The licensing of mobile operators in European markets and the consequences of new entry for competition

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Abstract

Purpose – *This paper aims to investigate whether new entry via mobile licensing in Europe has had any longer-term consequences for competition.*

Design/methodology/approach – *A database is presented covering certain recent periods and the issue of licences for the provision of 2G, 3G and 4G mobile services.*

Findings – *It would appear that new entry has had very little overall effect on competition, although Hutchison Whampoa has, almost uniquely, forced a response from incumbents via a strategy of low prices, albeit without gaining significant market share at their expense.*

Research limitations/implications – *Interpretation of databases cannot by its very nature be entirely free from ambiguity.*

Practical implications – *In practice, given that very few 4G (long-term evolution) licence regulations have reserved spectrum for new entrants, it may be presumed that most regulators in European countries have already observed that such new entry as is likely to be attracted will take the form of poorly funded companies from outside the mobile sector rather than incumbents from other countries.*

Social implications – *Choice of incumbent network is being reduced, although mobile virtual network operators remain active. The implications for prices and service quality are for now a matter of debate.*

Originality/value – *The databases underpinning this analysis are not available from other sources in the private or public domain in the form presented in this paper.*

Keywords *Communications, Licences, Mobile, New entry*

Paper type *Research paper*

1. Introduction

European mobile communication markets are competitive in the sense that multiple operators compete against one another, providing a similar set of services epitomised by the ubiquitous smartphone. This is the end-product of a liberalisation process that began in the early-1980s, and which saw the monopoly provision of communication services transformed through the licensing of new entrants. At the heart of this transformational process was the presumption that new entrants would compete against established operators, with coverage and quality improving and prices falling as a consequence. In other words, new entry was seen as a major mechanism through which a wide array of benefits were to be realised.

However, this transformation was based on the assumption that new entrants would be in a position to compete effectively against the established operators. In practice, as a result of a very rapid expansion in the overall market, the earlier new entrants – those companies that changed market structures from monopolies to duopolies and oligopolies – were able

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to attract significant numbers of subscribers and provide the necessary competitive pressure to achieve the sought-after benefits. However, it does not follow that new entry can continue to have the same effects once three or more operators have attracted significant brand loyalty.

To test this hypothesis, this paper focuses on the more recent examples of new entry that in most cases added the fourth or subsequent operator to a mobile communication market. We find that although additional licences have been granted over successive generations of mobile technologies, the more recent new entrants have found it very difficult to thrive. Many of the operators that were awarded new licences have in practice proved unable to launch their services, while those that did launch generally struggled to compete against their established rivals.

The aim of this paper is to conduct an empirical investigation into the effects of new entry within a specific industrial sector where entry is restricted via the issue of new licences. The approach is accordingly to examine three scenarios for new entry in mobile communications, namely, entry via a 2G (GSM) licence, entry via a 3G (UMTS) licence and entry via a 4G (long-term evolution, LTE) licence. The paper will assess whether any of these either has, or is likely to, alter the provision of mobile communications in Europe. With this in mind, the paper first briefly addresses the issue of first-mover advantages in mobile communications before discussing each of the entry scenarios in turn. Conclusions are drawn in the final section of the paper.

2. First-mover advantages

Before examining the entry of new operators into European mobile communications markets, it is useful to address the issue of whether, in principle, new entrants can expect to prosper. In other words, is there a first-mover advantage? The advantages that accrue from being first into a market have been extensively discussed – see, for example, De Castro and Chrisman (1995), Lieberman and Montgomery (1988, 1998) or Tuppara *et al.* (2008). Lieberman and Montgomery (1988) identify three different types of first-mover advantage, namely:

1 technological leadership;

2 pre-emption of assets; and

3 buyer switching costs.

As the technology used within the mobile communications industry is widely available and not associated with a single vendor, the other two forms of advantage are likely to be more significant.

