

On-net/off-net differentials

THE POTENTIAL FOR LARGE NETWORKS TO USE ON-NET/OFF-NET DIFFERENTIALS OR HIGH M2M CALL TERMINATION CHARGES AS A MEANS OF FORECLOSURE

It is becoming received wisdom amongst telecoms regulators that large mobile operators can use high off-net and low on-net pricing to protect themselves from competition from smaller rivals. It is odd that such a view is gaining currency, because there is little support for it from the academic literature on network pricing. Furthermore, it is not even clear that historically it has been the large rather than the small networks that have introduced these differentials. In this note we examine the arguments and try to explain in simple terms why on-net/off-net differentials and high M2M call termination charges do not obviously act to the advantage of larger networks as has been claimed.

In many, but not all countries, mobile phone customers have to pay higher charges to call subscribers of different mobile networks (“off-net” calls) than to call other subscribers on their own network (“on-net” calls). However, a relatively recent phenomenon is that in discussions between national telecoms regulators it seems to be becoming accepted that differential on-net and off-net pricing could be used as a foreclosure mechanism by large operators against smaller competitors¹.

It is relatively easy to see why such suspicions might be aroused. First, there is no obvious justification for on-net/off-net differentials on welfare or efficiency grounds. Clearly, if mobile telephony were offered by a single network there would be no off-net calls and therefore no reason to price discriminate between calls to different subscribers. Therefore, at best it appears that on-net/off-net differentials may be a cost/consequence of having competing mobile networks, along with other costs such as increased expenditure on customer acquisition and retention and replication of fixed network costs.

Furthermore, on casual inspection on-net/off-net differentials appear to have a similarity to “margin squeeze” cases, because the retail price of an on-net call on large network A is less than the wholesale cost to small network B of sending an off-net call to network A².

Nonetheless it is strange that the idea of on-net/off-net differentials as a form of *foreclosure* is gaining credibility. First and foremost, while there is a considerable and growing academic literature on the issue of pricing between competing mobile networks, this literature does not support the use of high M2M call termination charges or high off-net retail charges as a foreclosure device. Indeed it is not at all clear that on-net/off-net differentials advantage large networks relative to small ones. Papers published to date typically indicate that mobile

¹ For instance see recent “Consultation Document on a Draft joint ERG/EC approach on appropriate remedies in the new regulatory framework”, 21st November 2003.

² Made up of the LRIC of originating the call and the M2M call termination charge levied by network A.

operators would choose to set M2M call termination charges (and thereby off-net retail charges) at cost³. Indeed Laffont-Rey-Tirole (LRT)⁴ suggests that it may be profit maximising to set call termination charges and retail off-net charges *below* cost when operators can discriminate between the retail price of on-net and off-net calls, while Carter and Wright⁵ suggests that when networks are of unequal size it is the larger network that has the stronger incentive to set termination (and off-net retail charges) at cost.

Furthermore, as a simple matter of historical fact it has not always been larger incumbent networks that have introduced these differentials. For example:

- In the UK, on-net/off-net differentials were first introduced in late 1993/early 1994 by One2One and Orange when these networks launched their services. Vodafone only introduced such differentials in its charges in October 1998. BT Cellnet introduced differential pricing in spring 1999.
- In Germany, E-Plus, the third entrant, launched with on-net/off-net differentials in 1994. The two existing GSM-900 operators then introduced similar differentials approximately six months later.
- In Ireland, Digifone launched in May 1997 with on-net/off-net differentials. Eircell, only responded with similar differentials in May 1999.

These facts do not immediately suggest that on-net/off-net differentials were being used by large incumbents for foreclosure. It was the *entrants* that chose to set differential prices, while the incumbents did not choose to follow suit after varying periods of delay. During this time the entrants established themselves in the market. Hence, it seems clear that high off-net and low on-net charges did not have the suggested effect of preventing the small operators gaining a foothold in the market or growing their market share⁶.

