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Hutchison 3G UK Limited Response to:

Mobile citizens, mobile consumers

Adapting regulation for a mobile, wireless world (The Mobile Sector Assessment)

Redacted

6 November 2008

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Executive Summary

We would like to take this opportunity to welcome Ofcom's mobile sector assessment. It offers the industry and other stakeholders the opportunity to think broadly about the future evolution of the mobile sector while also appreciating what has been delivered to date.

We agree with Ofcom that the mobile sector is indeed at an important junction in its evolution and we are excited at the prospect of playing a central role in how the market evolves going forward.

We begin our response by first setting out our view of the mobile market and then focussing on what we feel are the most important regulatory challenges facing the industry. We then go on to outline our view of the regulator's role in the broader development of the sector.

In sharing our views on the main regulatory impediments we have intentionally framed our arguments in light of competitive and/or consumer detriment since we share Ofcom's view that it is these two factors that are most relevant to its mandate.

We look forward to engaging with Ofcom on future consultations and working with the regulator in developing the mobile sector to its greatest potential.

Market Considerations

The way in which consumers communicate has undergone significant transformation over the past 3-5 years

- Wireless access is increasingly a viable alternative to fixed line for the delivery of both traditional voice services and broadband services;
- The internet has driven changes in how people communicate through the introduction of new forms of communication services such as social networking and instant messaging;
- Untethered (e.g. mobile) access to these new services is now being offered and would appear to be highly valued by consumers - the opportunity to release significant consumer surplus though these services is high

In the UK, as well as internationally, new entrants have been the catalyst for increased competition in the mobile sector; this has been good for consumers.

- Incumbent operators are not as incentivised as new entrants to change or innovate; and
- New entrants must (and do) drive increased competition and innovation (i.e. reducing tariff prices, introducing innovative new products and services).

Regulatory Challenges

Elements of the existing UK regulatory regime are no longer fit for purpose and have been and/or could continue to be a barrier to competition; this harms UK citizens and consumers:

- the existing **Mobile Termination Rate** ("MTR") system and specifically Ofcom's 2007 MTR decision has restricted competition in the provision of voice services by the new entrant - the large gains from competition from the new entrant in mobile data have not been matched by equivalent price reductions in voice and indeed what gains we have seen maybe under threat;
- access to additional spectrum and **2G Liberalisation** are key to the maintenance of effective competition in the mobile sector and particularly mobile broadband; and
- control of customer's telephone numbers by the incumbent mobile operators has maintained a significant barrier to customer **switching** which has significantly undermined the benefits of competition in the provision of voice services which would otherwise have accrued to customers.

These three areas should be the top priorities for regulatory attention. Although spectrum policy is not specifically raised in the MSA we raise it here because if its immediate importance to the sector.

By enabling a competitive mobile sector across all services, Ofcom will be delivering valuable benefits to consumers. However, in some areas, the market alone will not be able to achieve desirable outcomes. Here, Ofcom could take a more active role in bringing parties together and overcoming coordination problems between many participants in the market.

Mobile Termination Rates

Ofcom's current approach to setting mobile termination rates results in charges which are inefficiently high for fixed to mobile calls and off net mobile to mobile calls. Two reasons lie behind this. Firstly, Ofcom allows the recovery of large levels of common and fixed costs through the variable termination charge. Consequently, the current charges are significantly higher than the true incremental cost of terminating a voice minute. Secondly, Ofcom does not take into account the benefits accruing to the receiving party from a phone call when setting its charges. The combination of these factors results in an inefficiently high price for mobile termination.

In the past, high termination charges for mobile networks were justified by the argument that fixed customers benefitted from the network effects of having more people contactable through mobile networks. The fixed to mobile transfer may have helped to drive adoption of mobile services. However, now that mobile penetration is almost universal, and the unsubsidised cost of handsets is very low, inefficiently high mobile MTRs cannot be justified, especially in light of the significant market distortions they cause.

These distortions include:

- **An artificial barrier to competition between small and larger networks** – under a system of high MTRs the new entrant cannot compete effectively with larger incumbents - this denies consumers access to the additional capacity created by the new entrant and the lower prices that this should deliver;
- **Inefficiently high prices for voice services** – high MTRs set an artificial price floor for off-net mobile calls which is not reflective of the incremental

costs of termination; this leads to an inefficiently low consumption of voice services for off net calls and fixed to mobile calls;

- **Distorted incentives for MNOs** – as operators stand to gain financially from customers who receive more calls than they generate, they spend more on retaining these consumers; this appears to be a *prima facie* allocative inefficiency;
- **A restriction of innovative services such as Voice Over Internet Protocol (VOIP) and Instant Messaging (IM)** – new services such as VOIP and IM do not generate termination revenues (for either voice termination or SMS termination) and as such most operators actively restrict their usage to protect their existing (termination) revenues; consumers lose out by being unable to use these new services as older technologies are preferred over more modern equivalents by arbitrary and discriminatory regulatory treatment; and
- **Prevention of effective competition between fixed and mobile voice services** – high MTRs artificially inflate the costs of calling mobiles from fixed networks and other mobile networks which results in some consumers retaining a fixed line connection where a single mobile subscription would be more efficient.

Under the current system network common costs are recovered on a pence per minute basis from other networks. There are strong arguments for no longer permitting recovery in this way by adopting alternative systems such as mobile to mobile bill and keep. Such approaches would allow for a more efficient recovery of costs. In two sided markets network operators have other more efficient options to recover their access costs. Contrary to what incumbent operators have suggested, charging consumers on a pence-per-minute (ppm) basis for incoming calls is not the only way to recover costs – it is only one way to do so.[1]

Bill and keep would also remove the distortions outlined above, providing significant benefits to consumers including;

- enhanced competition between mobile operators;
- lower priced voice calls;
- fairer treatment of all consumers regardless of their net call termination balance;
- faster introduction and cross network adoption of new and innovative products and services; and
- the possibility of fixed/mobile convergence for both calls and subscription.

The international experience with bill and keep presented later in this response suggests that territories that have implemented this system benefit from lower-priced voice calls, higher utilisation and enjoy rates of mobile penetration comparable with that in the UK. In Annex 1 we present evidence, from our sister company in Hong Kong, on the practical operation of bill and keep and its positive impact on consumers.

[1] H3G is prepared to guarantee that it will not charge consumers to receive calls in the event that bill and keep is introduced in the UK.

It is worthwhile to note that a low marginal cost MTR regime could generate many of the benefits of a bill and keep system. As such, it may prove to be an important transitional step.

2G Spectrum Liberalisation

H3G supports the process of liberalising the current 2G spectrum as the future anticipated growth in mobile broadband and data usage on mobile phones will eventually necessitate the need for additional spectrum. However, the liberalisation process must be undertaken in a way that does not unfairly advantage some operators to the disadvantage of others, thereby reducing competition and consumer welfare. Ofcom's current proposals do not accomplish this, instead recommending that most of the 2G spectrum be awarded to its current holders rather than using a competitive allocation process. This runs against Ofcom's own stated policy. The current proposals will give a windfall to incumbent operators in three ways:

- **Capacity** – some operators will end up with larger spectrum holdings than others. These operators will be able to support proportionally greater traffic on each of their cell sites. To remain competitive, remaining operators will be forced to deploy extra sites as traffic increases (incurring a significant cost in the process).
- **Coverage** – operators retaining 900MHz spectrum for 3G use will gain a significant advantage in coverage. The propagation characteristics of 900MHz spectrum will allow these operators to deliver better coverage of rural areas and within buildings (given a certain density of cell sites).
- **Speed** – in future revisions of the 3G technology standard, such as 3G long term evolution ("LTE"), operators possessing larger amounts of contiguous spectrum will be able to deliver greater headline speeds to a particular terminal than those possessing only fragmented spectrum. The advantaged operators will then be able to advertise higher speeds and thus gain a competitive edge with consumers.

To ensure that the 2G liberalisation process does not distort competition, Ofcom must remain true to its stated principles of allocating spectrum using competitive processes. An auction of the 2G spectrum would be the fairest method of ensuring the greatest benefit for consumers from 2G liberalisation.

A further benefit of a swift resolution to the questions surrounding 2G liberalisation is that it would provide additional certainty over the proposed awards of 2.6 GHz and DDR spectrum.

Removal of barriers to customer migration - Switching

An essential part of any well functioning market is the ability for consumers to be able to switch between operators with relative ease. This allows consumers to take-up attractive offers and enables competitive signals to propagate through the marketplace. In addition, operators will be encouraged to place a greater emphasis on maintaining high levels of consumer satisfaction as unsatisfied consumers will find it easier (and are therefore more likely) to switch. In markets where switching is difficult, operators can extract higher prices from their consumers; as switching costs are high, consumers are less likely to change operators.

It is difficult for competition to function effectively, for the benefit of consumers, in a market where switching is difficult. The current donor led porting system in the UK allows incumbent operators to engage in price discrimination in favour of some consumers and against others. As users must contact their network providers before they port their numbers, donor networks can discriminate between customers based on lifetime value including the value of (inflated) call termination revenues. Subsequently, they are able to discriminate; offering net revenue generators more attractive packages as any discounts are offset by the incoming termination charges. This harms the ability of new entrants to compete and ultimately harms consumers as incumbent operators do not have to match lower prices and competitive offers for all their subscribers.

Active regulatory involvement

By addressing the issues considered above, Ofcom can strengthen competition in the UK mobile sector, generating substantial benefits for consumers. However, in some areas, competition alone may not be able to generate the most beneficial outcomes. Here, however, Ofcom may also have an active role to play. The challenge for the regulator is to choose when and how to intervene in these particular areas. Ofcom should consider providing guidance to the market, using as minimal a level of intervention as possible, to stimulate the right market conditions without distorting competition.

Key areas that require further consideration include:

- International roaming – the price disparities between national and roaming data services create significant adverse effects on consumers and undermine the development and adoption of new services;
- Harmonisation of standards – harmonisation is a key catalyst in promoting the development of valuable new services for consumers as it helps deliver the economies of scale required for innovation to be realised in the sector;
- Greater interoperability – cooperation and coordination between operators, manufacturers and service providers is needed to help establish common sets of protocols that facilitate the development of a range of innovative services;
- Universal service – mobile can play an important part in ensuring the delivery of broadband to all citizens. The regulator has a key role to play in this by encouraging collaboration amongst operators and supporting expanded network coverage where commercial viability is limited;
- Publicly valuable services – the regulator has a role to play in coordinating the efforts of industry stakeholders if the value of the mobile broadband platform is to be successfully exploited for public services.

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1. Market Considerations

Introduction

In short, the existing UK regime has delivered in terms of driving mobile penetration but at the expense of restricting utilisation through excessive call prices.

Even though the market is fully penetrated at around 75 million reported subscribers[2] the MTR model applied in the UK continues to drive greater penetration at the expense of usage. This is especially true in PAYG, where Enders estimate that almost sixteen million PAYG SIMs are inactive or barely active. The challenge in the UK now is to grow usage to the efficient level and accelerate the take up of new services, so that customers get more value and utility from mobile. As Ofcom has indicated, a fundamental review of regulation, and specifically interconnection pricing, is now due to reflect the changed circumstances.

1.1. The emergence of wireless as an alternative

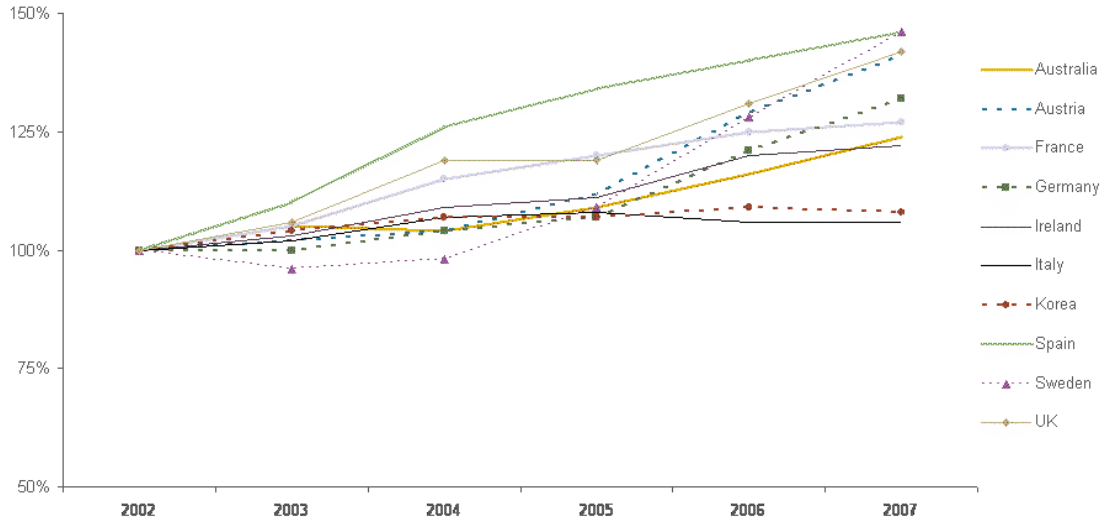
Wireless technologies are competing with fixed technologies for voice services and are acting as both a complement and a substitute to fixed line broadband access. This is occurring thanks to the overall convenience and utility of mobile compared to fixed and in the case of broadband, the retail pricing.

1.1.1. Mobile voice

Consumers are increasingly using their mobile phone to make and receive calls both in the UK as well as across much of Western Europe. **Figure 1** shows that the growth in mobile phone voice usage was on average 29% across a basket of ten international territories from 2002-2007.

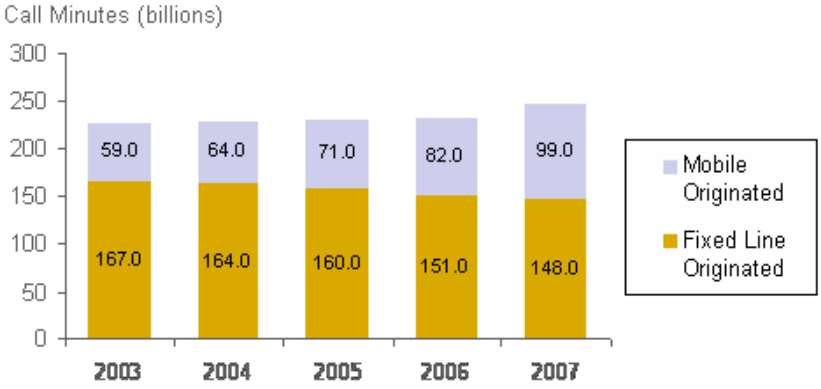
[2] Enders Analysis UK Mobile User Survey 2008-53

Figure 1: Total Outbound Voice Call Volumes on Mobile Networks[3] - Indexed Minutes



This increased usage appears to be coming at the expense of fixed line calling. In the UK, the share of fixed calls has decreased from 76% in 2002 to 60% in 2007 (see **Figure 2** below). Through cross net bundles and the greater utility and convenience of mobile calling, the mobile sector has naturally increased its share of total minutes. However, only 12% of UK households have given up their fixed line completely in order to be mobile only.

Figure 2: Total Outbound Voice Call Volumes[4]



1.1.2. Mobile broadband

Mobile Broadband has seen significant growth in the last 2 years. From 2006-2007, nearly one million mobile broadband connections have been taken up in the UK. In 2008, this figure is expected to reach over two million; representing approximately twelve percent (12%) of total broadband connections (see Figure 3 below).

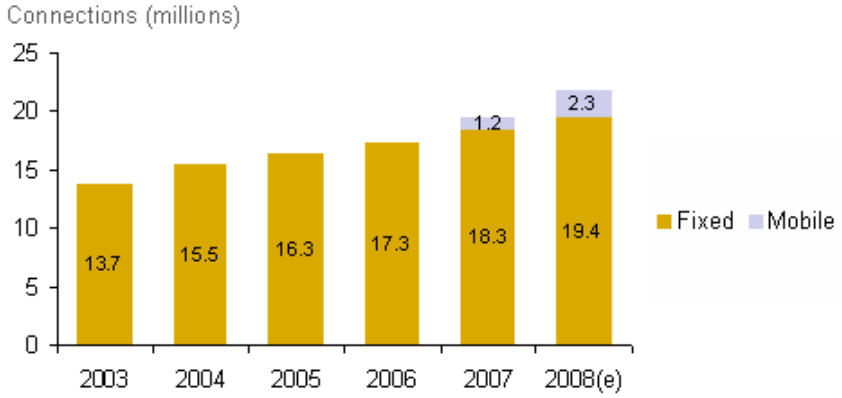
Mobile broadband has overtaken Wi-Fi as the most common way for people in the UK to access the Internet away from home. A survey by Point Topic in September

[3] *Source: Merrill Lynch, Global Wireless Matrix 1Q 2008 – Indexed to 2002*
[4] *Source: Ofcom Mobile Sector Assessment - Excludes dial-up internet access*

2008 puts mobile broadband at 47% and Wi-Fi at 42% for out-of-home access. Analysys-Mason have predicted that by 2013, 47% of European broadband subscriptions will use mobile networks and nearly a quarter of broadband-equipped sites will use mobile-only[5].

YouGov's DongleTrack research estimates that for one in every eight users[6], mobile broadband is a substitute for a fixed-line rather than simply an addition. Approximately 50% of H3G's subscribers use mobile broadband in place of a fixed connection.

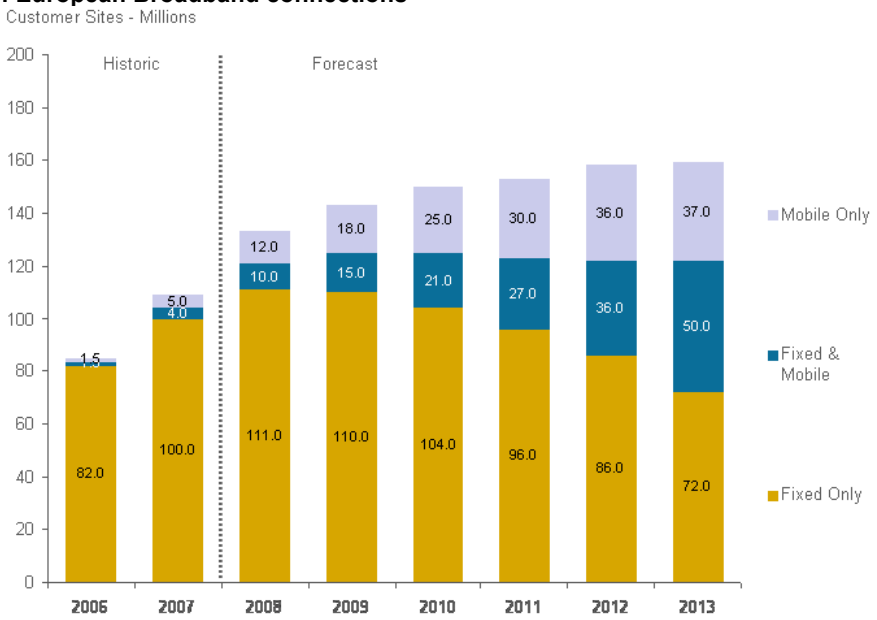
Figure 3: UK Broadband Connections[7]



Across Europe, the trend has been consistent. The number of either mobile only or mobile and fixed households is expected to grow at a compound annual growth rate of 38.3% from 2006-2013 (see **Figure 4** below).

[5] Source: A quarter of broadband homes to be mobile-only by 2013, says Analysys Mason Rupert Wood, Principal Analyst London 14 October 2008
[6] *Source: YouGov - Dongle Tracker Wave 1 (Researched June 2008)*
[7] *Source: Fixed broadband data from 2003-2007 from Ofcom 2008 Communications Report, with 2008 (e) data calculated based on a CAGR of 6%. Mobile Broadband data sourced from Enders Analysis.*

Figure 4: European Broadband connections[8]



This trend is most pronounced in European countries where there has been a later 3G entrant. For example, in Austria and Sweden low-cost packages have stimulated a comparably higher penetration rate of mobile broadband subscriptions.

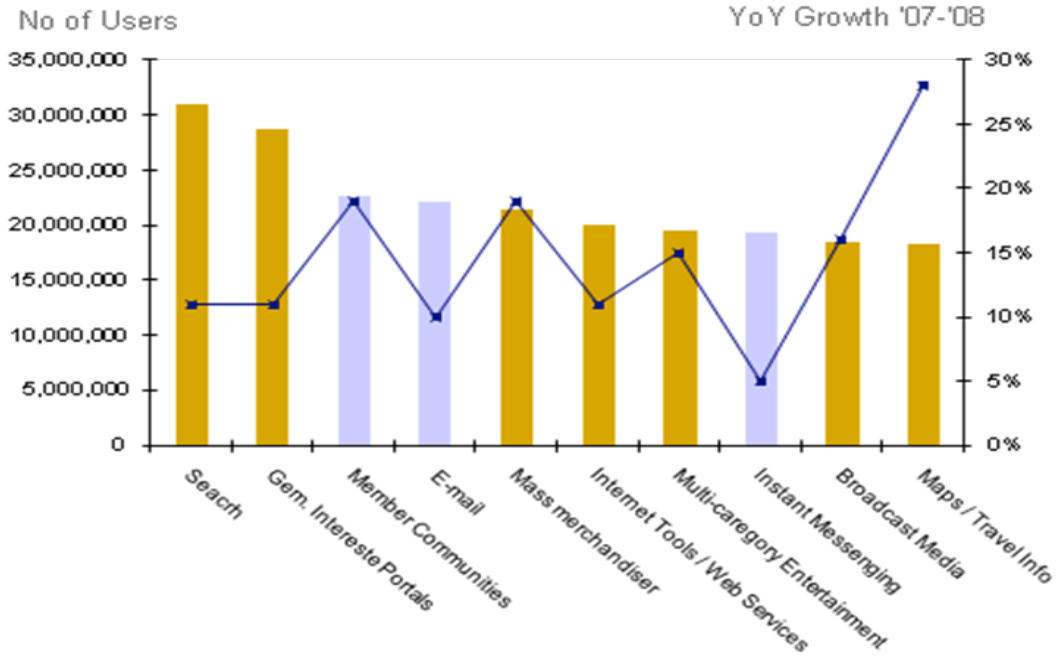
In either case the service has been positioned as a mass market proposition, not an expensive niche alternative. This positioning has been supported by competitive pricing, availability of low cost devices, simplicity of connection, and the ubiquity and convenience of the service. It demonstrates consumers willingness to take their Internet world mobile if priced and marketed effectively.

1.2. The changing ways people communicate

In order to unlock the Internet on handsets, it is important to understand what consumers are using it for. The Internet is fundamentally changing the way in which people communicate, access information, and transact. New communication services such as e-mail, instant messaging (IM), and social/member communities have become mass market applications, and command an increasing amount of people's time spent online. The chart below shows that communication related activities have achieved widespread penetration.

[8] *Source: Analysys Mason, 16 September 2008, Mobile and fixed broadband: co-habitation or competition?*

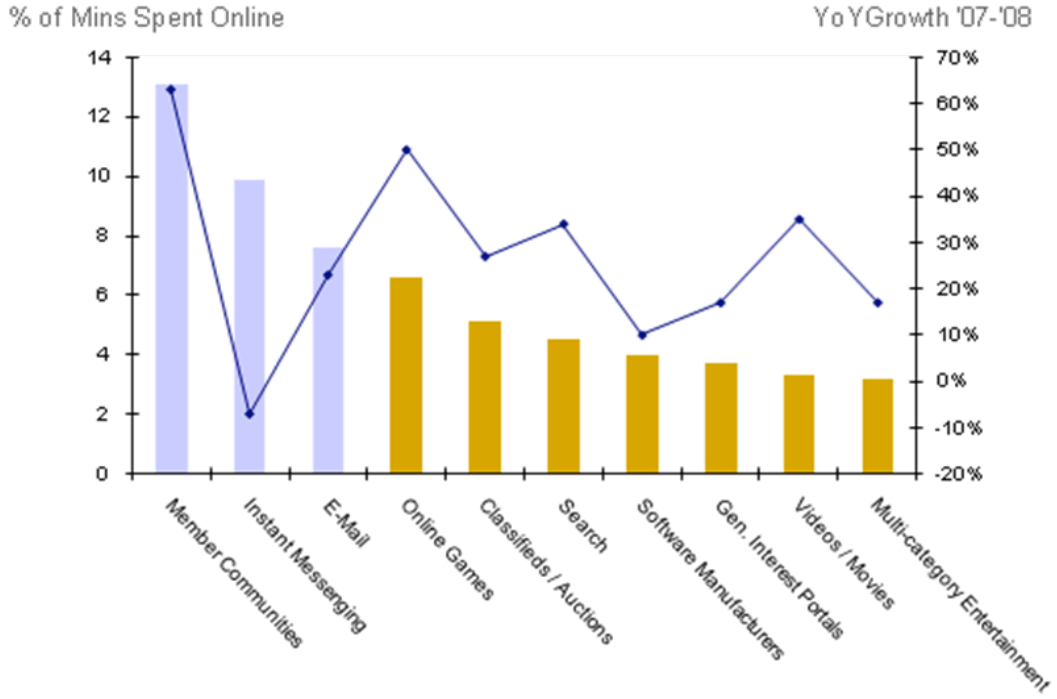
Figure 5: Internet Usage – The Most Popular Online Activities in UK July 2008[9]



Additionally, in terms of user engagement, communication related activities command the greatest amount of user time spent online. Over thirty percent of time spent online is using member communities, IM and email[10] (see **Figure 6**).

[9] *Nielsen Online, NetView, home & work data – July 2007 – July 2008*
[10] *Source: Nielsen Online, NetView, home & work data – July 2007 – July 2008*

Figure 6: Internet Usage – The Most Engaging Online Activities in UK July 2008[11]



Internet communications will also continue to play an increasingly important role in supporting all forms of interactions including social, political, educational and cultural activities including the provision of public and local services.

1.3. Untethered access is valued by customers

The popularity of the Internet in introducing new forms of communication and entertainment is clear. The success of Mobile Broadband demonstrates that increasingly, consumers are looking to extend their online behaviour (generally performed over a fixed line connection via a PC terminal) into a mobile environment. More widespread mobile access will increase the value of the Internet for consumers and citizens as it makes connectivity to more people, more of the time, multiplying the network effect.

The ability to access Internet based communications services such as email and social networks anywhere and anytime via mobile networks is more pronounced. As they are communications services with network effects, the greater their availability and uptake, the greater their value for consumers. Despite their success in the fixed internet world, penetration and usage of mail, VoiP and Instant Messaging on mobile phones is still relatively low.

- The current penetration of email on mobile is 2.9m, some 6.0% of mobile subscribers[12]. This compares with a total of nearly 28 million people in the UK that access email on a fixed terminal, 75% of total fixed Internet users.
- The current penetration of instant messaging on mobile is 5% of mobile subscribers in the UK. [13] Given the number of active mobile subscribers is

[11] *Nielsen Online, NetView, home & work data – July 2007 – July 2008*
[12] *Source: Nielsen Mobile, UK, Q2* 2008

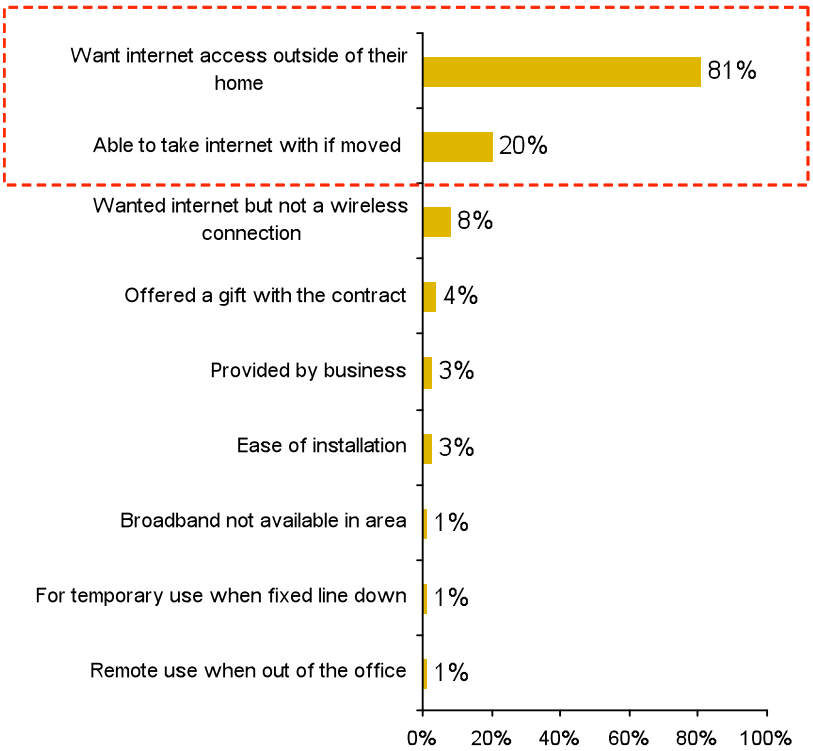
some 49m[14], this equates to 2.45m mobile IM users. This compares with 14m fixed users of IM services.

- The current penetration of social networks on mobile is 1.3m, 2.6% of mobile subscribers[15]. This compares with a total of nearly 23 million people in the UK that use Internet based social networks, 62% of total fixed Internet users.

1.3.1. Consumers want to take the Internet with them

Recently published data (see Figure 7 below) from YouGov supports the view that consumers value mobility and the ability to access the Internet 'on the go'. The ability to access the Internet in an open environment represents a substantial opportunity to deliver private and public value.

Figure 7: Percentage of people that purchased mobile broadband as an addition to existing fixed broadband [16]



1.3.2. Mobile users tend to do many of the same activities as online ones

As the market leader in the consumer mobile broadband market, an analysis of the activities of H3G users in the UK reveals that they are largely using their mobile broadband access for communication and entertainment related activities

[13] Source : Going Mobile M Metrics survey of mobile subscribers aged 13+ over 3 month period ending Feb 08.
[14] Enders Analysis UK Mobile User Survey
[15] *Source: Nielsen Mobile, UK, Q2 2008*
[16] *Source: YouGov - Dongle Tracker Wave 1 (Researched June 2008) – based on a sample size of 673 people*

The table below shows the top ten search terms H3G customers are inputting. The requested searches are very similar to the Fixed Broadband usage table provided earlier from Nielsen. Communication services (mail and social networking) come top of both surveys. This is an indication that demand for services on mobile reflects fixed internet usage.

Figure 8: Top 10 Search terms and Internet Sites

Top 10 Search Terms and Internet Sites

Top 10 Search Terms (Yahoo)	Top 10 Search Terms (Google)
1. facebook	1. Flirtomatic
2. mail	2. Bebo
3. yahoo mail	3. Facebook
4. flirtomatic	4. YouTube
5. bebo	5. MySpace
6. yahoo	6. Hotmail
7. hotmail	7. BBC Sport
8. google	8. Ebay
9. ebay	9. You Tube
10. youtube	10. BBC

Facebook users on the H3G portal have more than doubled since launch as has usage of YouTube (see Figure 9 below).

Figure 9: YouTube and Facebook usage on H3G's network

Figure redacted

1.4. Incumbents are not as incentivised as new entrants to lead change

In the UK, as well as internationally, incumbents are not as incentivised to innovate as new services risk cannibalising existing voice and/or fixed line revenue streams and the potentially high margins that these represent. Evidence suggests that they are more likely to follow the change efforts of other operators than lead them themselves.

