Review of interconnect usage charges - a submission to the TRAI

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1 Introduction

In this paper I make an independent assessment of the interconnect regime in India and put forward proposals on the future interconnect arrangements which best serve the interests of India's economy and society. These are based on my experience of advising regulators on interconnection regimes in both developing and developed markets.

I confine my comments to considerations of simple interconnect in which Indian operators exchange voice traffic. In this paper, I focus entirely on termination charges and do not consider:

- Origination charges
- Carriage or transit charges
- Charges for termination of international calls.

Nor do I consider the issue of what costing standard should be used to establish a cost based termination charge for the simple reason that, if I am correct in my arguments about termination charges in India, such debate is now of only limited relevance.

2 My qualifications to offer an opinion

I have provided advice at the highest level to both regulators and operators worldwide on appropriate interconnect arrangements for the past 20 years. For example:

- I was the principal author of an authoritative review of interconnect arrangements in competitive telecommunications markets in 1994[1]
- I was the project manager for a study for the European Commission which formed the basis for the EU's Access and Interconnect Directive of 2002
- I have advised Ofcom in the UK and, more recently, the European Commission on the best way to regulate next-generation access so as to promote efficient investment while maintaining strong retail competition[2]
- I have worked extensively on studies to explore the best way to structure mobile charging arrangements. This includes submissions to the UK's Competition Commission on mobile termination charges (MTCs) in 2002, a major study for the Hong Kong regulator OFTA in 2006[3], and a review for Telstra on the current EU debate on MTCs in 2008.

In all cases I have carried out economic analysis from a public interest perspective. I provide more details on my qualifications in Annex A where I attach a copy of my CV.

[1] *Interconnect – the key to effective competition*, Lewin D and Kitchen M, Ovum, 1994

[2] *Draft Commission Recommendation on regulated access to Next Generation Access Networks (NGA),* DG Info Soc, October 2008

[3] *Review of the Regulatory Framework for Fixed-Mobile Convergence in Hong Kong*, Ovum Limited for OFTA, April 2006

3 My opinion in summary

I propose that:

- ***The TRAI should oblige all of India's operators to interconnect so as to enable voice calls to be terminated on every network.*** This requirement, often referred to as the any-to-any interconnect principle, is important, both to maximise economic welfare and to maximise competition
- ***India's operators should provide local termination services to each other on a Bill and Keep (BAK) basis.***

I argue that such a proposal:

- ***Maximises economic welfare in India*** through lower prices and higher calling volumes per subscriber than with existing arrangements
- ***Stimulates mobile take up among the rural and poorer segments*** of Indian society through lower prices
- ***Eliminates the costs of negotiating and determining termination charges*** as well as minimises risks of legal challenge since termination charges are set to zero
- ***Provides a much simpler and more future proofed form of interconnect than the existing regime.*** My proposal makes interconnect charging much simpler, and removes barriers to developments such as:
  - the migration to 3G services
  - the move to next-generation networks
  - the complimentary use of WiFi networks, femto cells and macro layer cells by mobile networks in future so as to maximise efficient use of spectrum.

  Such developments are central to the future economic development of India.

I set out my arguments and supporting evidence in detail below.

4 The need for the any-to-any interconnect principle

I believe that the TRAI should, as OFTA has in Hong Kong, make explicit the any-to-any interconnect principle by which operators are required interconnect so as to terminate calls from other networks. Without the any-to-any requirement operators could refuse to terminate calls.

Potentially this has two serious consequences:

- It can significantly reduce economic welfare. Subscribers on one network are not able to talk to subscribers on another and the services available to both sets of subscribers are substantially reduced in value
- It can significantly weaken competition in certain circumstances. For example:
  - when one operator has a substantial share of a market it has strong incentives to refuse to interconnect with rivals
  - customers are then attracted to the larger network which grows in size, making it even more attractive. This leads, in the absence of regulatory intervention, to a monopoly.

  There are examples of such effects from early in the 20th century. At that time in the US the Bell Operating Companies refused to interconnect with their rivals. This lead to monopolisation of the America telephone system

5 When should interconnect charges be cost based?

In answering this question it is important for telecommunications regulators to distinguish clearly between setting ***access prices*** and setting ***termination charges***.

Access prices

An access price is a price at which one operator buys inputs from another in order to create a retail service. Here it is important for the regulator to ensure that:

- The access price is not excessive, as it might be if the access provider is competing at the retail level with the access seeker. It then has strong incentives to raise access prices to weaken the competitive position of the access seeker
- The access price gives the right signal to the access seeker as to whether it should buy the access facility/service or build it. If the price is set too high the access seeker will build when it should buy. And if the price is set too low it will buy when it should build

Both of these considerations point the regulator towards ensuring that the access provider charges the access seeker a cost based price.

Termination charges

A termination charge is a price which a terminating network operator charges an originating network for completing calls destined for subscribers to the terminating network.

Here the terminating operator has a monopoly on supply of the service if, as we propose, the any-to-any interconnect principle is applied. The originating operator must then deliver the call and the terminating operator has a monopoly on routing the call to its destination.

So, in the absence of regulation, the terminating operator could charge what it liked. This problem is especially acute when the originating and terminating operators are in competition with each other in the retail markets. Then both operators have strong incentives to raise their termination charges well above cost and use the resulting profits to subsidise retail prices so as to achieve a greater market share. This analysis suggests that the regulator should prevent the terminating operator from charging a price in excess of what is cost based. But it does not stop the regulator from requiring the terminating operators to charge a price which is below cost or even zero.

The economic analysis set out above indicates to me that***, for economic efficiency, access prices should be cost based, while termination charges should be set at a level which does not exceed a cost based level[4].***

The rest of my paper considers what level of termination charge is best for India. Should termination charges be set at cost based levels or some lower level?

[4] There are circumstances, related to network externality effects, in which above cost termination charges are economically efficient. These circumstances are not relevant in India as we discuss in Section 9 of this note

6 The economic case for setting termination charges to zero

Back in the 1980s, when competition was first introduced into national telecommunications services, most regulators, starting with the FCC in the USA and Oftel in the UK[5], set cost based call origination and call termination charges. So a tradition of cost based termination charges, which was later incorporated into EU regulation and the annex to the 1997 WTO agreement on trade in telecommunications services, sprang up.