Through being better informed than its rivals, one company may be able to acquire scarce assets before its rivals (Lieberman and Montgomery, 1988, p. 44). With respect to mobile communications, such assets could include spectrum as well as access to the best sites to locate the necessary infrastructure. By acquiring these assets, the first mover could target the most profitable parts of the market – in terms of both geography and market segment – and thus deter the subsequent entry of other companies. Buyer switching costs also provide another source of first-mover advantage. The presence of switching costs requires later entrants into the market to find ways to attract customers away from the first entrant (Klemperer, 1987a, 1987b; Lieberman and Montgomery, 1988).

These first-mover advantages raise barriers to entry which have, in the context of the telecommunications industry, been outlined by Park (2009) among others. Although a broad array of entry barriers are identified by Park, the large investment required to enter and then compete within a communications market as well as the lack of economies of scale associated with later entry appear to be of particular importance. Nevertheless, it is not necessarily a good idea to be first into a high-technology market. Perhaps the most obvious reason is that if the technology works imperfectly when first launched, those

launching it may find that this has a negative impact on their reputation. In addition, the costs associated with launching the technology and then developing the market may be substantial, while the benefits are shared with other companies. In other words, later entrants may "free ride" on the market development efforts of the first mover. One possible consequence of this is that the first mover may find it difficult to recoup its investment, while another is that it could struggle to develop competitive strategies as new entrants come into the market (Chung *et al.*, 2007; Finney *et al.*, 2008; Tuppara *et al.*, 2008). A more prudent strategy may, therefore, be to wait until the technology has matured and has been widely advertised before entering the market.

While such a strategy is possible in many markets, within mobile communications, it is complicated by the fact that spectrum is needed before a company can enter the market. For a variety of technical and economic reasons, spectrum is a managed resource – see, among others, Cave *et al.* (2007), for an overview of spectrum management. As a result of this process, spectrum in specific bands is allocated to a particular use. However, this allocation is not static and has evolved as technologies have changed. This is particularly true for mobile communications, where successive generations of technologies are evident. Curwen and Whalley (2008, Chapter 2) show how mobile technologies have evolved over time, from second- (2G) through third- (3G) and now fourth-generation (4G) technologies. Each of these technological generations is associated with a round of licensing that gave a mobile communication operator a band of spectrum to use. Within Western Europe, for example, most 2G licences were issued between 1992 and 1996, while 3G licensing commenced around the turn of the millennium. The licensing of 4G is a more recent affair, starting with the granting of licences in Norway in November 2007.

The licensing of each of these technologies represents an opportunity for a new operator to enter the market. However, when new generations of mobile technologies were licensed, most licences were awarded in practice to existing operators, although this should not be interpreted as indicating that incumbents were automatically awarded licences. In the (albeit very unusual) case of Sweden, Telia, one of the existing 2G operators, was not awarded a 3G licence in December 2000 (Andersson *et al.*, 2005). Moreover, the opportunities for new entry were further enhanced by the decision of many countries to increase the number of licences as they moved from 2G to 3G. Austria and Germany, for example, both granted two more 3G licences than the number of existing 2G operators. This increase was driven, at least partly, by the desire to increase competition. However, some of the new entrants awarded a licence did not enter the market, deterred by the aforementioned barriers to entry (Curwen and Whalley, 2006, 2008), while others entered only subsequently to leave the market. Not only has the exit of KPN from Germany and Orange from Austria fuelled demands for further consolidation within Europe (Thomas and Barker, 2014), but it also illustrates the LTE of mobile communication markets structured around fewer operators. With this in mind, the remainder of this paper will focus on successive rounds of mobile licensing to determine whether entry has occurred and to examine its impact on the market.