The facts also raise another important point: that is the relationship between on-net/off-net differentials and M2M call termination charges. It is usually assumed (in the academic literature) that call charges are set at marginal cost and therefore on-net/off-net differentials are synonymous with having above-cost M2M call termination charges, hence the discussion usually surrounds the optimum level of M2M call termination charge rather than on-net/off-net differentials *per se*

³ If charges were set reciprocally and without the risk of arbitrage with F2M call termination charges.

⁴ Laffont J.J., Rey P. and J Tirole (1998), "Network Competition I: Overview and Nondiscriminatory Pricing", *RAND Journal of Economics* 29 (1-37)

⁵ Carter M. and W. Wright (2003), "Asymmetric Network Interconnection", *Review of Industrial Organisation* 22 (27-46).

⁶ Although off the main topic of this note, one could speculate on why small networks have chosen to launch with on-net/off-net differentials and what determines the very variable speed at which larger rivals appear to have responded. We comment below on the possible use of differentials to segment customers, offering better prices to closed user groups. As for the speed of response by incumbents, this would require further study of the circumstances surrounding each individual case, but may relate either to the abandonment of bill and keep arrangements, or to the point at which the volume of M2M traffic became material.

In reality it seems that we need to consider two different points relating to on-net/off-net differentials:

- could high M2M call termination charges be used by large operators as a form of foreclosure? and
- could on-net/off-net differentials be used by large operators as a form of foreclosure, regardless of the level of M2M call termination charges?

In the rest of this paper we attempt to explain, in simple terms with examples, why small networks do not clearly suffer a disadvantage from on-net/off-net differentials. However, we begin by briefly considering the issue of predatory pricing, in order to clarify exactly what it is we are concerned with as regards on-net/off-net differentials.

PREDATORY PRICING

It is worth at the outset drawing a distinction between on-net/off-net differentials and simple predatory pricing.

In practice, mobile operators charge their customers multi-part tariffs for their services. There are separate charges for handsets and usage. Furthermore both handset and usage charges vary between different packages and, within package, by network destination and by time of day. For contract customers there is also a complex pattern of bundled “free” minutes and other bundled services (e.g. SMS messages). We see that handset charges are frequently subsidised, with call charges, on average, set above cost. In these circumstances it is neither possible nor sensible to consider predatory pricing in the context of the price of one single service (e.g. on-net or off-net pricing) out of the entirety of services offered by the mobile operator.

Now, if an operator with market power in the outbound market were to price all services at cost *except* on-net calls, which it priced below cost, then a small competitor could not hope to match such pricing and recover its costs.

In this case an on-net/off-net differential is simply one of many ways in which a dominant operator could, in principle, act in a predatory way. The appropriate test of whether the dominant operator is attempting to foreclose the market would be whether the dominant operator’s prices, in aggregate across all relevant services, are sufficient to recover its costs.

This form of predation seems to us relatively straightforward and is already addressed by standard competition law. It is not our focus here. Rather we are concerned to ask whether a large operator could set M2M call termination charges above cost to foreclose the retail market to smaller competitors or whether the simple use of on-net/off-net differentials (even assuming that *average* charges cover costs for the large operator) could constitute foreclosure?⁷

⁷ Thus we see that the wholesale access analogy is not correct, because operators do not compete for subscribers that only call customers on the large network. Subscribers on both networks will pay subscription (or handset) charges and will make both on-net and off-net calls. While it is obviously

In the former case it is also interesting to ask whether it is necessary for the large operator to be dominant in the outbound market? While this would normally be a necessary condition for any finding of foreclosure, could it be argued that a large operator could leverage its monopoly in the call termination market on its own network to gain advantage over smaller rivals in the outbound market?

DO HIGH M2M CALL TERMINATION CHARGES ADVANTAGE LARGER OPERATORS?

Given the above discussion, the first question we ask is whether high M2M call termination charges can be expected to act to the advantage of larger operators? This is a view that has been expressed by, for example, Ofcom/Oftel on a number of occasions, most recently in its notification to the European Commission on call termination⁸.

It is possible to envisage such an advantage arising in one of two ways:

- by raising the profits of large operators at the expense of the small, thus providing large operators with additional funds to spend on attracting and keeping subscribers; or
- by making the smaller network intrinsically less “attractive” to subscribers than its larger rival.