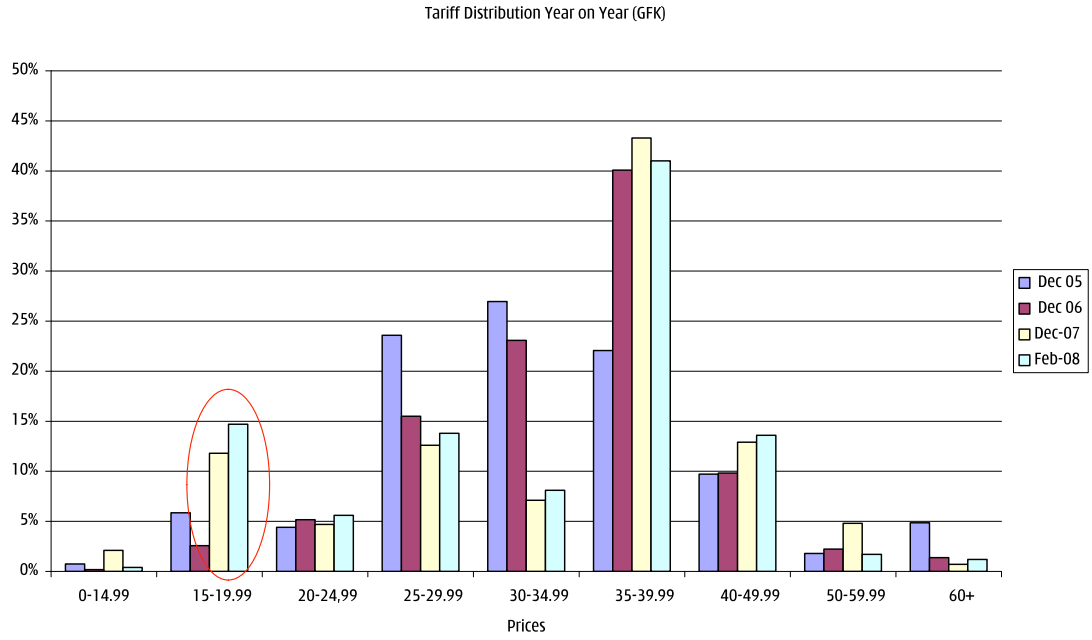
1.4.1. Protect existing revenue and margins

Incumbents are encouraged to maintain prices so as to preserve existing revenue levels.

- In the UK mobile voice market, incumbents have done this by keeping access fees high compensated for by higher minute bundles as well as promoting on-net

calling. As a consequence the distribution of tariffs in the UK has changed little in 3 years with £35 accounting for 40% of the contract market for the last 2 years and the growth of the £15-19 is mainly accounted for by H3G.

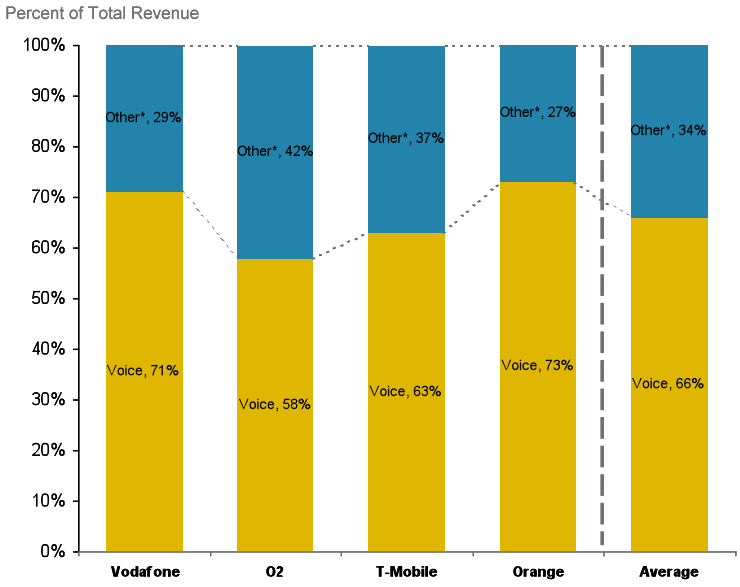
Figure 10 Tariff Distribution in the UK



- In the text market, incumbent operators are attempting to apply interconnect style wholesale pricing in order to implement Instant Messaging on mobile, as demonstrated by the GSMA agreement in February 2006.
- In the UK, despite the growth of unlimited data packages, most operators do not include instant messaging or VoIP services in their data bundles. Little or no reason is given for this, therefore the conclusion one may draw is that they fear cannibalisation of voice and text revenues by these new (and better) services.

Incumbents are concerned not to undermine higher value revenue segments or alternative access platforms (e.g. fixed line broadband in the case of O2 and Orange and the mobile business segment in the case of Vodafone); by offering lower priced consumer mobile tariffs. In the UK, three out of four mobile incumbents are owned by fixed incumbent operators in their own territories with key commitments to their fixed broadband strategies. The other incumbent UK mobile operator, Vodafone, has been cautious of offering low price data tariffs that compete with its business customer pricing, but when pushed have followed 3 UK's pricing. H3G does not have existing legacy revenues that discourage it from maximising its revenues from driving adoption of consumer mobile broadband.

Figure 11: The 'Big 4' UK Mobile Network Operators – Voice Revenue vs. Other Revenue[17]



1.4.2. Incumbents only innovate outside core products/services (e.g. voice)

Incumbents focus their innovation on complementary services so as to avoid cannibalising their existing voice revenues, while investing only when the business case is robust, taking into account the impact on existing revenues. The slower rollout by the existing MNOs of their 3G networks and services provides an example of this.

1.5. New entrants drive increased competition and innovation

New entrants, not incumbents, have increased competition, brought innovation to market and delivered consumer benefit. This is because they are not driven by the desire to protect pre-existing revenues. A new entrant in a high fixed cost business has to quickly attract a critical mass of customers to be sustainable, as well as differentiate itself. To that end new entrants tend to compete more aggressively on price and/or bring innovative products and services to market.

As outlined by Oxera[18], the entrant of a fifth operator into a concentrated market will improve the market outcome. At a high level of generalisation, the likely outcomes derived from successful new entry are as follows:

- Normally entry into a market is driven by a new firm seeing an opportunity to make a profit from a particular activity. The significant profits being earned by the existing suppliers are one indication of the contestable profits for which the new entrant will compete. It will be successful if its costs are at, or below, those of the existing supplier (or its products are of a higher quality).

[17] *Total Mobile Connections (Wireless Intelligence), Mobile Broadband Connections (Enders Analysis) – Percent based on average across Q4 2007 and Q1 2008.*

[18] *Analysis of H3G's competitive impact on the mobile market, Page 2, March 2008*

- Entry will enhance competitive pressure in the market, reflected through lower prices and/or higher-quality goods or services.
- Price reductions or quality increases result in greater demand and consequently increased output.
- Lower prices and the reduced (or maintained) market share of the incumbent firms causes their profits to be lower (or they increase their efficiency of production).
- Consumer welfare increases in the short term due to higher quantities and lower prices (or better value for money).
- In addition, theory suggests that the entry of a fifth operator is likely to reduce the probability of collusive behaviour as increasing the variety and number of firms in the market will make it more difficult to sustain price increases above costs.

H3G believes that these effects have been stronger in mobile data in the UK than in voice because of the barriers to growth created by high MTRs and the barriers to customer migration of the inadequate UK MNP process.

1.5.1. Reduction of tariff prices in voice (UK)

In the UK, the fifth operator (H3G) offers consistently cheaper calls than those offered by the incumbent mobile network operators (MNOs). The prices charged by these same MNOs have been falling over time, suggesting that H3G may be exerting competitive pressure on the prices of comparable contacts offered by its competitors. The pricing packages offered by MNOs are complex (e.g. they include a host of different *types* of minute – off-net, on-net, off-peak, on-peak, etc.). Given this complexity we have use a couple of different approaches to compare packages across operators. We have chosen the Option Value approach[19] and the Consumer profile approach[20]. The results are presented below in

Figure 12 and Figure 13.

[19] *Performed by Oxera*
[20] *Performed by Oxera*

Figure 12: Option Value analysis: average ppm by which H3G's call charges are cheaper than rivals' average[21]

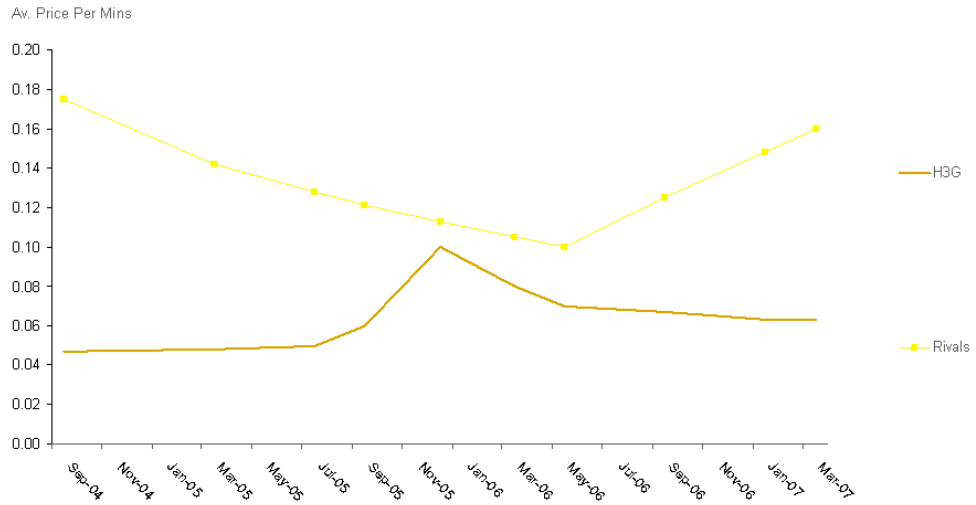
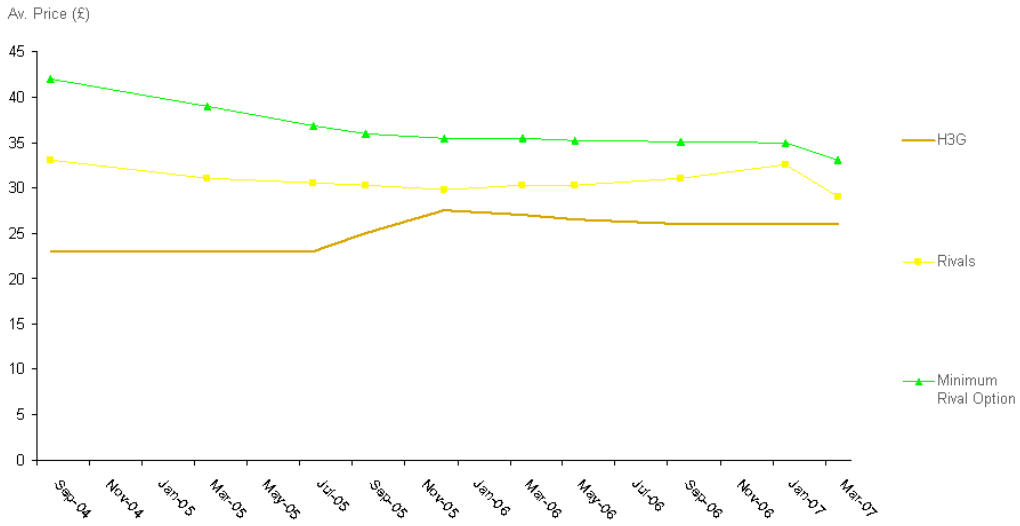


Figure 13: Customer Profile analysis: comparison of average prices charged by H3G and other MNOs for 12-month contracts[22]



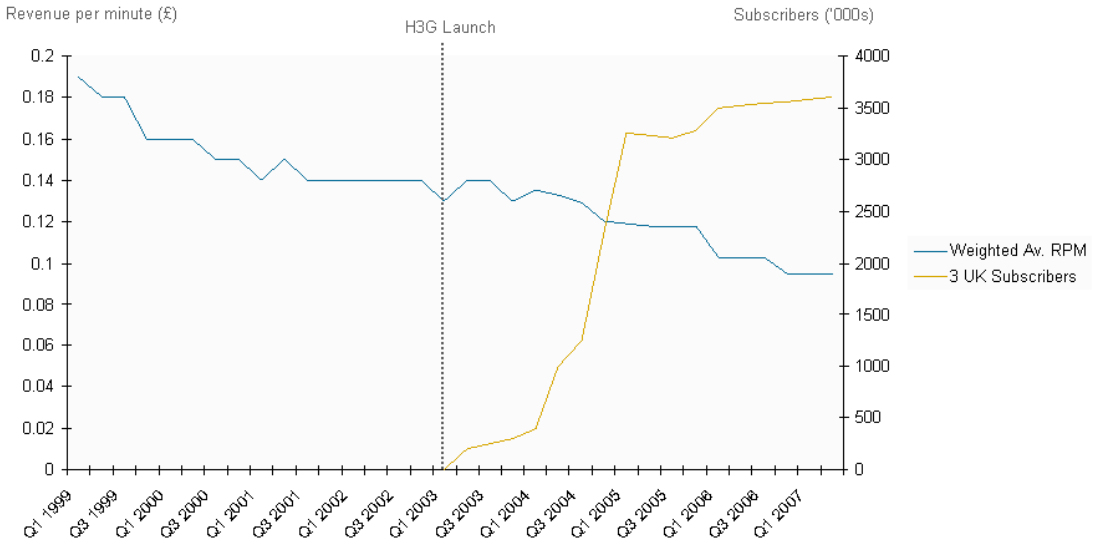
As can be seen with both the approaches chosen, H3G tariff bundles are (and have consistently been) lower than those of its rivals.

In addition, revenue per minute across incumbent MNOs has declined subsequent to H3G's entry into the market (see Figure 14 below). While the evidence is not conclusive in ascertaining that the *cause* of the trends in declining revenues per minute (RPM) amongst incumbent MNOs to the entrance of H3G into the market, it does point to a correlation.

[21] *Source: Pure Pricing Analysis*

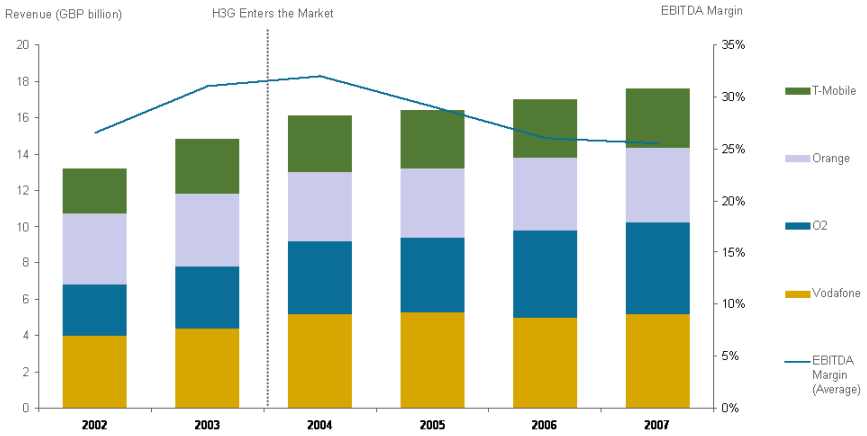
[22] *H3G prices and rival prices available from each, averaged across the profiles examined. The minimum rival price is the lowest price available from rival operators, averaged across the profiles examined. Based on analysis of any network, anytime contracts. Source: Oxera calculations, Pure Pricing.*

Figure 14 : UK historical MNO revenue per minute (pence per minute, average across operators) and subscriptions to H3G[23]



The profitability of incumbent MNOs has decreased since H3G's arrival in the market. Margins peaked in 2004 at just over 30% and since then have come down to just under 25%. This reduction in margins is akin to a value transfer to UK consumers and an expected outcome as predicted by economic theory.

Figure 15 : UK operator Revenues and EBITDA margins[24]



[23] *Note: The values reported up to Q4 2004 are for revenue per minute, while the values reported from Q1 2005 are for voice revenue per minute. The source does not contain revenue per minute for H3G. Source: Merrill Lynch 'Global Wireless Matrix Q2'04'; 'Global Wireless Matrix Q3'07'; and GSMA Wireless Intelligence database*

[24] *Source: Analysys Mason, Merrill Lynch*

1.5.2. Reduction of tariff prices in voice (International)

In international territories competitive pressure from a new 3G entrant has had a similar market impact, delivering consumer benefit via a value transfer exemplified by a reduction in the margins of major incumbents. The table below shows the impact of a new 3G entrant on the margins of the major incumbents.

Figure 16 : Analysis of Incumbent MNO EBITDA growth rate[25]

	No. of Operators	New 3G Entrant	Incumbent MNO Analysis	Compound Quarterly Growth Rate ('06-'08)
UK	5	Yes	Vodafone UK	-3%
Italy	4	Yes	TIM	-2%
Sweden	5	Yes	Tele2 Sweden	-2%
Austria	5	Yes	Mobilkom Austria	-2%
Denmark	6	Yes	Telia Denmark	-1%
Spain	4	Yes (Q4 '06)	Telefonica Moviles	0%
Belgium	3	No	Proximus	-1%
Germany	4	No	T-Mobile Germany	0%
France	3	No	Orange France	0%
Switzerland	3	No	Swisscom	0%
Netherlands	5	No	KPN Mobile	1%

The examples below of Australia, Austria and Hong Kong provide specific examples where 3 has impacted the market and delivered consumer benefits,

During 2007, 3 Australia launched new mobile broadband plans in an effort to make mobile broadband an affordable choice for consumers and businesses – and not a premium service. When priced for the mass consumer market, such as in the UK, demand has been considerable. Since launch, 3 Australia has seen a [over threefold] increase in mobile broadband subscribers (accessing the internet via a USB modem or PC card, via a handset or with an X-Series pack) from ✂at the end of June 2007 to ✂ at the end of June 2008.

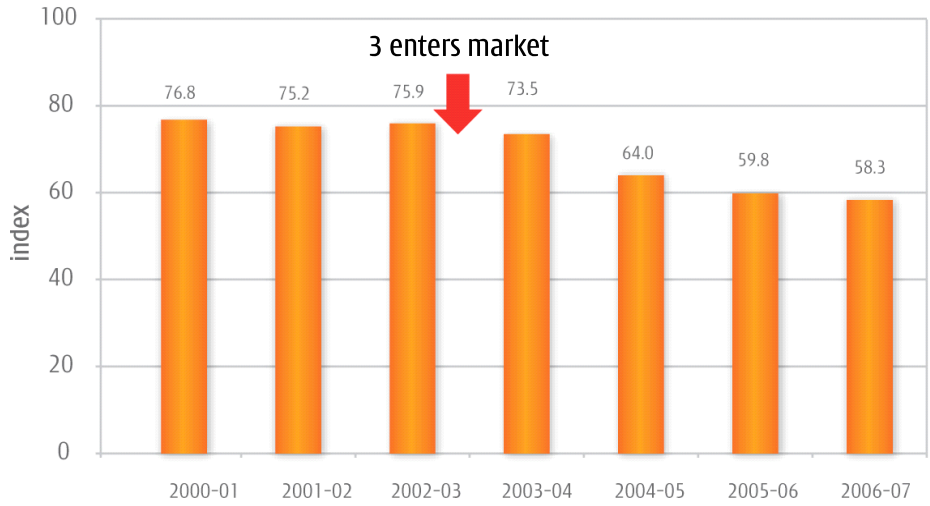
In terms of voice 3 Australia was the first operator to launch Cap Plans in Australia in 2003 driving voice pricing down from its artificially high point. Following 3's entrance, all other local carriers followed 3's lead and launched their versions of Cap Plans.

The Australian Competition and Consumer Commission produces a Mobile Services Index that illustrates how average prices have changed for consumers. The chart below shows that following 3's entrance into the market the average price have decreased.[26]

[25] *Source: Strategy Analytics*

[26] The index is calculated by estimating sample prices for bundles of mobile services that represent the usage patterns of consumers with very low, low, average, high and very high consumption of mobile services.

Figure 17: ACCC price index survey



In Austria, 3 competed on similar lines, bringing what had been an expensive premium product to the mass market with lower priced offers. In November 2006, Mobilkom Austria A1 was offering 300MB for €19, in February 2007 3 launched their mobile broadband offers with 3 GB for €19, a one thousand fold difference in value. Now Mobile broadband in Austria competes at a discount to fixed broadband providing competition to an adjacent sector and consequently further consumer benefits in the form of lower prices. 3 can do this because of the capacity provided by a new UMTS network. 3 has the largest network in Austria with 94 percent population coverage.

1.5.3. Introduction of innovative products and services (UK)

The comparison of the propensity to innovate is more difficult than price comparisons as there is no standard methodology to value particular innovations, nor is there any agreed definition of what counts as an innovation. Therefore, we do not aim to compare the relative 'innovativeness' of MNOs but rather focus on illustrating examples of how in the UK, the fifth operator (H3G), has launched new products or services.

Although all the MNOs were awarded 3G spectrum at the same time, H3G launched its 3G services approximately a year before the other operators. Thus, at a high level, this early introduction of 3G services may be seen in itself as a sign of innovative behaviour. However, perhaps H3G's mould-breaking innovation was its move away from charging per MB for data services and to provide a large 1 GB bundle. This played a vital role in mobilising the internet for retail customers.

H3G have also won a number of awards for specific new or innovative services. These include:

- Consumer Innovation Award for the X-Series
- Best Mobile Community and User Generated Content award for its social networking product, MOKO
- Communications Innovation Content Award for SeeMeTV

- Best Mobile Messenger Service for its Windows Live Messenger application
- Best Digital Music Service[27]

More importantly than simply going first is that some of these innovations have now been picked up by other operators in their own offerings.

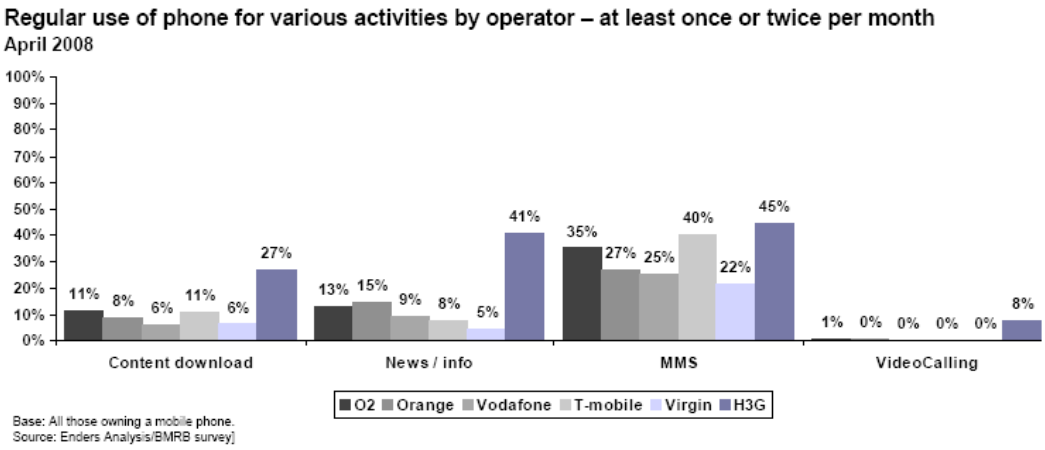
H3G's focus on innovation and considerable investment in educating its base and making these services available has led to a marked difference in the behaviour of its own customer base as compared to that of the other operators. Figure [18] earlier showed the dramatic take up of Windows Live Messenger and Skype Customers on 3's base.

Figure 18 : Combined totals of users: Skype, WLM, Email, Facebook and other Internet Communications Services on H3G mobiles[28]

Chart Redacted

The chart below[29] shows H3G customers are more disposed to download content, browse for news and information; send MMS and make video calls than customers of rivals.

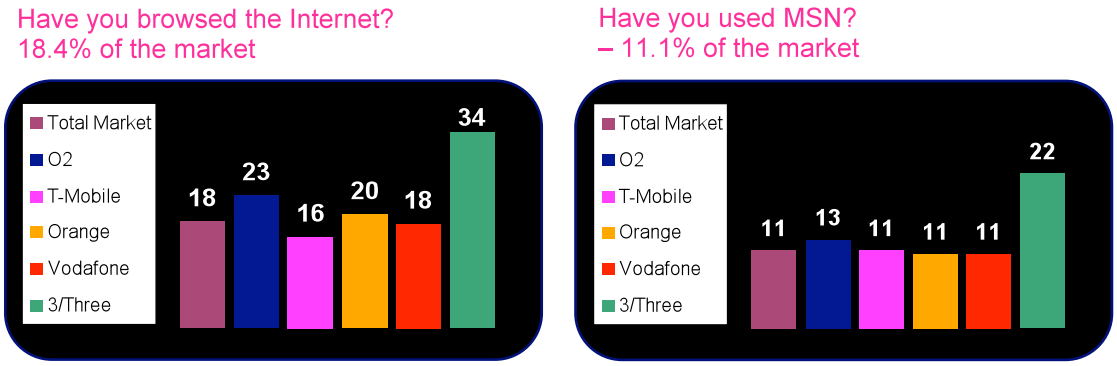
Figure 19: Activity usage by customers across UK operator services



[27] H3G Media Centre (2006), '3 Takes top honours at the Financials Times World', November. H3G Media Centre (2007), '3 shortlisted for Mobile messaging at GSM awards', January. H3G Media Centre (2007), 3UK beats off rivals at GSM Awards', February. H3G Media Centre (2007), '3 Honoured at Two Prestigious Awards Evenings', June.
[28] *Source: H3G data*
[29] Enders MBMRB Survey of UK Adult Mobile Phone Users 1002 adults in sample

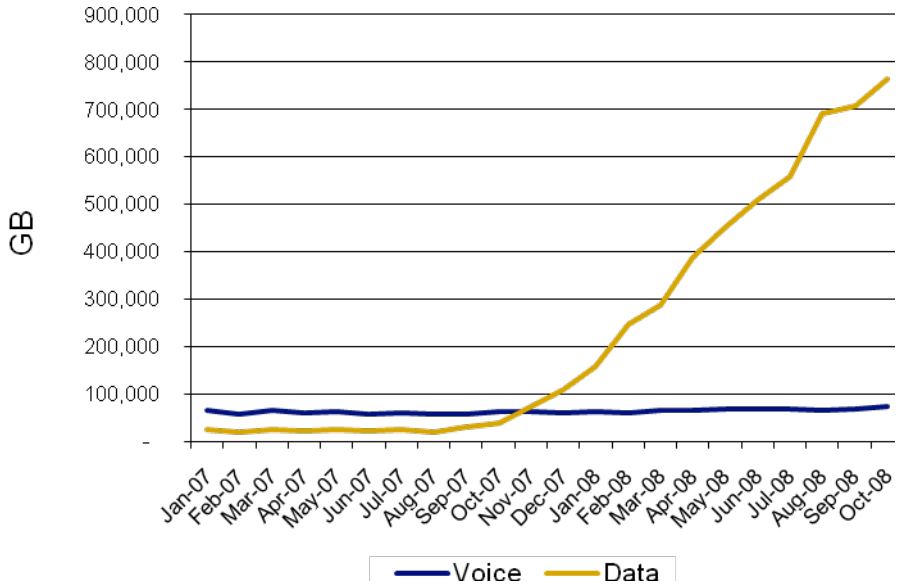
Similar patterns are born out in different surveys, where H3G has encouraged a specific type of usage. The table below (on the right) shows Windows Live messenger penetration usage. Only 11% of the total users in the market have used MSN, whereas H3G customers are twice as likely to have done so.

Figure 20: TNS Usage Survey



As mentioned already, Mobile Broadband is another area where innovation by 3UK is readily apparent in the market. Through September 2007, mobile broadband was struggling for take up in the UK. While Vodafone had launched the first HSDPA card in June 2006, it was priced at attracting corporate users. H3G launched its mobile broadband offering in the autumn of 2007 as a mass market proposition, and take-up has since increased dramatically.

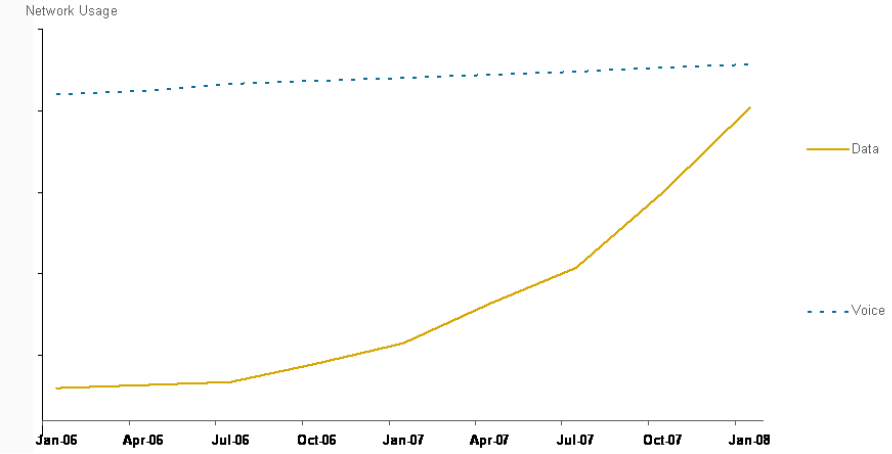
Figure 21 : Growth in H3G data traffic[30]



Rival networks are also seeing significant higher levels of increased traffic. Note: Vodafone's service was targeted at the corporate market but saw significant take up (see below).

[30] *Source: H3G data*

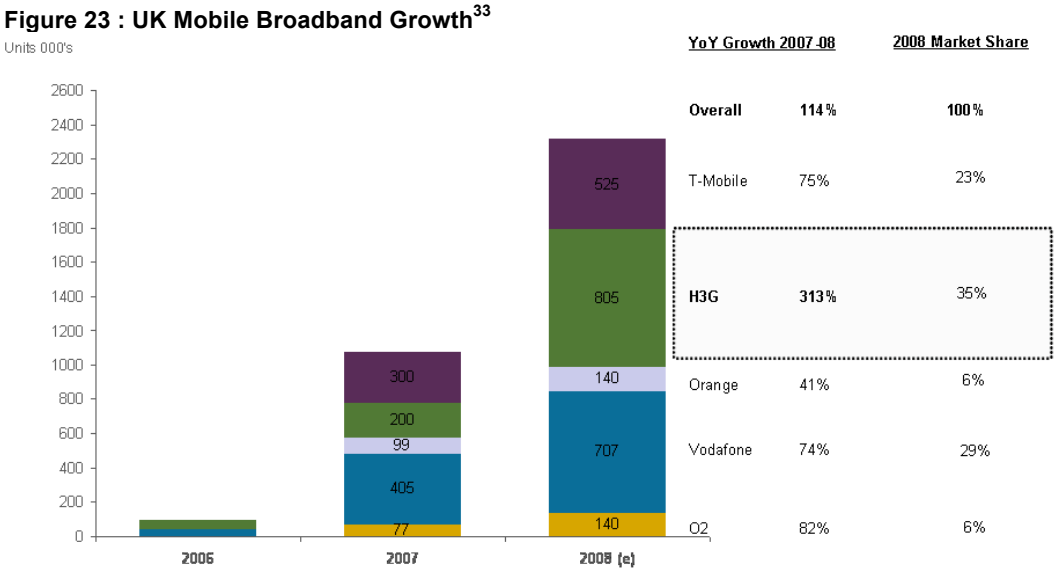
Figure 22 : Growth in Vodafone's data traffic[31]



Further, mobile broadband has had a knock on effect in terms of increased mobile usage of Internet based communications services. Usage of such services on mobile are not yet saturated and will be driven by potentially large network effects were other operators to also offer and market these services.

It is notable that although H3G has been the latest entrant in the mobile sector it has been pivotal in the rapid expansion of mobile broadband. H3G is the fastest growing provider of mobile broadband and is also expected to be the market leader in 2008 (see Figure 23 below). In fact by the end of 2008 H3G will be the UK's sixth largest internet service provider[32].

Figure 23 : UK Mobile Broadband Growth[33]

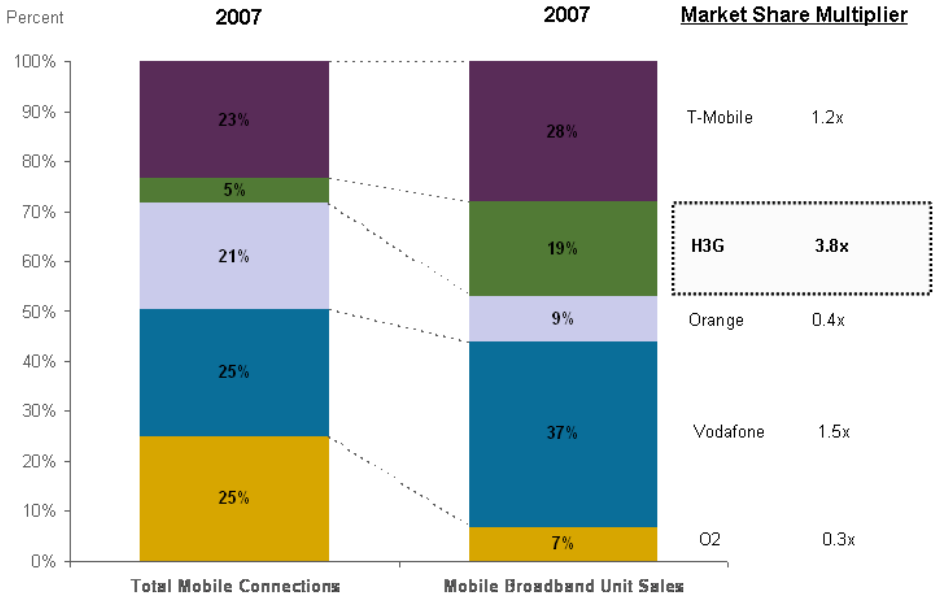


H3G's success in the mobile broadband market is in contrast to its position in the voice market: its share in broadband is almost four fold its voice share (see below).