Such an approach was justified using the cost causation principle. This requires that

> *"The party which causes the cost should bear the cost ".*

Applying this principle it is reasonable to assume that, since the caller makes the call, the caller causes the cost and should bear the full cost of the call. This then leads to a calling party pays system in which the originating network pays the terminating network a cost based termination charge.

As competition has developed, and as interconnect between mobile and fixed networks and between competing mobile networks has become more important, economists have developed their theories about what level of termination charges maximise economic welfare. We can summarise such thinking as follows:

- Both the calling (A) and called (B) party to a call play a part in causing the cost of the call. The calling party A generates an initial cost by initiating the call but the called party B can minimise the cost by refusing the call (e.g. by looking at the CLI) and both A and B can terminate the call at any point in the conversation. Laffont and Tirole refer to this as the "receiver sovereignty" property of calls
- From this perspective the cost causation principle leads not to cost based termination charges but to a system in which the A and B parties share the costs in some way
- Laffont and Tirole[6] conclude that, for calls between interconnected networks:
  - there is an efficient equilibrium for sharing the end-to-end cost of calls between the calling and receiving parties
  - this equilibrium is a function of the utility which the calling and receiving parties extract from the call. It is not a function of the costs incurred by the two networks
- Operators in the market implement such a principle when they offer freephone services. These recognise that, for some calls, it is the receiving party which derives the bulk of benefit. So the operator establishes a set of freephone numbers which, when called, involve the B party bearing the full cost of the call
- Economic welfare is maximised when the cost of each call is split in proportion to the benefit each party derives from the call. If the costs are not shared then the network operator who does not pay does not have the incentive to signal to his subscribers through retail prices the costs that they cause

[5] *Interconnect – the key to effective competition*, Lewin D and Kitchen M, Ovum, 1994

[6] On the Receiver Party Pays Principle, D S Jeon, J J Laffont and J Tirole, March 2001

- The split of benefits between the two parties varies considerably. In some cases the A party receives the bulk of benefits. But in other cases (for example a builder who relies on his mobile phone to receive calls asking him for quotations) the bulk of the benefits flow to the B party.

It is not practical to charge so as to divide costs between A and B in line with benefits received for each individual call. But it is clear that a bill and keep system in which the cost of the calls is split evenly between the two networks[7] comes closer to meeting this rule than existing arrangements, in which the calling network bears 100% of the cost for all calls.

Recognising these arguments:

- The bill and keep system with zero termination charges is used extensively for the interconnection of the IP networks of the Internet and increasingly in a significant number of commercially negotiated mobile interconnect agreements
- This system forms the basis for fixed mobile interconnect arrangements in countries such as the USA, Canada, Singapore and Hong Kong[8]
- The European Commission is now consulting[9] on a substantial reduction of MTCs to a level at or close to zero following a report in which the consulting company WIK concluded that the European Union would be best served by a bill and keep system for interconnection termination fees. To quote from its report[10]:

  > *"In an ideal world, the second option [bill and keep] would appear to offer many advantages in comparison to the other two. The outright elimination of call termination fees is simple, it minimises economic distortions, and it involves the fewest impediments to the evolution over time of interconnection arrangements as networks evolve to an IP basis."*

- The FCC's Deputy Chief Economist recommended the introduction of the bill and keep system for fixed termination charges as well as MTCs in 2000[11].

Based on this analysis, I conclude that, ***according to current economic theory, India would be better served by an interconnection regime based on bill and keep with zero termination charges rather than on one based on cost based termination charges***.

[7] Assuming that the costs of conveyance is roughly the same in each network

[8] Although the MTC is not quite zero in three of these four countries

[9] *Commission recommendation of […] on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU*, September 2008, European Commission

[10] *The Future of IP Interconnection - Technical, Economic, and Public Policy Aspects*, WIK-Consult, January 2008

[11] *Bill and keep at the central office as the efficient interconnect regime*, DeGraba P , December 2000, FCC OPP 33

7 Empirical arguments in favour of reducing MTCs to zero

As well as theoretical arguments in favour of the bill and keep system, there is mounting empirical evidence that such a system produces better economic outcomes. I review this evidence below. In doing so I focus on the question of whether MTCs should be set to zero for interconnection involving mobile operators or set at a cost recovery level.

Argument 1: **Moving to zero MTCs removes the floor[12] on the retail prices which operators can charge their customers.**

This means that:

- Both fixed and mobile operators have more flexibility to offer their customers a wide range of innovative price packages. Innovative pricing is important to the development of telecommunications markets. For example prepay pricing had a massive positive impact on the take-up of mobile phones when first introduced in the EU in 1996. Subsequently it has transformed the development of mobile markets in much of the developing world
- Prices tend to be significantly higher in countries where there are high MTCs than in countries where MTCs are close to zero. Figure 1 illustrates. It measures the price of calls by dividing total retail revenues by the volume of minutes of calls to and from subscribers.

Clearly India has low tariffs compared with those of Figure 1. But **these prices are not low when expressed in purchasing power parity terms and it is important for the future expansion of telecommunications services in India to implement an interconnect regime which leads to the lowest possible prices.**

Figure 1 is based on data from the latest Merrill Lynch Wireless Matrix report[13]. To make the revenue per minute compatible across the two sets of countries, I have made two adjustments to the raw data[14]. I have:

- Reduced the revenue to EU mobile operators to remove the MTC revenue stream
- Increased the call volumes generated by EU mobile operators to allow for the fact that on-net mobile call minutes are counted once in EU countries but twice in countries using RPP charging systems.