3. New entry via GSM licensing

Most new entry in the GSM (900 and 1,800 MHz) bands – by which, in this context, is meant the licensing of a second or subsequent entrant – at a time when 2G was the only available digital technology, took place so long ago that it makes sense to treat even the most recent entrant as an incumbent when examining the potential for new entry via more recent (3G and 4G) forms of licence. However, there were a number of GSM band entries within Europe, broadly defined, during the period 2005 to 2010 which mostly occurred in the former Eastern Europe because open competition was far slower to develop there than in Western Europe – this is a common feature of countries worldwide where the state exercises tight control over economic life. These are as shown in Table I, with market shares given to the nearest 5 per cent, as regulators and operators are not always in agreement about the precise figures.

Table I GSM new entrants, 2005 to 2010

Country	*Operator*[1]	*Entrant*	*Position 31/12/14*	*Market share (%)*
Albania	Eagle Mobile	3rd	3rd	30
Belarus	Turkcell	3rd	3rd	10
Bulgaria	Vivacom	3rd	3rd	20
Croatia	Tele2	3rd	3rd	15
Guernsey	Bharti Airtel	3rd	2nd =	15
Isle of Man	Wave9	2nd	Shut down	–
Isle of Man	Batelco	3rd	2nd of 2 left	5
Jersey	Batelco	2nd	–	All 3 roughly equal
Jersey	Bharti Airtel	3rd	–	All 3 roughly equal
Kosovo	Ipko-Net	2nd	2nd	15
Macedonia	Telekom Austria	3rd	2nd	25[3]
Moldova	Eventis Mobile	4th	Shut down	–
Montenegro	m:tel	3rd	3rd	25
Norway	Tele2	4th	3rd of 3 left	20
Poland	P4	4th	4th	15
Poland	Aero2	5th	5th	< 5
Poland	Mobyland	6th=	–[2]	–
Poland	CenterNet	6th=	6th	< 5
Serbia	Telekom Austria	3rd	3rd	20
Sweden	Hutchison	4th	4th	10
Ukraine	Astelit	4th	3rd (two larger merged)	25
Ukraine	Ukrtelecom	5th	4th (two larger merged)	< 5

Notes: [1]Identification of operators presents awkward issues because so many networks have changed hands and many are better known in terms of their brands than in terms of ultimate ownership; by and large, the latter format is preferred, as it reveals where networks in different countries share common ownership; [2]bought by Aero2 which also has an indirect stake in CenterNet; [3]in October 2014, it announced its intention to merge with the smallest operator, Telekom Slovenije

The first point to make is that, in most cases, the new entrant faced a small number of established incumbents and hence had an opportunity to gain a quick advantage by undercutting existing high prices. Secondly, the 2G licence was generally awarded in conjunction with a licence to provide 3G, as the latter had already been issued to incumbent operators by this point in time. What stands out very clearly is that (leaving aside the tiny markets of Guernsey and Jersey) in only one case – Telekom Austria in Macedonia – has a new entrant made a successful attempt to overhaul an incumbent. The largest market share gained is roughly 30 per cent but the average is much lower and is quite modest, considering how long the new entrants have had to become established and the existence of national roaming rights.

Overall, therefore, one must conclude that over the past decade, new entrants awarded GSM licences between 2005 and 2010 have with one exception managed to stay in business – albeit with some changes in ownership – but have not been able to make much headway in catching up with incumbents.

4. New entry via 3G licensing

The starting point for our analysis is Table II. This table depicts the end-2014 state of 3G licensing across Europe, which is defined here as encompassing the 28 Member States of the European Union (EU), the European Economic Free Trade Area, prospective accession countries to the EU and all other countries or territories having some form of independent government within the post-Communist understanding of Europe even where part of their land mass lies in Asia.