[31] *Source: Analysys Mason, Assessment of the UK Mobile Sector, August 2008 - Figures indicative*
[32] *Source: Enders Analysis and H3G*
[33] *Source: Enders Analysis, European Mobile Market Analysis, Revenue & Market Trends, June 2008*

As indicated elsewhere in this document H3G believes that the reason for this difference in performance are barriers to growth in the UK voice market; MTRs being too high and the inadequate MNP regime.

Figure 24 : UK Voice vs. Mobile Broadband market share (2007)



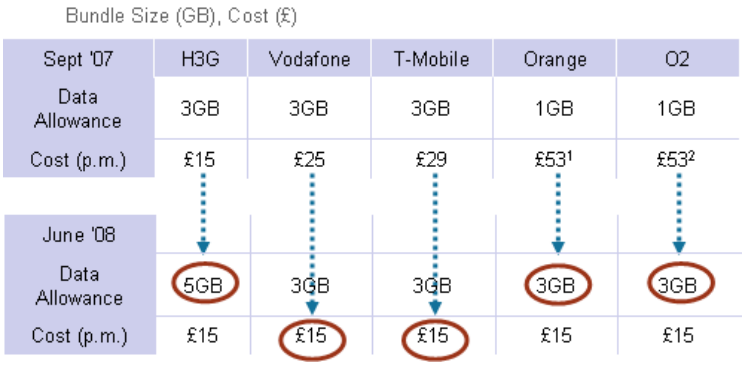
Finally, the Austrian market provides a strong example of how the mobile broadband market could evolve.

In Austria, tariffs for mobile broadband access are significantly lower than fixed line DSL (almost one third the price). This price differential has fuelled strong growth in mobile broadband while net fixed line broadband additions are close to zero. Over the course of one year, mobile subscriptions grew to represent 27% of total Austrian broadband connections. There is now a wide selection of mobile broadband tariff options catering for a range of consumer.

In the UK market, there is every reason to expect similarly strong growth in mobile broadband in its development as an alternative to fixed line access. In the UK, there is also evidence to suggest that H3G is stimulating downward price pressure on mobile broadband packages; again, a strategy that incumbent MNOs seem to be following.

Figure 25 : UK Mobile broadband bundle allowances and price[34]

[34] *Source: H3G Data*



1.5.4. Introduction of innovative products and services (International)

The presence of new entrants is also helping to drive higher penetration rates for mobile broadband products in international territories. The evidence presented in below suggests that sales of mobile broadband products including PC cards, Express cards, USB modems and embedded 3G notebooks are, on average, higher per capita in countries where there have been new entrants.

Figure 26 : International mobile broadband penetration rates[35]

	No. of Operators	New 3G Entrant	Price of MBB (Euro)	Premium to Fixed Broadband	Population Penetration
Austria	5	Yes	13	-60%	7.8%
Sweden	5	Yes	20	-20%	5.7%
Ireland	4	Yes	20	-20%	3.7%
UK	5	Yes	20	-7%	2.6%
Italy	*4*	*Yes*	*20*	*-7%*	*1.8%*
Spain	*4*	*Yes (Q4 '06)*	*38*	*40%*	*1.9%*
France	3	No	60	145%	1.6%
Germany	4	No	20	-20%	1.2%

1.6. Summary

The mobile sector both within the UK and internationally continues to experience significant change. The growth in mobile broadband and new communications services on handsets appears to be a natural extension of the fundamental changes the Internet has introduced into the ways in which people communicate and consume entertainment services.

Mobile data usage has been driven largely by new entrants. In the UK, as elsewhere, H3G has been able to bring mobile broadband to the mass market. Through its pricing and services, its customers have a distinct behaviour that demonstrates demand for mobile internet and communications services in particular. This has been accompanied by an explosion in the variety of products and the volume of data that is consumed.

[35] *Source: Strategy Analytics, October 2008, Analysis Mason*

However, a similarly emphatic trend has not been observed in voice telephony in spite of new entry due to the restrictions caused by high mobile termination rates (MTRs) and an archaic mobile number portability (MNP) system.

To realise fully the consumer benefits the mobile sector is capable of delivering, Ofcom must adapt its existing regulatory strategy. Section 2 details H3G's view on the major regulatory impediments that exist, how specifically they have served to limit consumer benefit, and proposed solutions.

2. Regulatory Challenges

2.1. Introduction

The previous chapter outlined the trends that are at work in the mobile industry, and how the rise of mobile data usage and new Internet based services are changing consumer behaviour. In this chapter we outline the regulatory challenges which need to be overcome to allow the mobile sector to reach its full potential.

The first three sections deal with existing and future barriers to competition, which serve to harm consumers. The existing MTR system limits competition in the provision of voice services. It also disadvantages new entrants who have been active in leading the uptake of mobile data services. 2G liberalisation needs to be carried out in a fashion consistent with Ofcom's stated principles of spectrum management otherwise it could threaten the competitiveness of the mobile industry in the future; a future in which high speed data services will become increasingly important for consumers. An effective switching regime is also vitally important in ensuring that competition in voice services works effectively.

By encouraging a competitive mobile sector, Ofcom will be delivering valuable benefits to consumers. However, in some areas, the market alone will not be able to achieve desirable outcomes for consumers. In these areas Ofcom could take a more active role in bringing parties together and overcoming coordination problems between many actors. We outline some of these challenges in the fourth section.

2.2. The recovery of network common costs through per minute call termination charges

2.2.1. Introduction

Ofcom's current approach to setting mobile termination charges results in charges which are inefficiently high. Two reasons lie behind this. Firstly, Ofcom allows the recovery of large levels of common and fixed costs through the variable termination charge; consequently the current charges are significantly higher than the true incremental cost of termination. Secondly, Ofcom does not take into account the benefits received by the receiving party from a phone call when setting its charges. The combination of these factors results in an inefficiently high price for mobile termination.

In the past, operators sought to justify high termination charges for mobile networks were by the argument that fixed customers benefitted from the network effects of having more people contactable through mobile networks. The fixed to mobile transfer may historically have helped to drive adoption of mobile services. However, now that mobile penetration is almost universal, and the unsubsidised cost of handsets is low, inefficiently high mobile MTRs cannot be justified, especially in light of the significant market distortions and higher call prices that they cause.

These distortions include:

- **An artificial barrier to competition between small and large networks** – under a system of high MTRs the new entrant cannot compete effectively with

larger incumbents - this denies consumers access to the additional capacity created by the new entrant and the lower prices that this should deliver;

- **Inefficiently high prices for voice services** – high MTRs set an artificial price floor for off-net mobile calls which is not reflective of the incremental costs of termination; this leads to an inefficiently low consumption of voice services for off net calls and fixed to mobile calls;
- **Distorted incentives for MNOs** – as operators stand to gain financially from customers who receive more calls than they generate, they spend more on retaining these consumers; this appears to be a *prima facie* allocative inefficiency;
- **A restriction of innovative services such as Voice Over Internet Protocol (VOIP) and Instant Messaging (IM)** – new services such as VOIP and IM do not generate termination revenues (for either voice termination or SMS termination) and as such most operators actively restrict their usage to protect their existing (termination) revenues; consumers lose out by being unable to use these new services as older technologies are preferred over more modern equivalents by arbitrary and discriminatory regulatory treatment; and
- **Prevention of effective competition between fixed and mobile voice services** – high MTRs artificially inflate the costs of calling mobiles from fixed networks and other mobile networks which results in some consumers retaining a fixed line connection where a single mobile subscription would be more efficient.

Under the current system network common costs are recovered on a pence per minute basis from other networks. There are strong arguments for no longer permitting recovery in this way by adopting alternative systems such as mobile to mobile bill and keep. Such approaches would allow for a more efficient recovery of costs. In two sided markets network operators have other more efficient options to recover their access costs. Contrary to what incumbent operators have suggested, charging consumers on a pence-per-minute (ppm) basis for incoming calls is not the only way to recover costs – it is only one way to do so.[36]

Bill and keep would also remove the distortions outlined above, providing significant benefits to consumers including:

- enhanced competition between mobile operators;
- lower priced voice calls;
- fairer treatment of all consumers regardless of their net call termination balance;
- faster introduction and cross network adoption of new and innovative products and services; and
- the possibility of fixed/mobile convergence for both calls and subscription.

[36] H3G is prepared to guarantee that it will not charge consumers to receive calls in the event that bill and keep is introduced in the UK.

The international experience with "bill and keep" presented later in this response suggests that territories that have implemented this system benefit from lower-priced voice calls, higher utilisation and enjoy rates of mobile penetration comparable with that in the UK. In Annex 1 we present evidence, from our sister company in Hong Kong, on the practical operation of bill and keep and its positive impact on consumers.

It is worthwhile to note that a low marginal cost MTR regime could generate many of the benefits of a bill and keep system. As such, it may prove to be an important transitional step.

2.2.2. Background

The mobile termination rate (MTR) system is designed to allow mobile network operators (MNOs) to recover the long-run incremental costs (LRIC) associated with terminating calls that originate on other networks. The originating network purchases call termination, a wholesale service, from the terminating network at a regulated price per minute (ppm) charge.

Termination charges were originally set when BT, the dominant fixed operator owned one of the mobile operators - Cellnet (now O2). BT therefore had incentives to set its MTR high; this served to shift profits from its heavily regulated fixed retail business into its less regulated mobile business.

As a large proportion of mobile calls are between mobile phones and fixed lines and fixed call termination rates are set on a different basis and are lower than MTRs this results in large net payments by fixed line consumers to the mobile operators. This situation persists today even though the MTRs are subject to price controls. Net payments from fixed line consumers to mobile operators are still of the order of £1bn per year[37].

Following an investigation in 1998 which concluded that the termination charges of Vodafone and Cellnet (now O2) were too high in relation to cost and against the public interest, the Monopolies and Mergers Commission (now the Competition Commission) imposed controls on the networks' termination charges. In subsequent years a series of cuts in the price of termination were imposed on the MNOs by the competition authorities and the regulators with the last Competition Commission control ending in 2006. In 2006 Ofcom did not reduce the rates for the price control period 2006/2007 even though the Competition Commission's decision would have suggested a reduction, choosing instead to maintain the 2G rates at the same absolute level and actually to allow the incumbents to increase their rates for 3G call termination. Furthermore, Ofcom's 2007 decision on its review of the market for mobile call termination did not substantially reduce MTRs for the incumbents for the period 2007/2011. Rather Ofcom only reduced the rate for H3G in the belief that greater rate symmetry was competitively neutral. This decision mandated that the average charges of H3G should be reduced to 5.9 ppm by 2010. The average charges of the incumbent MNOs were reduced slightly to 5.1 ppm by April 2010, from their levels in 2007 which were 5.6 ppm for Vodafone and O2, and 6.3 ppm for Orange and T-Mobile.

[37] See Ofcom's statement on MTR, 2007.

2.2.3. MTRs are currently set at an inefficient level

The current MTR system is an example of a 'Calling Party's Network Pays' (CPNP) system, under which the entire cost of the call is borne ultimately by the caller. Although, the originating network must pay the ppm termination charge, which is set by regulation, it is free to recover its origination costs from its own customers in any way it sees fit. It could charge a ppm charge or provide a customer with a monthlybundle of minutes in return for a subscription charge. If a bundle is offered at retail the operator must set prices to ensure that at minimum it recovers the per minute termination charges that will be incurred by off-net calls. Under this system the calling party's network (CPN) must purchase termination from the receiving party's network (RPN) and this leads to what is known as the 'bottleneck monopoly': the RPN is the monopolist of termination on its own network. This leads to the necessity of regulation to set the price for call termination in the absence of other constraints such as countervailing buyer power.

The use of an unsuitable increment in calculating the termination charge:

If, under a CPNP regime, termination costs must be determined by regulators, how should they be set? In its draft recommendation on the regulatory treatment of fixed and mobile termination rates, the European Commission takes the clear position that "costs of termination services should be calculated on the basis of forward-looking long-run incremental costs (LRIC)…the relevant increment should be defined as the wholesale voice call termination service *provided to third parties*."[38]

This position is at odds with the methodology employed by Ofcom in its 2007 determination that used a "total service increment", which consists of the incremental costs caused by terminating ALL minutes and not just those supplied wholesale to third parties. This had the effect of including a large number of costs which are common to both the termination of each network's own on-network calls, as well as those supplied to third parties. Figure 23 below shows the effect in more detail.

Figure 27 : Different outcomes using different definitions of incremental cost

[38] Draft Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/termination_rates/termination.pdf

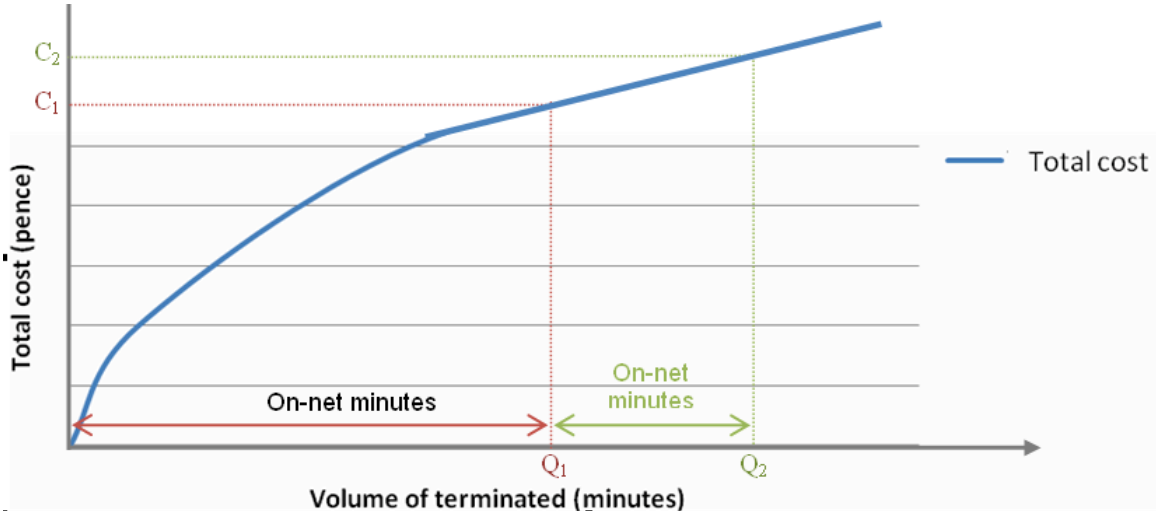


Figure 27 shows how the costs of termination to an MNO evolve with the number of minutes terminated. The shape of the curve is typical of a case where there are economies of scale; that is the incremental cost of an additional unit decreases as the total volume increases.

Q_1 is the volume of on-net minutes terminated by the MNO and Q_2 is the total volume of minutes terminated, C_1 and C_2 are the respective total costs of termination. Applying the common definition of increment, as used by the European Commission, leads to an incremental charge of $(C_2 – C_1) / (Q_2 – Q_1)$ for wholesale termination. However, Ofcom's definition of the "total service increment" would lead to termination charge set at Q_2/C_2 and by definition this will be significantly higher[39].

Using Ofcom's own model for mobile termination rates, it is possible to derive a termination charge for the UK using the European Commission's definition of the correct increment. This is estimated as being less than 1.0ppm[40].

Since a necessary condition for Pareto efficiency is that that the marginal willingness to pay must equal marginal cost, Ofcom's high MTR (which includes large levels of common costs) sets a price floor for off-net calls which is significantly above incremental cost and will therefore result in inefficiently low consumption of voice termination minutes. In a retail context this will be manifest as smaller bundles of voice minutes, which is effectively a higher retail price.

No recognition of call externalities

Although the incremental cost for termination can be determined through cost modelling, it does not follow that this is the most efficient charge to set for call termination. This is due to the presence of *call externalities*, a situation where both the sender and receiver of a call gain a benefit, but under a CPNP regime, only the

[39] It is also clearly visible from this diagrammatic treatment that the European Commission's method would lead to a ppm termination charge which is far closer to the marginal cost at the total volume of minutes terminated than Ofcom's approach. This means that price signals sent to other networks for the costs of termination over and above the predicted volume of minutes will be inflated and thus restrict the further consumption of minutes.
[40] H3G analysis of Ofcom's MTR model

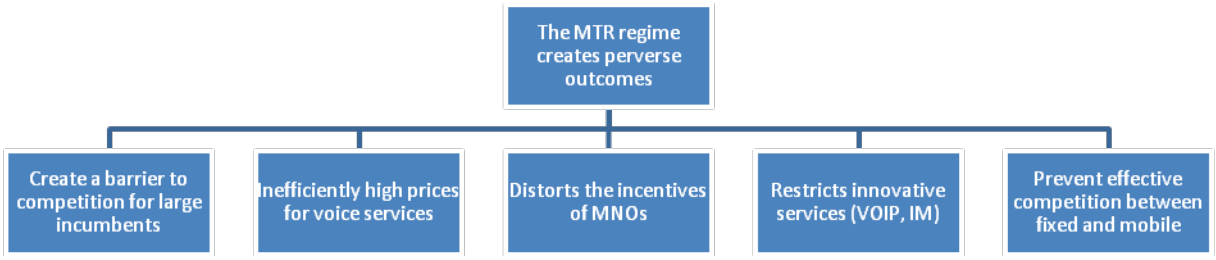
caller pays the costs. Standard cost causation principles used in setting cost-orientated prices would suggest that both parties, each of whom gain benefit from the call, should share the costs of termination. Therefore, setting the termination charge at less than the incremental costs of termination allows the internalisation of this externality and is likely to lead to more efficient calling decisions being made.

2.2.4. The problem: consumer detriment caused by high inefficient MTRs

Although the long and protracted battles between the regulator and the MNOs have historically led to some reductions in mobile termination rates, these rates remain inefficiently high for the reasons outlined above. The regulated ppm charge for termination is highly unreflective of the incremental cost of terminating an additional minute on a given network. Furthermore, the MTR charge is not adjusted downwards to take into account the external benefit that is gained by the receiving party from a phone call.

These factors result in outcomes which cause real harm to consumers, outlined below in lFigure 28.

lFigure 28: Perverse outcomes resulting from the current MTRs



Acts in favour of large incumbent operators, hurts entrants

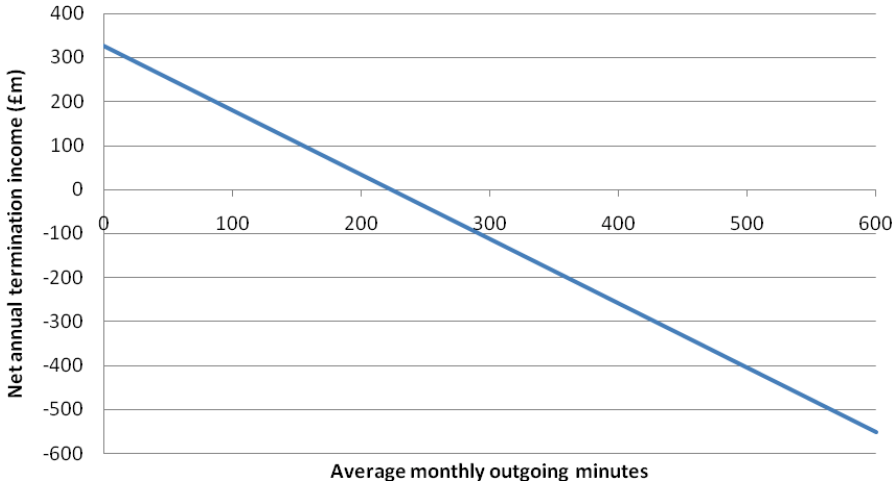
The current MTR system serves to disadvantage newer entrants into the mobile market, thus reducing the potential for competition to work to the benefit of consumers. It does this in two ways: firstly, by financially penalising the traffic imbalances which are typically faced by new entrants, and secondly, by creating incentives for large incumbents to engage in on-net/off-net price discrimination.

New entrants into a saturated mobile market will face a traffic imbalance; they are likely to generate more outbound minutes than inbound minutes. There are a number of causes of the imbalance including the following: that newer entrants must offer attractive deals to entice consumers, and that due to the current switching arrangements incumbent operators can retain those consumers who generate the best net termination income, and on net/off net price discrimination by the incumbents

In a saturated mobile market, such as the UK, where mobile penetration is over 100%, a new entrant must offer packages that are more attractive than those offered by the existing operators to gain market share. This can involve deals on data and mobile broadband usage, where H3G has made great strides. However, consumers' focus continues to be primarily on voice, and in a CPNP regime, such as the UK, more attractive voice deals will generally involve more attractively priced voice calls. This will tend to increase termination out payments with little corresponding increase in revenues.

Figure 29 below shows how the financial position of a new entrant worsens the more minutes its consumers use.

Figure 29 : Average monthly minutes vs. Net MTR Income for a hypothetical new entrant facing a traffic imbalance[41]



Furthermore, the current MNP system is donor operator[42] led, and it provides operators with both the opportunity and incentive to retain customers which generate positive net termination income. These customers are those who receive large numbers of calls from other networks yet make few off network calls. Donor operators can precisely target their retention strategies to favour the retention of customers who generate large levels of net termination income. Receiving operators can at best provide general offers. Therefore, it is likely that new entrants into a saturated market will have a subscriber base composed of customers who make more outgoing calls than receive incoming calls. This situation is likely to persist for some time even after the reform of the UK MNP system.

These factors, taken together, suggest that new entrants will suffer a traffic imbalance. This severity of this imbalance is highly dependent on the rate of churn and the details of number portability. Figure 30: New Entrants and Traffic Imbalance below shows new entrants in variety of countries and their associated traffic imbalance.

[41] Source: Ingenious analysis based on H3G figures
[42] The donor operator is the operator from whom the subscriber is porting away

Figure 30: New Entrants and Traffic Imbalance[43]

Operator	Country	Date Launched	Incoming as % of outgoing
3	Austria	2003	✂
3	Sweden	2003	✂
E-Plus	Germany	1994	✂
Avea	Turkey	2001	✂
Play	Poland	2007	✂
3	UK	2003	✂
3	Italy	2003	✂
Bouygues	France	1996	✂

This results in a financial disparity for new entrants, even if they can deploy networks which are more efficient than those of existing operators, effectively discouraging entry by new entrants and limiting the benefits of competition for consumers.

The second way in which high MTRs harm competition is by giving large incumbent operators the ability to successfully employ a strategy of large on-net/off-net price differentials. These differentials are particularly damaging to new entrants and to competition from smaller networks. Call externalities are crucial to understanding why larger networks can successfully adopt this strategy.

By implementing large on-net/off-net price differentials, larger operators create *tariff-mediated network externalities.*[44] Larger networks will incur lower termination out payments per subscriber than smaller networks, since a larger proportion of calls on large networks will be on-net. This will result in larger networks being more profitable than smaller ones as a result of the high pence per minute MTRs.

High mobile-to-mobile termination charges can lead to permanent traffic imbalances for smaller networks. Since the bulk of a smaller network's subscribers' calls will be off-net, the smaller network will be forced to incur large payments to rival networks. Call externalities reinforce this disadvantage since when large networks set high off-net prices, subscribers of a smaller network will also receive fewer calls, as callers are dis-incentivised to pay more for calls off-net.

There is a significant body of evidence that operators in the UK, and in other CPNP territories within Europe, employ large on-net/off-net price differentials. The table below summarises the differences in on-net and off-net pricing in various territories laid out in Harbord and Pagnozzi (2007).

[43] Source: Challengers Group
[44] Described in Laffont et al.

Figure 31: MNO price plans – On-net vs. Off-net pricing[45]

UK Pre-pay	On-net	Off-net
O2	25ppm (first 3 mins) 5ppm thereafter	40ppm
T-Mobile	8ppm	40ppm
Orange	15pph (for 3 nominated numbers)	15ppm
Vodafone	20ppm	20ppm

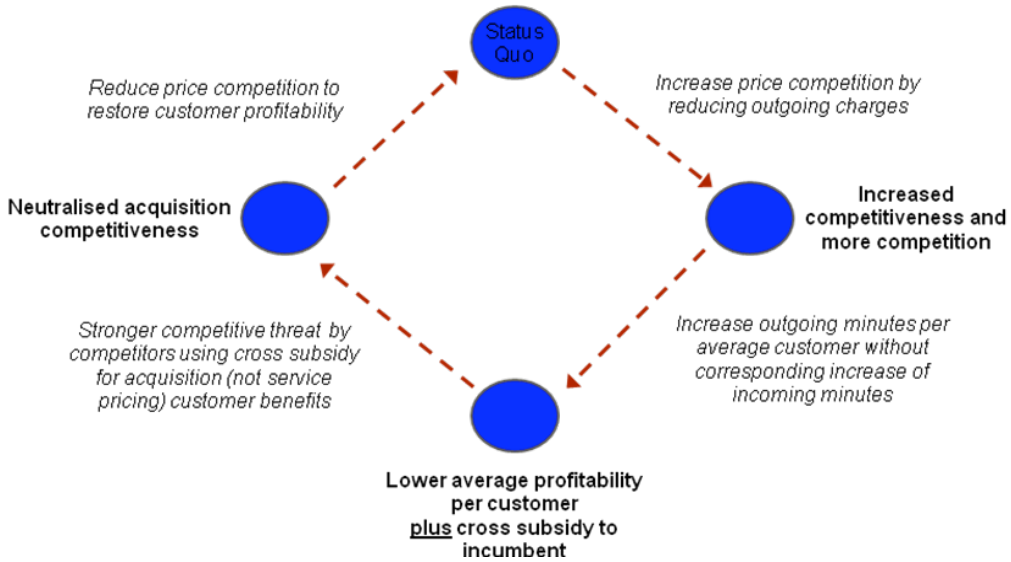
UK Post-pay	On-net	Off-net
O2	Unlimited allowance	Fixed minute allowance
T-Mobile	10ppm	35ppm
Orange	Unlimited allowance	Fixed minute allowance
Vodafone	18ppm	40ppm

Europe	On-net	Off-net
France	Unlimited monthly on-net calls (Orange)	Fixed minute allowance
Germany	Unlimited monthly on-net calls (some operators)	Fixed minute allowance
Spain	3.3ppm (Telefonica pre-pay)	39.9ppm

The high MTRs set by Ofcom serve to exacerbate the incentives faced by larger operators to engage in on-net/off-net price discrimination by creating greater incentives to maintain a high on-net/off-net traffic ratio and to create a traffic imbalance for smaller operators. Harbord and Pagnozzi (2007) suggest that this distortion in prices is as serious as the initial distortion that regulated MTRs were designed to combat, that of excessive fixed to mobile subsidy caused by high MTRs.

The overall result of high MTRs is a cycle whereby the price-cutting efforts by new entrants to gain customers are ultimately self-defeating. This is detailed diagrammatically below.

Figure 32: The self-defeating cycle of price competition under inefficiently high MTRs

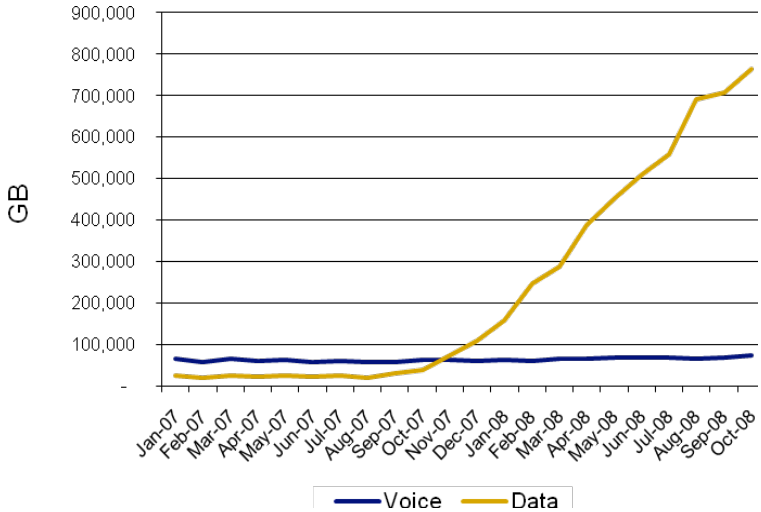


[45] *Source: Harbord & Pagnozzi (2007)*

Price cuts by new entrants to attract consumers result in increased termination out payments to incumbent operators. These transfer payments can be used by incumbents to subsidise consumer acquisition costs and prevent the new entrant from gaining market share. The new entrant is then forced to increase its prices to maintain profitability and the status quo is re-established. Under a system of high MTRs it becomes near impossible for a new entrant to compete effectively to reach market share parity and prices for voice services remain well above the efficient level.

The chart below shows the data traffic on H3G's network compared to the voice traffic, and it is visible that although H3G has been able to expand data offerings to consumers it has not been able to do the same for voice.

Figure 33: Comparison of data and voice traffic across H3G's network



This highlights the bizarre consequences of the high MTR system on mobile competition, H3G is able to offer its customer large levels of cost-effective data usage but cannot do the same in voice.

Inefficient structure of prices

High MTRs reduce the ability for operators to exercise the freedom to price to reflect their own network costs. They have two principal effects. Firstly, they act as an artificial price floor for calls off network. Secondly, they provide an incentive to price to manage the reciprocation ratio as opposed to usage or some other need, so as to maximise the inbound revenue for low use customers.

This is evidenced in two ways. High use and potentially high spend customers actually become low margin as their greater usage incurs greater cost and the cost per minute is linear. This prevents flat rate cross net pricing. Unlimited call tariffs, for example, are far more common in countries which have lower MTRs or different cost recovery systems. Secondly, there is little incentive to drop the price per minute for low use customers where a large proportion of the value is concentrated in their

inbound revenue. Dropping that price may encourage usage and diminish their value. Therefore, high MTRs do not benefit either high use or low use customers

Furthermore, we have already noted the inefficiency that arises if fixed costs are recovered through variable charges rather than through lump-sum charges; and high MTRs result in exactly this inefficiency. The marginal cost for a receiving network to terminate a call is far less than termination charge applied, leading to inefficiently high charges for consumers for off-net mobile to mobile and fixed to mobile calls.

Restricts innovative services as operators protect their MTR income:

A further adverse effect of the MTR regime is to inhibit the wide-spread offering of new services such as 'voice over Internet protocol' (VOIP) and instant messaging (IM) which could provide significant value to UK consumers.

As outlined above, termination charges represent a substantial source of revenue for large incumbent MNOs and also serve to prop up retail costs of mobile voice telephony. Therefore, they may be reluctant to make available services which threaten the termination system. VOIP services such as Skype bypass the mobile termination regime. It would allow zero cost calling to mobiles from computers and other mobiles running the services and give access to the superior addressing system that VOIP systems adopt (for example the called party can receive calls on multiple devices and are not tied to a particular number). IM services are similarly Internet based and again do not face any associated termination charges, unlike SMSs where common practice has established SMS wholesale prices at a particular level which the incumbents are reluctant to reduce. Both VOIP and[46], IM are functionally superior to traditional voice and text in terms of addressing and presence information yet the high MTR system and commercial practice mitigates against innovation to better systems.

The four incumbent operators have historically resisted the introduction services that pose a risk to their ability to generate income through termination charges, whether for voice calls or text messages. This reluctance has hindered the adoption of these potentially valuable services and limited the value of the services by reducing network externalities. For example, the majority of UK operators still forbid the use of VOIP on their networks.

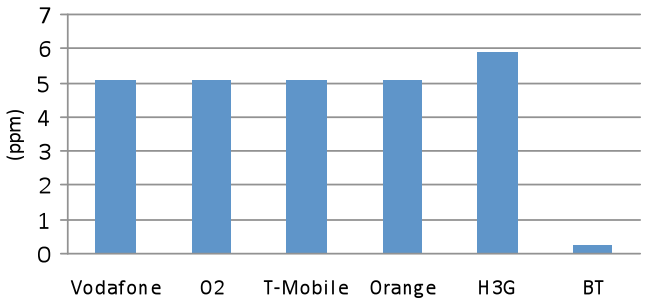
Large barrier to fixed mobile substitution of voice:

Finally, the large disparities between termination rates for fixed and mobile lines creates an artificial distinction between fixed and mobile voice services, preventing real competition and substitution between the two.

Figure 34 below shows the variation in ppm termination rates between the mobile operators and BT[47] even by the end of the present MTR charge control in 2011.