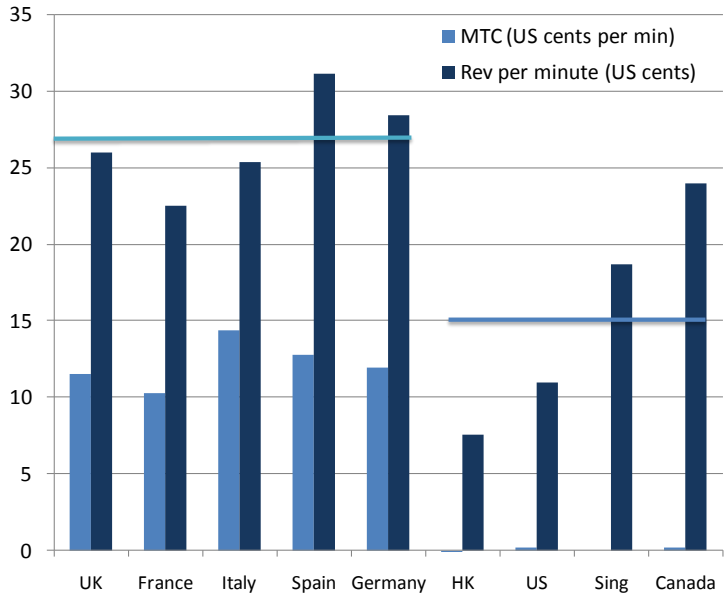
These adjustments narrow the gap between the revenue per minute in the high and low MTC countries. But prices in the former are still nearly twice those in the latter.

[12] Operators are not prepared to set retail prices for calls which are below their marginal cost. For off-net mobile to mobile calls and fixed to mobile calls this at least the MTC. So the MTC is a floor on retail prices.

[13] *Global Wireless Matrix*, Campbell G, Merrill Lynch, September 2008

[14] See *Assessing the impact of lowering mobile termination rates,* Frontier Economics, July 2008 for a discussion of the need for these correction factors

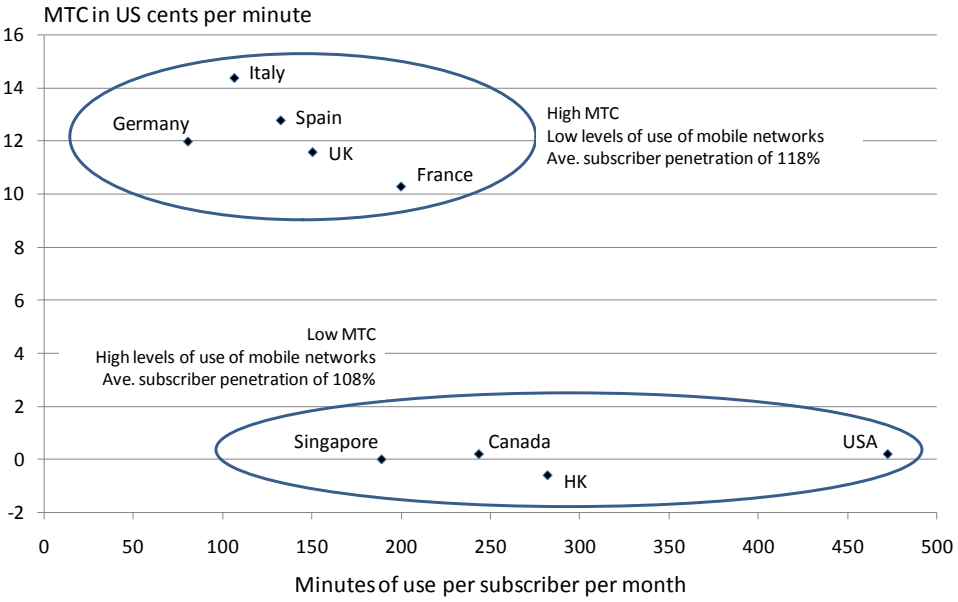
Figure 1: High MTCs form a floor on mobile retail prices



Argument 2: ***Reducing MTCs to zero leads to calling volumes per subscriber which are significantly higher than those in countries with cost based MTCs***.

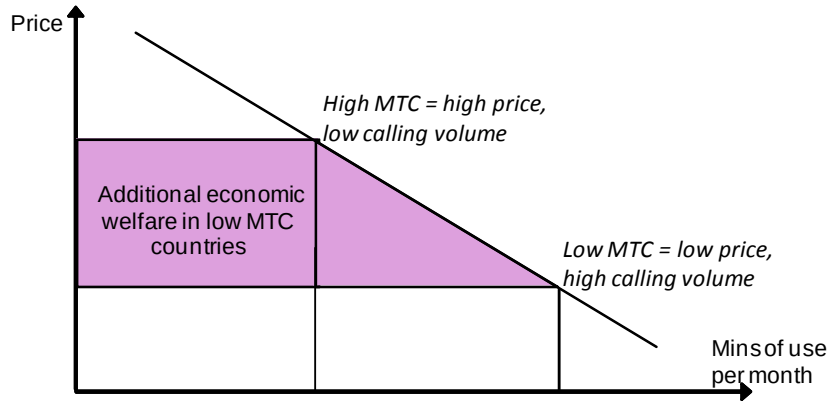
Evidence supporting this assumption is presented in Figure 2. Again the data are taken from the latest Merrill Lynch Mobile Matrix report and adjusted as indicated under Argument 1.

Figure 2: High MTCs lead to low calling volumes



In combination, higher calling volumes and lower prices lead to a greater economic welfare for consumers as illustrated in Figure 3.

Figure 3: Higher calling volumes and lower prices lead to greater economic welfare



Argument 3: **Reducing MTCs to zero eliminates the transaction costs generated when operators negotiate, and regulators determine, MTCs.**

In countries like the UK these costs have reached over Rs 7 billion in the last few years.

In addition the processes required to determine costs of termination are likely to get more complex in future with the deployment of femto cells, and the complementary use of WiFi and cellular mobile cells by mobile terminals. If this happens under current interconnect arrangements then different MTCs will be required for different cell types. Operators can then send the right price signals to end users so as to get them to use spectrum as efficiently as possible.

Having a zero or near zero termination charge for both fixed and mobile networks would eliminate these problems and make charging for calls in a fixed mobile convergence environment considerably simpler.