To illustrate the answer to these proposals it is best to set up a simple model. We assume that operators have no fixed costs and all calls are M2M (i.e. no calls to or from fixed networks). Subscribers can make on-net or off-net calls, the proportions of which reflects the proportion of subscribers on each network⁹. For simplicity we also assume that the number of subscribers on each network is fixed¹⁰. We also assume that M2M call termination charges are set reciprocally, i.e. both networks charge each other the same M2M call termination charge.

As we are not dealing with the exercise of market power in the outbound market, we assume that operators generate no economic profits. If the M2M call termination charge is set at marginal cost then operators would be expected to

the case that there are more people to be called on the larger network (and so the price of off-net calls may be more important for the subscribers on a smaller network) this distinction is crucial. The fact that subscribers are buying a service to make both on-net and off-net calls means that the combined cost must be considered in considering any question of predatory pricing.

⁸ Ofcom, “Wholesale mobile voice call termination consultation: Proposals for the identification and analysis of markets, determination of market power and setting of SMP conditions. Explanatory Statement and Notification”, 19 December 2003. See para. 5.69.

⁹ This is a routine assumption in the network pricing literature.

¹⁰ There is no loss of generality in doing so. Although, clearly we are interested in how network pricing influences subscribers choice of network, we can think of our simple model like a repeated game: in the first round the number of subscribers is fixed and the operators provide phone services; in the second round, operators compete to reengage their customers for the following rounds, and so on. If, in the first round, a large network can generate more profits for a *given* level of subscribers from its smaller rival then we can assume that it can use these profits to attract customers from the smaller network in subsequent rounds. Hence profits in the first round suggest the ability of the larger network to foreclose the market.

see the prices subscription, on-net and off-net calls all at marginal cost. The price of on-net and off-net calls will also be equal¹¹. The small network's subscribers will make a greater proportion of off-net calls than the subscribers of the larger network, but as the price of calls will be the same there will be no interconnection imbalance between the two¹². In this world both operators will make normal profits.

The details of this scenario are set out in the first worked example presented at the end of this note.

Profits from termination

Consider now what would happen if the operators were to raise the M2M call termination charge¹³. If retail call charges stay unchanged then both operators will lose money on each off-net call placed, but make a profit on each off-net call received. Because retail charges have not changed interconnection traffic will remain in balance and these profits and losses would cancel out. Hence neither operator benefits from raising M2M call termination charges. This calculation is shown in the second worked example below. This is a simple example of the "profit neutrality" result identified for M2M call termination charges by LRT when subscription is exogenous and operators use multi-part tariffs.

Of course, it is unlikely that retail charges would remain unchanged if M2M call termination charges were increased above marginal cost. *Given* the call termination charge, the most efficient thing for operators to do is to price calls at marginal cost, including the call termination charge on off-net calls¹⁴. Because both networks still charge the same off-net call charge interconnection traffic will remain in balance. However, if operators price in this way then they break even on all outbound calls, but make a profit from call termination. As the overall market is competitive, they cannot retain this profit, so they will compete it away in pricing subscription below cost. It is easy to show that the small operator gains at the expense of the larger operator in these circumstances. Assuming for simplicity that both operators charge the same subscription charge then the level that reduces overall industry profits to zero leaves the small operator with a profit and the large one with a loss. This is shown in the third worked example below.

¹¹ Assuming that the marginal costs of terminating on-net and off-net calls are the same.

¹² That it each network will send and receive equal numbers of calls from the other network.

¹³ Or in the context that we are considering it, that the larger operator were to do so with the smaller one following suit.

¹⁴ It is well known that marginal cost pricing maximises welfare. In the case of off-net calls, the marginal cost the originating operator experiences does not include the LRIC of call termination (because that is paid by the termination operator). Rather it is the M2M call termination charge that enters into the marginal cost that it pays. If the operator chooses not to reflect the M2M call termination charge in its retail off-net price then it will make a loss on every off-net call, which it would prefer to avoid. Furthermore, if the operators set different off-net rates then the result will be an interconnection imbalance. The operator that sets a lower off-net charge will tend to generate more off-net calls than its rival and so will have an interconnection deficit. For this reason there is likely to be a strong tendency for operators to equalise off-net call charges.