Drawing on Table II, the first observation that can be made is that every country within Europe (broadly defined) has issued 3G licences. As of 30 December 2014, all 53 countries had awarded 3G licences. The first 3G licence in Europe was awarded in March 1999 by Finland, which was joined at the forefront of 3G in April 1999 by the Isle of Man. A significant proportion of the listed countries awarded their 3G licenses during 2000 and 2001, in good

Table II 3G licensing across Europe, 31 December 2014

Country/ Territory	*2G licences*[1]	*3G licences available*	*3G licences awarded*	*Method*[1] *(BC = beauty contest)*	*Date*	*3G licence winners*[1]
Albania[2]	3	1	1	Auction	November 2010	Vodafone
Albania	4	1	1	Auction	June 2011	AMC
Albania	4	1	0	Auction	February 2012	–
Albania	4	2	1	Auction	August 2012	Eagle Mobile
Andorra[2]	1	1	1	Assigned	January 2005	STA
Austria	4	4-6	6	BC + auction	November 2000	Hutchison 3G, max. Mobil, Mobilkom Austria, ONE, tele.ring[12], 3G Mobile[13]
Belarus[2]	3	1	1	Assigned	August 2009	BeST
Belarus	3	2	2	Assigned	December 2009	MTS, Velcomf
Belgium	3	4	3	Auction	February 2001	KPN Mobile 3G, Mobistar, Proximus
Belgium	3	1	1	Auction	July 2011	Telenet Tecteo Bidco[14]
Bosnia-Herz.[2]	3	3	3	Assigned	March 2009	Eronet, GSM BiH, Mobilna Srpske
Bulgaria	3	3	3	Auction (1) Assigned (2)	March 2005[3]	MobilTel, Viva Ventures, GloBul
Croatia	2	3	2	Tender – assigned	October 2004	T-Mobile, VIPnet
Croatia	3	1	1	Assigned	December 2004	Treca Sreca
Cyprus (S)	2	2	2	Auction – assigned[4]	December 2003	Investcom, CyTA
Czech Repub.	3	3	2	Auction – assigned[4]	December 2001[6]	EuroTel Praha, RadioMobil
Czech Repub.	3	1	1	Assigned	February 2005	Oskar
Denmark	4	4	4	Auction	September 2001	Hi3G Denmark, Orange[15], TDC, Telia Denmark
Denmark	3	1	1	Auction – assigned[4]	December 2005	Sonofon[15]
Estonia	3	3	3	BC – assigned[4]	July 2003[7]	Eesti Telecom, Radiolinja, Tele2
Estonia	3	1	1	Tender	December 2006	Grosson/Renberg/RealGroup/ProGroup[16]
Faroe Isles[2]	2	–	–	n/a	n/a	Faroese Telecom, Kall GSM
Finland	3	4	4	BC	March 1999	Radiolinja, Sonera, Suomen 3G[17], Telia Finland
France	3	4	2	BC – assigned[4]	July 2001	Orange, SFR
France	3	2	1	BC – assigned[4]	September 2002	Bouygues Télécom
France	3	1	0	Tender	October 2007	–
France	3	3	3	BC – assigned[4]	December 2009	Free Mobile
Georgia[2]	2	1	1	Auction	August 2005	Magti
Georgia	3	1	1	Auction	April 2006	Argotex
Georgia	3	1	1	Auction	May 2006	Telekom Invest, Geocell[18]
Georgia	3	1	0	Auction	Oct 2009	–
Germany	4	4-6	6	Auction	July 2000	E-Plus Hutchison, Group 3G, Mannesmann, MobilCom Multimedia[19], T-Mobile, Viag Interkom
Gibraltar[2]	2	n/a	n/a	Assigned	n/a	Gibtelecom, CTS Gibraltar, Shine Mobile[20]
Greece	3	4	3	Auction – assigned[4]	July 2001	CosmOTE, Panafon, Stet Hellas
Greenland[2]	1	–	–	n/a	March 2010	Tele Greenland[21]
Guernsey[2]	1	2	1	BC – assigned[4]	March 2003	Wave Telecom
Guernsey	2	1	1	BC	September 2006	Guernsey TeleNet
Hungary	3	4	3	Tender	December 2004	Pannon, T-Mobile, Vodafone
Hungary	3	1	0	Tender	March 2009	–[22]
Iceland[2]	3	4	3	BC – assigned	March 2007	Og fjarskipti, Novator, Síminn[23]
Ireland	3	4	3	BC – assigned	June 2002[8]	Hutchison 3G Ireland, mmO_2, Vodafone
Ireland	3	1	1	BC	November 2005	Smart Telecom[24]
Ireland	3	1	1	Assigned	March 2007	eircom (Meteor)[24]
Isle of Man[2]	1	1	1	Assigned	April 1999	Manx Telecom
Isle of Man	1	2	2	Assigned	May 2006	Cable & Wireless, Wire9 Telecom
Italy	4	5	5	BC + auction	November 2000	H3G, IPSE 2000, TIM, Wind, Omnitel
Italy	4	1-3	3	TE	May 2009	TIM, Wind, Vodafone[25]
Jersey[2]	1	4	3	Assigned[4]	December 2005	Jersey Telecom, Cable & Wireless, Jersey Airtel
Kosovo[2]	2	2	2	Assigned	December 2013	IPKO, Vala900
Latvia	2	3	2	Auction – assigned[4]	September 2002	LMT, Tele2
Latvia	3	1	1	Auction	May 2005	Bité[26]
Liechtenstein[2]	4	4	3	Assigned	July 2001[9]	mobilkom, Tele2/Tango, Viag Europlattform
Liechtenstein	4	1	1	Assigned	October 2003[10]	Liechtenstein TeleNet
Lithuania	3	3	3	BC – assigned	February 2006	Bité[27], Omnitel, Tele2
Luxembourg	2	4	3	BC – assigned[4]	May 2002	EPT, Orange[28], Tele2
Luxembourg	2	1	1	Tender – assigned	July 2003	LuXcommunications
Macedonia[2]	3	Upto4	1	Tender	January 2008	OTE
Macedonia	3	3	1	Tender – assigned[4]	December 2008	T-Mobile
Macedonia	3	2	0	Tender	July 2009	–
Macedonia	3	1	1	Assigned	August 2012	Telekom Austria
Malta	2	3	3	BC – assigned[4]	August 2005	Go Mobile, Vodafone, 3G Telecoms
Moldova[2]	4	1	1	Assigned	August 2008	Orange