Argument 4: **Reducing MTCs to zero increases incentives for migration from legacy circuit switched networks to more efficient IP and next generation networks.**

This is particularly true given that:

- Interconnection between IP networks is based around bill and keep, where MTCs are set to zero. This is unlikely to change
- Circuit switched operators have incentives to delay transition from circuit switched to IP networks to preserve MTC revenue streams, unless MTCs are set to zero

To quote from the WIK report to the European Commission[15]

[15] *The Future of IP Interconnection - Technical, Economic, and Public Policy Aspects*, WIK-Consult, January 2008

"Newer operators and cable operators may move quickly to IP-based interconnection, but established incumbents and mobile operators may prefer to maintain traditional voice interconnection methods. To the extent that call termination were driven to much lower rates prior to the migration to an IP-based NGN, it would avoid disincentives to migrate to new IP-based interconnection arrangements" (Section 6.1)

Removing barriers to the migration to IP networks is important for the economic development of India. In the long run such networks will offer the Indian economy higher functionality and more cost-effective services. So it is important to remove barriers to such migration. According to a recent Hutchison submission to the European Commission[16]:

*"... the high MTRs of incumbents are holding back innovation. This can be tariff innovation such as flat rate access pricing, but it is also innovation in new services. The **3** Group offers VoIP and Instant Messaging but few other operators do so. Most mobile operators discourage their customers from using these services by making them difficult to use, trying to block them or threatening to terminate the customer's contract. The reason for this is that VoIP and IM bypass call termination and so mean a loss of lucrative termination revenues."*

Argument 5: **Reducing MTCs to zero makes the mobile market more competitive by allowing the smaller operators to compete on more equal terms with their larger rivals.**

As happens in India, all mobile operators can profitably offer discounts for on-net calls because they pay no MTCs on such calls. But large operators who offer discounts for on-net calls are more attractive than small operators to subscribers because there are many more people which a subscriber can call at the on-net rate. Over time this leads to a concentration of market power and a weakening of competition. This is a major issue under debate now in the EU[17] and one which was picked up in a recent editorial in the Financial Times[18]:

"[mobile] termination charges mean it is expensive for customers to call another network, encouraging customers to flock to the large incumbents, who offer more "on network" calls. That is bad for new players and bad for competition. Regulators should not intervene in markets without good reason – but here, the status quo is unacceptable, and market forces unlikely to sweep it away."

Setting MTCs to zero eliminates this advantage for the larger mobile operators. The price floor for on-net and off-net calls is then the same (at zero).

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[16] *3 Group's response to the Commission's draft Recommendation on the regulatory treatment of fixed and mobile termination rates in the EU*, Hutchison 3 Group, September 2008

[17] See for example *3 Group's response to the Commission's draft Recommendation on the regulatory treatment of fixed and mobile termination rates in the EU*, Hutchison 3 Group, September 2008

[18] Editorial in the Financial Times of 16 June 2008

8 Arguments against reducing MTCs to zero

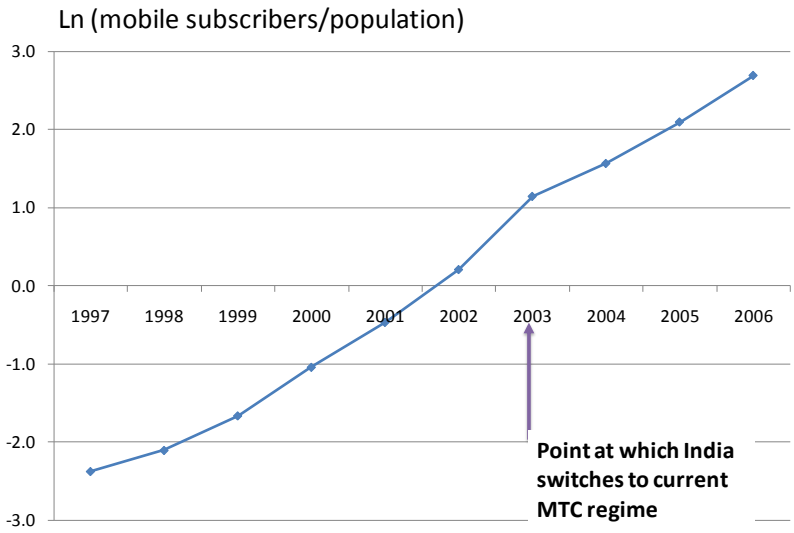
In this next section I review the arguments which are advanced against moving to bill and keep by reducing MTCs to zero.

Argument A: *"***If it ain't broke don't fix it".** India switched from a receiving party pays system (with zero MTCs) to a calling party pays system in 2003. This has lead to very substantial growth in demand, to an industry which is now very competitive, and to some of the lowest prices in the world. Given this track record for existing arrangements why should India change now?

Response: On the face of it this is a powerful argument. But the argument that a move to calling party pays has resulted in high growth is not supported by the data. Figure 4 plots the penetration of mobile services in India over time on a log scale[19]. We can see that:

- There is a discontinuity in demand growth in early 2003 when India switched to the current cost based MTC regime
- Mobile subscription growth was actually reduced as a result of this change to the current regime
- Growth rates, while exceptionally strong over the past five years, would have been higher if India had stayed with an RPP regime.

Figure 4: The impact on subscriber growth of moving to existing interconnect arrangements in 2003



Argument B: **Reducing MTCs to zero leads to increased retail prices so as to preserve margins.** This is known in the EU as the waterbed effect. These price increases slow down the rate of take-up of mobile services in India with a loss of economic welfare. Such losses could be substantial given the

[19] A log scale is relevant because it shows the rate of growth of the sector which is lost in a linear scale due to the volumes involved

positive network externalities which the marginal subscribers would otherwise generate by giving existing subscribers more calling opportunities.

Proponents of this argument point to the lower mobile penetration rates in countries where MTCs are set to zero. This is confirmed by Figure 3 - which shows that the penetration rate is lower (109% average) in low MTC countries than in high MTC countries (119% average penetration rate).

Response: This effect is relevant in countries where there is a well-developed fixed network infrastructure[20] and the MTC revenue from fixed to mobile calls is substantial[21]. But in India this revenue stream is small. I estimate that this source of revenue (i.e. termination revenues from fixed networks) is less than 1% of the retail revenues generated by India's mobile operators. This difference in MTC revenues from fixed to mobile calls between India and the EU reflects the fact that the fixed line penetration in the countries of Figure 3 is typically in excess of 50% while it is less than 4% in India.

Argument C: **Setting MTCs to zero could lead to "hot potato routing"**, where operators hand over calls at the earliest opportunity to take advantage of free termination services. This can lead to economically inefficient behaviour by operators.

Response: I understand that it is possible for operators in India to distinguish between local termination and long haul termination and to charge a carriage fee for transit. Also, due to long distance carriage fee charges, there is an economic incentive to carry the call for as long as possible. This should eliminate the hot potato routing problem.