[46] Using a service such as Skype and Skype-out allows a user to reach both the galaxy of Skype and traditional circuit-switched voice users.
[47] Where the BT figure is the cost of single tandem termination

Figure 34: termination rates in 2011, at the end of the current MTR determination[48]



As can be seen, there is a large discrepancy between the termination charges on mobile networks and BT. This renders calling mobiles more expensive, both from fixed lines and from other off net mobiles and does not reflect real cost differences. Figure 35 below shows how these termination rates translate into the costs of calls to mobiles.

Figure 35: Mobile and Fixed Price Comparisons[49]

		Calls to	
		Fixed line	**Mobile phone**
Calls from	**Fixed line**	4.0ppm	12.5ppm
	Mobile phone	3.5 ppm	7.8ppm

Mobile operators can include cross-network minutes as part of their bundle of calls as they receive some amount of balancing calls from other operators, this serves to obscure high MTRs. However, from fixed lines it is clearer that the cost of calling a mobile is relatively high. H3G research below shows the majority of consumers still think it is cheaper to make and receive call from fixed lines.

[48] *Source: Ofcom*
[49] *Source: Ingenious analysis, derived from BT residential pricing and Ofcom: The Communications Market 2007*

Figure 36: Motivations for Using Fixed Line [50]

Table Redacted

The high costs of calling a mobile from a fixed line may largely be responsible for the reluctance consumers have displayed in substituting away from fixed lines to mobile for voice calls. It may be that consumers maintain a fixed line so that other people are more able to call them cheaply, especially calls originating from fixed lines and internationally. This is shown in research below:-

Figure 37: Importance of cost of incoming calls[51]

Table Redacted

This is evidence that the call externality is significant. For consumers, this results in having to maintain both a mobile and fixed subscription, which they need not do if fixed and mobile were able to compete on a more level playing field. Essentially high MTRs are preventing consumers from expressing their valuation of incoming calls through a mobile service - instead they have to maintain a fixed line service for this purpose. Low or zero MTRs would allow the customer to decide to move to a single service which more closely reflects their valuation of incoming calls.

2.2.5. The problem: high economic costs of inefficient MTRs

H3G has attempted to calculate the marginal costs of mobile call termination based on Ofcom's existing model data. H3G has also prepared a welfare model which estimates the economic benefit as a whole of moving to marginal cost based rates (with LRIC calculations acting as a proxy) from the current common cost recovery model in the 2007 Ofcom decision. The indications of the model are that a move from the level of MCT rates imposed by Ofcom for 2010/11 to marginal cost based termination results in an overall welfare gain of £0.3 billion, when call externalities are entirely absent, to £1.1 billion, when call externalities are taken into account. The economic costs to the UK economy of the current system are therefore substantial. The welfare model is attached at Annexe 4.

2.2.6. The resolution: bill and keep as a practical alternative

We have explored above the distortions and consumer harm that results from MTRs set at a level which far exceeds marginal cost. We have also seen that an efficient

[50] 3 Fixed line omnibus questionnaire 1004 UK consumers
[51] 3 Fixed line omnibus questionnaire 1004 UK consumers

termination charge would at most be at the level of a true incremental cost, or even lower to account for the call externality. This entails that an economically efficient termination charge would be close to zero.

One practical option for implementing an effective MTR of zero is to use a "receiving party's network pays" (RPNP) system, where the receiving network typically makes no charge on the caller for receiving and terminating calls from other networks. Instead, the receiving network recovers this cost from its own subscribers. RPNP thus means that the cost of a call is shared between the caller and receiver, along with the benefit that is received from a call. A particular approach to RPNP is the system known as "bill and keep"[52] in which there are no payments for interconnection between operators, and each operator recovers the cost of its own network from its own subscribers.

RPNP is not synonymous with subscribers paying for incoming calls as some operators claim. In fact, H3G is prepared to guarantee that under a RPNP system it would not charge its customers for incoming calls.

Under bill and keep, each network recovers its own costs from its own customers. Both operators can do this in a number of ways; using ppm charging, a bundled allowance of incoming or outgoing minutes, or free unlimited calling and receiving packages funded through subscription. Networks are free to recover costs using any methodology they wish.

A bill and keep system has increasing relevance and applicability in a world of new services and mobile telephony. In the pre-mobile era, before the widespread advent of calling line identification systems, the receiving party would not generally be aware of who was calling them. With the advent of caller identification and voice mail, the receiving party is immediately aware of who the caller is and can screen unwanted calls. This further increases the call externality and strengthens the case for much lower MTRs.

How a bill and keep system can address each of the areas of consumer detriment is outlined below.

Encourage new entrants/entry:

Under a bill and keep system, new entrants would no longer face financial penalties from having a traffic imbalance of incoming and outgoing minutes that is discussed above. This would serve to reduce some of the disincentives to entering the market for mobile services as new entrants would be able to compete on the strength of their networks and investment in new technology.

Furthermore, this would reduce to some degree the strategic incentive described above for larger operators to create tariff mediated network externalities using on-net/off-net price discrimination.

Both these effects would increase competition in the mobile market, with consumers reaping the benefits through lower prices and greater innovation.

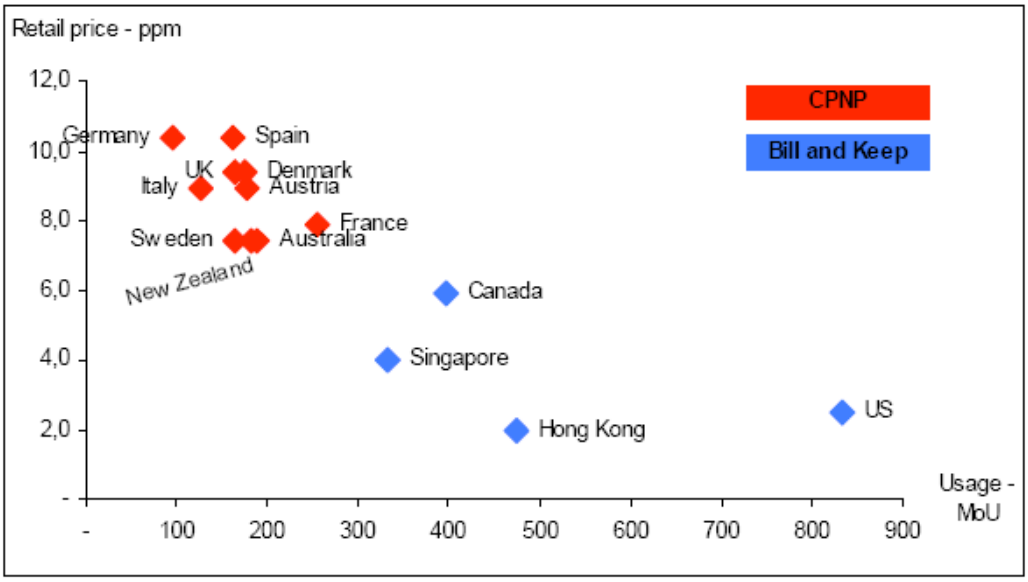
[52] Also known as "net payment zero" (NPZ) in some of the literature

Incentivise efficient pricing and cost recovery:

Currently operators are limited in the pricing plans and the bundled minutes they can provide by the existence of high termination charges for off-net calls. This would no longer be the case under a bill and keep system. Operators would be free to recover the costs of their own network in a number of different ways. The traditional methods of using ppm charges or allowing a fixed bundle of minutes would still be possible. However, in addition mobile operators would be able to offer unlimited calling bundles for an extra fee, if they could recover their costs. This is already common practice in the USA. The benefits for consumers would manifest in an increase in the number of voice calls made and received.[53]

The chart below shows how consumers in those countries which currently use bill and keep benefit from lower ppm prices for calls and thus consume more mobile voice telephony.

Figure 38: Comparison of retail prices and average monthly usage in countries which use CPNP and those which use RPNP[54]



The key difference between these two sets of countries is that CPNP territories use an inefficient pence per minute charge to recover large elements of common cost, which necessarily send inaccurate signals about the true incremental cost of a voice minute, whereas RPNP territories can recover common costs in other ways, which leads to a greater, more efficient, consumption of voice telephony.

Remove distortions in the incentives of MNOs

Under a bill and keep system, the incentive that operators currently face to fight to retain consumers who have a large volume of net incoming calls will be eliminated.

[53] Littlechild (2006),
[54] *Source: Harbord and Pagnozzi (2007),*

This will serve to reduce the levels of inefficient subsidy that are focussed on this particular group of customers.

Incentivise the provision of innovative services by operators:

As set out above, it is the desire to protect termination revenues that is at least partly responsible for the unwillingness of most networks to provide innovative services like VOIP and IM. Under a bill and keep system, this incentive would no longer exist and operators would be encouraged to innovate. In fact, there would be stiffer competition to gain and retain subscribers and the provision of new services may assist operators in doing so; as shown in section 1, IM and Skype have proven immensely popular with H3G's customers. Consumers would benefit from the wider adoption of these services and the ability to use them across networks; currently this is not the case.

Allow fixed and mobile to compete and converge:

Moving to a bill and keep system would also finally allow fixed and mobile to compete by reducing the price of calling mobile phones. This would allow three sets of users to benefit:

- Users who primarily use their mobile phones but also keep a fixed line to allow others to call them without incurring high costs – under a bill and keep system these users would no longer have to maintain their fixed lines.
- Users who primarily use their fixed lines but also keep a mobile subscription to be able to use the bundled minutes to call other mobiles – under a bill and keep system these users would no longer have to maintain their mobile subscriptions.
- Fixed line users who make a large number of calls to mobiles would save significant sums of money under a bill and keep system.

Reduce the regulatory burden:

In the preceding paragraphs we have identified how a bill and keep system would address the distortionary effects of excessive MTRs that we identified earlier. However, another major benefit from this system would be the elimination of a large regulatory burden.

The struggle to reform MTRs has required a substantial input of work by the regulatory authorities. Littlechild calculates that the "aggregate cost of the UK price control process might have been of the order of £25m"[55], incurred by the authorities and stakeholders, and this does not include Ofcom's 2007 determination and subsequent appeals. Further costs will continue to be incurred, as termination regulation will be needed indefinitely under the present CPP system. Moreover, if the upcoming spectrum awards entailed by 2G liberalisation, 2.6 GHz and DDR lead to new mobile entrants[56], then these entities will also need their termination rates to be regulated, leading to an increase in the costs and uncertainty associated with the present regime.

[55] Littlechild (2006),
[56] Other networks, such as the pan-London Cloud Wi-Fi network could also host mobile services. These networks would face significantly different cost structures than existing GSM/WCDMA networks.

These costs are non-trivial and will eventually be borne by citizens and consumers of mobile services. There are also multiple risks of regulatory failure, either through delay in the timing of decisions and inaccuracies regarding the absolute level of termination charge caps or relative levels of charges between operators.

The move to bill and keep would eliminate the need for such expensive, lengthy and intrusive regulation; as the prime cause of the need for regulation, each operator's monopoly in the termination of calls to their own network, would be eliminated.

2.2.7. Potential concerns:

Although there are significant benefits from the application of a bill and keep system, there are some potential problems and issues with implementation that would need to be addressed.

As explained earlier, there is a large net payment from fixed line callers to the mobile industry due to the termination regime. In the past these funds have been used by mobile operators to cross-subsidise handsets and subscription packages, which has arguably helped to drive the adoption of mobile services.

Some incumbent operators have argued that the loss of net termination income from fixed operators resulting from moving to a bill and keep system would drive down spend on handset subsidy and customer acquisition. They say that this would reduce the level of mobile subscription in the UK. However, the conclusions reached through this argument and the justification of the ongoing existence of this subsidy is both highly questionable in our mature mobile market. The growth of SIM only for PAYG and contract customers as well as the adoption of H3G's Mix and Match tariffs indicates an increasing acceptance of the separation of handset purchase and purchase of the network service.

The major transfers under this system would appear to be from consumers making fixed to mobile calls and off-net mobile to mobile calls to consumers receiving large volumes of calls in the form of handset subsidies and upgrades. However, these transfers are likely to be distortive of competition. The standard economic assumption applies that customers do not value the basket of goods and services resulting from a resource misallocation as highly as the basket of goods and services that would otherwise be produced.

It is also highly unlikely that users would be forced to abandon their mobile subscriptions. Firstly, due to the high penetration of mobile telephony in the UK the benefits of having a phone are high. Secondly, the unsubsidised cost of the cheapest 2G handset is now low, around £20, and the cost of 3G handsets is rapidly falling (around £✂)[57]. And thirdly, the international experience suggests that similarly advanced territories as the UK which use bill and keep show similar level of mobile penetration; the take-up in Hong Kong was 125% and in Singapore was 173% by the end of Q2 2008[58].

[57] Source: H3G
[58] Wireless Intelligence

Opponents of the bill and keep system, argue that mobile operators may be forced to implement ppm charges on consumers to receive incoming calls, and this has been shown to be unpopular with end users.

It is important to emphasise again that a bill and keep system allows operators to recover their costs in a variety of ways. Although an operator may choose to use a ppm charging system to recover costs of terminating voice calls it is under no obligation to do so. In fact it may make no commercial sense to apply this mechanism if it had the effect of alienating customers, since these customers could switch to networks where different methods were used to recover costs, such as an inclusive bundle of minutes or free incoming calls (funded through a fixed cost 'bolt-on' or special subscription package).

To address these concerns H3G is prepared to guarantee that under a bill and keep system it would not charge its customers for incoming calls and it will continue to match existing prepay tarriff options.

Hong Kong experience

These issues and others have all been addressed in regimes where bill and keep operates. At annex 1 we set out the experiences drawn from our sister company Hutchison Telecommunications (Hong Kong) Limited operating bill and keep in the world's most competitive telecoms environment.

Alternative routes to efficiency

Many of the benefits of bill and keep could be achieved by significantly reducing the level of MTR charges under the current framework. The justification for this is clear; common costs which are currently included in the MTR cost stack should be recovered by network operators from their own subscriber base and an allowance should be made for the call externality. However, the calculations involved in such a step may be complicated and contentious, and may not deliver one of the primary benefits of bill and keep, a significant reduction of the regulatory cost and uncertainty of current MTR regime.

2.2.8. Practical Implementation Considerations

In order to determine the direction that Ofcom should take after the expiry of the current price controls in 2011, the practicalities of implementing either bill and keep or low reciprocal MTRs have to be considered.

In the current UK context there may be greater difficulties associated with implementing bill and keep than low reciprocal MTRs. This is essentially due to the fact that in a bill and keep system which does not incorporate all operators, each member of the bill and keep scheme will have two different MTRs; a zero MTR for all other members of the scheme and a non-zero MTR for non-members. To ensure that the correct MTR is charged, the operator may find it necessary to perform "A-number" analysis and "trunk group" analysis or at least audit some calls on this basis. The first would allow the network to identify which network the call originated on and the second would allow the operator to determine the network from which it received the call. Not all operators currently have these facilities available. There may also be

capital costs associated with implementing these features, for example, H3G estimate that an investment of approximately £500,000 would be needed to activate "A-number" analysis on a network that does not have it.

Two further potential complications arise from the existence of two different termination rates for a set of operators. Firstly, the system may have to be made to work within the UK's current MNP system. Since the UK, at present, does not use a central database of ported numbers it may prove difficult for a network to identify whether a particular number should be part of the zero-termination regime or fall outside of it. The second risk is that of arbitrage, whereby operators outside of the bill and keep regime might try to take advantage of the scheme – especially if the MTR otherwise would be much greater than zero. France suffered such a problem under its mobile bill and keep regime.

These problems are not impossible to overcome and developments in the UK's MNP system may contribute to their solution. However, at present they remain obstacles to the rapid adoption of bill and keep especially where the incumbent operators would likely be reluctant to implement and a large information asymmetry exists between operators and Ofcom on the actual cost of implementation.

Low reciprocal MTRs would not suffer the same problems as bill and keep within a group of operators as this would still maintain only one termination rate per operator. Networks would not have to discover the identity of the originating operator, they would be indifferent as to whether a number was ported or not and there would be no incentive for arbitrage in the manner suggested above.

As a route map for Ofcom to proceed, it may advisable to move initially to low reciprocal MTRs before working to ensure that the conditions are met for an effective transition to bill and keep. The first part of the plan could be adopted after the present price controls expired and then the details for bill and keep could be finalised as consumers started to experience the benefits of low MTRs.

A similar incremental approach to achieving bill and keep has recently been suggested by Viviane Reding, the Commissioner for Information Society and Media, who suggested in a speech to incumbent operators that:

> *"bill and keep will continue to be an option for the medium term – but it will be achieved not by revolution, but step by step, by progressively lower termination rates across Europe, as the Commission is recommending."*

Already regulators around Europe are taking steps in this direction. For example, ARCEP has recently announced cuts in the termination rates of French mobile operators. The first in July 2009 would see Orange/SFR's rates fall from €6.5c/min to €4.5c, whilst BYG's would trend from €8.5c to €6c. The second in July 2010 then reduces Orange/SFR's rate to €3c and BYG's to €4c.

2.2.9. Summary

In summary, the high MTR, which is unreflective of marginal cost and the benefits to the calling party, continues to create distortions in the market which harm consumers

and necessitates regulatory involvement. A bill and keep alternative would remove these distortions and produce real consumer benefits:

- Improve the conditions for competition in the mobile market
- Provide an efficient pricing structure resulting in an efficient level of usage
- Incentivise the speedier introduction of innovative products and services
- Create cost savings by increasing network efficiency
- Significantly reduce the regulatory burden and the risk of regulatory failure

Moving to this system would require the regulator to clearly articulate the resultant benefits for consumers against the costs to established incumbent operators.

In terms of achieving these benefits, an incremental approach might be taken; firstly to move to low reciprocal MTRs when the current controls expire in 2011, and then to work towards full bill and keep.

H3G finds little to disagree with in Littlechild's summary in 2004[59] as follows:-

> *"The main conclusions here are (a) that price controls on mobile termination charges are an endless, relatively ineffective, expensive and no longer defensible method of protecting users against a problem created by CPP; (b) that RPP is superior to CPP in all respects except the perceived dislike in CPP countries of paying to receive calls; and (c) that 'bill and keep' offers the advantages of RPP without the disadvantage: it represents a solution to the monopoly termination problem that allows competition and customer choice, instead of regulation, to determine how to pay for incoming calls."*

[59] Mobile Termination Charges: Calling Party Pays vs Receiving Party Pays, Stephen C Littlechild, April 2004, revised January 2006 CWPE 0426

2.3. 2G Spectrum Liberalisation

2.3.1. Introduction

Spectrum policy is not directly raised in the MSA. However H3G believes that spectrum policy has such a key impact on competition in the mobile sector that the MSA does need to be informed by and feed in to the key decisions which are expected in 2009 on refarm and the expansion band auction.

H3G supports the process of removing the usage restrictions on the 900 and 1800 MHz spectrum; the growth in mobile broadband and data usage on mobile phones will eventually necessitate the deployment of more efficient 3G technologies in these bands. However, this process has to be undertaken in a way that does not unfairly advantage some operators to the disadvantage of others, causing damage to competition and consumer welfare. Ofcom's current proposals are flawed because they recommend that most of the 2G spectrum should be awarded to its current users without using a competitive process; which runs against stated Ofcom policy. The current proposals will advantage the incumbent operators in three major ways:

- Capacity – some operators will end up with far greater spectrum holdings than others and these operators will be able to support proportionally greater traffic on each of their cell sites, whereas other operators will be forced to incur greater costs by deploying more site as traffic increases.
- Coverage – operators possessing 900MHz spectrum will gain a significant advantage in coverage. The better propagation characteristics of 900MHz spectrum will allow better coverage of rural areas and within buildings using a lower density of cell sites.
- Speed – in future revisions of mobile technology, such as 3G long term evolution (LTE). Using LTE, operators possessing larger amounts of contiguous spectrum will be able to deliver greater speeds to a particular terminal than those possessing only fragmented spectrum. The advantaged operators will be able to advertise higher speeds and thus gain a competitive edge which cannot be replicated.

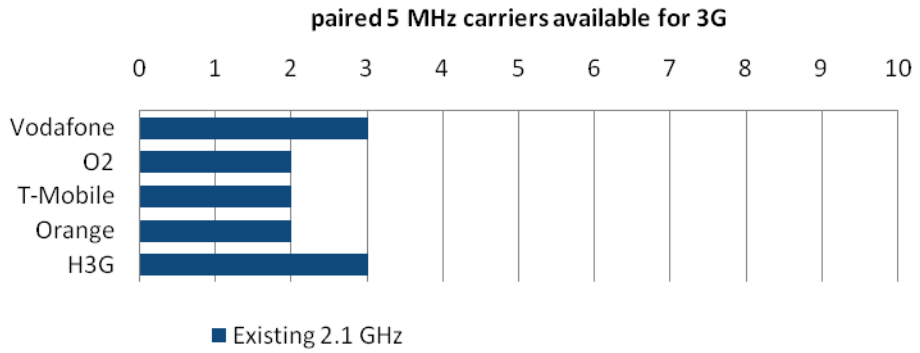
To ensure that the 2G liberalisation process does not distort competition and cause consumer harm, Ofcom has to remain true to its principles of ensuring that spectrum is allocated through a competitive process. An auction of the released 2G spectrum would be the fairest method of ensuring the greatest benefit for consumers from 2G liberalisation.

A further benefit of a swift resolution of the questions surrounding 2G liberalisation would be to allow more certainty over the proposed awards of 2.6 GHz and DDR spectrum.

2.3.2. Background

Currently, only the 3G spectrum auctioned by the Radiocommunications Agency in 2000 is used to provide mobile broadband services. This consists of 140 MHz of spectrum in the 2.1 GHz band. The auction was won by five parties, all four of the incumbent UK operators and a new-entrant, H3G. The allocation of 2.1 GHz spectrum following the 2000 auction is shown below.

Figure 39: Current 3G Spectrum Allocation[60]



It should be noted that this is a fairly even allocation of spectrum, and consequently UK operators are competing to provide mobile broadband solutions with approximately even levels of spectrum input. It is important to emphasise that the imbalance in holdings at 2.1 GHz is the result of a competitive allocation process.

3G HSDPA (part of the 3G standard that significantly increases download speeds) was initially positioned by some operators as a premium business offering with a price tag to match. However, the launch of H3G's mobile broadband package in September 2007, at a low and transparent price, has resulted in an explosion of mobile broadband usage amongst retail consumers.

In a very short period, post 2006, over one million mobile broadband connections have been taken up and from 2007 to 2008, this figure is expected to double to at least 2 million[61]; this would represent approximately 12% of total broadband connections in the UK. This rapid increase in usage has highlighted the importance of spectrum as a vital input in allowing operators to service increasing demand and compete on equal terms.

The existing 2G spectrum is only held by the four incumbent mobile operators. This spectrum was administratively assigned to its current users by a 'beauty contest' rather than by competitive auctions. Existing rules mandate that it must be used only for 2G mobile services. Vodafone and O2 currently share the 900MHz spectrum (seven 2x5MHz channels in total) and also possess a smaller amount of the 1800MHz band (two 2x5MHz channels in total); Orange and T-Mobile possess larger amounts of the latter (twelve 2x5MHz channels in total). Ofcom has proposed that the existing 2G spectrum be liberalised and thus made available for the delivery of mobile broadband services.

2.3.3. The problem: potential consumer detriment from Ofcom's proposals for 2G liberalisation

Ofcom currently propose to distribute rights to most of the 2G spectrum without using a competitive process, running counter to Ofcom's policy towards spectrum allocation

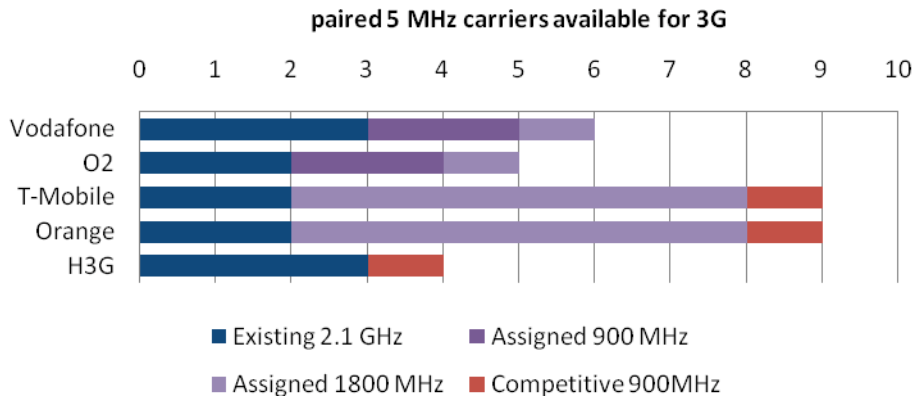
[60] Ingenious analysis
[61] Source: Enders Analysis

since 2003. Furthermore, in the DDR consultation Ofcom stated that if it picked preferred users it risked, "distorting incentives, reducing flexibility, distorting competition and getting it wrong" and that an auction would best serve the public interest.

Ofcom's current proposals risk producing an allocative inefficiency; where spectrum will not be assigned to operators who value it the most or who are best able to use it. This includes new entrants who may wish to deploy new services that may bring significant value to consumers, and existing operators who may be better placed to deliver more valuable services given their existing network investments.

A potential outcome of this process (under the most aggressive case where Ofcom takes back enough spectrum to create three auctionable channels) is shown below.

Figure 40: Ofcom proposal – potential outcome



As shown, the 2G spectrum represents a large spectrum resource and the large majority of it would be given to the present holders. This risks creating a serious imbalance in spectrum holdings between the mobile network operators that could undermine competition in the sector.

Capacity

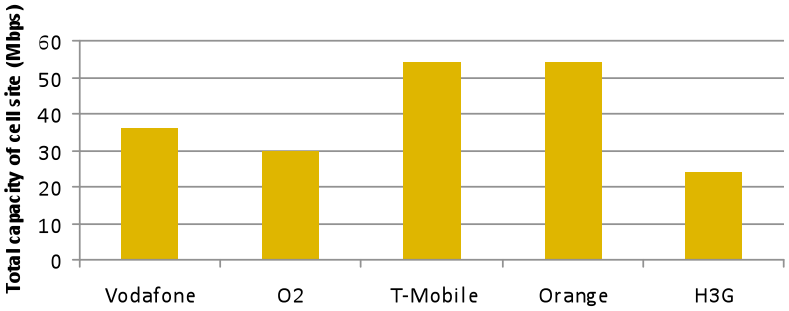
The first distortion that will be caused by Ofcom's proposed solution will be of the capacity that will be available for mobile data services for each operators.

Already we have seen that there has been a large rise in the demand for mobile data services (see Section 1.1.2) and this is expected to continue over the coming years, both due to more people making use of mobile broadband services as well as more intensive use by each user. Therefore each operator's cell sites will have to handle increasing peak traffic demands. The capacity of each cell site is determined by the number of spectrum carriers that each operator has available.

After liberalisation, the maximum theoretical capacity of each operator's cell sites if all spectrum were used for 3G is given in

Figure 41 below.

Figure 41: Maximum cell site capacity per operator under Ofcom's liberalisation proposals[62]



Therefore, in the face of rising demands for bandwidth, the operators with smaller spectrum holdings will face an unpalatable choice: to either build more cell sites - which will result in large capital expenditure, or to ration bandwidth amongst their customers - which lessens the attractiveness of their mobile broadband proposition. In either case, these operators will become less competitive for no other reason than the arbitrary allocation decision proposed by Ofcom.

Coverage

The second distortion caused by Ofcom's current proposals will be in the coverage that will be achievable by different operators.

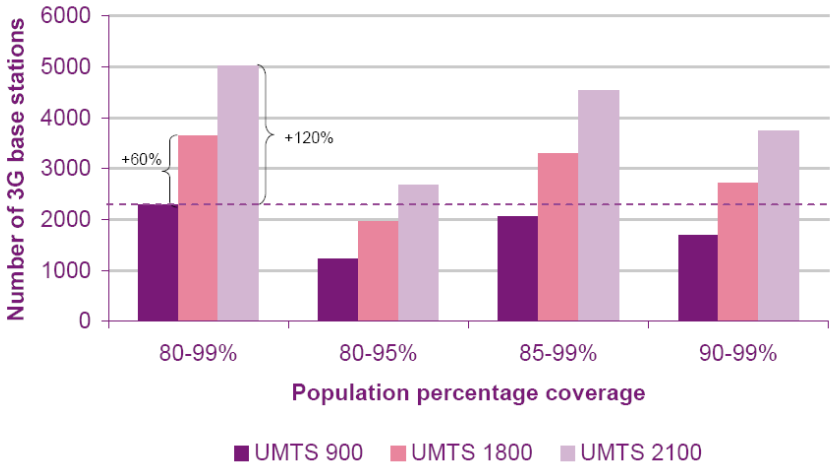
Although a given amount of higher frequency spectrum has the same data carrying capacity as the same amount of lower frequency spectrum, the lower frequency spectrum will have better propagation characteristics. That is, for a given power level, lower frequency spectrum will be able to establish a connection between terminal and base station over greater distances or through more obstructions (such as trees and walls) than higher frequency spectrum.

This characteristic is aptly demonstrated by Ofcom's own modelling in its consultation on 2G spectrum liberalisation published in November 2007.

In rural areas, Ofcom modelled the number of sites that would be required to extend coverage from a base of 80% population coverage using 2.1 GHz, 1800 MHz and 900 MHz. The results are reproduced below in
Figure 42.

[62] This chart assumes 2 Mbps per sector per carrier, and 3 sectors per cell site
Source: Ingenious analysis

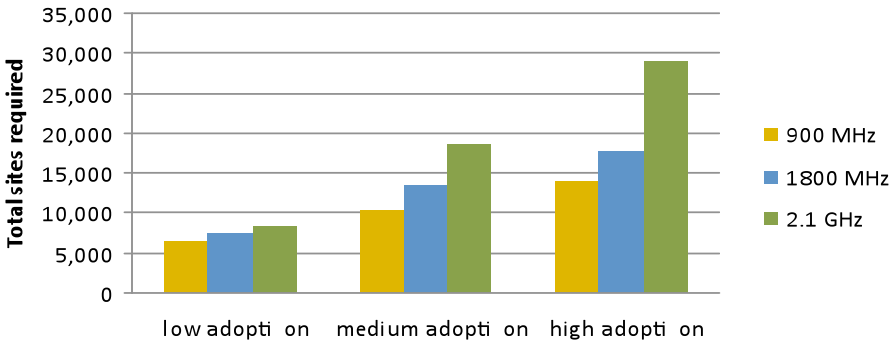
Figure 42: Cell sites required to expand coverage beyond 80% using different frequency spectrum[63]



This chart shows the clear advantage that 900 MHz spectrum has in providing coverage. Far more sites would be needed to provide truly national coverage using 2.1 GHz spectrum than using 900 MHz spectrum. This translates into a substantial cost advantage from possessing 900 MHz spectrum for rural coverage.

In this consultation, Ofcom also looked at the advantage that 900 MHz spectrum would provide in an urban setting[64]. These results are presented in Figure 43 below.

Figure 43: Sites required for 80% UK coverage using different frequencies[65]



As can be seen, 900 MHz presents a large advantage over other frequencies and this is exacerbated in high usage scenarios. Ofcom's scenarios only envisaged usage by 10% of users, made use of high-rate data services at 384 kbps in the downlink and 144 kbps in the uplink. These speeds are far below the current

[63] *Source: Ofcom*
[64] Whilst Ofcom did not do a country-wide simulation, it did examine in some detail at a 10x10 km section of London, encompassing Camden, Islington, Hackney, Tottenham, Wood Green and Hornsey. This was chosen as it contained a wide range of urban environments. These results were then extrapolated to the rest of the UK.
[65] *Source: Ofcom*

maximum offered by HSPA services of 7.2 Mbps downlink and 1.4 Mbps uplink. Ofcom's modelling was also performed before the current surge in mobile broadband usage. As such it would appear to be reasonable to assume that their high adoption scenario is the most appropriate to consider.

In both rural and urban areas we can see that possession of 900 MHz spectrum will give operators significant cost advantages. Concentration of access to 900 MHz spectrum in the hands of only a few operators would seriously impair the ability of other operators to compete. This would result in serious harm to the consumer.