Hence, we observe a number of important results. First, as is obvious, M2M call termination charges cannot generate profits for the mobile industry as a whole, as they are simply transfers between mobile operators that must, by definition, sum to zero. Setting call termination charges above cost would be expected to alter the pattern of retail prices, increasing the retail price of off-net calls relative to on-net ones. However, unless an operator has market power in the outbound market it will not be able to raise the prices of its combined bundle services above cost (including calls and subscription). In this case, raising M2M call termination charges could actually advantage the smaller operator. An alternative way of looking at this advantage is that setting M2M call termination charges above costs creates the same absolute amount of profit from termination for the small and large operator, because interconnection traffic is in balance. As a result the smaller operator generates more profit *per customer* than its larger rival, which it can then use to attempt to attract more customers onto its network.

We suspect that a major reason why it tends to be assumed that high M2M call termination charges may benefit larger networks is a confusion over the relative importance of the volume of off-net calls and interconnection balance.

What is critical to assessing the net impact of high M2M call termination charges is not the volume of off-net calls as a proportion of total outbound calls, but whether the traffic between the two networks is in balance. Customers of the small network would always be expected to make more off-net calls than the customers of the larger network, simply because, proportionately, there are more people to call on the larger network. Hence it is true that if M2M call termination charges are set above cost a small network might be expected to have to pay a greater amount per subscriber in M2M call termination charges than its rivals. However, as we have already said, by the same logic the customers of the smaller network would also be expected to *receive* more off-net calls than the customers of the larger network. Hence the small network will also receive more income from call termination revenues per customer than its larger rival. The net cost (or receipts) of the small network depends on whether the network runs an interconnection surplus or deficit not on the absolute or relative magnitude of off-net traffic. As long as the calling pattern of the small network's customers does not favour other networks there is no reason to expect the small network to face an interconnection traffic deficit.

The effect of high M2M call termination charges on the value of subscription to large or small networks

It seems clear that large networks cannot use high M2M call termination charges to divert profit from smaller networks, unless they enjoy an interconnection surplus, and there is no *a priori* reason to expect that they will have a surplus.

However, as we have suggested this is not the only way that high M2M call termination charges could potentially influence competition between large and small networks. Raising M2M call termination charges can be expected to raise off-net retail call charges and we have recognised that the smaller network's subscribers will make more off-net calls than those of the larger rival. Is it not possible, therefore that this increase will have a more adverse effect on the small

network's subscribers, thus making it relatively less attractive to be a customer of that network?

Recent publications have supported this hypothesis. In its consultation on appropriate remedies under the new EU framework, the European Regulators Group of National Regulatory Authorities (the ERG) puts the case that low on-net and high off-net charges generate "tariff mediated network externalities" for the customers of the larger network and thus put small networks with few participants "at a disadvantage"¹⁵. In addition, Valletti, in his recent report on the same subject for the European Commission¹⁶, makes a more subtle point that if subscribers value *receiving* calls then high off-net charges deprive the rival's subscribers of the "benefits from receiving calls" and thus make subscription on the smaller network less attractive.

It seems to us, however, that these arguments do not stand up to close scrutiny. At first sight our third worked example might appear to support this line of reasoning. In this example the retail price of on-calls is 1.0 and, as a result of the call termination charge exceeding LRIC by 0.2, the price of off-net calls is 1.2. Because Network B's customers make proportionately more off-net calls their average call price is 1.13, compared with 1.06 for Network A's customers. Moreover, given the elasticity assumptions, Network A's customers both make and receive 0.98 calls each, whereas Network B's customers make and receive 0.96 calls each.

This therefore demonstrates both the problems suggested by Valletti and ERG. Clearly at these prices network B's customers receive fewer calls than Network A's (and presumably therefore get less value from their phones as a result). Also as, on average, calling appears cheaper on the larger network, there is evidently a "tariff mediated network externality" in favour of the larger network.