Argument D: **Cutting MTCs to zero makes it unprofitable to serve low volume users** who receive more calls than they make. Mobile operators would then need to raise prices significantly to restore profits. This might double the cost of ownership of a mobile phone for this group, who would stop using mobile services. In addition a proportion of potential new customers among the rural community would not to take out mobile subscriptions.

Response: It is important to consider this argument. But it is also important to keep it in perspective. There are several strong counter arguments. In particular:

- The higher call volumes which a move to zero MTCs would stimulate (Argument 2 of Section 7) should lead to greater economies of scale and lower unit costs. This would offset any increased cost of ownership for the small subset of mobile users affected.
- An MTC of zero would help lower the price of calls from public call offices and fixed wireless calls to mobiles by reducing the price floor on these calls from the current Rs0.3 per minute to zero. These services are most used by the poor and rural population.
- Moving MTCs to zero would not double the cost of ownership for this subset of customers. Instead it would modify their behaviour. Faced with the cost of their actions, such customers would cut their inbound calls so as to preserve their cost of ownership at current levels rather than leaving the network

[20] The fixed line penetration in the countries of Figure 3 is typically in excess of 50%. In India it is less than 4%

[21] We can ignore MTC revenue streams from mobile to mobile calls when considering the mobile industry as a whole. Such revenues are simply transfer payments within the mobile industry

- Competition would limit the extent to which mobile operators charge for incoming calls. This has already happened in China. A move by China Unicom to first cut, and then abolish, charges for incoming calls was quickly copied by China Mobile. If this happened in a two operator market, the likelihood of it happening in India is high.
- Mobile operators can introduce reverse charging mechanisms to deal with this problem. For example:
  - mobile operators which stick with CPP charging could introduce a “call me” SMS service at some nominal price which the low-volume user could send when wanting to speak to other wealthier, mobile users
  - mobile operators which move to RPP charging (which is more likely to be economically efficient since it sends the right price signals to users) could introduce reverse charging services for nominated numbers. Rich people could then call their drivers or maids, or urban mobile users could call them poorer rural relatives, and pay the full cost of the call i.e. the RPP charge is suspended for these calls.

9 Conclusions

For economic efficiency access prices should be cost based while termination charges should be set at a level which does not exceed the cost based price.

Economic theory suggests that termination rates are better set to zero than to cost base prices.

When compared with existing arrangements there is strong ***empirical evidence*** that reducing MTCs to zero would:

- Mean lower retail mobile prices and higher mobile calling volumes in India
- Lead, through lower prices, to accelerated take up of mobile services by the poorer and rural segments of Indian society
- Make small mobile operators more competitive with their larger rivals
- Eliminate the costs of negotiating and determining MTCs
- Make the introduction of 3G networks and fixed mobile convergence simpler
- Produce stronger incentives for operators to migrate to (higher functionality and more cost-effective) IP networks.

Short-term issues for those customers who primarily receive calls would be addressed by a combination of changes in calling behaviour and the introduction of innovative pricing such as reverse charging services.

Overall the balance of the arguments is strongly in favour of moving termination charges in general, and MTCs in particular, to zero in India.

DML
30/1/09

Annex A: CV for David Lewin

Summary

David Lewin is one of the founders of Plum where he specialises in the area of telecommunications policy and regulation in a competitive environment. He previously worked at Ovum, which he helped found in 1985.

David's career in IT and telecommunications has spanned over 35 years. After leaving Oxford in 1969 with a first class honours degree, he worked first for Scicon and then for the British Airports Authority and Peat Marwick Mitchell on a range of planning and policy studies. In 1977 he joined Logica, where he became increasingly involved in studying the world's IT markets. In his last three years there he ran the company's IT market studies division. He co-founded Ovum in 1985. During his 20 years there he was Director of Consulting, Chief Executive and then Chairman, before deciding to concentrate on directing and managing major consulting projects for clients.

Career history

2007 to date	Director and principal consultant at Plum Consulting
2005 - 2007	Indepen, Principal consultant
1985 - 2005	Ovum, Director and, at various times, Managing Director and Chairman
1977 - 1985	Logica, Senior then Principal Consultant then Manager responsible for Market Studies
1975 - 1977	Peat Marwick Mitchell, Management Science Consultant
1971 - 1974	British Airports Authority, Operational Research Analyst or Manager
1969 - 1971	Scicon Ltd, Computer Analyst

Education and professional qualification

1965 - 1969	Oxford University, MA Physics, first class honours
1972 - 1974	Brunel University, MSc in Operational Research

Experience

This section presents profiles of some of relevant assignments on which David Lewin has played an important role. They are selected to illustrate the range of his experience.

Interconnect and access studies

For the past six years Mr Lewin has specialised in interconnect studies. For example he:

- Provided extensive advice to a group of entrants in Austria in their interconnect negotiations
- Reviewed the interconnect agreements entered into by the leading mobile operators in Nigeria and recommended areas for renegotiation. As part of this work he provided evidence and argument which the operators used to make radical changes to the price of interconnect with the fixed incumbent
- Carried out a detailed analysis of the policy implications of competitive interconnect for six incumbent operators in Switzerland, Greece, the Czech Republic, Norway, Sweden and Italy

- Worked for one of the new entrants in Hong Kong, advising it on a wide range of interconnect issues so that it can prepare effective submissions to the regulator, OFTA
- Directed a multi-client study to look at the regulatory, commercial and technical issues of local loop unbundling
- Helped SPT Telecom, the incumbent operator in the Czech Republic, develop its interconnect charging principles, and negotiate its interconnect agreement with the new entrants
- Carried out a review of interconnect arrangements in the UK for one of its CATV operators
- Advised operators in New Zealand and South Africa on interconnect
- Carried out a detailed investigation into the way in which regulators and operators in the UK and Sweden reached commercial interconnect contracts and developed interoperability standards
- Helped a new entrant in Germany in its interconnect negotiations with Deutsche Telekom

Telecommunications costing studies

Over the past four years Mr Lewin has conducted a number of studies on the costs of telecommunications carriers and the way in which these costs relate to prices. In particular he has:

