include gross handset costs because these are a better reflection of the cost of subscription than net costs.

F.187 As stated in the May consultation, during the CC's consultation the MNOs generally said that their administration costs level could be expected to remain relatively constant with changes in traffic, unless there was a significant increase in traffic or subscriber numbers. Given that the forecast traffic in the LRIC model grows only slowly until 2005/06, the Director considers it reasonable that the estimated mark-up of 0.33ppm for non-network common costs should remain constant over this period in real terms.

4 Conclusion

F.188 In conclusion, the table below sets out the original LRIC+ figures from the April 2002 model (at 12% cost of capital) and the adjustments discussed above to derive the LRIC+ figures that include the EPMU for network and non-network common costs. The fair charge is then determined by the sum of the adjusted LRIC+ figures below and the surcharge for the network externality (discussed in Annex G).

F.189 The resulting LRIC+ figures (excluding the network externality surcharge) in 2005/06 of 4.21ppm and 4.79ppm (in real 2000/01 terms) for combined 900/1800MHz and 1800MHz operators respectively, are similar (approximately 0.1ppm lower) to the equivalent figures proposed in the May consultation.

Table 8: Revised LRIC+ figures

Pence per minute (real 2000/01)	2001/02	2002/03	2003/04	2004/05	2005/06
900/1800MHz operators					
LRIC+ at 12% CoC (May consultation)	4.86	4.57	3.90	3.70	3.53
Capital cost adjustment – 12.25% (ppm)	-0.02	-0.03	0.04	0.03	0.03
Revision for 32Mbit/s links	0.02	0.02	0.02	0.02	0.02
Revision for swapped out / declining equip	-0.02	-0.01	0.02	0.03	0.04
Revision for location update / HLR	0.23	0.20	0.18	0.16	0.15
Revised model LRIC+	5.07	4.76	4.16	3.95	3.76

Capital / operating cost adjustment	0.57	0.45	0.26	0.18	0.11
Non-network common cost mark-up	0.33	0.33	0.33	0.33	0.33
Resulting LRIC+ (excluding network ext)	5.97	5.55	4.75	4.46	4.21
1800MHz operators					
LRIC+ at 12% CoC (May consultation)	6.06	5.67	4.77	4.50	4.27
Capital cost adjustment – 12.25% (ppm)	-0.03	-0.03	0.05	0.05	0.04
Revision for 32Mbit/s links	0.02	0.02	0.02	0.02	0.02
Revision for swapped out / declining equip	-0.02	-0.01	0.01	0.02	0.02
Revision for location update / HLR	0.23	0.20	0.18	0.16	0.15
Revised model LRIC+	6.26	5.85	5.03	4.75	4.50
Capital / operating cost adjustment	0.58	0.42	0.15	0.05	-0.05
Non-network common cost mark-up	0.33	0.33	0.33	0.33	0.33
Resulting LRIC+ (excluding network ext)	7.17	6.60	5.51	5.13	4.79