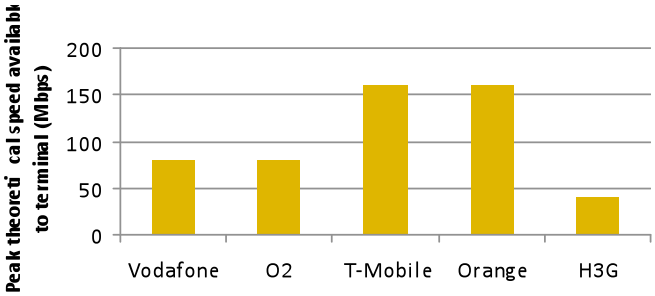
Speed

The final distortion would be to the peak theoretical speeds available to an individual subscriber when next generation mobile technologies, such as LTE, come on line.

Current 3G technology, including all the present and future revisions of HSPA, uses 2x5 MHz carriers to each subscriber to facilitate data transfer. However, next generation technologies, such as LTE, will be able to make use of variable width channels, ranging from 2x1.25 to 2x20 MHz. In addition, for operators to provide the highest speeds possible using LTE they have to have access to contiguous spectrum; one 2x20MHz channel will be able to provide a faster connection for an end-user than four non-contiguous 2x5MHz, even though both consist of the same amount of spectrum.

In Ofcom's current proposals, as shown in Figure 33 some operators will be gifted large blocks of contiguous 2x20 MHz spectrum by refarming 2G spectrum, which if used for LTE, will allow these operators to provide higher peak speeds to individual users. **Figure 44** below shows the maximum speeds that would be possible in each operator's band allocation as shown in figure 33 under Ofcom's proposals.

Figure 44: Maximum speed to a terminal using next generation mobile terminals given Ofcom's liberalisation proposals[66]



[66] This chart is based only on current 3G and 2G spectrum, it does not take into account any mobile usage of 2.6 GHz nor DDR spectrum. LTE deployment in 2G bands after 900 MHz re-assignment is considered. LTE deployment in 2.1 GHz is not included – it is assumed all 2.1 GHz spectrum would have deployed HSPA. For LTE operators 160 Mbps with 2x2 MIMO and 320 Mbps with 4x4 MIMO technologies is possible, but only a more practical 2x2 MIMO is assumed. However, H3G will be limited to HSPA technology deployment in 5 MHz band offering peak data rates of 40 Mbps with 2x2 MIMO (4x4 MIMO has not been standardised for HSPA).
Source: H3G

Operators with access to contiguous spectrum, especially Orange and T-Mobile will have a significant advantage in terms of headline speeds they will be able to offer. Being able to advertise these speeds to end-users, even if they will be difficult to achieve in practice, is likely to provide a significant competitive edge for these operators. It may therefore be difficult for other operators to compete and maintain a competitive market for end-users.

2.3.4. The Resolution

There are three broad approaches to liberalisation which may result in more competitive future outcomes than the initial proposal floated by Ofcom; to engage in a competitive allocation of spectrum or to ensure competitive access to spectrum.

1) The first is for Ofcom to follow its own stated preferences in spectrum policy and allocate the 2G spectrum in a fair and open competition - a clear auction. This would not only allow existing MNOs to bid but could also provide opportunities for potential new entry. If the bidders have similar valuations for the 2G spectrum then this is likely to result in allocations of spectrum that are broadly competitive, whereas if some bidders have much higher valuations then they would gain proportionately more. In either case, the outcome is likely to achieve greater allocative efficiency than Ofcom's current proposals.

2) The second would be to reassign the existing 2G spectrum amongst the five existing MNOs on a neutral basis such that broadly each operator receives four 2x5MHz carriers.

3) Although a competitive allocation is likely to lead to the most efficient allocation of spectrum, ensuring competitive access to spectrum, even if allocations are unequal, can lead to a more efficient, and ultimately more beneficial, outcome. This could be achieved by placing obligations on the owners of gifted spectrum to allow access to other operators. In the case of 900 MHz spectrum (which has better propagation characteristics than either 1800 MHz or 2.1 GHz) this might consist of wholesale access to coverage, where the benefits of 900 MHz are likely to be greatest. In the case of the more plentiful 1800 MHz spectrum this might consist of wholesale access to capacity.

If such an approach were to be taken up, then there would be an important role for the regulator to play in setting the rules under which these wholesale access schemes would operate. For example, it would be important for the regulator to ensure that the scheme could not be abused by niche operators looking to cheaply obtain national coverage without investing in a national network. Furthermore, the regulator would have to ensure that the prices charged for wholesale access were fair and non-discriminatory. This would be a large regulatory intervention. Previously we have understood that Ofcom was unwilling to engage in such an intervention and therefore H3G has rejected it - as without detailed regulatory scrutiny there is a grave risk that roaming access will not in fact be given on appropriate terms.

2.3.5. Summary

Spectrum is an key input to the wireless industry and 2G spectrum is of particular importance as it is globally harmonised for use with mobile communications. Ofcom's

current proposals may have the effect of distorting competition as spectrum will not be awarded competitively and will be concentrated in the hands of certain operators.

Market mechanisms should be used to ensure the public get fair value for public assets used for commercial activity and that spectrum is allocated to its most highly valued use. While these are principles which Ofcom has consistently claimed are central to its decisions on spectrum awards, they seem to have been ignored in its consultations on the proposed 2G liberalisation decision.

2.4. Switching

2.4.1. Introduction

An essential part of a competitive market is the ability for consumers to be able to switch between operators with relative ease. This allows consumers to take-up attractive offers they find in the marketplace and enables competitive signals to propagate through a market. Furthermore operators will place a greater emphasis on maintaining consumer satisfaction, as unsatisfied consumers will be more likely to switch. Without the ability to switch smoothly, operators can extract higher prices from their consumers, since their costs of switching may be high in relation to the benefits they derive.

2.4.2. The problem: the current switching regime hinders competition in the mobile sector

A well-functioning MNP system is essential if consumers are to be able to take up offer from rival operators and switch between them with ease.

The UK has taken faltering steps towards effective MNP. In January 1999 Mobile Number Portability (MNP) was launched in the UK. The customer had to request a 'port authorisation code' (PAC) from her existing network and the porting process took one calendar week to accomplish. In July 2007, Ofcom released its conclusions from the review of UK MNP and mandated a reduction of porting time to two working days with effect from April 2008. In November 2007, Ofcom completed its consultation on a further reduction to porting time along with recipient led porting and mandated that near-instant (no more than 2 hours) recipient-led porting be implemented by no later than 1 September 2009.

However, in September 2008 an appeal led by Vodafone supported by each of the incumbent operators at the Competition Appeals Tribunal led to Ofcom's plans being thwarted. This means that the existing system of MNP in the UK will continue, maintaining a number of barriers to the effective functioning of competition.

The UK is one of the few countries in the world that uses a donor led porting system. This system entails users having to contact their network to notify it of their intention to port. At this stage, the user can be subjected to an intensive retention process whereby deals and handsets are offered to the user to persuade them to stay with the network in question. If the customer still wishes to port, then they will be sent a PAC code which then has to be passed on to the receiving operator. This system has a number of consequences.

Firstly, it allows networks to engage in a large degree of price discrimination. For example, even if network A were not offering packages as attractive as those offered by network B it could simply agree to match the offer for all its customers who request a PAC. In this way it can price discriminate; offering lower prices to consumers who express an interest in porting whilst simultaneously extracting higher revenues from the remainder. However, in a receiver led porting system, network A would not get the chance to make the counteroffer and would have to price more competitively generally to ensure that it did not lose consumers to network B. In the latter scenario network A would have to respond to attractive deals put forward by

network B with better general pricing, and so more of network A's customers would benefit from competition.

The donor-led system is particularly difficult to overcome for new entrants in the UK context, and serves to amplify the traffic imbalances which extract a heavy financial toll through the MTR regime. As noted above, donating operators have a stronger incentive to retain consumers who generate greater incoming minutes than outgoing minutes, and can tailor their retention offers accordingly. This tends to generate a greater churn of consumers who make relatively more calls than they receive. These are the relatively low margin consumers which are then picked up by receiving new entrants.

2.4.3. The Resolution

There are many positive reports of the impact on consumer welfare from countries which have made the switch to efficient systems of number portability. CIMB Research state

> *"industry revenues in Japan and Taiwan declined following the introduction of MNP, largely due to lower ARPU (average revenue per user)."*

This is consistent with an increased level of competition, serving to drive down prices. Whilst this is not good news for incumbent MNOs, it is very good news for consumers. H3G's own figures show that ported numbers are far more common in other European territories where it operates than in the UK. For example, 30% of the new contracts activated in Ireland are with ported numbers, whereas the comparable figure in the UK is only 15%.

H3G are supportive of the view reached by Ofcom in November 2007 that porting should be recipient led and rapid. Although there are costs associated with setting up a central database of ported numbers and the implementation of a new regime, we believe that the benefits for consumers will be significantly greater. Furthermore, a number of other issues in the mobile sector, such as those of poor consumer service and mis-selling, stand to be alleviated if consumers could vote with their wallets and leave underperforming networks. As such, Ofcom should proceed with implementing a system which has these essential characteristics.

2.4.4. Summary

It is difficult for competition to function effectively in a market and deliver the greatest consumer benefit if switching is difficult. The current system in the UK allows incumbent operators to engage in significant price discrimination in favour of some consumers and against others. This harms the ability of new entrants to compete and ultimately harms the consumer: as incumbent operators do not have to respond fully to competitive packages offered by new entrants.

2.5. An active role for the Regulator

2.5.1. Introduction

In the previous sections of this chapter, we have examined areas in which regulatory action can strengthen the ability of competition to deliver valuable consumer benefits. In some cases this can involve the redesign of particular regimes, such as the switching arrangements, or adopting different regulatory positions to reduce artificial monopoly power, such as moving eventually to a bill and keep system instead of the current MTR system of common cost recovery on a usage basis. In some areas, competition between operators alone may not be able to deliver the best outcomes for consumers and more active regulatory involvement may be required.

In this section we outline some areas where a more active role played by the regulator may succeed in generating significant benefits for the UK consumer. The areas we discuss are:

- International Data Roaming
- Harmonisation
- Interoperability
- Universal Service
- The development of publicly valuable services using the mobile broadband platform

2.5.2. International Data Roaming

The cost disparities between data usage nationally and internationally are very large. The ERG announced that the average retail charge for downloading data was €3.50 per megabyte when roaming in Europe[67] in March 2008, whereas some of the domestic bundles that are offered in the UK offer up to 3GB of data for £15. In this instance the cost per megabyte when roaming is over 560 times greater than when used domestically. The roaming price would appear in no way to reflect the cost of delivering data services.

These vastly inflated roaming charges cause serious consumer detriment.

Firstly, there is the risk that consumers face 'bill shock' when they realise the charges that have been incurred by using their mobile data services in the same way abroad as they do at home[68]. In some cases this can run into many thousands of pounds, which can cause serious harm to affected consumers. To avoid the risks both to the consumer and to itself, H3G now bars data roaming as a default option for countries where it does not have a sister network.

In addition, the excessive international roaming charges stunt the development of mobile broadband and the services of which consumers can take advantage. Whilst abroad some data services are likely to be particularly useful for tourists, including services such as maps and picture messaging, and others for business, such as push email. However, current charges do not allow the meaningful use of these services.

[67] ERG 2008
[68] See http://www.timesonline.co.uk/tol/travel/business/article4219555.ece

H3G has taken steps to try to address this problem by offering operators in Europe a reciprocal wholesale rate of 25 euro cents per megabyte - but the response has been small and scattered[69]. Therefore, with voluntary action not forthcoming, H3G believes that action by national regulators or the Commission is essential in bringing down prices. The steps announced by the Commission to bring wholesale charges down to €1 per megabyte is a welcome start but still leaves the roaming charge at 160 times the level of the national charge. Ofcom should continue to push for cost reflective regulation of these services to ultimately benefit consumers and businesses in the UK.

2.5.3. Harmonisation

Harmonised standards lead to the development of valuable products and services for consumers. Although regulators should not mandate standards, they can argue the importance of harmonisation and bring disparate parties together in appropriate forums and seek to ensure the proper use of IPR is standards that are adopted.

The case of 3G HSPA provides an important example of the benefits of harmonisation. The global uptake of this standard has created a rich ecosystem which has brought down prices of equipment and resulted in innovative products being brought to market. The GSMA, the global trade group for the mobile industry, announced in August 2008 that the number of worldwide subscribers using HSPA networks had almost reached the 60 million mark, up from 11 million in 2007. The number of operators with commercial HSPA networks has reached 191 and there are now over 740 HSPA-enabled devices (including mobiles, dongles and notebooks) available from 116 manufacturers.[70]

3G now provides a platform upon which operators and device manufacturers compete to provide attractive products and services for consumers. However, it is questionable whether such widespread development and acceptance would have been achieved without a global standard in place. For example CDMA2000 EV-DO, a 3G equivalent based on Qualcomm's CDMA air interface, has not reached the adoption levels of UMTS[71] and as such does not support the same range of equipment and handsets as UMTS.

Therefore, although the Commission and Ofcom have stated the importance of "technology neutrality" it is also important for regulators to ensure that fragmentation of technology standards does not occur, as eventually it is consumers who will have to bear the costs of lower economies of scale.

H3G remains concerned that Ofcom has failed to properly identify and assess the pros and cons of inter-standard competition compared with intra- standard competition i.e. is it better to have competing standards that deliver similar functionalities or competing operators using the same standard with better economies of scale. H3G is not suggesting that there is a right answer for every situation, rather that Ofcom should specifically engage in these questions. To

[69] Kevin Russell, CEO of H3G quoted in an interview
[70] CNET news.com – January 2008 http://www.news.com/3.5G-driving-rapid-mobile-broadband-growth/2100-1039_3-6225531.html?part=rss&tag=2547-1_3-0-20&subj=news
[71] Press release UMTS forum – October 2008 http://www.umts-forum.org/content/view/2522/174/

suggest that Ofcom can somehow leave these question to the market is highly misleading as many Ofcom actions will drive the outcome.

2.5.4. Interoperability

The term interoperability is used to describe the capability of different programs to exchange data via a common set of exchange formats, to read and write the same file formats, and to use the same protocols. As access to mobile broadband becomes an ever more common feature on handsets, the importance of interoperability increases as operators seek to provide value-added services. These can be services which seek to combine data from the handset (such as GPS data, phonebook entries, images and video files), facilities from the operator (such as billing, location and authentication) and applications online (such as email, VOIP, IM, e-commerce and social networking).

For example, at present, if an operator such as H3G wishes to provide VOIP services across its handsets it has to work with a number of different handset operating systems to develop relevant clients. Although there are some widely used open operating systems, such as Symbian and Android there are also a large number of proprietary and closed operating systems.

Sometimes interoperability occurs at a level which is outside of the control of the operator. For example in IM there are a number of different providers, such as AOL, Google, Microsoft and Yahoo, all of whose services are not interoperable. If a route to interoperability were found this could create large gains for the consumer, especially as IM is proving to be an increasingly popular service on mobile handsets.

It would be unhelpful, even if it were feasible, for a single national regulator to mandate interoperability. However, Ofcom can, both in the UK and at a European and global level, push for there to be greater cooperation and coordination between operators, manufacturers and service providers. A common set of protocols enabling the use and exchange of data could allow a large number of innovative services to be developed, using disparate sources of data to generate significant consumer value. These public value driven processes are more common in relation to the Internet but need to be adopted more widely.

2.5.5. Universal service and access

There are a number of questions about universal service and access which arise in relation to mobile broadband. As people increasingly come to rely on broadband and demands are raised for universal access, what role can mobile play in delivering these services?

In terms of delivering broadband access, the European Commission has noted that as the level of broadband penetration in the EU approaches 50%, the question of including broadband access in the Universal Service directive has been raised. The Commission also invited responses on how broadband could be delivered.

Traditionally the fixed network has been the primary mechanism for delivering broadband but the advent of HSDPA has raised the possibility of mobile networks playing a role in delivery. Mobile networks would appear to have a significant cost

advantage in rolling out broadband to areas which do not as yet have fixed line access. For instance, H3G is currently providing HSDPA services to areas which do not currently have access to ADSL. As H3G extends its network coverage to 99% of the population by 2012, it will provide broadband for the first time to many such areas which have not had access to broadband enabled fixed networks. When 900MHz spectrum is liberalised for use with new technologies including HSPA, mobile broadband may be able to reach an even larger proportion of the country on a commercial basis.

However, it is unlikely that commercial roll-out will ever reach complete national coverage due to the diminishing returns on expanding networks in areas with decreasing population density. Furthermore, there are also currently so-called 'not-spots' where areas with higher population densities do not have adequate coverage due to particular local circumstances – such as a lack of suitable cell-site locations or an inability to gain planning permission.

In both cases regulatory involvement may help to overcome the barriers. In rural areas, if the regulator were to coordinate a process by which operators were able to share the cost of building and maintaining a radio access network, then many more areas would become economically viable. Furthermore this would then help identify the areas where even this approach would not yield coverage and which might require direct government assistance to construct networks. In not-spots, a similar approach could be used if the construction of an expensive cell site location were holding up rolling out. The regulator could also advocate streamlining the planning process for cell site construction if this were acting as the barrier to mobile broadband coverage.

2.5.6. The development of publicly valuable services using the mobile broadband platform

By 2012 H3G will have together with T-Mobile the most extensive mobile broadband network in the UK, covering 99% of the UK population. Whilst operators and service providers will be increasingly be looking to provide new commercial services there is also potential for government and other public bodies to provide socially valuable public services, which may not be commercially viable, over ubiquitous mobile networks.

There are already trials of potential services taking place. One example is outlined below.

Qualcomm's Project K-Nect is a two year pilot programme running in North Carolina, USA. Ninth-grade students with limited or no Internet access at home have been given 3G smart phones so that they can wirelessly access supplemental maths content aligned with their teachers' lesson plans and contact tutors for assistance. The project hopes to demonstrate that wireless connectivity, combined with traditional teaching methods, can deliver successful education outcomes.

The key challenge here is to establish the conditions that can foster the creation and applicability of such services. Any approach must address a number of factors:

- Coverage – if public services are to be delivered over mobile broadband than this increases the urgency of the question of how to deliver coverage to the 1% of the UK population who will not be covered by a commercial roll-out, and the regulator will play a vital role in ascertaining the best way in which to achieve this goal.
- Accessibility –public services are likely to be disproportionately used by older and lower-income groups, and historically these groups have been later adopters of broadband technology. Handsets and terminals have to be available which can be used by a large cross-section of society. The harmonisation and interoperability goals we have outlined above for the regulator to pursue should bear the potential for these services in mind.
- Education – government needs to be aware of the potential of mobile broadband networks and modern equipment and network operators need to understand the priorities and outcomes that public body's desire. There is a role here for the regulator to facilitate the flow of information and to educate the respective parties.
- Collaboration – developing imaginative services and delivering them in a cost-effective manner will require a large level of collaboration between government agencies, manufacturers and network operators. The regulator is potentially best placed to coordinate the efforts of the disparate parties.

Annex 1: The Hong Kong Experience with Bill and Keep

Introduction

This Appendix draws on a mobile operator's experience in Hong Kong, under a bill and keep regime (B&K). It is structured as comments on issues claimed to be of concern in considering European application of B&K.

We assume Ofcom is familiar with the regulatory structure of Hong Kong; only the briefest summary is given of that. It is also important to be aware of the (Hong Kong) Office of Telecommunications Authority's (OFTA) recent report on performance,[72] referred to as the Performance Report.

The HK Regulatory Structure

The Hong Kong's 7 million population is served by five Mobile Network Operators (MNOs), with lower market concentration than in the UK[73]. The cornerstone of regulation is the "any-to any" interconnect obligation. MNOs interconnect without payment between themselves, under a B&K regime which has applied since mobile service was first offered. However, interconnect (and transit) between mobile and fixed operators is regulated under a "Mobile Party Pays" (MPP) regime, whereby the mobile network pays an interconnect fee to the fixed network, regardless of which network the call originates on. This MPP regime will cease in April 2009. It is not yet known what commercial interconnect arrangements for fixed to mobile will replace it.

Retail Outcomes

Bundled minutes and texts are large by European standards. A typical package of HK$138 (£10.90) per month buys around 2,000 minutes. Minutes are counted both outgoing and incoming, on the basis of "airtime". Texts may be included in bundles; out of bundle they cost around 50c (4p) off-net, 20c (1.5p) on-net. Data may be included in bundles (e.g. 150MB in a HK$138 bundle); out of bundle it costs around 33c (3p)/MB.

Pre-pay voice tariffs are around 10-20c (0.8 -1.5p) per minute. Prices as low as 2c can be found if a monthly fee (around HK$50 (£4)) is paid.

There is significant price differentiation and pricing innovation around Value Added Services. 3G is priced at a premium over 2G.

There is differentiation between on- and off-net minutes, but generally not between calls between mobiles, and calls between mobile and fixed.

Overall, Hong Kong prices as less than half those in the UK for each category of user (low, medium, high)[74]. This is at Purchasing Power Parity; for nominal prices the difference is even greater.

[72] http://www.ofta.gov.hk/en/report-paper-guide/report/rp20081012.pdf
[73] Performance Report 4.2.4
[74] Performance Report 4.2.3

European concerns with B&K, in the HK context

1. Consumers won't like paying to receive calls

In HK, consumers think in terms of paying for airtime - for time connected – regardless of the direction of the call. There is no consumer resistance to this. The large size of even basic bundles (typically well over 1,000 mins per month) mean that consumers are inclined to think of paying for access rather than usage. Less than ✂% of HWL's post-pay customers exceed their bundles.

Pre-paid tariffs are also per minute of airtime. Again, there is no consumer resistance. Pre-pay is popular with roamers from the PRC, where prices are higher.

Customers are, however, familiar with CPP. It applies to SMS, and to international calls. There is no resistance to or apparent confusion over this.

Of course, it should not be assumed that the HK retail structure would be replicated in a European B&K environment. As with all two-sided markets, it is difficult to predict how the charges will be allocated between the parties. If Europeans are not comfortable paying for airtime, such retail structures will not emerge. B&K allows any retail model to apply, including CPP.

2. Low-users will be worse off, and may forego mobiles

Basic contract tariffs are below HK$60 (£4.70) per month, for 600+ mins, 2G only. Pre-paid SIM tariffs are around 5-20c (0.3-1.6p) per min, with no minimum payment.

Penetration is about 18% higher in HK than in the UK, at 159% (July 2008).

3. Spamming will be worse

Regulatory-induced arbitrage has encouraged spamming, as follows. IVR units (interactive voice response) originate into HK's fixed network, for termination on a mobile number. The MNO pays the FNO a MPP fee, which the FNO can use in part to subsidise the originator. The subsidy can be increased if the spam encourages a mobile-to-fixed response call by the spammed party, since the FNO receives its MPP fee on that call also.

Origination of machine-generated spam in HK is now prohibited.[75] The identity of the caller must be revealed. Additionally, citizens have the right to opt-out of any direct marketing by whatever means.[76] This concern is of course not a function of M2M bill and keep but rather the M2F payments.

[75] Unsolicited Electronic Messages Ordinance ("UEMO") 2007. *http://www.legislation.gov.hk/blis_ind.nsf/CurAllEngDoc?OpenView&Start=590&Count=30&Expand=590.1#590.1*

[76] http://www.pcpd.org.hk/english/ordinance/section_42.html

4. Must include fixed in B&K, or arbitrage will result

The experience in France pre-2004 supports this thesis, though differential incremental costs might justify differential termination rates between fixed and mobile.

HK post April 2009 may be an empirical test of this thesis. It may also test OFTA's mechanisms to enforce any-to-any interconnect in the absence of commercial agreement. We might see OFTA imposing B&K between fixed and mobile.

5. MTRs are necessary to obtain the required return on capital.

This concern is not tenable in theory or practice, and is a smokescreen for 6 below. In HK, return on mobile investment is obtained directly from retail revenue.

6. B&K does not provide incentives to invest

This is in turn a smokescreen for a yet deeper concern that small free-riding operators will benefit from using others' networks, without making equivalent investment. A regime which permitted that would dis-incentivise the large-scale investment necessary for economies of scale and network effects. So this concern is subsumed into the bigger question:

7. How to define the boundary of B&K?

In HK, the five MNOs have agreed to operate B&K. We do not know of any attempts at free-riding by small operators claiming rights to be in the B&K club. Nor do we know of any attempts at the "internet model", whereby smaller operators pay transit fees for access to the peering network.

8. How is international traffic treated?

Outgoing international calls are charged to the caller.

Traffic originating abroad is received mostly into the fixed network, which is allowed to charge (1) a regulated Local Access Charge from international, and (2) the MPP charge from an MNO if the call is destined for a mobile.

MNOs are allowed to receive incoming international calls and apply Local Access Charges at a commercially agreed rate (not regulated, unlike the FNOs' LACs). In practice, not much traffic is received direct by MNOs - the FNOs could always undercut them due to the MPP, so long as it lasts. MNOs are not allowed to receive international traffic for re-filing.

9. The hot potato problem

The US literature dwells on the incentive under B&K for an operator to handover the call to his competitor as close as possible to his own terminal. This is not an issue identified in HK perhaps because of its smaller geography, or perhaps it is not a problem for MNOs in any case, whose terminals could be anywhere on their networks.

10. Conclusions

B&K operates well between Mobile Operators in Hong Kong. To all categories of customers it provides significantly better value than applies in the UK.

Mechanisms exist in Hong Kong to address all of the concerns voiced about B&K in Europe. Such problems as do appear are in part driven by arbitrage around the Mobile Party Pays regime, due to cease in April 2009.

Annex 2: Answers to Specific Consultation Questions

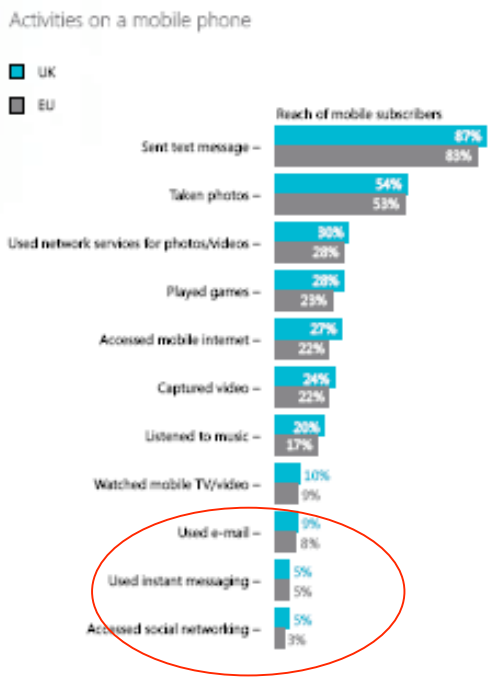
A4.1 Section 1 - Executive summary

Question 1.1: What are the implications of market change for mobile and wireless services?

Much has already been discussed in the main body of 3UK's response. In summary the market change as described here would have dramatic effects on mobile and wireless services. The distinction between fixed and mobile services would be heavily blurred as Mobile Voice and Broadband, not just broadband would be priced to compete with their fixed counterparts. In that environment competition would be more focussed on the quality of service.

Mobile would offer a wider range of communication services, especially, the new communications services such as MSN and E Mail as the incentive to stick with the interconnect regime for IP services as put forward by the GSMA would be negated. Operators would then concentrate on enhancing the utility of the internet on mobile and bringing services and innovation

The chart below compares penetration of advanced mobile services in the UK with the rest of Europe. Firstly, it shows that the UK is in line not behind Europe in terms of take up. Secondly, the services which are most used on fixed IP networks (E Mail, IM and Social Networking) perform poorly on mobile. Figures 15, 16 and 19 in the main body of the response point to the fact, that there is unmet demand in the UK for these services and that by innovative pricing and investment in handsets, 3 has gone some way to encouraging take up. However for consumers to get the greater utility of a ubiquitous internet more needs to be done to encourage interoperability, remove incentives for operators to maintain status quo and to ensure that those operators willing to maximise the return on their mobile assets that they have sufficient spectrum.



Question 1.2: How are citizens and consumers affected by developments in the mobile sector?

Citizens and Consumers are affected in several ways. Primarily, society and economies require effective communications to interact. A greater and growing proportion of communications is now electronic. This communication is both leisure related e.g. instant messaging, social networking but also functional e.g. business. Hence for an effective society at all levels, an advanced communications sector is required to maintain support and develop society's need to interact and maintain competitiveness.

Question 1.3: What are the purposes of mobile regulation, and where should its focus lie?

The purpose of mobile regulation needs to take into account the developments in the mobile market itself and in technology. The two most impactful developments are the saturation of the UK market and the convergence of the mobile industry and its associated rules with the IP world. Given this the regulator needs to focus on quality not quantity of competition. It can do this by providing a level playing field, removing barriers to effective and efficient competition, ensuring the market continues to innovate and evolve and that the market it serves is technically and commercially advanced enough to support the convergence of mobile and IP related industries.

Where regulation should focus is well documented in the main body. The most pressing issues being

1. MTR
2. Spectrum Refarm
3. Switching

Question 1.4: What is the scope for deregulation, competition and innovation in the mobile sector?

If barriers to competition are addressed and competition works the role of the regulator would eventually reduce - but the basic environment of competition has to be right. This has not yet been achieved in the UK because of high MTRs and a poor MNP system.

A4.3 Section 3 – Today's UK mobile markets

Question 3.1: What do you think are the features of a well-functioning mobile market? What evidence do you see that those features are present in the UK market?

Large increases in capacity, new entry and new technology should lead operators to reduce prices, increase utilisation and offer new services. These benefits have only been partially achieved in the UK because of the barriers to competition in voice that have been identified. Although achieved in data they are at risk unless spectrum is made available on fair and non-discriminatory terms.

The features of a well functioning market would also include

1. A market that operates over a wide variety of price points as opposed to an even distribution of tariffs where customers have a wider degree of choice and greater transparency in making purchase decisions. For example removing handset costs from network service allows operators to focus on a wider variety of price points.
2. Demonstrable advances in customer behaviour for example penetration and usage of core services that indicate customers' utility of mobile is growing.

Question 3.2: What measures are most appropriate to assess whether the mobile sector is performing well for citizens and consumers?

International comparisons of price and utilisation should be used for both Europe and beyond.

Question 3.3: How will market dynamics change as a result of trends such as availability of new spectrum, mobile broadband and new ways of delivering voice services?

See the main body of H3G's submission.

A4.4 Section 4 – Consumers

Question 4.1: What is your experience, as an individual consumer or an organisation that uses mobile services?

Not applicable.

Question 4.2: How should regulators and policy-makers respond to signs of rising consumer concern?

If competition is working then consumer concern should principally be addressed by changing operator in the market. Ofcom should focus its attention on areas where competition cannot operate - such as MNP where the incumbents are incentivised to deny their customer's access to an efficient and easy to use system.

Question 4.3: What are the important factors to consider in striking a balance between protecting mobile consumers and enabling markets to work flexibly? Have we got this balance right in today's mobile market?

If competition was effective Ofcom would have to intervene less to protect consumers as market mechanisms would protect them. Unfortunately competition in the UK mobile market remains distorted by the MTR regime.

A4.5 Section 5 - Citizens

Question 5.1: How does the use of mobile services affect our participation as citizens in society?

Access to telecommunications and increasingly mobile communications is a key mechanism for participation in civil society and is likely to become more so.

Question 5.2: What factors should we take into account in thinking about access and inclusion issues in mobile markets?

Key factors are availability, price, coverage and network effects for existing and new services.

Question 5.3: What factors should we take into account in thinking about new services, and how those services may affect issues like protection of children, privacy and security?

Question 5.4: Have you been affected by issues about coverage or 'not spots'? How has it affected you?

A4.7 Section 7 - Scenarios

Question 7.1: What do you see as the most influential trends and features of mobile and wireless markets in future?

See main submission.

Question 7.2: What new policy and regulatory challenges could the trends identified in this section bring? Which policy and regulatory challenges could they address?

A4.8 Section 8 – Implications

Promoting competition

Question 8.1: Should Ofcom do more to promote competition in mobile and wireless markets?

Yes - reform of interconnection and the MNP regime.

Question 8.2: Ofcom's strategy in telecommunications is to promote competition at the deepest level of infrastructure that is effective and sustainable. How might this strategy be applied, given future developments in the mobile sector? Under what circumstances, if ever, would it make sense to consider access regulation for mobile platforms?

In relation to roaming at 900MHz in some circumstances as discussed at page 55.

Question 8.3: What role can competition play in ensuring that future development of the mobile Internet provides an open and flexible environment for a wide range of services? Should Ofcom explore open access requirements to ensure opportunities for innovation? What role might 'net neutrality' play in the mobile sector?