- Worked for Ofcom to examine the validity of the product planning and provisioning (PPP) component of BT's interconnect charges. This involved a detailed examination of BT's wholesale cost accounts to assess the appropriate scale of the charge
- Was centrally involved in a 12 month study for a Korean mobile operator to:
  - review a fully allocated cost model of its network operations
  - develop a LRIC model to replace it
  - reconcile the results of this model with those from a bottom up LRIC model built in parallel
  - use the reconciled model for regulatory debate
- Was one of the main authors of a 250 page report on estimating costs and setting cost based prices for interconnect and access products
- Project directed a study to develop a top down LRIC model for a major African mobile operator. The model looks at retail as well as network costs so that the client can use it to take important retail pricing decisions as well as using it for regulatory purposes
- Carried out a critical review for the European Commission of guidelines proposed by the ERG for use of bottom up and top down cost models in setting cost based prices for access and interconnect products
- Developed a top down LRIC model for an Argentinean mobile operator and used it to help them agree cost based call termination charges with the regulator
- Built a set of cost models of mobile networks and used them to help the independent operators in Mexico to set cost based interconnect prices
- Advised the incumbent operator in Jordan and its mobile subsidiary on the development of cost models and associated regulatory issues

- Examined the extent to which European telecommunications operators are structured so as to set tariffs based on costs. As part of the study he developed a model of the cost to an operator of leased circuits and packet switched data networks.

Telecommunications Policy Studies

Mr Lewin has directed a range of studies in which he has helped the client to shape telecommunications policy. For example he:

- Lead two studies which formed major inputs to the European Commission's 1999 review of telecommunications regulation. He carried out a review of the Interconnect Directive and made recommendations for a revised directive for the joint regulation of interconnect for both the fixed and mobile industries. He also managed a study to assess the problems of tariff transparency for callers in a competitive environment and methods for preserving this tariff transparency in future
- Carried out a comparative review of the effectiveness of the telecommunications industry in four major European countries as part of a review of telecommunications liberalisation
- Carried out numerous studies for the European Commission on telecommunications policy. He has worked on both regulation (through studies of ONP - for ISDN and for MANS) and industry development (through studies on LAN interconnect, language engineering, and video communications)
- Provided a monthly service to a major Asia Pac operator to update it on regulatory developments in the EU and their commercial implications
- Helped the ETO develop a regulatory framework for carrier selection in a competitive environment
- Carried out a study to assess the degree of retail price rebalancing which should be allowed in Peru

Regulatory strategy

Mr Lewin has helped a number of operators develop their regulatory strategy. In each case the work required him to develop a good understanding of the company's business strategy first. Clients have included:

- A pan European fixed operator with an extensive fibre network
- A major European mobile operator
- A new entrant in Austria
- BT Openreach

Studies in low and middle income countries

Over the past few years Mr Lewin has devoted an increasing amount of his time to advising Government, operators and regulators in developing countries. For example he:

- Lead a major study for the Botswana Telecommunications Authority to consider the case for further liberalisation of its telecommunications markets and the best way to implement this liberalisation programme
- Worked for the incumbent operator in Trinidad to advise it on new telecommunications legislation, on interconnect issues and on cost efficiency

- Worked for the GSM Association to assess the economic impact of mobile services in India and to make recommendations to the Government there on changes to policy which would maximise future economic benefits from mobile services
- Studied the economic impacts of mobile services in six countries of Latin America. The study involved providing general advice to policy makers there on the best way to maximise future mobile take up
- Has worked extensively on telecommunications issues in Mexico – both on the development of a universal services policy and on the best form for interconnect arrangements
- Has worked in Nigeria to review the nature of fixed mobile interconnect there and to advise on more efficient arrangements.

Studies on Allocation of Scarce Resources

Mr Lewin played the major role in a study for Ofcom to estimate the economic value of licence exempt spectrum and to assess the costs and benefits of harmonising use of this spectrum at the EU or global level.

Mr Lewin played as central role in developing the methodology for estimating the level of use of 3G spectrum by mobile operators in Hong. Kong so as to estimate the licence fees which the operators should make for use of this spectrum.

As part of a major study to develop a regulatory strategy for a leading EU mobile operator. Mr Lewin reviewed the proposals to enable spectrum trading in the UK.

Mr Lewin is an acknowledged expert on the allocation, use, and pricing of E164 numbering resources. He has carried out more than 30 studies to redesign national numbering plans, to assess how best to administer these plans, and to consider charging mechanisms which would lead to optimal use of this scarce resource. See below for more details.

Economic analysis in telecommunications

Mr Lewin has applied economic theory to analyse important telecommunications issues. For example:

- He played the leading role in a study to assess the policy changes required to maximise the contribution of ICT to the economic development of Korea
- Worked for a pan European supplier of communications services to quantify the economic benefits of ubiquitous access across the EU to the wholesale access products they need
- Worked for Ofcom to carry out a cost benefit analysis to assess different options for regulating premium rate services
- He made a substantial contribution to a study for the five biggest telecoms operators in the EU to look at the relationship between economic growth and telecoms regulation
- He has produced an economic analysis on how best to solve competition problems associated with the development of investment in emerging market services for the regulator OPTA
- He has looked at the special problems which arise for NRAs of microstates[22] when applying the EU's 2003 regulatory framework

[22] ie states with a population of less than 1 million

- He has carried out several major cost benefit analyses to assess whether or not specific countries should introduce number portability services
- He has carried out extensive work to assess the economic contribution which mobile services make. These studies have looked at the contribution of the mobile services industries of the US, the EU, the UK, German, Latin America, South Africa and India.
- He provided an economic analysis of the case for introducing wholesale line rental as a remedy under the EU's 2003 regulatory framework into the Netherlands
- He has used economic analysis to evaluate the case for introducing tariff transparency services
- He has made extensive economic submissions to the UK's Competition Commission on the issues surrounding the regulation of mobile call termination charges
- He worked as a central member of a team to make an assessment of the costs and benefits of extending the rules of the TV Without Frontiers Directive to all audio visual content services.