What this example fails to take into account, however, is that the smaller network has further degrees of freedom to adjust its tariffs so as to make itself equally attractive. To begin with, we have already noted that in example 3 the smaller network has some excess profit that it can use to compete more aggressively for customers with its larger rival. The key question is how should the smaller network respond?

Worked example 4 demonstrates that if the smaller network matches the larger network's off-net charge (to maintain interconnection balance) and subscription charge, it can match the larger network's average call charge and ensure that its subscribers make and receive as many calls as those on the larger network. It

¹⁵ A "network externality" occurs when the value that each subscriber to a network gets from being a subscriber increases as the total number of subscribers increases. Assuming equal pricing for all calls, interconnection between two competing networks, allowing subscribers to call other subscribers on *either* network, also creates a network externality effect by increasing the number of people with whom each subscriber can communicate. If the price of on-net and off-net calls differ then "tariff-mediated network externalities" are created, because subscribers care about which network the people they want to call are on.

¹⁶ Valletti, T., "Obligations that can be imposed on operators with significant market power under the new regulatory framework for electronic communications: Access services to public mobile networks", September 2003.

does so by setting its on-net call charge *below* cost. In this worked example, normal profits can be established for both operators at a subscription price of 0.14, and if Network B reduces its on-net charge to 0.82, which is below the LRIC of 1.0 for an on-net call. With these prices profits are zero and interconnection traffic is balanced. Subscribers of both networks also make and receive 0.98 calls each. Furthermore, the average call charge paid by subscribers on each network is equal at 1.06.

Example 4 is a simple demonstration of why LRT argue that reciprocal access charges cannot be used to deter entry, since the entrant can avoid incurring an access deficit by “match” the marketing and pricing policy of the incumbent. In this case, the smaller network can neutralise any advantage given to the larger one by higher off-net charges by setting the same off-net charge, but undercutting the larger network on on-net.

The situation becomes more complicated if the size difference between the large and small network is very great. In this case, it may be that the small network cannot fully neutralise the tariff mediated network externalities of the larger network simply by setting a lower on-net charge, because the volume of on-net calls is too small to achieve this at any non-zero on-net price. However, in this case, if the smaller network sets a positive on-net charge, it will also be able to largely compensate for higher average calling charges by offering a lower subscription charge than its larger rival. Hence even in this case tariff mediated network externalities created by on-net/off-net differentials can be largely neutralised¹⁷.

ON-NET/OFF-NET DIFFERENTIALS REGARDLESS OF THE LEVEL OF M2M CALL TERMINATION CHARGES

In the academic literature it is usually assumed that calls are priced at marginal cost. However, we have noted an example where a small network would choose to price on-net calls below cost in order to compete with its larger rival. This brings us back to the question, of whether on-net/off-net differentials, regardless of the level of the M2M call termination charge, could be used as a method of foreclosure?

It should be apparent from the previous discussion that we have effectively answered this question. Provided interconnection traffic is balanced, a large network gains no advantage from high M2M call termination charges for given retail charges (see worked example 2 below). Furthermore, we have shown that the effect of on-net/off-net differentials is not through profits from termination but through the potential for tariff mediated network externalities, but that these can be effectively neutralised by the small network imposing a *greater* on-net/off-net differentials than the large network (see worked example 4). It does not,

¹⁷ If there is already more than one incumbent network, any tendency to attempt to “tip” the market in this way will also be offset provided the incumbents cannot discriminate against the entrant on M2M call termination charges. Provided these charges have to be common between all operators, the incumbents would have a disincentive to set high M2M call termination charges because of the damage this would do to the level of traffic between the incumbents.

therefore seem possible to argue that on-net/off-net differentials per se can be used by large networks to foreclose entry.

Furthermore, the fact that a smaller network might choose to set a wider on-net/off-net differentials than a larger one hints at the possibility that smaller networks might actually choose to use on-net/off-net differentials as a means of segmenting the market and gaining competitive advantage. The fact that, when small, there are fewer on-net calling options on a small network presents that network with an opportunity as well as a problem. Specifically, it is able to offer cheap (possibly below cost) on-net calls at relatively little cost in terms of profits, because few of these calls are made. This will then make the small network more attractive than the larger one to closed user groups and others who might subscribe collectively and who call predominantly within the group. It would be hard for the larger network to respond to this strategy because the cost to the larger network of discounting on-net calls is much more substantial given the greater proportion of these calls on the larger network.