The harmonisation of standards is a key catalyst in promoting the development of new services. Harmonisation acts as a supply side driver that can help to deliver the necessary economies of scale required to entice investment and deliver a return. We have seen how the global support and roll-out of HSPA interface standards by commercial networks has stimulated investment in handsets by manufacturers.

Services: The large and increasing array of handset and mobile operating systems indicates healthy competition at certain stages of the value chain. However, it can

also impact other stages of the value chain that are equally important when considering consumer value. In this case, common standards on handsets, especially at the operating system level, would help to create a wide and accessible platform that would be attractive for developers seeking to compete and deliver innovative value-added services for end users.

Ofcom should consider how and where to set minimum requirements to provide guidance that will stimulate the right market conditions at the right point in the value chain whilst also remaining alert to the requirement to allow innovation and competition to operate.

Setting clear rules for consumer protection

Question 8.4: What role might competition play in addressing questions about transparency of prices, services and contractual conditions offered to consumers of mobile and wireless services? What role should regulation play in addressing these questions?

The regulator should favour self and co-regulation as the preferred form of consumer regulation. It encourages mobile network operators to compete in areas such as customer service and information provision in order to differentiate themselves to attract and retain new customers.

Question 8.5: What is the best way to promote content standards and ensure privacy protection for increasingly complex content and transaction services? How will privacy issues fare in a world where services are more personal and more complex?

The treatment of personal data – particularly under the environment envisaged under the 'SIMs everywhere scenario' (Analysis Mason – Assessment of the UK Mobile sector - Final Report for Ofcom, August 2008) – raises a series of difficult questions. The sharing of authentication location and presence data between mobile network operators and third parties has the potential to deliver significant benefits to the consumer via a wide range of applications. However, this raises questions over the ownership of such data, the right to determine how this data is used, what the scope of those rights are and how ownership rights and privacy rights of the individual to whom the data relates should be protected. There is a clear need for debate on those issues.

Adapting regulation to converging markets

Question 8.6: Will the mobile termination rate regime need to evolve or change more fundamentally? What is the best approach to adopt?

The mobile termination regime must change to enable to a level competitive playing field and the development of much needed greater competition in voice markets. See main response section 2.2 for H3G's detailed views on this issue.

Question 8.7: If competition does not reduce international roaming charges sufficiently, how should regulators respond, if at all?

High international roaming charges can block innovative new consumer services as fears of higher pricing reduce usage - these prices risk bill shock which in turn may

mean it will take many years for consumers to learn to trust these services in the future.

Question 8.8: How might universal service and universal access need to adapt in a world where we increasingly rely on mobile services? What role might mobile play in universal access delivery in future?

Mobile broadband can reach areas of the country that other fixed line solutions such as ADSL cannot. Consequently, mobile can play an integral part of the ambitions to deliver universal service and access. By mid 2010, 3UK's network will extend to 13,000 cell sites providing high speed coverage (14.4Mbit/s) to 98% of the UK population.

Question 8.9: Can markets and commercial agreements address issues such as 'not spots' and emergency access? If not, what role might be played by a regulator to address these issues?

See response at page 60.

Question 8.10: How might access for particular groups (such as the elderly and disabled users) need to evolve in future? What role can competition play in addressing these questions?

Handsets play a key role in driving adoption of services. M:Metrics research suggests that the Apple iPhone and smartphones in general have helped to drive new usage behaviour – with 85% and 60% respectively accessing the Internet over their mobiles. Handsets with large screens and quick links to targeted services for the elderly should help to service the demands / needs of that particular group.

Ofcom's proposed way forward

Question 8.11: Do you have any comments regarding our proposed way forward and the objectives of the next phase of this Assessment?

H3G is concerned that spectrum issues may have to be considered as part of the MSA process in more detail.

Annex 3: On-Net/Off-Net Price Discrimination and 'Bill-and-Keep' vs. 'Cost-Based' Regulation of Mobile Termination Rates, David Harbord and Marco Pagnozzi Università di Napoli Federico II, 30 November 2007

On-Net/Off-Net Price Discrimination and 'Bill-and-Keep' vs. 'Cost-Based' Regulation of Mobile Termination Rates*

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30 November 2007

Abstract

This paper surveys the recent literature on competition between mobile network operators in the presence of *call externalities* and *network effects*. It shows that regulation of mobile termination rates based on "long-run incremental costs" increases networks' strategic incentive to inefficiently set high on-net/off-net price differentials, thus harming small networks and new entrants. The paper argues in favor of a "bill-and-keep" system for mobile-to-mobile termination, and presents international evidence in support of this system.

*This article is partly based on research undertaken for Hutchison 3G UK Ltd. The authors are solely responsible for its contents.

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1 Introduction

The UK telecoms authority (Ofcom) regulates the termination rates of the four incumbent mobile network operators (MNOs) in the UK at "long-run incremental cost" (LRIC), and it has recently included the new entrant, Hutchison 3G UK, within this regulatory framework.[1] The main rationale for Ofcom's regulation of these charges is to prevent a welfare-reducing distortion in the structure of prices, whereby excessive profits from the exploitation of monopoly power in call termination are used to subsidize subscriber acquisition costs.[2] Indeed, Ofcom's estimates of the welfare benefits of regulation (Ofcom 2007a, Annex 19, pp. 387-395) are exclusively concerned with correcting this inefficiency in the structure of prices, which it believes leads to over-consumption of mobile retail services and under-consumption of other retail services that use mobile termination, such as fixed retail services (Ofcom 2006, p. 80).[3]

Ofcom treats fixed-to-mobile and mobile-to-mobile termination charges symmetrically,[4] and its cost model estimates LRIC by allocating the fixed and common costs of a hypothetical efficient network operator over mobile retail and wholesale services. We shall argue in this paper that this approach

[1] Termination rates are the charges that mobile operators levy on fixed network operators and other mobile operators for terminating calls on their networks. The price caps for the MNOs in the UK are actually set at Ofcom's estimate of LRIC for each network, plus a markup for non-network common costs and a network externality surcharge.

[2] This issue is frequently discussed in terms of the "waterbed" effect, whereby a reduction (or increase) in termination charges leads to a corresponding increase (or reduction) in subscription charges to consumers (see Ofcom 2006, pp. 77-85; Ofcom 2007a, pp. 101-115; and Armstrong and Wright 2007, pp. 13-14). The characterization of mobile call termination as a "monopoly" assumes that mobile operators can make "take-it-or-leave-it" offers to fixed-line operators and to each other, which is typically justified by reference to various interconnectivity obligations. Binmore and Harbord (2005) question this assumption, and provide an analysis of mobile call termination instead as a bilateral-monopoly bargaining problem.

[3] That is, Ofcom does not claim that the MNOs in the UK are earning excessive profits overall via excessive charges for voice termination (see Ofcom 2007a, pp. 8-9), although it "remains of the view that the waterbed effect is unlikely to be complete" (Ofcom 2007a, p. 109). See Genakos and Valletti (2007) for recent empirical evidence on the strength of the waterbed effect in twenty countries.

[4] Specifically, the price caps, or "target average charges," for the two services are set at the same level. See Ofcom (2007, pp.404-408).

to regulating termination charges is flawed for a number of reasons, and that consequently Ofcom's regulatory policy — by distorting retail pricing incentives in the mobile market — may be doing as much harm as good.

A first simple point, which has been frequently made elsewhere,[5] is that even in the absence of any strategic effects (which are discussed immediately below), the regulation of pence per minute (ppm) mobile termination charges should in principle be based on marginal costs, and not on the fully-allocated costs estimated by Ofcom's LRIC model. Very few, if any, mobile telecommunications costs are traffic-sensitive, but they are nevertheless recovered on a traffic-sensitive basis under Ofcom's approach. To the extent that regulated termination rates represent fixed costs that are recovered on a per-minute basis, they are too high, and act to inefficiently increase retail call charges and reduce the number of calls made to mobile networks.

By setting a LRIC-based price cap, Ofcom is therefore allowing MNOs to charge termination rates far in excess of marginal costs.[6] A more efficient price structure would set per-minute rates at or near zero, but possibly allow for networks to contribute to each others' capacity costs via capacity surcharges. If, for most practical purposes, such capacity charges can be expected to net out, a better regulatory policy is likely to be "bill-and-keep," under which reciprocal termination charges are set equal to zero.[7,8]

Our second point is more complex, and has only recently become clear

[5] See, for example, Quigley and Vogelsang (2003) and DeGraba (2003).

[6] Some evidence for this comes from the fact that MNOs in the UK and Europe frequently set prices for on-net calls — i.e. calls originating and terminating on their own networks — much lower than regulatory estimates of their incremental termination costs. See the discussion of the French regulator Arcep (2007), Chapter 4 and pp. 81-82, and the evidence presented in Section 4 below.

[7] Quigley and Vogelsang (2003), for example, argue that, *"capacity-based interconnection charges would be ideal, because they would correctly reflect the costs incurred by the networks*," and note that, "*bill and keep is like a two-part tariff in access charges: the fixed fee equals the own-network costs for termination of the call generated by the other network, while the variable fee is zero.*"

[8] Armstrong and Wright (2007, p. 14) suggest another reason for excluding fixed and common costs from regulated termination charges in competitive mobile markets. In the presence of strong "waterbed" effects, high termination charges will not provide MNOs with any contribution towards their fixed or common costs, but rather be dissipated in competition to attract new subscribers.

as the academic literature on network competition has become increasingly realistic. It now appears that Ofcom's regulatory policy is founded on an incomplete understanding of competitive interaction in mobile markets, which has led it to focus on one potential distortion in relative prices at the expense of others. Its LRIC-based price regulation is consequently contributing to another welfare-reducing distortion of prices — off-net versus on-net price discrimination — which is particularly damaging to new entrants and to competition from smaller networks. By focusing solely on the absolute level of mobile termination rates, and associated "waterbed" effects, Ofcom's regulatory policy may well be damaging competition and reducing welfare in the mobile market.

It is now widely recognized that new entrants in mobile markets face a barrier to entry due to the structure of prices charged by incumbent networks. In particular, on-net versus off-net price differentials create *tariff-mediated network externalities*, as described by Laffont et al. (1998b), which make larger networks more attractive to consumers than smaller networks. When on-net calls are priced below off-net calls, *ceteris paribus,* subscribers to large networks experience lower average call charges than subscribers to smaller networks, since more of their calls are made on-net. This makes larger networks more attractive and places smaller networks at a competitive disadvantage.

Large price differentials for on-net and off-net calls are common in most European mobile markets. In the UK, according to Ofcom's own estimates, the average charge in 2002 was 22.6 ppm for off-net calls versus 5.1 ppm for on-net calls. Although by 2006 this differential had been reduced to 8.9 ppm for off-net calls versus 3.5 ppm for on-net calls, it remains significant.[9] Data from European countries such as France, Germany and Spain tell a similar story.[10]

[9] See figure 4.40 in Ofcom (2007b).

[10] See Section 4.2 below for further detail; also Armstrong and Wright (2007, pp. 6-7). As Armstrong and Wright note, it is a complex and largely arbitrary task to give precise estimates for the prices of the various types of calls and messages originating on mobile networks, since mobile networks each offer a wide variety of tariffs, with different monthly rentals, corresponding to different volumes of inclusive call minutes and text messages. The method of calculation used by Ofcom is not made clear in their documents.

If networks have roughly equal termination costs, however, economic efficiency requires equal on-net and off-net call charges. So why do large incumbent mobile operators engage in on-net/off-net price discrimination? Until recently, the academic literature was unable to explain large price differentials for on-net and off-net calls. This literature — like Ofcom — focused on the exploitation of monopoly power in setting termination rates to subsidize competition to acquire subscribers, via low fixed tariffs, handset subsidies and the like. It also concluded that purely cost-based access (i.e. termination) charges are welfare optimal, and that consequently fixed-to-mobile and mobile-to-mobile termination charges should be regulated at the same level.[11]

This issue has now been addressed in a number of recent papers, including Jeon et al. (2004), Berger (2004) (2005), Armstrong and Wright (2007), Hoernig (2007), and Calzada and Valletti (2007), who consider the impact of *call externalities* and *network effects* on competition and market structure in the mobile sector. Call externalities refer to the fact that both the sender and receiver of a call receive a benefit from it, although under a "Calling Party Pays" (CPP) regime only one party is charged for the call. The importance of call externalities is beyond doubt, but they have been largely ignored until recently both by the academic literature and by regulatory authorities. DeGraba (2000, p. 15), for example, notes that:

> *"the economic analyses of interconnection pricing generally assumed that the calling party is the sole cost-causer and the sole beneficiary of a call. While these assumptions may have been a useful means of simplifying the analysis of various interconnection pricing problems, they have long been recognized as unrealistic, and, with the growth of competition in telecommunications, they need to be reconsidered."*

The inclusion of call externalities in the analysis is of particular importance, since this has been shown to have significant effects on competition, the structure of retail prices, and optimal regulatory policy. The main conclusion of the more recent literature is that, in the presence of call externalities,

[11] See, for example, Armstrong (2002); Wright (2002a); and Gans and King (2000a).

mobile networks have strong incentives to implement on-net/off-net price differentials due to:

(*i*) High mobile-to-mobile termination charges which are above marginal cost; and

(*ii*) Their strategic incentives to reduce the number of calls that subscribers on rival networks receive, reducing the attractiveness of rival networks, and hence their ability to compete.

In addition, this literature finds that:

(*iii*) Large networks charge higher off-net prices, and create higher on-net/off-net price differentials, than smaller networks. This reduces the attractiveness of smaller networks, since subscribers to a large network can be expected to make proportionately more on-net calls than the customers of a smaller network. Therefore, *ceteris paribus*, subscribers to smaller networks will experience higher average call charges, placing the smaller network at a competitive disadvantage;

(*iv*) High (i.e. above marginal cost) mobile-to-mobile termination charges can lead to permanent "access deficits" for smaller networks, because even with a "balanced calling pattern"[12] traffic between networks will not be in balance. Since the bulk of a smaller network's subscribers' calls will be off-net, the smaller network will be forced to incur large payments to rival networks. Call externalities reinforce this disadvantage, since when large networks set high off-net prices, subscribers of a smaller network will also receive relatively few calls; and

(*v*) Welfare-optimal termination charges should be set below the marginal costs of termination for both fixed-to-mobile and mobile-to-mobile calls, in order to reduce incentives for on-net/off-net price discrimination. *But optimal mobile-to-mobile termination charges will typically be lower than fixed-to-mobile termination charges* to take account of the fact

[12] Where in the absence of tariff differentials, each subscriber calls every other subscriber with the same probability.

that the retail prices of mobile-to-mobile calls are unregulated, and the greater intensity of competition between mobile networks than between fixed versus mobile networks.

Thus, Ofcom's policy of imposing identical "cost-based" rates for fixed-to-mobile and mobile-to-mobile calls is unlikely to be optimal, even if we assume that its LRIC model provides reasonable estimates of the marginal costs of termination, since both rates should be less than marginal cost, *and by different amounts*. In any event, as noted above, Ofcom's methodology results in termination charges far in excess of marginal termination costs, which are likely to be close to zero. This policy is therefore potentially distorting pricing incentives in the mobile market.

Ofcom's "cost-based" regulation of termination rates is consequently exacerbating the incentives of MNOs to set off-net prices in excess of on-net prices, resulting in welfare losses from an inefficient pricing structure and barriers to entry and growth for smaller networks. Indeed, it is likely that high off-net call charges are a distortion in the structure of prices potentially as serious as the distortion in prices that the regulation of mobile termination charges was designed to repair in the first place (i.e. the subsidy of mobile subscription via high termination charges), and are particularly damaging to competition from smaller networks and new entrants.

A move to "bill-and-keep" for mobile-to-mobile termination — as suggested by Berger (2004) (2005), DeGraba (2003) (2004), Littlechild (2006), Quigley and Vogelsang (2003) and Valetti and Houpis (2005) — would likely result in a more efficient wholesale and retail price structure, help to eliminate barriers to entry caused by "tariff-mediated" network effects, and increase welfare and competition in the mobile market. While Gans and King (2001) argued that bill-and-keep arrangements can be used to soften retail competition between mobile networks, and may hence be undesirable, the more recent literature has shown that when call externalities are taken into account, this conclusion changes. Indeed, when both parties to a call receive benefits from it, setting access charges equal to the cost of completing a call is typically inefficient, and bill-and-keep, by imposing some of the cost of a call on each network, is more efficient than cost-based termination charges.[13]

[13] And as we note in Section 3 below, bill-and-keep can be more efficient than cost-based

Recent empirical evidence (e.g. Birke and Swann 2006, 2007) confirms that tariff-mediated network effects play an important role in mobile telecommunications, and that inducing network effects via off-net/on-net price differentials has been a successful strategy for incumbent mobile operators in Europe. According to Birke and Swann (2006), their empirical analysis supports the conclusion that, "*the high price of off-net calls cannot only be a result of market power, but can be a significant source of market power, which can especially be used to preempt entry by new competitors.*" These studies thus provide support for the recent theoretical literature which suggests that strategically inducing network effects can be a profitable strategy for attracting and maintaining market share, and for preempting entry or retarding the growth of smaller networks. International evidence from countries where bill-and-keep has been used in practice also appears to support the conclusion that bill-and-keep arrangements tend to encourage a more efficient retail pricing structure.

The remainder of this survey paper is organized as follows. Section 2 describes the recent academic literature on call externalities and competition between mobile networks, leading to the conclusions noted above, while Section 3 considers the theoretical arguments for and against bill-and-keep as a basis for setting termination charges. Section 4 then discusses some empirical evidence. Section 4.1 describes the recent results of Birke and Swann (2006)(2007), who attempt to quantify the extent of off-net/on-net price discrimination in the UK and other countries, and its effects on consumers' subscription behavior. Section 4.2 describes some international evidence on prices, usage and penetration levels in bill and keep countries compared to countries with relatively high termination rates. Section 5 concludes.

termination charges even when traffic between networks is not in balance, contradicting the widely-held view that bill-and-keep arrangements are only appropriate when traffic between networks is balanced.

2 Call Externalities and Competition Between Networks

As noted above, the academic literature on network competition was until recently unable to explain the large price differentials for on-net and off-net calls observed in most European mobile markets. The standard conclusions were that purely cost-based access (i.e. termination) charges were welfare optimal, and that consequently fixed-to-mobile and mobile-to-mobile termination charges should be regulated at the same level.

These conclusions have now been overturned in a number of recent papers which consider the effects of call externalities and network effects on competition and pricing in mobile markets. The inclusion of call externalities in the analysis has been found to have significant implications for welfare and optimal regulatory policy. As Armstrong and Wright (2007) have noted, "*it is beyond doubt that call externalities are significant, since why else would anyone leave their mobile phone on to receive calls?*" What wasn't clear until recently was the significance of call externalities for the analysis of price discrimination and competitive interaction in mobile markets.

This section summarizes the results of a number of recent papers which analyze the interaction of call externalities with pricing and competition in mobile networks, including Jeon et al. (2004), Armstrong and Wright (2007), Hoernig (2007), Calzada and Valletti (2007), and Cambini and Valletti (2007). The key conclusions of this analysis are that call externalities create a strategic motive for off-net/on-net price discrimination which can lead to socially inefficient tariff structures, and create an entry barrier for small networks which are unable to profitably replicate incumbents' pricing strategies. Further, high mobile-to-mobile termination rates, coupled with high charges for off-net calls, can be used strategically by incumbent operators to either prevent entry or reduce competition from new entrants into their markets.

Jeon, Laffont and Tirole (2004) Jeon et al. (2004) analyze competition between two symmetric communications networks which compete in nonlinear prices, and in which both senders and receivers of calls benefit from them

— i.e. in the presence of call externalities. Specifically, they assume that a sender obtains a gross surplus $u(q)$ from a call of length q, while the receiver obtains a surplus of $\widetilde{u}(q) = \beta u(q)$, where $\beta > 0$ is a measure of the strength of the call externality. Each network i charges its subscribers a fixed fee F_i, and per-unit call charges p_{ii}^* for on-net calls and p_{ij}^* for off-net calls, for $i, j = 1, 2$.

Jeon et al. (2004) show that, with "network-based price discrimination" (i.e. when firms are allowed to set different prices for on-net and off-net calls), each firm fully internalizes the call externalities on its own network, and sets an on-net price equal to marginal cost less a factor which depends upon the size of the call externality. By contrast, because off-net call charges affect the welfare of consumers *on the rival network*, they are subject to strategic manipulation.

Specifically, when c_O is the marginal cost of originating a call and c_T is the marginal cost of terminating a call, the profit-maximizing *on-net price* for network i is equal to the social-welfare-maximizing price,

$$p_{ii}^* = c_O + c_T - \widetilde{u}'\left(q(p_{ii}^*)\right). \tag{1}$$

Since each firm has a monopoly in the market for on-net calls on its own network, it uses the efficient on-net call price p_{ii}^* to maximize the total surplus, and the fixed charge F_i to extract consumer surplus. Hence, both networks choose the same on-net price regardless of their market shares, and on-net calls are priced below total marginal cost.

Noting that in equilibrium $\widetilde{u}'\left(q(p_{ii}^*)\right) = \beta p_{ii}^*$, equation (1) may be rewritten as

$$p_{ii}^* = \frac{c_O + c_T}{1 + \beta}. \tag{2}$$

Thus in the absence of a call externality (i.e. when $\beta = 0$), on-net prices for each network are set equal to marginal cost, and always exceed zero for any finite value of β.

By contrast, given that network i has market share α_i, the profit-maximizing

off-net price for network i is given by[14]

$$p_{ij}^{*} = \begin{cases} \frac{(1-\alpha_i)(c_0+a)}{1-\alpha_i(1+\beta)} & \text{for } \alpha_i < \frac{1}{1+\beta}, \\ +\infty & \text{otherwise,} \end{cases} \tag{3}$$

where a is the reciprocal mobile-to-mobile termination access charge, which is assumed to be equal for the two networks. Note that from (3), $\frac{\partial p_{ij}^{*}}{\partial \alpha_i} > 0$.[15] Hence a larger network charges a higher off-net price, and has a higher off-net/on-net price differential, than a smaller network.

In a symmetric equilibrium, when $\alpha_i = \alpha_j = \frac{1}{2}$, the profit-maximizing off-net price is given by

$$p_{ij}^{*} = \begin{cases} \frac{c_0+a}{1-\beta} & \text{for } 0 \leq \beta < 1, \\ +\infty & \text{for } \beta \geq 1, \end{cases} \tag{4}$$

for each network. In the absence of a call externality (when $\beta = 0$), the off-net price is equal to $c_O + a$ and the on-net price to $c_O + c_T$: the on-net/off-net price differential is therefore completely determined by $a - c_T$, the difference between marginal termination costs and the termination access charge.[16]

When the call externality is taken into account, however, strategic considerations change this result. The call externality creates strong incentives for each firm to increase its off-net price in order to reduce the number of calls made to the rival network, thereby reducing the attractiveness of the rival network to subscribers. Further, when the receiver of a call benefits as much as, or more than, the sender (i.e. when $\beta \geq 1$), this leads to what Jeon et al. (2004) refer to as a "connectivity breakdown," where both networks set off-net call charges so high as to eliminate off-net calling altogether. Intuitively, a network's profitability is determined by the attractiveness of its

[14] Equation (3) is obtained by maximizing network i's profit with respect to p_{ij} for a given market share, adjusting the fixed charge to keep its market share constant when it changes its off-net price, and then using the fact that $p_{ij}^{*} = u'\left(q(p_{ij}^{*})\right)$ to obtain the equilibrium price.

[15] Specifically, $\frac{\partial p_{ij}^{*}}{\partial \alpha_i} = \frac{(c_0+a)\beta}{[1-\alpha_i(1+\beta)]^2}$.

[16] De Bijl and Peitz (2002, ch. 6.4) also solve for the equilibrium pricing structure with two-part tariffs and price discrimination in the absence of a call externality. As in Jeon et al. (2004), both on-net and off-net prices are set equal to marginal cost, and therefore the on-net/off-net price differential is completely determined by the reciprocal termination charge.

offer *relative* to that of its competitor. By allowing off-net calls, a network bears the cost of those calls and, if the receivers enjoy a sufficiently high surplus from receiving calls, this makes the other network relatively more attractive.[17]

In less drastic cases, when $\beta < 1$, competition for market share leads to "suboptimal connectivity." That is, off-net prices which result in too few off-net calls being made relative to the welfare optimum. This can be seen from the fact that the social-welfare-maximizing off-net price is equal to the on-net price in equation (1). From (4), two factors potentially increase the firms' off-net prices above the first-best value: the access charge a, and the call externality effect represented by β. Comparing equations (2) and (4) it is clear that, even when the reciprocal termination charge a is set equal to marginal cost c_T, equilibrium off-net call charges still exceed the efficient level due to the strategic effect induced by the presence of the call externality.[18]

Armstrong and Wright (2007) Armstrong and Wright (2007, Section 3) use a similar set-up to that of Jeon et al. (2004),[19] to analyze pricing and termination charges in an oligopolistic market which includes both mobile and fixed networks choosing two-part tariffs. The authors also provide an explanation for on-net/off-net price differentials in the presence of call externalities. In contrast to Jeon et al. (2004), however, they assume that the receiver of a mobile-to-mobile call of length q obtains a surplus $b \cdot q$, where $b > 0$ is the measure of the strength of the mobile-to-mobile call externality; and the receiver of a fixed-to-mobile call of length q obtains a surplus $B \cdot q$, where $B > 0$ is the measure of the strength of the fixed-to-mobile call externality. Therefore, Armstrong and Wright (2007) restrict the analysis to linear call externalities which are unrelated to the surplus obtained by the

[17] This result requires that the market is "covered" — i.e. that every consumer subscribes to a network.

[18] This can also be seen by noting that $\frac{\partial p_{ij}^*}{\partial a} = \frac{1}{1-\beta} > 1$ when $\beta > 0$ in (4), so an increase in the reciprocal termination charge results in an increase in both networks' off-net prices *which exceed the increase in the termination charge.*

[19] Both papers build on the model in section 8 of Laffont, Rey, and Tirole (1998a).

caller.[20]

The welfare-maximizing fixed-to-mobile call price in the set-up of Armstrong and Wright (2007) is given by

$$P^* = C + c_T - B, \tag{5}$$

where C is the marginal origination cost of the fixed network. That is, the fixed-to-mobile price should equal the total marginal cost of a fixed-to-mobile call less the relevant call externality. As in Jeon at al. (2004), the profit-maximizing on-net price for network i is equal to the social-welfare-maximizing call price, which is given here by

$$p_{ii}^* = c_O + c_T - b, \tag{6}$$

or the mobile network's on-net marginal cost adjusted *downwards* to reflect the call externality its subscribers enjoy from being called by people on the same network.

By contrast, in a symmetric equilibrium, each mobile firm sets its profit-maximizing off-net price equal to

$$p_{ij}^* = c_O + a + \frac{1}{n-1}b, \tag{7}$$

where a is again the reciprocal termination charge, and n is the number of mobile firms. This exceeds the welfare-maximizing price given by equation (6), and is equal to a network's marginal cost for an off-net call adjusted *upwards* to reflect the fact that when a network's subscribers make fewer calls to subscribers of other networks, the utility of subscribers to other networks is reduced because of the call externality. As Armstrong and Wright (2007, p. 18) note, "*this represents the chief anti-competitive motive to set high off-net call charges.*"

Although the qualitative effect of call externalities on the networks' mobile-to-mobile prices is the same as in Jeon et al. (2004), because of the different

[20] One way of understanding this distinction is to note that Jeon et al. (2004) assume that the "total surplus" from a call, $(1+\beta)\,u(q)$, is "shared" by the sender and receiver in proportions $\frac{1}{1+\beta}$ and $\frac{\beta}{1+\beta}$ respectively. Armstrong and Wright (2007), on the other hand, treat the sender's utility as being completely urelated to the benefit obtained by the receiver.

assumptions on the nature of the call externality the model of Armstrong and Wright (2007) never leads to infinite off-net mobile-to-mobile prices and "connectivity breakdown."[21] As in Jeon et al. (2004), however, setting the reciprocal mobile-to-mobile termination charge equal to marginal cost, i.e. $a = c_T$, does not lead to an efficient off-net price and does not eliminate the on-net/off-net price differential.

Both models thus predict that the observed differences in on-net and off-net call charges are not solely due to above-cost mobile-to-mobile termination rates. Rather, a network sets high off-net prices in order to reduce the number of calls received by subscribers to rival networks, thus reducing the rival networks' ability to compete.[22] Therefore, mobile-to-mobile off-net prices are distorted away from their welfare-maximizing levels by both the regulated mobile-to-mobile termination rate a, and by the "strategic effect," which in the model of Armstrong and Wright (2007) is represented by the term $\frac{1}{n-1}b$ in equation (7).

When the prices of fixed-to-mobile calls are regulated at cost (so that $P = C + A$), as they have been until recently in the UK for example, from (5) the optimal fixed-to-mobile termination charge in Armstrong and Wright's model is given by

$$A^* = c_T - B, \tag{8}$$

i.e. the mobile networks' marginal cost of termination less the fixed-to-mobile call externality.

In the absence of regulation, but assuming that fixed networks and mobile networks are not viewed as substitutes for each other by consumers, the optimal fixed-to-mobile access charge is still given by (8). This is because, when fixed and mobile networks are not substitutes, fixed networks have no strategic motive for setting fixed-to-mobile call prices above marginal cost, so long as they are able to extract consumer surplus via fixed fees.[23]

[21] Although for a large enough externality parameter, b, it can predict negative on-net prices.

[22] See Armstrong and Wright (2007, pp. 18-19) for a discussion.

[23] Using world data on mobile penetration rates, Gruber and Verboven (2001a) and Anh and Lee (1999) find that fixed and mobile telephony are largely viewed as complements by consumers. In contrast, using penetration data for the European Union from 1991-1997, Gruber and Verboven (2001b) find a substitution effect between fixed and mobile phones.

Hence, setting the fixed-to-mobile access charge according to (8) is likely to be approximately optimal even in the absence of regulation of fixed-to-mobile retail prices.

The welfare-maximizing mobile-to-mobile termination rate, which sets off-net charges equal to on-net charges (i.e. $p_{ij}^* = p_{ii}^*$), is given by

$$a^* = c_T - \frac{n}{n-1}b. \tag{9}$$

Hence, when $B = b$, the welfare-maximizing fixed-to-mobile termination rate A^* exceeds the welfare-maximizing mobile-to-mobile rate a^*, and only as n becomes large does this difference vanish.[24] Welfare-maximizing mobile-to-mobile access charges need to be lower than fixed-to-mobile access charges to off-set the strategic motive for setting mobile-to-mobile off-net charges which are too high relative to their first best levels, and these strategic motives are largely absent for fixed network firms.

As do Berger (2005) and Gans and King (2000b), Armstrong and Wright (2007) also show that, if mobile networks are able to coordinate on reciprocal termination charges, they will choose a mobile-to-mobile termination charge *lower* than the welfare-maximizing rate, in order to relax competition for subscribers. The reason is that, from equation (7), a higher termination charge makes off-net calls more expensive than on-net calls, and the mobile market then exhibits positive network effects, i.e. subscribers prefer to join a larger network. This intensifies competition between networks for market share, and reduces profits. By setting a low termination charge, which results in off-net call charges which are below on-net charges, subscribers prefer to join a smaller network, which relaxes retail-market competition.

The prediction that mobile networks should agree on low mobile-to-mobile termination charges contrasts sharply with what these firms actually do in

Cadima and Barros (2000) and Sung and Lee (2002) report analogous results using data from Portugal and Korea respectively. Gans, King and Wright (2005) hypothesize that the conflicting results may be due to the fact that fixed and mobile phones were initially complements, but as mobile penetration has increased, they are increasingly being viewed as substitutes. See also Andersson et al. (2006).