Telecommunications pricing studies

Over the past four years Mr Lewin has conducted a number of studies on the pricing of telecommunications services. In particular he has:

- Provided advice to a consortium of alternative network operators in the UK on the economic case for proposed changes to the pricing of number translation services
- Examined the extent to which European Telecommunications Operators (TOs) are structured so as to set tariffs based on costs. As part of the study he developed a model of the cost to a TO of leased circuits and packet switched PDNs.
- Helped KPN develop commercially oriented tariff setting processes. Working closely with a team of KPN staff he established an approach to pricing which focused on profit and competitive position as well as revenue generation.
- Helped a European incumbent operator set cost based tariffs for its public Email service. As well as meeting profit and market share objectives, these tariffs were designed to take account of the increasing use of off line message preparation software and the effect of this trend on the operator's resources
- Carried out a major study to help a Pacific rim carrier set rules for the pricing relativities between its range of switched and leased line services
- Directed a study for Oftel to assess the telecommunications prices charged to support key business application in five countries and hence the contribution the UK telecommunications industry makes to the global competitiveness of the UK economy.

Telecommunications market strategy studies

Mr Lewin has managed and directed many strategy studies on telecommunication markets. For example he has:

- Directed a major study to help Telecom Australia rationalise its portfolio of advanced network services for corporate users
- Worked on a major study to analyse how incumbent fixed operators might maximise shareholder value following the dotcom collapse of 2001

- Worked for the chairman and CEO of an Irish mobile phone company to value the network assets they acquired from the national railway company. The findings were uses in a parliamentary inquiry into the sale price of these public assets
- Carried out a major review of the M&A activities of 20 selected players in the telecommunications markets of Europe and the US for a major operator. The results were presented at board level and used to develop the clients own M&A strategy
- Developed an overall business strategy for the messaging services and products of the Netherlands PTT. The strategy focused on the PTT's investment policy towards new services.
- Carried out extensive business consultancy for a major international courier and electronic mail company. His advice covered company acquisitions, new product definition, business planning, and telecommunications regulation.
- Developed a business plan and market entry strategy for a company which would be established by Scottish Enterprises to create teleworking jobs in rural Scotland using a combination of work flow management systems and ISDN.
- Assessed the opportunities for new value added network services (VANS) in the UK through an examination of the competitive environment and likely changes in the regulatory position.
- Developed scenarios for European telecommunications in the 1990s and used these to create strategies which the European carriers could adopt.
- Helped Telstra develop its policy on volume discounts - from both a regulatory and commercial viewpoint.
- Assessed the businesses of two small Irish software companies serving the telecommunications industry. He used the findings to develop recommendations for strengthening the Irish Software industry. Both companies subsequently became global market leaders in their fields.

Consumer issues

Mr Lewin has worked on consumer issues in telecommunications in a number of ways. For example:

- He carried out a study for DGIX of the European Commission to examine what regulation was required to protect consumers in Europe in the rapidly growing mobile services markets. The study findings formed an important input to the Commission's Green Paper of 1996 on mobile services
- He managed a major study to review universal service arrangements around the world and recommend modifications to the Government of Korea on how to develop universal service funding there
- He directed a project to examine how best to empower and protect consumers in the Information Society
- He has studied the use of explicit cross subsidies for consumers in competitive telecommunications markets as part of a number of studies on interconnect charging in developed and developing countries
- He has worked extensively on the rights of consumers to tariff information through the number as part of many of the numbering and number portability studies outlined above.

Mobile telephony

Mr Lewin has worked on a number of market and policy studies of mobile telecommunications. For example he has:

- Played a major role in a study for OFTA, the regulator in Hong Kong, in which he examined how the markets for fixed mobile convergence services are developing in seven leading countries and to assess the likely winners and losers
- Worked on a study for a leading EU incumbent operator to assess the business strategies of Europe's leading mobile operators and to evaluate their likely acquisition strategies over the next three years
- Worked for a series of clients, including Vodafone and Telefonica, to assess the economic impacts of mobile services in Ireland, Germany, UK and Latin America
- Carried out a major study for a major European operator to quantify the impacts of various strategies for developing international roaming services on profitability
- Made a detailed assessment of the barriers to competition in EU mobile service markets as part of a major study for the European Commission
- Lead a study to review the issues raised by the use of cellular mobile and cordless telephones for residential users for the Consumer Policy Services unit of the European Commission
- Analysed the competitive opportunities for telecommunications services in Belgium, Ireland, Austria, Switzerland, the UK and Japan. These reviews typically provided an assessment of the activities and strategies of all the major players, and identified the major opportunities which competition and deregulation is generating.
- Directed a major study (involving 300 interviews) to assess the needs of the top 5000 companies in Europe for mobile services (cellular, cordless, paging, mobile data, PMR)
- Directed a study to assess the impact of radio technologies (cellular, wireless local loops) on the UK telecommunications market over the next 20 years
- Lead a team of consultants examining the technical, economic and market features of providing paging services by satellite.

Next generation networks

Mr Lewin has worked on a number of studies to consider the need for regulation of next generation core and access networks. For example he worked:

- For the UK's Broadband Stakeholder Group to assess the economic value of NGA
- For the European Commission to develop guidance on how NRAs should regulate NGA in ways which would strengthen competition while encouraging efficient investment.
- For OPTA to look at the application of the EU regulatory framework to emerging markets and services such as those which run on NGA-based products.
- For Openreach in the UK to help it develop a regulatory strategy. This Study focussed on the best way to regulate NGA from a public interest perspective.
- For a European operator to help it develop its response to the ERG Position Paper on NGA regulation

- To help Ofcom develop its policy on NGA, by considering the options for price regulating NGA in ways which would both strengthen competition and encourage efficient investment.
- For a major EU operator to help it develop its NGN strategy.