CONCLUSIONS

We have raised the issue of high M2M call termination charges and on-net/off-net differentials and addressed whether it can credibly be argued, as has been recently by a number of regulators, that these pricing differentials can be used to create an advantage for large networks over small ones. This might potentially foreclose the market to new entrants or prevent small competitors from establishing greater market shares.

We have first drawn the key distinction between price differentials (where off-net calls are more expensive than on-net ones, but where the larger network is pricing at or in excess of average variable cost across all its services) and predatory pricing. In the latter case a network with market power could set one, or several, tariffs below cost as a predatory act. If it were to do so this could be dealt with under existing competition law and is not directly relevant to the issue of on-net/off-net differentials and M2M call termination charges.

We have then gone on to ask whether a large network could, in principle use its bottleneck over call termination on its own network to raise the whole price of call termination and thus gain advantage in the retail market, even if it does not directly possess market power in that market? Here we conclude, with the support of the literature and some worked examples, that there is no clear advantage to larger networks in high M2M call termination charges, nor in on-net/off-net differentials, if the large operator does not have market power in the outbound market.

In the former case, profits are only generated if there are traffic imbalances as well as call termination charges in excess of cost. Despite the greater importance of off-net traffic for a smaller network, there is no reason to believe that small networks will systematically run interconnection traffic deficits relative to their larger rivals. In the case of on-net/off-net differentials, we have shown that if the small network simply matches its larger rivals prices then it could suffer as a result of tariff mediated network externalities. However, by setting on-net call charges below cost, and hence having a larger on-net/off-net differential than its rival, the small network can neutralise this effect.

There does not, therefore, seem to be an argument to support the use of high M2M call termination charges or on-net/off-net differentials by large networks as a foreclosure device.

However, given that on-net/off-net differentials do not seem to be a small network/ large network issue, nor are they readily explained by the existing literature, there remains a need to provide a coherent explanation for their use. In our view two factors are likely to be most relevant. First, M2M call termination charges tend to be set above cost because non-discrimination obligations and regulatory pressure has made it very difficult for operators to set materially different M2M and F2M call termination charges. Given the clear incentive for mobile operators to set high F2M rates, this tends to drag up M2M charges. This, in turn leads to on-net/off-net differentials simply because off-net charges reflect the higher perceived marginal cost of off-net calls. Secondly, the

fact that small operators have tended to be the first to introduce on-net/off-net differentials leads us to suppose that differentials are being used to segment customers, by allowing networks to offer more advantageous calling rates to high value closed user groups. This effect is not captured in the standard pricing models in which calling patterns are proportional to network size and which do not feature closed user groups whose calling patterns are very different from the average.

WORKED EXAMPLE 1

Table 1 shows the “base case” of our simple model. Network A has 100 subscribers and Network B has 50. Each subscriber makes 1 unit of calls (continuously divisible) at a price of 1 per unit, with a demand elasticity of -0.3 .

As prices equal marginal cost profits from each service are zero, by definition. This example shows that although two-thirds (33.3 out of 50) of the calls made by Network B’s subscribers are off-net (to Network A), while only one-third (33.3 out of 100) of the calls made by Network A’s subscribers are off-net (to Network B), interconnection traffic is balanced.