[24] It is not easy to think of a good reason for the call externality parmeters to be different for the two types of network. Hence, $B = b$ appears to be a reasonable assumption.

practice, however, casting considerable doubt on the ability of mobile networks to coordinate on profit-maximizing termination rates.[25] When termination rates are set unilaterally by each network, Armstrong and Wright (2007, pp. 20-21) show that the net incentive is to set a termination charge above the efficient level, but below the monopoly level. Finally, Armstrong and Wright (2007, pp. 16-17) also note an anti-competitive motive for the incumbent MNOs to prefer high termination charges when facing the threat of entry by smaller networks:

> "*Another possible reason why existing operators prefer high mobile-to-mobile termination charges is that high charges may deter entry. By setting above-cost mobile-to-mobile termination charges, the incumbent networks can induce network effects which make entry less attractive for the newcomer. With high mobile-to-mobile termination charges, off-net calls will be more expensive, which particularly hurts a small network since the bulk of its subscribers' calls will be off-net. Call externalities will reinforce this effect, since when the established firms have high off-net prices, subscribers of a new (smaller) network will also receive relatively few calls.*"

Hoernig (2007) The argument that high off-net prices can be used to create network effects which reduce the competitive threat posed by smaller networks is developed in Hoernig (2007), who analyzes the duopoly model of Jeon et al. (2004) with asymmetrically-sized networks. He assumes that the termination charge is set by the regulator, and analyzes Nash equilibria with price discrimination between on-net and off-net calls, for both linear and two-part tariffs. He also considers the possibility that the larger network engages in a form of "predatory pricing," whereby it leverages the tariff-mediated network externality to reduce the profits of the smaller network.

Hoernig (2007) finds that both asymmetries in network size and call externalities have strong effects on the equilibrium on-net and off-net prices,

[25] As Armstrong and Wright (2007, p. 20) put it, "*it is by no means clear that unregulated networks do actually negotiate over their mutual MTM termination charges.*"

and the resulting price differentials. Specifically, the large network charges higher off-net prices, and creates a higher on-net/off-net differential, than the smaller network, in order to improve its relative competitive position by making the rival network less attractive. This result can be readily obtained from equations (2) and (3) above.[26]

As a result, even with a "balanced calling pattern" — i.e. when each consumer calls every other consumer with the same probability in the absence of any tariff differentials — the traffic between the two networks will not be in balance, because the number or the duration of calls is affected by the different prices charged by the two networks. Therefore, when the reciprocal access charge is above marginal cost, the smaller network will incur a permanent access deficit due to its lower off-net price. Hoernig (2007) shows that this result holds under both linear and two-part tariffs. With linear tariffs the larger network also charges a higher on-net price, while with two-part tariffs both firms set the on-net price at the socially efficient (and profit-maximizing) level.

But Hoernig (2007) argues that a large network is capable of further harming the small network by adopting an anti-competitive, predatory-pricing strategy aimed at inducing the smaller network to exit the market. By increasing its off-net price above the Nash equilibrium level, the large network can further reduce the smaller network's access revenue (if access is priced above cost), and the call externality enjoyed by the small network's customers.

Hoernig considers both "full predation" which, by choosing arbitrarily low on-net prices and high off-net prices, allows the large network to drive the market share and profits of the smaller network to zero; and "limited predation," which instead of provoking immediate exit restricts the small firm's profits and cash flows, making it more difficult for it to invest in either customer retention or improvement of its network.

[26] One way of explaining this is that with call externalities, an increase in a network's off-net price has a first-order effect on the attractiveness of the rival network for subscribers. This effect is greater for larger networks, because larger networks have more subscribers who call the subscribers of the other network and generate a call externality for them. In other words, with call externalities, receiving calls from the other network is relatively more important for the smaller network's subscribers.

In either case, predation involves a larger on-net/off-net price differential by the large network. As the author stresses, call externalities are crucial for this result. In the absence of a call externality, the on-net/off-net differential is driven by the access charge. By contrast, in the presence of the call externality, this differential is also driven by the difference in market shares between networks and by strategic motivations.[27]

Calzada and Valletti (2007) While Hoernig (2007) assumes that termination charges are set by the regulator, Calzada and Valletti (2007) consider whether networks can strategically coordinate on reciprocal access charges in order to reduce competition and entry in their market. They consider a multi-firm industry in which the incumbent networks negotiate termination rates which apply to all firms, including new entrants, and allow for network-based price discrimination. Since the firms' profits are not neutral with respect to the industry-wide termination charge, the incumbent operators recognize that the level of the access charge affects *ex post* profitability, and thus the attractiveness of entry *ex ante*. Calzada and Valletti (2007) identify circumstances in which incumbents will want to distort access charges away from the efficient level in order to deter the entry of potential rivals. For a given fixed cost of entry, incumbent firms may decide to accommodate entry, accommodate only a subset of entrants, or deter entry altogether.

As observed by Armstrong and Wright (2007) (which is discussed immediately above), the authors show that when the incumbents do not face entry threats, they will agree on below-cost termination rates. Under the threat of entry, however, the incumbent networks may choose to set an inefficiently high access charge which deters the entry of potential rivals into the industry. The reason, as noted, is that a high access charge reduces the entrant's profits *ex post*, reducing the attractiveness of entry into the market. Calzada and Valletti (2007) note that, "*whenever incumbents increase the access charge above cost in order to deter entrants, they introduce allocative distortions for calls, as the off-net price is set above marginal cost. This behaviour also*

[27] Another way of saying this is that in the absence of call externalities, high off-net prices on the larger network have no effect on the utility of subscribers to the smaller network, by definition, since these subscribers do not care about receiving calls.

limits the gains from entry for consumers."

Call externalities — which Calzada and Valletti model by assuming that groups of people that tend to call each other more often join the same network — further increase incumbents' incentives to coordinate on a high access charge in order to deter entry. The reason is that a high access charge makes it less attractive for an incumbent network's subscribers to join an entrant network, because doing so means that a larger fraction of their calls will be made off-net. Call externalities of this type imply that the entrant suffers more from any mark-up of the access price, while the incumbents suffer less.[28]

Internalizing Call Externalities? Despite their prominence in the recent theoretical literature, call externalities have been largely ignored by European regulatory authorities to date.[29] During the last Competition Commission inquiry in the UK, Ofcom suggested that call externalities did not justify any adjustment to termination charges because

> "*it was possible that call externalities were already largely internalized as people tended to be in stable calling relationships with each other. The caller might be prepared to make a call even if his expected benefit was less than the price, because he expected that a further call (or calls) would be generated, initiated and paid for by the other party, from which he would receive a benefit without having to pay.*"[30]

[28] Atiyah and Dogan (2006) (see also Calzada and Valletti 2007, pp. 2-3), discuss the example of the Turkish mobile industry, where the incumbent duopolists (Turkcell and Telsmin) agreed to low reciprocal access charges until March 2001, but then they sharply increased their termination rates from 1.5 eurocents/min to 20 eurocents/min, when faced with the prospect of entry by two new operators (Aria and Ayacell). After struggling to reach profitability, the two new operators merged to form Avea in 2003, resulting in a market structure with only three operators.

[29] A notable exception is the Portuguese regulator, ICP-ANACOM, that has recently implicitly recognized their effects in referring to the "strong network effects" which create a competitive disadvantage for the smaller network, Optimus, in the Portuguese mobile market. It further argued that these network effects were being intensified by the large networks' on-net/off-net price differentiation. See Case PT/2007/0707: "Remedies related to the market for voice call termination on individual mobile networks in Portugal: Comments pursuant to Article 7(3) of Directive 2002/21/EC1."

[30] Competition Commission (2003), paras. 8.257 to 8.260. See also Ofcom, Statement on

The empirical basis for these assertions is unclear, however. In any event, the strategic incentive to engage in off-net/on-net price discrimination discussed above depends primarily upon the existence of receiver benefits from receiving calls, which is not in dispute, and less upon the degree to which the associated externalities may be internalized by people in stable calling relationships. Therefore, even if call externalities are partially or fully internalized, to the extent that a call to a subscriber on a rival network benefits the receiver, a network still has a strategic incentive to set inefficiently high off-net prices to reduce the number of calls received by rival networks' subscribers.

This can be seen in the recent analysis of Cambini and Valetti (2007), who consider a model of "call propagation" in which each outgoing off-net call results in a fraction x of incoming calls. Comparing their results with Jeon et al. (2004), the authors show that networks will have reduced incentives to use off-net/on-net price discrimination to induce a connectivity breakdown when outgoing and incoming calls are complements, but that off-net/on-net price differentials do not disappear.

Specifically, Cambini and Valetti (2007) find that the profit-maximizing off-net price is equal to

$$p_{ij}^{*} = \frac{c_0 + a - (a - c_T)x}{1 - \beta(1 - x)}, \tag{10}$$

which takes finite values for $0 \leq \beta \leq \frac{1}{1-x}$. This is lower than the off-net price obtained by Jeon et al. (2004) (see equation (4) above), showing that call propagation does reduce a network's incentive to set high off-net prices. Note, however, that even if the termination rate is set equal to marginal cost (i.e. $a = c_T$), the strategic incentive to inefficiently increase the off-net price above marginal costs remains, since equation (10) is higher than $c_O + c_T$ as

Wholesale Mobile Voice Call Termination, 2003, D.16, where it states: "*Call externalities — while they almost certainly do exist — probably do not justify any adjustment to call prices. As noted in Oftel's Review of the Charge Control on Calls to Mobiles (2001), and in the CC report, these are likely to be effectively internalised by callers, as a high percentage of calls are from known parties and there are likely to be implicit or explicit agreements to split the origination of calls.*"

long as $x < 1$ (which is the empirically relevant case).[31]

Call propagation, in any event, is not identical to the notion of "internalizing call externalities."[32] Suppose instead that individuals in stable calling relationships fully internalized the call externality, as hypothesized by Ofcom's quote above, and consider the model of Jeon et al. (2004). Then the sender of a call acts so as to maximize the total utility of the call, which is given by $(1+\beta)u(q)$ when call externalities are fully internalized, and so sets $p_{ij}^* = (1+\beta)u'\left(q(p_{ij}^*)\right)$.

It is straightforward to show that, in this case, the equilibrium off-net price for a network i with market share α_i is then given by[33]

$$p_{ij}^* = \begin{cases} \frac{(1-\alpha_i)(c_0+a)}{1-\alpha_i(1+\frac{\beta}{1+\beta})} & \text{for } \alpha_i < \frac{1}{1+\frac{\beta}{1+\beta}}, \\ +\infty & \text{otherwise,} \end{cases} \tag{11}$$

which is also lower than the off-net price in equation (3) above. Nevertheless, a strategic motive to increase off-net prices above marginal cost remains, since even if $a = c_T$ and $\alpha_i = \frac{1}{2}$ the off-net price in equation (11) is higher than $c_O + c_T$. Moreover, when market shares are asymmetric a "connectivity breakdown" can still occur,[34] and a large network still has an incentive to create higher on-net/off-net price differentials than a smaller network. The reason is that, even when call externalities are fully internalized, a large network remains more capable of reducing the utility of a smaller network's subscribers, by reducing the number of calls received by each of those subscribers, than *vice versa*.[35]

[31] Cambini and Valletti (2007) cite the empirical evidence in Taylor (2004), who in turn cites the point-to-point demand models of Southwestern Bell and Telecom Canada, which suggest that "*a call in one direction stimulates something like one-half to two-thirds of a call in return.*"

[32] Taylor (2004, Section 3) sharply distingushes call externalities from what he terms "the dynamics of information exchange."

[33] This can be obtained by setting the first-order derivative of network i's profit with respect to p_{ij} equal to zero (see Jeon et al. 2004, p. 105). Since network j's subscribers also send more calls to network i when externalities are internalized in this way, profits from interconnection also increase whenever $a > c_T$. However, this effect has no influence on the optimal choice of p_{ij} by network i.

[34] By contrast, with symmetric market shares $p_{ij}^* = (c_0 + a)(1+\beta)$, which remains finite for all finite values of β.

[35] We conjecture that this result would also hold in the model of Cambini and Valletti (2007) — i.e. that with asymmetric market shares, a larger network would charge higher

An additional effect occurs if individuals in stable calling relationships act so as to minimize the total costs of their communication. Then, *ceteris paribus*, an increase in network i's off-net price results in an increase in incoming off-net calls from network j, which will tend to increase its profits, whenever $a > c_T$, without reducing the utility of network i's subscribers. This creates an additional motive for implementing high off-net prices when call externalities are internalized by subscribers to different networks who act as a team. Hence, the degree to which the internalization of call externalities, or related call propagation effects, reduce networks' strategic incentives to engage in on-net/off-net price discrimination is an empirical question which is at present far from being resolved.

3 "Bill-and-Keep" versus "Cost-Based" Termination Charges

An important issue in the access pricing literature, starting with the seminal work of Armstrong (1998) and Laffont et al. (1998a, b), has been whether reciprocal access pricing agreements can be used as instruments of tacit collusion, and if and how they should be regulated. In particular, several papers have asked if bill-and-keep arrangements, which correspond to zero access charges, can actually be anticompetitive. A natural benchmark against which the welfare effects of such agreements can be evaluated is cost-based access pricing, which sets access charges equal to marginal cost.

The early literature (Laffont et al. 1998a; Armstrong 1998; Carter and Wright 1999) showed that networks can achieve monopoly outcomes by agreeing on *high* interconnect charges. As noted above, high interconnect charges imply high marginal costs for off-net calls, resulting in higher variable call charges. By agreeing on high enough interconnect charges, monopoly call prices can be achieved, and if inter-network traffic flows are symmetric, firms do not bear any burden from the high charges they pay to each other. On the basis of these conclusions, Carter and Wright (1999, p. 24) argued that bill-and-keep may be the second-best regulatory policy when the first-best

off-net prices than a smaller network, even if $x = 1$.

(i.e. marginal cost pricing) is unobtainable.

Subsequent papers have extended the analysis in several directions and have shown that networks may wish to agree on interconnect prices *below* marginal cost if: (i) networks compete in two-part tariffs with discriminatory prices (Gans and King 2001), or (ii) demand for subscription is elastic (Dessein 2003; Schiff 2002). On the basis of these results, Gans and King (2001) argued that bill-and-keep arrangements may be used to soften retail competition between mobile networks, and are hence undesirable from the consumer's perspective.[36] An opposing position was taken by Cambini and Valletti. Valletti and Cambini (2005) showed that networks may wish to agree on interconnect prices *above* marginal cost if ex-ante investments have to be made. And Cambini and Valletti (2003) demonstrated that bill-and-keep arrangements may be beneficial due to a positive impact on investments in quality prior to price competition occurring.

All of these papers shared the assumption that only the caller benefits from a call, but not the receiver, and until recently the literature lacked a model of a caller-pays system incorporating nonlinear pricing and price discrimination, as well as call externalities. As noted above, the inclusion of call externalities in the analysis is of particular importance, since this has significant effects on competition, the equilibrium structure of retail prices, and optimal regulatory policy. Indeed, once it is recognized that both parties to a call receive benefits from it, it is surprisingly easy to demonstrate that this profoundly changes the analysis of welfare-optimal prices and termination rates.

[36] See also the discussion in Armstrong and Wright (2007). Gans and King (2001) showed that when firms compete in two-part tariffs and discriminatory prices (but without allowing for call externalities), both on-net and off-net prices will be set equal to marginal cost, with the latter depending upon the wholesale termination rates. When the firms set termination charges independently (i.e. non-cooperatively), prices are higher than they otherwise would be, and profits and consumer surplus are lower. When firms set termination charges cooperatively, however, the negotiated interconnect charge is less than marginal cost, so each network makes losses on interconnection. This is profitable because it makes attracting marginal subscribers less valuable, and so price competition is muted. The profit-maximizing symmetric termination charge may be greater or less than zero. In the latter case, bill-and-keep may be as close as firms can get to collusive profit maximization.

DeGraba (2003) In a very simple and general framework, DeGraba (2003) shows that in the presence of call externalities, access prices equal to a network's cost of completing a call is typically inefficient. He considers a model in which the sender of a call obtains a fraction λ of the total utility of the call, while the receiver obtains a fraction $(1-\lambda)$ of the total utility. The total per-minute cost of a call is $c = c_O + c_T$, where, as in Section 2, c_O is the cost of originating a call, and c_T is the cost of terminating a call.

DeGraba (2003) argues that a call can be viewed as a public good jointly consumed by the sender and the receiver, and hence applies the same logic as in a "Lindhal equilibrium." Letting p_O be the price charged to the sender and p_T the price charged to the receiver, the only prices which result in efficient consumption *and* add up to c are

$$p_O = \lambda c \quad \text{and} \quad p_T = (1-\lambda)c. \tag{12}$$

So only in the case $\lambda = 1$ — i.e. in the absence of call externalities — should the sender pay for the entire cost of the call.[37]

If regulation or competition forces networks to charge prices equal to marginal cost, then the optimal access charge that the network of the sender of a call should pay to the network of the receiver is equal to

$$a^* = (\lambda - 1)c_O + \lambda c_{T.} \tag{13}$$

Then the effective cost of a call paid by the sender's network is $c_O + a^* = \lambda c$, and the effective cost paid by the receiver's network is $c_T - a^* = (1-\lambda)c$. So the optimal access charge is such that each network pays a fraction of the cost of producing a call equal to the fraction of the value of the call received by its subscribers. The principle is that when both parties benefit from a call, they should bear its cost in proportion to the benefit they receive. Only when $\lambda = 1$ is the optimal access charge equal to the termination cost. And the optimal access charge is equal to zero or even negative if, for example, $\lambda \leq \frac{1}{2}$ and $c_O \geq c_T$.[38]

[37] Efficient consumption will also be achieved if the sender pays λc and the receiver pays 0 (or indeed any price lower than $(1-\lambda)c$), so it is not necessary to introduce charges for receiving calls to induce consumption efficiency. If $p_T = 0$, the "unrecovered" costs $(1-\lambda)c$ can be recovered via a fixed fee or subscription charges, levied on either party.

[38] An access charge equal to zero is also efficient when the marginal cost of a call is zero.

On the basis of these results, DeGraba (2003) argues that bill-and-keep, by imposing some of the cost of a call on each network, is more efficient than cost-based termination charges. DeGraba (2003) also notes that, since the optimal access charge does not depend on the number of calls originating on one network as opposed to the other, bill-and-keep is more efficient than cost-based termination charges *even when traffic between networks is not in balance,* contradicting the widely-held belief that bill-and-keep arrangements are only appropriate when traffic between networks is balanced. Finally, another obvious advantage of bill-and-keep is that it is much simpler to implement for the regulator than cost-based termination charges.[39]

Berger (2004, 2005) DeGraba's simple model is not well-suited to analyzing competition between networks. By contrast, Berger (2004) analyzes network competition in linear prices using the standard Hotelling model of Laffont et al. (1998b) in the presence of call externalities. As in the models discussed in Section 2 above, he shows that call externalities have a significant effect on competition because, given the access charge, networks set higher off-net prices to make subscription to the rival networks less attractive. Therefore, on-net prices are lower than off-net prices and, contrary to the results of Gans and King (2001), cooperatively agreed access charges may exceed the welfare-optimal charge, even if the cooperatively agreed charge is below marginal cost.

Building on the model of Jeon et al. (2004), Berger (2005) completes the analysis by considering optimal access charges in the presence of nonlinear (i.e. two-part) tariffs and call externalities. He shows that the welfare maximizing termination rate is less than marginal cost even in this case, and quite possibly less than zero.

[39] Wright (2002b) criticizes this conclusion, arguing that bill-and-keep does not solve "*the fundamental problem of pricing out network externalities.*" Because bill-and-keep excludes a positive termination charge that may serve to internalize the network externality, Wright concludes that it often leads to less efficient outcomes. In response to this, DeGraba (2002) points out that a positive termination charge will typically harm the subscribers of the (e.g. fixed) network, and may consequently reduce the number of subscribers to this network. Hence the net effect on welfare of positive termination charges is at best ambiguous, with both network and call externalities, and must be evaluated empirically.

This result can be obtained by noting that the efficient off-net price is equal to the equilibrium on-net price and, from equation (4), the welfare-maximizing access charge is equal to

$$a^* = \frac{(1-\beta)\, c_T - 2\beta c_O}{(1+\beta)}. \tag{14}$$

Thus the welfare-maximizing access charge is always less than the total marginal cost of a call ($c_O + c_T$) and, for realistic values of β, frequently negative (e.g., for $c_O = c_T$ and $\beta > 1/3$). Therefore, in contrast to Gans and King's result, and corroborating the view of Cambini and Valletti (2003), Berger (2005) argues in favor of bill-and-keep, showing that such an arrangement is welfare improving compared to cost-based access pricing.

Finally, Armstrong and Wright (2007, pp. 20-21) also consider the non-cooperative setting of termination rates in the presence of call externalities. Similar to Berger's results, their analysis suggests that, with two-part tariffs and discriminatory prices, cost-based access pricing can never be optimal from the social viewpoint, when the call externality is taken into account. In realistic cases, the optimal access charge is less than zero. It follows that, from the social viewpoint, bill-and-keep — i.e. $a = 0$ — is an improvement over cost-based access pricing.

4 Empirical Evidence

4.1 Market Shares and Network Effects

As mobile networks are highly compatible with each other, the network effects that exist in mobile markets are primarily induced by the network operators themselves, through off-net/on-net call price differentials (these have been described as "tariff-mediated network effects" by Laffont et al. 1998b). With tariff-mediated network effects, other things being equal, consumers will prefer to join the network which has the largest number of their calling partners, and hence large networks are favoured over smaller ones. Some recent empirical work has attempted to estimate the extent to which tariff-mediated network effects influence consumer behavior in mobile markets.

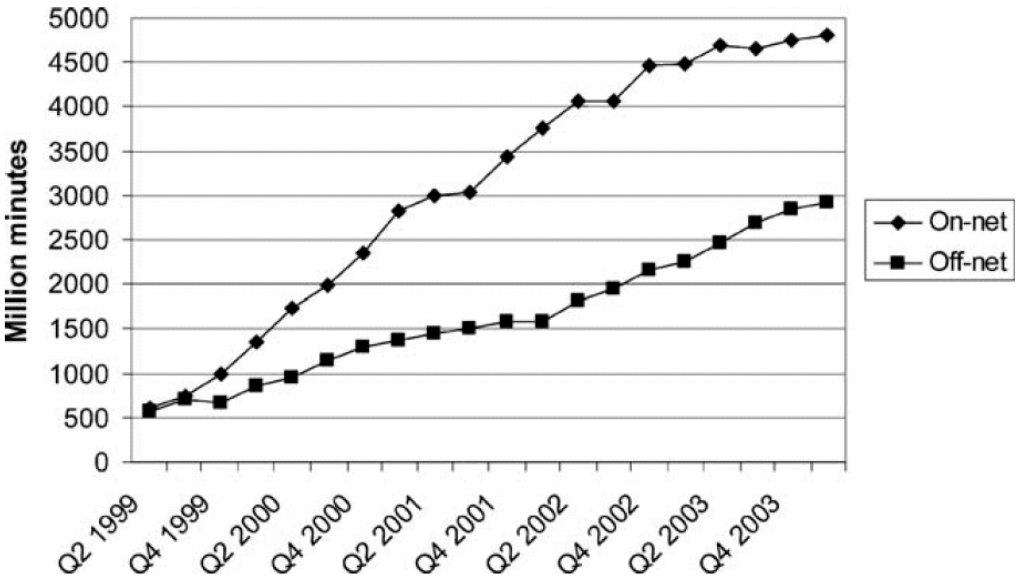

Figure 1: Birke and Swann (2006). Development of on-net and off-net call volumes. Based on data from Ofcom.

Birke and Swann (2006) study mobile network calling patterns and estimate subscription-level network effects using market data from Ofcom and micro-level data on consumers' usage of mobile telephones from the survey Home OnLine. They estimate two classes of models which illustrate the role of network effects. The first is an aggregate model of the comparative volume of on-net and off-net calls which shows that the proportion of off-net calls falls as mobile operators charge a premium for off-net calls.

Figure 1 — taken from Birke and Swann (2006) — shows the actual development of on-net and off-net calls from the beginning of 1999 to the end of 2003. Whereas a roughly equal amount of on-net and off-net calls were made at the beginning of the period, the on-net call volume increased considerably from Q4 1999. For the whole period the percentage of on-net calls is above 50%, which is far higher than the expected percentage that Birke and Swann (2006) calculated in the absence of any network effects.

Figure 2 — taken from Birke and Swann (2006) — depicts the develop-

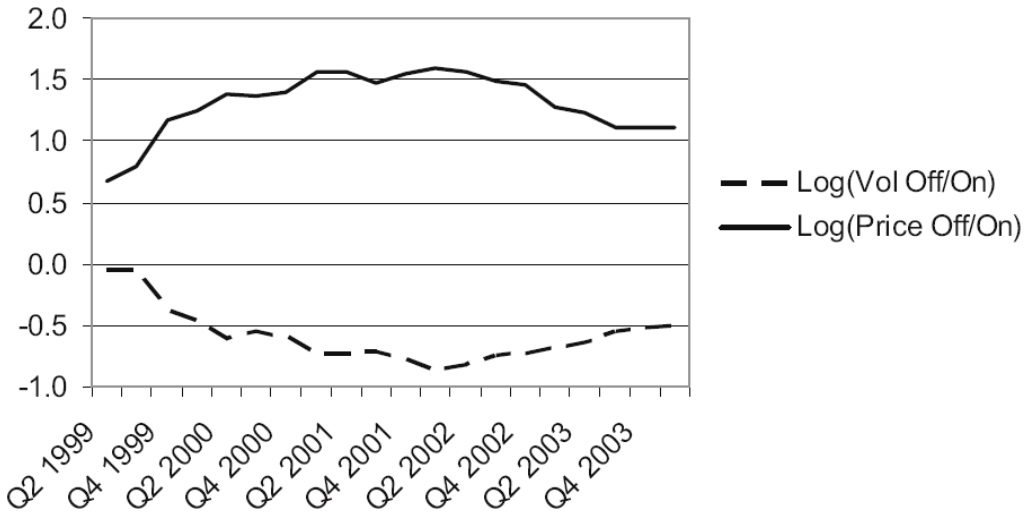

Figure 2: Birke and Swann (2006). Price-ratio between off-net and on-net calls.

ment of the ratio between prices for off-net calls and for on-net calls. In early 1999, off-net calls were about twice as expensive as on-net calls (19 ppm compared to 10 ppm). Two years later, off-net calls were about five times more expensive (26 ppm compared to 6 ppm). Afterwards, a decrease in the price ratio can be observed, but prices for off-net calls were still about three times higher in early 2004 (16 ppm compared to 5 ppm).

Birke and Swann's estimation results indicate that the observed ratio of off-net to on-net calls is sensitive to the price premium for off-net calls, especially when time lags for consumer inertia and imperfect price information are allowed for. However they also find that, even in the absence of any price discrimination between on-net and off-net calls, a disproportionate number of calls are on-net, suggesting the existence of a "pure" network effect unrelated to price differentials.

Their second model analyses the choice of operator by individual consumers. They find that individual subscribers' choices show considerable inertia, but are heavily influenced by the choices of the other members of the same household. There is also some evidence that individual choice of

operator is influenced by the total number of subscribers for each operator.

Birke and Swann (2006) argue that their results provide a strong indication that network effects play an important role in mobile telecommunications, particularly on usage patterns of mobile phones and on operator choice. They suggest that tariff-mediated network effects lead to the coordination of operator choice, and (Birke and Swann 2006, p. 83):

> "*the strong reaction from consumers to changes in the price ratio of off- and on-net calls suggest that inducing network effects by operators has been a successful strategy. It can in particular be used by the incumbent operators to fend off challenges by new entrants, such as '3' in the UK and also by any operator gaining a lead over the other operators. [...] High termination charges and high costs for off-net calls have been regarded in a recent ruling by the UK regulator OFCOM as being the result of significant market power that operators have on their individual networks. As our results suggest, the high price of off-net calls cannot only be a result of market power, but can be a significant source of market power, which can especially be used to preempt entry by new competitors. If high switching costs are present in mobile telecommunications, this market power would be highly stable once consumers have aligned their operator choice even after the price differential between on- and off-net calls has been lowered.*"

In a companion paper, Birke and Swann (2007) directly examine provider choice in mobile networks using class surveys undertaken in the UK, Malaysia, Italy and the Netherlands. The Netherlands differs from the other countries in the study in that its mobile operators do not charge different prices for on-net and off-net calls. They found that the respondents strongly coordinated on their choice of mobile phone operator if operators induced tariff-mediated network effects, but not if prices for off-net calls were the same as prices for on-net calls, suggesting that coordination and network choice strongly depends on tariff-mediated network effects, rather than on other factors. Interestingly, they found that the degree of coordination for H3G subscribers in the UK was insignificant when compared to the larger networks such as

Vodafone (Table 6, p. 15). They attribute this to the fact that in 2005, H3G was the only UK mobile operator that did not charge higher prices for off-net calls, but offered packages of calling time regardless of the network to which calls are made.[40]

The Birke-Swann studies therefore provide considerable support for the recent theoretical literature, which suggests the importance of on-net/off-net price discrimination in influencing network choice and calling behavior in mobile markets. In particular, that strategically inducing network effects can be a successful strategy for attracting and maintaining market share, and for preempting entry or retarding the growth of smaller networks.

4.2 International Experience with Bill and Keep

Only a few countries internationally use bill-and-keep, and it tends to be used selectively. The United States, for example, is "calling party network pays" (CPNP) for calls to fixed incumbent operators, but is effectively bill-and-keep for mobile-to-mobile calls and for calls from one non-incumbent fixed provider to another (or to a mobile operator). In France, bill-and-keep was used for mobile-to-mobile calls until 2004. Hong Kong has bill-and-keep for mobile-to-mobile calls whereas mobile networks pay to both send and receive calls from fixed networks. Singapore uses a U.S.-like system, with bill-and-keep for calls terminating on the mobile network, but CPNP for calls terminating on the fixed network. A general conclusion which emerges however, is that bill-and-keep arrangements lead to low retail prices and very high mobile utilization rates compared with CPNP countries, with little effect on penetration rates. Further, with bill-and-keep, incentives for on-net/off-net price discrimination are reduced, and in some cases these disappear altogether. So as claimed above, bill-and-keep arrangements tend to encourage a more efficient retail-pricing structure.

[40] In a related study, Birke and Swann (2005) estimate the importance of tariff-mediated network effects in mobile telephony, and the impact of the structure of social networks on consumers' network adoption decisions, using social network data from a survey of second year undergraduate students at the University of Nottingham Business School. As in their other studies, they find that students strongly coordinate their choice of mobile phone operators, but do this only for operators which charge a price differential between on-net and off-net calls.

On-net/off-net price differentials Large price differentials for on-net and off-net calls are common in most European mobile markets. In the UK, pre-pay packages, to which some 65% of customers subscribe, frequently discriminate between on-net and off-net calls.[41] Typically these price differentials are much larger than can be accounted for by mobile-to-mobile termination charges of approximately 6 ppm. Discrimination is also apparent in the MNOs' monthly packages.[42] Ofcom reports that for the UK market as a whole, average charges for off-net calls were 8.9 ppm in 2006, compared with 3.5 ppm for on-net calls, having been as high as 22.6 ppm versus 5.1 ppm in 2002.[43]

Data from European countries such as France, Germany and Spain tell a similar story. France's largest mobile operator, Orange, offers monthly packages with unlimited on-net call allowances. The second largest operator, SFR, offers monthly packages with unlimited call allowances to 3 nominated on-net numbers.[44] In Germany, some operators' tariffs offer unlimited on-net calls.[45] And in Spain, the largest mobile operator, Telefonica, offers a pre-pay tariff which charges 3.3 ppm for on-net calls compared with an off-net call rate of 39.9 ppm.[46] Other operators also offer on-net call discounts.

[41] A review of operators' websites in September 2007 provides several examples of this. O2's Pay & Go Talk Anytime tariff offered on-net calls at 25 ppm for the first 3 minutes of a day, and 5 ppm afterwards, compared with an off-net mobile rate of 40 ppm. T-Mobile's "Mates Rates" tariff (its default tariff for new customers), offered on-net calls for 8 ppm, compared with an off-net mobile rate of 40 ppm. Orange's "Magic Numbers" scheme offered calls at 15p per hour (as opposed to the standard rate of 15 ppm) to 3 nominated on-net numbers. Of the four incumbent operators, only Vodafone failed to discriminate between on-net and off-net calls in its pre-pay tariffs, although as noted below, it did discriminate in some of its monthly packages.

[42] A review of operators' websites in September 2007 again provides examples. O2's more costly Anytime packages offered a fixed minute allowance for peak off-net calls, but an unlimited allowance for on-net calls. Vodafone's Small Business packages offered unlimited allowances for on-net calls to other business numbers. T-Mobile's U-Fix packages offered on-net calls at 10 ppm, compared with an off-net mobile rate of 35 ppm. Finally, Orange's more costly Canary packages offered a fixed minute allowance for off-net calls but an unlimited allowance for on-net calls.

[43] See Ofcom (2007b), Figure 4.40.

[44] Sourced from operator websites: 12 September 2007.