Local loop unbundling

Mr Lewin has been involved in more than a dozen studies to look at various aspects of local loop unbundling. This includes:

- Acting as an expert witness in legal case in Hong Kong on obligations to provide unbundled local loops for broadband access
- A study in 2007 for the regulator in Bahrain to assess whether the incumbent operator there should be required to provide a local loop unbundling as well as bitstream. The work involved detailed operational issues as well as broad regulatory principles
- Work for BT during 2006 to develop a regulatory strategy for its access business. The study involved a detailed consideration of local loop unbundling
- A major study for the European Commission in 2000 to assess the development of access networks in Europe, to identify regulatory barriers to this development and propose measures for minimising or removing them. The study focussed on the issue of local loop unbundling
- Another major study in 2003 for the European Commission to look at barriers to competition in the electronic communications networks and services markets of the EU. This again included a detailed look at the impact of local loop unbundling on competition.
- Worked for the regulator in Norway to assess whether the incumbent should be required to unbundle its local loops

Telecommunications numbering studies

David Lewin is one of the world's leading consultants in the field of telecommunications numbering. He has worked on a wide range of studies since 1990, helping to review national numbering plans and their administration. For example:

- In 1990 he carried out a major study for the UK NRA to review the UK national numbering plan. He was then involved in drafting the national numbering conventions for its implementation
- He has subsequently carried out detailed reviews of the national numbering plans of Portugal, Ireland, Sweden, Finland, Denmark, Netherlands, Spain, Switzerland, and Germany
- He was responsible for a major study to develop the numbering policy for the EU in the early 1990s
- He provided detailed guidance to the European Telecommunications Office in Copenhagen so that it could assess the merits of numbering plans for a competitive environment
- He ran a study for the Dutch Government which looked at how best to administer both the E164 numbering plan and the IP naming and addressing schemes of the Netherlands
- He worked on a major study for the UK NRA to advise it on how best to manage numbering resources. This work involved an assessment of the advantages and disadvantages of charging for numbers in various ways

- He has also worked for the NRAs of Germany, the Netherlands, Spain and the UK on the best way to administer national numbering plans
- He has made various assessments of various carrier selection mechanisms and the demands which such services place on the national numbering plan – including work in New Zealand, Spain and Denmark
- He worked on a study for the UK NRA to look at options for expanding the supply of access codes and the best use of the freephone numbering ranges.

Studies on number portability

In parallel with his work on number plans Mr Lewin has also worked on a number of studies to advise regulators and operators on number portability. This includes:

- Advice the UK's Competition Commission in 1995 in a dispute between BT and Oftel on fixed number portability (FNP)
- A project for the Dutch government in 1996 to help it decide whether or not to introduce both FNP and mobile number portability (MNP)
- Advice on number portability to the Spanish government in 1997
- Work for the Irish Regulator to advise on whether it should introduce FNP (1998) and subsequently to assess the case for introducing full MNP(2001)
- Work for the Swedish Regulator to assess the case for introducing number portability there in the late 1990s
- A study for a major mobile operator in 2004 to review regulatory decisions to introduce MNP in six countries[23]. The aim of this study was to identify the lessons to be learnt from these six decisions to introduce MNP which regulators could then apply more generally to future regulatory decisions
- Work for the NRA in Hong Kong in 2006 to review arrangements for both FMP and MNP and to recommend appropriate changes
- Provide evidence in 2006 and 2007 in a court case over a dispute on whether mobile number portability should be introduced in Jersey or not.

Work on TV markets

David has worked on several studies to consider the development of TV, and especially the development of TV services delivered over IP networks, in the last three years. For example:

- He project managed a study for Ofcom to make a critical assessment of the proposed measures to extend content regulation in the EU's TV Without Frontiers Directive to new media including Internet TV
- He was centrally involved in a study for the regulator in Singapore to develop a framework for the licensing and regulation of mobile TV services there
- He project managed a study for Ofcom to produce scenarios for the development of the UK's entertainment sector over the next 20 years and to assess the implications of these scenarios for

[23] Australia, Germany, Hong Kong, Ireland, the Netherlands and the UK

spectrum policy. Examining the likely business models for the transition from broadcast to Internet TV was a central part of the project.

Work as an expert witness

- Provided expert advice in a dispute in New Zealand over the best way to number the services of a new entrant
- Acted as an expert witness in a dispute in the UK over the provision of e-mail services
- Worked for one of the parties involved in a margin squeeze case put before the UK's Competition Appeals Tribunal
- Provided expert testimony to the courts in Jersey in a dispute over the introduction of mobile number portability there
- Acted as an expert witness in a dispute in Hong Kong between the regulator and the main operator over obligations to supply unbundled local loops for broadband services
- Provided a critical review of an expert witness statement in a dispute in Hong Kong over charging arrangements for fixed mobile interconnect
- Provided expert advice to an arbitrator in New Zealand on requirements for carrier pre-selection.

Publications

Interconnect – the key to effective competition, with Kitchen M, Ovum, 1994

A Global Guide to Competitive Interconnect, Ovum report, with Richard Kee, 1999

A review of the Interconnect Directive, for European Commission, October 1999, with David Rogerson and Mark Armstrong

Tariff transparency in a multi-operator environment, for European Commission, November 1999, with Claire Milne and John Horrocks

The Business Case for Next Generation Networks, Ovum report, with John Delaney, 2000

The development of competition for electronic Conditional Access networks and services, for European Commission, in association with Squire Sanders & Dempsey LLP,

Maximising the Value of the Fixed Incumbent's Home Network Business, with Tony Lavender, 2002

Barriers to Competition in the ECNS markets of the EU, consulting study for the Info Soc Directorate of the European Commission, with Miranda Cole of Gibson, Dunn and Crutcher, January 2004

Achieving the Lisbon Agenda: the contribution of ICT, A report for the Brussels Round Table, with Phillipa Marks and Brian Williamson of Indepen, January 2005.

Further liberalisation of the telecommunications markets of Botswana, for the BTA, February 2005

The economic benefits from the mobile services industry of the European Union, for the GSM Association, February 2005

The economic benefits from the mobile services industry of India, for the GSM Association, February 2005

Regulating emerging markets, Economic Policy Note 5, OPTA, with Brian Williamson of Indepen, April 2005

The impact of the Wireless Telecom Industry on the US economy, David Lewin and Roger Entner, published by the CTIA, November 2005

The economic impact of mobile services in Latin America, David Lewin and Susan Sweet, published by Telefonica, December 2005.

Restoring European economic and social progress: unleashing the potential of ICT, for BRT, with Brian Williamson and Phillipa Marks, January 2006

Applying the EU Regulatory Framework in microstates, for CYTA, Maltacom and EPT, with Brian Williamson, March 2006

Review of the Regulatory Framework for Fixed-Mobile Convergence in Hong Kong, OFTA, July 2006 with Ovum

Maximising ICT's contribution to the economic growth of Korea, with Ovum, July 2006

The economic value of licence exempt spectrum, for Ofcom, January 2007

Regulating Next Generation Networks, December 2007, Journal of Telecommunications Management, Volume 1.1