Base Quantities	Network A	Network B
No.of subscribers	100	50
Calls per subscriber	1	1
Base Costs		
Fixed Cost Per Cust	0.20	0.20
LRIC Origination	0.50	0.50
LRIC Termination	0.50	0.50
Call Elasticity	-0.30	-0.30
Prices		
Subscription Charge	0.20	0.20
Calls To Network A	1.00	1.00
Calls To Network B	1.00	1.00
Termination Charge	0.50	0.50
Calls Made		
To Network A	66.7	33.3
To Network B	33.3	16.7
Total	100.0	50.0
Traffic Balance	0.0	0.0
Profit		
Subscription Charge	0.0	0.0
Calls To Network A	0.0	0.0
Calls To Network B	0.0	0.0
<u>Termination Charges</u>	<u>0.0</u>	<u>0.0</u>
Total	0.0	0.0

Table 1: Base scenario with all prices at marginal cost

WORKED EXAMPLE 2

Table 2 shows the effects on profits of raising M2M call termination charges (from 0.5 per unit to 0.7) if retail call charges do not change. Unsurprisingly call volumes do not change. Profits are made from call termination but these are axiomatically cancelled out by losses on off-net calls.

Base Quantities	Network	
	A	B
No. of subscribers	100	50
Calls per subscriber	1	1
Base Costs		
Fixed Cost Per Cust	0.20	0.20
LRIC Origination	0.50	0.50
LRIC Termination	0.50	0.50
Call Elasticity	-0.30	-0.30
Prices		
Subscription Charge	0.20	0.20
Calls To Network A	1.00	1.00
Calls To Network B	1.00	1.00
Termination Charge	0.70	0.70
Calls Made		
To Network A	66.7	33.3
To Network B	33.3	16.7
Total	100.0	50.0
Traffic Balance	0.0	0.0
Profit		
Subscription Charge	0.0	0.0
Calls To Network A	0.0	-6.7
Calls To Network B	-6.7	0.0
Termination Charges	6.7	6.7
Total	0.0	0.0

Table 2: The effect on profits of raising M2M call termination charges with no change in retail pricing

WORKED EXAMPLE 3

Table 3 shows the effect on the profits of the large and small network of passing on higher M2M call termination charges in higher off-net retail charges and competing it away in lower subscription charges. The volume of off-net calls is reduced, but as both networks are still charging the *same* off-net charge interconnection balance is maintained. The common subscription charge that reduces industry profits to zero leaves the smaller network with a profit and the larger one with a loss, because the smaller network generates more profit per subscriber from call termination.

Base Quantities	Network	Network
	A	B
No. of subscribers	100	50
Calls per subscriber	1	1
Base Costs		
Fixed Cost Per Cust	0.20	0.20
LRIC Origination	0.50	0.50
LRIC Termination	0.50	0.50
Call Elasticity	-0.30	-0.30
Prices		
Subscription Charge	0.12	0.12
Calls To Network A	1.00	1.20
Calls To Network B	1.20	1.00
Termination Charge	0.70	0.70
Calls Made		
To Network A	66.7	31.4
To Network B	31.4	16.7
Total	98.1	48.1
Traffic Balance	0.0	0.0
Profit		
Subscription Charge	-8.4	-4.2
Calls To Network A	0.0	0.0
Calls To Network B	0.0	0.0
Termination Charges	6.3	6.3
Total	-2.1	2.1

Table 3: The effect on profits of high M2M call termination charges are reflected in retail call charges

WORKED EXAMPLE 4

Table 4 shows that if the smaller network lowers its on-net charge in response to a high M2M call termination charge it can generate normal profits, a traffic balance and ensure that its subscribers make and receive the same number of calls as those of the larger network, thus neutralising any tariff mediated network externalities.

Base Quantities	Network	
	A	B
No. of subscribers	100	50
Calls per subscriber	1	1
Base Costs		
Fixed Cost Per Cust	0.2	0.2
LRIC Origination	0.5	0.5
LRIC Termination	0.5	0.5
Call Elasticity	-0.3	-0.3
Prices		
Subscription Charge	0.14	0.14
Calls To Network A	1.00	1.20
Calls To Network B	1.20	0.82
Termination Charge	0.70	0.70
Calls Made		
To Network A	66.7	31.4
To Network B	31.4	17.6
Total	98.1	49.0
Traffic Balance	0.0	0.0
Profit		
Subscription Charge	-6.3	-3.1
Calls To Network A	0.0	0.0
Calls To Network B	0.0	-3.1
Termination Charges	6.3	6.3
Total	0.0	0.0

Table 4: On-net tariffs set by the smaller network to neutralise any tariff mediated network externalities.

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