[45] Annex to the European Electronic Communications Regulation and Markets 2006, Volume 1, European Commission, 29 March 2007, p. 112.

[46] "Solid performance, strong trends," Telefonica, 6 June 2007.

By contrast, in countries which have adopted bill-and-keep arrangements between mobile operators, these differentials are reduced, or even absent altogether. In the US and Canada, monthly packages, which are adopted by the majority of customers,[47] tend to offer a fixed monthly minute allowance for peak off-net calls, and unlimited minute allowances for both on-net and off-peak calls.[48] Pre-pay packages also tend to offer generous or unlimited minute allowances for both on-net and off-peak, off-net calls.[49]

The situation in Hong Kong and Singapore is very different. Pre-pay packages, which are common,[50] tend not to discriminate at all between on-net and off-net calls. Most monthly packages also tend not to discriminate between on-net and off-net calls.[51]

France provides a particularly interesting example of the possible relationship between wholesale termination arrangements and on-net/off-net price differentials. Mobile termination is currently CPNP, and as noted above differentials are common. However, these differentials have only emerged since 2005,[52] prior to which mobile-to-mobile termination was on a bill-and-keep basis (see Marcus 2007, Section 4.1.2.2).

Prices and usage The price and usage advantages of bill-and-keep over CPNP have been noted by a number of commentators. Marcus (2007) observes that "*countries with CPNP systems tend to have higher retail prices and lower use of mobile service than those with Bill and Keep.*" Littlechild

[47] In Q1 2007, only 15% of customers in the US, and 22% of customers in Canada, were pre-pay (Global Wireless Matrix 1Q07, Merrill Lynch, 15 June 2007).

[48] In some cases minute allowances are literally unlimited, whereas in others they are so generous, relative to the minute allowances for peak off-net calls, that they are effectively unlimited for most customers.

[49] Review of operator websites, August 2007.

[50] In Q1 2007, 66% of customers in Hong Kong, and 40% of customers in Singapore, were pre-pay, compared with 66% of customers in the UK (Global Wireless Matrix 1Q07, Merrill Lynch, 15 June 2007).

[51] Sourced from operator websites: August 2007. Some monthly plans have separate allowances for on-net and off-net calls, but the on-net allowances are far less generous than those seen in the US and Canada.

[52] 2006 Annual Report, ARCEP, p. 195, http://www.arcep.fr/index.php?id=1&L=1.

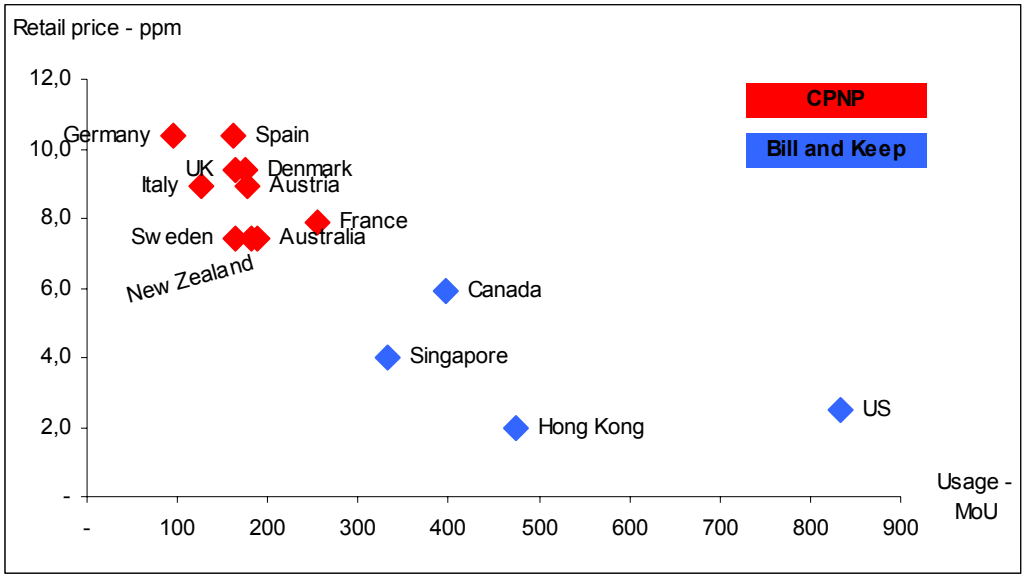

Figure 3: Usage and average retail prices, Q1 2007: bill-and-keep vs CPNP. Source: Merrill Lynch Global Wireless Matrix 1Q07, 15 June 2007.

(2006) and Ovum (2006, pp. 78-79) reach similar conclusions.[53] Ofcom has also recognized the advantages of bill-and-keep, noting that it "*tends to yields significantly higher minutes of use per subscriber*" and that "*average revenue per minute is lower.*"[54] Figure 3 compares usage and average retail prices between bill-and-keep and CPNP countries.

To summarize, high termination rates tend to lead to high retail prices for originating calls, and correspondingly lower usage rates. As we might

[53] Littlechild (2006) compares Receiving Party Pays (RPP) countries with Calling Party Pays (CPP) countries, noting that "*RPP tends to reduce average revenue per minute and increase average usage without adversely affecting mobile penetration*". However, while all of the countries he describes as RPP in this context have bill-and-keep wholesale arrangements, one of them (Singapore) is now CPP, and in two others (US and Canada), customers can opt for CPP tariffs if they wish. Hence Littlechild's conclusion that bill-and-keep "*has essentially all the beneficial consequences of RPP (for which it has traditionally been the basis) but offers the prospect of avoiding the downside [i.e. mandatory RPP]*".

[54] Paragraph 6.6, Mobile Call Termination — Market Review, Ofcom, 30 March 2006. Ofcom reaches its conclusion by comparing the bill-and-keep countries (USA, Canada, Hong Kong, Singapore and China) with CPNP countries in Europe and elsewhere.

expect, the higher marginal prices at the retail level tend to depress call origination due to the price elasticity of demand. It is difficult to avoid the conclusion that, via the effects identified in this paper, bill-and-keep leads to more intense price competition and hence lower prices for mobile subscribers.

5 Conclusion

In an extensive review of the economic arguments and empirical evidence surrounding the "Calling Party Pays" (CPP) versus "Receiving Party Pays" (RPP) debate, Littlechild (2006) has summarized the arguments in favour of bill-and-keep in terms of avoiding the "bottleneck monopoly problem:"

> *"In many countries there is widespread concern at the level of mobile termination charges. This is attributable to the bottleneck monopoly created by the Calling Party Pays (CPP) principle. It has led to increasingly severe price controls on termination charges. [...] The Receiving Party Pays (RPP) principle, which applies in North America and several Asian countries, avoids the bottleneck monopoly problem. [...] Surprisingly, CPP regulators have either ignored RPP or rejected it for various alleged disadvantages. These do not withstand investigation. However, in CPP countries there is still concern about the idea of paying to receive calls.*
>
> *There is a way to get the benefits associated with RPP without this disadvantage. RPP is based on a 'bill and keep' regime. Some mobile operators in RPP countries are now offering customers the option of calling plans with free incoming calls. Changing to a 'bill and keep' regime would avoid the bottleneck monopoly and associated distortions of conventional CPP regimes, yet enable operators and customers themselves to choose how to pay for calls — in effect, to choose between CPP and RPP."*

As we have argued in this paper, in addition to the advantages noted by Littlechild and others, a move to bill-and-keep also reduces incentives for

inefficient on-net/off-net price discrimination, which is at least partly responsible for softening price competition and maintaining higher call charges in the UK and other CPP countries. In addition, by exacerbating MNOs' incentives to introduce socially inefficient tariff structures, high mobile-to-mobile termination charges, which make off-net calls more costly than on-net calls, create an entry barrier for small networks which are unable to profitably replicate incumbents' pricing strategies.

Efficient pricing requires equal on-net and off-net charges below marginal cost to correct for the call externality. Hence, optimal termination charges are also below marginal cost, and the difference between termination charges and marginal costs is likely to be larger for mobile-to-mobile charges than for fixed-to-mobile charges, to compensate for more intense competition between mobile networks. A move to bill-and-keep for mobile-to-mobile termination would likely result in a more efficient wholesale and retail price structure, help to eliminate barriers to entry caused by "tariff-mediated" network effects, and increase welfare and competition in the mobile market.

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Annex 4: Welfare Model

H3G Welfare Model

Introduction and overview

1. Annex 19 of OFCOM's 27 March 2007 "Mobile call termination" Statement ("the MCT Statement") reports the results of OFCOM's welfare analysis which is intended to provide "*an order of magnitude indication of the consumer welfare gain from regulating MCT charges*". Paragraph A17.15 of the MCT Statement, however, states:

   "*In order to estimate the level of welfare-optimal termination charges, it is necessary to account not only for the impact that prices have on demand, as in a basic Ramsey model, but also for a variety of other important factors such as externalities, imperfect competition and price discrimination (in particular second degree price discrimination in the form of non-linear pricing). Developing a reliable applied modelling framework that captures all these relevant features, however, cannot be done robustly, in OFCOM's view, due to the difficulties and uncertainties inherent in dealing with such complex market environments.*"

2. OFCOM's welfare model apparently captures none of these relevant factors, with the exception of an adjustment for network externalities, which casts some doubt on its reliability.[1] If the model is unable to estimate the level of welfare-optimal termination charges, as implied by the passage above, it is unclear how it can be said to reliably estimate the welfare consequences of moving from one or another level of these charges to the regulated MCT charges. Notwithstanding this, the welfare model is the only quantitative evidence which OFCOM provides in favour of regulating termination charges at the levels specified in the MCT Statement.

3. H3G has therefore constructed its own welfare model which explicitly captures a number of the most important missing ingredients in OFCOM's model, in order to assess the welfare benefits of a move to much lower termination charges. In particular we consider the consequences of:

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[1] OFCOM's welfare model assumes the existence of two "firms" or networks, and linear, non-discriminatory prices. Specifically, it assumes a single mobile operator and a single fixed operator, with no competitive interaction between them. For a given fixed-to-mobile (FTM) termination rate, the mobile operator is assumed to set its retail prices so as to maximise consumer surplus subject to a zero-profit constraint. The fixed operator is assumed to set its FTM retail price to achieve a given level of "retention" (i.e. profit margin) on FTM calls. OFCOM's welfare model is therefore unable to capture any of the direct effects of varying MCT rates on mobile-to-mobile (MTM) competition, call prices or volumes, but rather focuses entirely on estimating the welfare costs of high fixed-to-mobile retail prices.

A. MCT rates set at zero - or "bill and keep" (B&K) - for both MTM calls and FTM calls (**NPZ 1**);[2]

B. MCT rates set at zero – or B&K - for MTM calls, with low, reciprocal rates for FTM calls based on MTF termination rates (**NPZ 2**); and

C. Low, reciprocal MCT rates for both MTM and FTM calls, based on MTF termination rates (**NPZ 3**).[3]

4. The key ingredients required for such a model are: (i) an appropriate equilibrium theory of the determination of mobile-to-mobile retail call charges, so that imperfect competition, or competitive interaction between a number of asymmetrically-sized MNOs, can be captured; (ii) reasonable estimates of the marginal (or avoidable) costs of call origination and termination; and (iii) allowance for the effects of call externalities, which practically all economists now accept are crucial determinants of competition between mobile networks and economic welfare (see the literature cited below).

Discriminatory pricing

5. The appropriate equilibrium theory when discriminatory pricing is considered is provided by Jeon, D., J.-J. Laffont and J. Tirole (2004) "On the Receiver Pays Principle," (*RAND Journal of Economics*, 35, 85-110) which allows for: (i) nonlinear pricing, i.e. two-part tariffs; (ii) "network-based price discrimination", i.e. different prices for on-net and off-net calls, so the impact of changing the level of MCT rates on mobile-to-mobile retail call charges can be captured; and (iii) call externalities, i.e. both senders and receivers of calls benefit from them.[4] Jeon et al. (2004) show that, with network-based price discrimination, each mobile firm will fully internalize call externalities on its own network, and set an on-net price equal to marginal cost less a factor which depends upon the size of the call externality. By contrast, because off-net call charges affect the welfare of consumers on rival networks, they are subject to strategic manipulation.

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2 MCT rates set at zero for FTM calls is not something H3G has explicitly requested as relief sought, but is useful as a comparator result for NPZ 2 and NPZ 3.

3 H3G's model can also be used to assess the effects of reductions in MCT rates on its traffic and termination revenue imbalances with the other MNOs. It can therefore be used to consider the levels of termination charges required to achieve different variants of "net payments zero" (NPZ), or close approximations to it (see paragraph 14 below).

4 The formulation of Jeon et al. (2004) is the standard one, and has been adopted by Berger, U. (2005) "Bill-and-Keep vs. Cost-Based Access Pricing Revisited," (*Economics Letters*, 86(1), 107-112); and Hoernig, S. (2007) "On-Net and Off-Net Pricing on Asymmetric Telecommunications Networks," (*Information Economics & Policy*, 19(2), 171-188), among others. Armstrong, M. and J. Wright (2007) "Mobile Call Termination in the UK," (UCL, September) offer a slightly different formulation of equilibrium call charges with call externalities, but with qualitatively similar conclusions. See Harbord, D. and M. Pagnozzi (2008) "On-Net/Off-Net Price Discrimination and `Bill-and-Keep' vs. `Cost-Based' Regulation of Mobile Termination Rates" (http://www.market-analysis.co.uk/toparticles.html) for a survey of this literature.

6. Specifically, Jeon et al. find that the socially optimal *on-net* and *off-net price* is equal to the equilibrium on-net price given by:

(1) $$p_{ii}^{*} = \frac{C_0 + C_T}{1 + \beta}$$

where C_0 is the marginal cost of origination; C_T the marginal cost of termination; and β the call externality factor.[5] The equilibrium off-net price, on the other hand, for a network with market share $\alpha_i<1$, is given by:

(2) $$p_{ij}^{*} = \begin{cases} \dfrac{(1-\alpha_i)(C_0 + a)}{1-\alpha_i(1+\beta)}, \; for \; \alpha_i < \dfrac{1}{1+\beta} \\ +\infty, otherwise \end{cases}$$

where *a* is the MTM termination charge. Hence: (a) in the absence of a call externality (when β=0), the off-net price is equal to c_0+*a* and the on-net price to c_0+c_T , so the on-net/off-net price differential is determined solely by the difference between marginal termination costs and the termination charge;[6] and (b) a larger network charges a higher off-net price, and has a higher off-net/on-net price differential, than a smaller network.

Non-discriminatory pricing

7. It is equally possible to use alternative pricing assumptions, such as equal on-net and off-net prices in the model. The relevant pricing formulae can be then found in the older economics literature (e.g. Laffont, J.-J., P. Rey and J. Tirole, 1998, "Network Competition I: Overview and Nondiscriminatory Pricing," *RAND Journal of Economics*, 29(1), 1-37), suitably adapted to take account of the number of competing networks and the relevant externalities.

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5 Specifically, Jeon et al. (2004) assume that a sender of call obtains a gross surplus *u(q)* from a call of length *q*, while the receiver obtains a surplus of *βu(q)*, where *β>0* is a measure of the strength of the call externality.

6 De Bijl, P. and M. Peitz (2002) *Regulation and Entry Into Telecommunications Markets*, (Cambridge University Press), Ch. 6.4, also solve for the equilibrium pricing structure with two-part tariffs and price discrimination in the absence of a call externality. As in Jeon et al. (2004), both on-net and off-net prices are set equal to marginal cost, and therefore the on-net/off-net price differential is completely determined by the reciprocal termination charge.

8. Under non-discriminatory pricing, the price for on-net and off-net calls on network *i* is then given by:[7]

(3) $$p_i^* = (C_0 + C_T)\alpha_i + (C_0 + a)(1 - \alpha_i)$$

9. The equilibrium call prices given by (1) and (2) or (3) above are used in H3G's welfare model to specify the call prices charged by five mobile network operators with different market shares as assumptions on the levels of marginal costs and MCT rates are changed between scenarios.[8] These then allow a calculation of individual and aggregate calling patterns and the associated levels of consumer surplus and profits derived from them once the relevant demand parameters have been specified.[9,10]

10. Equilibrium fixed charges are not included in the model as these only affect the division of total surplus (i.e. consumer surplus from making and receiving calls, and firms' profits from implementing the equilibrium call charges), between consumers and firms, and not the level of aggregate welfare for fixed market shares.[11] Fixed network and

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7 It is straightforward to establish that a network's incentive to increase off-net call prices due to the call externality is exactly offset by its incentive to reduce on-net call prices, so equation (3) is true for all values of β, and equivalent to equation (13) in Laffont et al. (1998).

8 The model assumes one small operator with a market share of 8% and four equal-sized larger operators with market shares of 23%. Jeon et al. (2004) consider a duopoly model. It is easy to see that the expression for equilibrium on-net prices given in (1) is independent of the number of networks and their market shares, however. It is also straightforward, but tedious, to show that the expression given by (2) for off-net prices generalizes to the case of N > 2 networks, by following, for example, the methods employed in Armstrong and Wright (2007).

9 The model thus assumes that networks offer two-part tariffs, whereas OFCOM assumes linear tariffs in its model (in reality MNOs offer both types of tariff). It also assumes a "balanced calling pattern" as is the near-universal practice in the literature, i.e. that each telephone subscriber calls every other subscriber with equal probability.

10 The model assumes linear demand curves which have been calibrated using the same data employed by OFCOM to calibrate its model in Annex 19 of the MCT Statement (Figure A19.1), and supplemented where necessary by data from other sources, such as OFCOM, The Communications Market 2007, and BT's Regulatory Accounts. Data assumptions are specified below. H3G's model excludes non-voice services (messaging and data) which are included in OFCOM's model, and does not include subscription as a separate "service". It also makes no allowance for OFCOM's assumed cross-elasticities of demand between services (Figure A19.2, MCT Statement). Exclusion of messaging and data will only affect aggregate welfare estimates, and not differences, when the assumed cross-elasticities are small (see paragraph 16 below).

11 The equilibrium fixed charges will also influence equilibrium market shares in general. Hoernig (2007) solves for equilibrium fixed charges and market shares in a duopoly model, but deriving similar expressions for an oligopoly model appears to be intractable (see also Calzada, J. and T. Valletti (2007) "Network Competition and Entry Deterrence," *Economic Journal*, forthcoming). For the purposes of an aggregate welfare analysis, however, it seems reasonable to assume fixed market shares, and sensitivity analysis shows that the effects of small changes in market shares are not material.

subscriber costs have also been excluded, as these effect aggregate welfare calculations only, and not the welfare comparisons between alternative scenarios.[12] Finally, network externalities have been excluded since the UK mobile market – like most European markets – is effectively saturated, and there is little evidence that network externalities remain significant. Following OFCOM's own welfare model, H3G has assumed a single fixed operator which does not price strategically (Armstrong and Wright 2007, make a similar assumption).

11. A range of assumptions on the marginal costs of termination have been considered. Estimates of marginal costs use H3G's own estimates of LRIC (or LRAIC) as well as, for comparison purposes, OFCOM's estimate of fully allocated network costs as used in its own welfare model.

12. Under discriminatory pricing, the conclusions of the model are that a move from the level of TACs imposed by OFCOM for 2010/11 to any of: (A) "full bill and keep" (i.e. **NPZ 1**); (B) "partial bill and keep" (**NPZ 2**); or (C) low, reciprocal MCT rates for MTM and FTM calls (**NPZ 3**), results in an overall welfare gain of approximately £0.3 billion, when call externalities are entirely absent (i.e. $\beta = 0$ in the spreadsheet), to approximately £1.1 billion, when call externalities are significant ($\beta = 1$ in the spreadsheet), assuming reasonable values for the marginal cost of termination of 0.8 ppm for the small network and 0.6 ppm for each of the large networks.[13] For a significant level of call externalities (e.g. $\beta = 1$), the model's estimated welfare gains from a move to (A), (B) or (C) are broadly similar under a wide variety of assumptions on the marginal costs of termination, including the fully-allocated network costs which are the output of OFCOM's cost model (i.e. 5.2 ppm for H3G and 4.5 ppm for each of the large MNOs).[14]

13. Since OFCOM's welfare model estimates welfare gains from regulation varying from £1.4 billion in 2010/11 (when the unregulated price of termination is assumed to be an unrealistic 24 ppm), to £0.4 billion (for an unregulated rate of 14.5 ppm),[15] H3G's estimated welfare gains from a move to NPZ are clearly significant.

14. Under **NPZ 1** and **NPZ 2** the small network's MTM off-net termination revenue balance is, of course, precisely zero. Under **NPZ 3** (low, reciprocal rates for all off-net traffic), the smaller network's MTM termination revenue imbalance is less than £500,000 per annum under all scenarios (with discriminatory pricing), and less than £100,000 per annum under the lowest marginal cost estimates. Hence **NPZ 3** effectively achieves "net payments zero" for all practical purposes.

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[12] It is a standard result of the literature on network competition since at least Laffont et al. (1998) that equilibrium call charges are not affected by the level of fixed network or per subscriber costs. Therefore these costs – so long as they are uninfluenced by changes in assumptions on the level of marginal costs and MTRs – effect aggregate welfare only, and not welfare comparisons between alternative scenarios.

[13] See "Estimates of origination and termination LRAICS", submitted by H3G on 7 March 2008.

[14] Paragraphs 17-18 below provide further details of the results of the model.

[15] OFCOM's MCT Statement, Annex 19, Figures A19.4 and A19.5.

15. Under non-discriminatory pricing, a move from the level of TACs imposed by OFCOM for 2010/11 to MCT rates set with reference to (A), (B) or (C) above results in an overall welfare gain of just under £0.3 billion, when call externalities are entirely absent (β = 0), to more than £0.6 billion when call externalities are significant (β = 1), assuming values for the marginal cost of termination of 0.8 ppm for the small network and 0.6 ppm for each of the large networks. Again, for a significant call externality factor, the model's estimated welfare gains from a move to NPZ are broadly similar under to a wide variety of assumptions on the marginal costs of termination, including OFCOM's fully-allocated network cost estimates.

16. Finally, when we follow OFCOM and assume an industry-wide, monopoly mobile firm in the model, and marginal call costs equal to OFCOM's estimates of fully-allocated network costs, the model estimates welfare gains from regulation in 2010/11 of £1.7 billion when the unregulated price of termination is assumed to be 23.9 ppm, as against OFCOM's estimate of £1.4 billion, and of £0.5 billion when the unregulated price is assumed to be 14.5 ppm, as against OFCOM's estimate of £0.4 billion.[16] This would appear to confirm that the additional services (messaging, data and subscription) and cross-elasticities of demand assumed in OFCOM's model, primarily affect aggregate estimates of welfare, but have only small effects on their estimates of welfare gains and losses from adopting alternative MCT rates.

[16] Figures A19.4 and A19.5, OFCOM's MCT Statement.

Summary of results of the welfare model

17. The results of the discriminatory pricing variant of the welfare model are summarised below:

Welfare gain/(loss) (£bn)	β = 0			β = 1/3			β = 1/2			β = 1		
	FAC	MC 1	MC 2	FAC	MC 1	MC 2	FAC	MC 1	MC 2	FAC	MC 1	MC 2
NPZ 1	(0.1)	0.3	0.3	0.2	0.5	0.5	0.4	0.6	0.6	1.2	1.1	1.1
NPZ 2	(0.1)	0.3	0.3	0.2	0.5	0.5	0.4	0.6	0.6	1.2	1.1	1.1
NPZ 3	(0.1)	0.3	0.3	0.2	0.5	0.5	0.4	0.6	0.6	1.2	1.1	1.1

Welfare gain/(loss) is based on move from OFCOM TACs to alternative MTR regimes
FAC = marginal costs estimated as OFCOM fully allocated network costs
MC1 = marginal costs estimated as per H3G LRAIC calculations (ED approach)
MC2 = marginal costs estimated as per H3G LRAIC calculations (LRAC approach)

18. The results of the non-discriminatory pricing variant of the welfare model are summarised below:

Welfare gain/(loss) (£bn)	β = 0			β = 1/3			β = 1/2			β = 1		
	FAC	MC 1	MC 2	FAC	MC 1	MC 2	FAC	MC 1	MC 2	FAC	MC 1	MC 2
NPZ 1	(0.1)	0.3	0.3	0.2	0.4	0.4	0.3	0.5	0.5	0.6	0.7	0.7
NPZ 2	(0.1)	0.2	0.3	0.2	0.4	0.4	0.3	0.4	0.5	0.6	0.6	0.6
NPZ 3	(0.0)	0.2	0.3	0.2	0.4	0.4	0.3	0.4	0.5	0.6	0.6	0.6

Copy of the welfare model

19. A copy of the welfare model is attached.[17] The file contains the welfare model itself, together with some functionality to allow the running of different scenarios.

[17] This is a slightly updated version of the model supplied on 7 March 2008. The only material change is the inclusion of welfare calculations based on non-discriminatory pricing as well as discriminatory on-net and off-net pricing.

Detailed description of the welfare model

20. The welfare model is contained in the "Base models" sheet. This sheet contains two variants of the model, one based on discriminatory pricing between on-net and off-net MTM calls, and another based on non-discriminatory pricing. The only difference between these two variants is the assumed pricing of MTM calls, which is explained below.

Overview of welfare model

21. The model estimates total (producer plus consumer) surplus, before fixed costs, for each of five MNOs and one FNO, arising from mobile-to-mobile (MTM), mobile-to-fixed (MTF) and fixed-to-mobile (FTM) calls. [18]

22. The model takes account of caller externalities but not of network externalities.

23. All inputs into the welfare model are shaded yellow, with all other cells being calculated.

24. A number of cells in the model, marked by a red triangle in the corner, contain comments which give information such as details of sources for inputs. This information is not repeated here.

25. The model is divided into a number of sections, each given a shaded heading. Each of these sections is discussed below.

Utility and demand parameters

26. The level of demand per subscriber is calculated in terms of call minutes (per year), as the product of:

    a) calls per subscriber per million potential recipients; and

    b) call length in minutes per call.

27. The model assumes that (a) is constant but that (b) varies according to a linear demand function. The values for (a) have been chosen so as to give a realistic call length per call, and the linear demand function for (b) has calibrated against OFCOM's own welfare model for any chosen value of (a).

28. The distinction between (a) and (b) is purely for presentational purposes and is designed to make the modelling easier to follow. The choice of (a) does not affect the results as in all cases (b) is automatically calibrated against OFCOM's welfare model, taking into account the chosen value for (a).

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[18] Fixed-to-fixed (FTF) calls are excluded on the assumption that they will not be affected by the level of MCT rates.

29. Two demand functions are assumed: one for MTM and MTF calls; and another for FTM calls.

30. In the case of both demand functions, the model allows for the existence of call externalities through an input a value for β, the call externality factor.

Subscribers

31. The model assumes a constant number of mobile subscribers, with four equally sized large MNOs and one small MNO.

32. The model also assumes a constant number of fixed subscribers for the FNO.

Per minute prices

33. The model estimates the equilibrium level of per minute prices for MTM, MTF and FTM calls.

34. This assumes that calls are charged according to a two-part tariff, with per minute prices and a fixed per subscriber charge.

35. The model does not estimate the equilibrium fixed per subscriber charge, since this is not relevant to the level of total surplus, assuming a fixed level of subscribers.

MTM prices

36. In the discriminatory pricing variant of the model, MTM prices are set by reference to equations (1) and (2) set out in the introduction section.

37. In the non-discriminatory pricing variant of the model, MTM prices are set by reference to equation (3) set out in the introduction section.

38. In all cases, maximum prices are constrained to the level at which demand falls to zero, on the grounds that there would be no reason to increase prices further.

MTF prices

39. MTF prices are set equal to the marginal cost of origination plus the fixed termination rate.

FTM prices

40. FTM prices are set equal to the fixed retention rate plus the average MNO termination rate.

41. A single FTM price is assumed for all FTM calls, regardless of the recipient MNO.

Call minutes per call

42. The model calculates the call duration for each type of call, based on demand functions and call prices.

Calls per subscriber

43. The model calculates the total calls made (regardless of duration) per subscriber for each type of call, based on subscriber numbers and calls per potential recipient.

44. The model assumes a balanced calling pattern, i.e. that each telephone subscriber calls every other subscriber with equal probability.

45. Total calls made per subscriber are assumed to remain constant regardless of MTRs and prices. MTRs and prices affect call duration only.

Call minutes per subscriber

46. The model calculates call minutes per subscriber for subscriber for each type of call, based on call durations and calls per subscriber.

Profit per subscriber, before fixed charges and fixed costs

47. The model calculates profit per subscriber, before fixed charges and fixed costs, for each type of call, based on call minutes per subscriber, marginal prices and marginal costs.

48. Note that equilibrium fixed charges and fixed costs will typically differ between MNOs, so these figures cannot be taken as an indicator of the relative profitability of subscribers between MNOs.

Consumer surplus per subscriber, before fixed charges

49. The model calculates consumer surplus per subscriber, before fixed charges, for each type of call, based on call minutes per subscriber, call prices, and demand functions.

Total surplus per subscriber, before fixed costs

50. The model calculates total surplus per subscriber, before fixed costs, based on profit per subscriber before fixed charges and fixed costs, and consumer surplus per subscriber before fixed charges.

51. Note that under the assumption of constant subscriber numbers, total surplus per subscriber does not depend on the level of fixed charges, which simply distributes total surplus between consumers and producers.

Total call minutes

52. The model calculates total call minutes for all subscribers, based on call minutes per subscriber and subscriber numbers.

53. The model also summarises here the MTM termination traffic balance faced by each MNO.

Total call revenues

54. The model calculates total revenues for all subscribers, based on total call minutes, retail prices, and termination rates.

55. The model also summarises here the MTM termination revenue balance faced by each MNO.

Average prices

56. The model calculates average pence per minute prices for each type of call, based on total call revenues and total call minutes.

Total profit, before fixed charges and fixed costs

57. The model calculates total profit for all subscribers, before fixed charges and fixed costs, based on profit per subscriber and the total number of subscribers.

58. As with the profit per subscriber calculations, equilibrium fixed charges and fixed costs will typically differ between MNOs, so these figures cannot be taken as an indicator of the relative profitability of MNOs.

Total consumer surplus, before fixed charges

59. The model calculates total consumer surplus for all subscribers, before fixed charges, based on consumer surplus per subscriber and the total number of subscribers.

Total surplus, before fixed costs

60. The model calculates total surplus for all subscribers, before fixed costs, based on total profit per before fixed charges and fixed costs, and total consumer surplus per before fixed charges.

Scenario functionality

Scenario modelling sheet

61. The "Scenario modelling" sheet has three versions of each of the two variants of the welfare model (i.e. six models in total). Each version assumes a set of marginal costs for termination and origination:

    a) The first set is based on the outputs of OFCOM's so-called LRIC model, excluding the mark-ups for non-network common costs and the network externality. As OFCOM has acknowledged, these figures include network common costs.[19] As such, they are unlikely to be reasonable estimates of common costs, but have been included for comparison purposes.

    b) The second set is based on the Long Run Average Incremental Cost (LRAIC) estimates on an Economic Depreciation basis, as set out in H3G's explanatory note of 7 March 2008. [20]

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[19] See for example paragraph A5.18 of OFCOM's March 2007 Statement

[20] Estimates of origination and termination LRAICs

c) The third set is based on the LRAIC estimates on a Long Run Average Cost basis, as set out in the same explanatory note.

Scenarios sheet

62. The "Scenarios" sheet facilitates and summarises a sensitivity analysis, against different assumptions for the value of Beta and the level of MTRs, of the results generated by the "Scenario modelling" sheet.

63. The first yellow shaded cell has a drop down box that allow different values to be chosen for β: 0; 1/3;1/2; and 1.

64. The second yellow shaded cell has a drop down box that allows different values to be chosen for MTRs:

    a) OFCOM's claimed "monopoly prices" of 23.9ppm;

    b) OFCOM's TACs;

    c) marginal cost;

    d) a first variant of NPZ, with MTM and MTF prices set at zero ppm (**NPZ 1**);

    e) a second variant of NPZ, with MTM prices set at zero ppm and FTM prices set at 0.4ppm (**NPZ 2**); and

    f) a third variant of NPZ, with MTM and FTM prices set at 0.4ppm (**NPZ 3**).

65. The results are divided into two sections: discriminatory pricing at the top; and non-discriminatory pricing at the bottom. In each section, the first set of three figures summarises the results of the welfare model under the β and MTR assumptions currently in use; and the shaded area below contains hard coded results of previous model runs for different permutations of β and MTR.