(*continued*)

Table II

Country/ Territory	*2G licences*[1]	*3G licences available*	*3G licences awarded*	*Method*[1] *(BC = beauty contest)*	*Date*	*3G licence winners*[1]
Moldova	4	1	1	Assigned	September 2008	Moldcell
Moldova	4	1	1	Assigned	January 2009	Mold Telecom
Monaco[2]	1	1	1	Assigned	June 2000	Monaco Telecom
Montenegro[2]	2	1	1	Tender	March 2007	m:tel
Montenegro	3	2	2	Assigned	May 2007	ProMonte, T-Mobile
Netherlands	5	5	5	Auction	July 2000	3G-Blue, Dutchtone, KPN Mobile, Libertel-Vodafone, Telfort[29]
Norway[2]	2	4	4	BC	December 2000	Broadband Mobile, NetCom GSM, Telenor, Tele2
Norway	2	2[3]	1	Auction – assigned[4]	September 2003	Hi3G Access
Norway	3	1[3]	1	Auction – assigned	December 2007	Mobile Norway
Poland	3	4	3	Tender – assigned[4]	December 2000	PKT Centertel, Polkomtel, Polska Telefónica Cyfrowa
Poland	3	1	1	Tender	May 2005	P4
Portugal	3	4	4	BC	December 2000	ONI-Way[30], Optimus, Telecel, TMN
Romania	4	4	2	BC	November 2004	MobiFon, Orange
Romania	4	2	2	BC	October 2006	RCS&RDS, TeleMobil[31]
Russia[2]	3	3	3	Assigned	April 2004	MegaFon, MTS, VimpelCom
San Marino[2]	1	1	1	Assigned	n/a	San Marino Telecom
Serbia[2]	2	3	3	Assigned	August 2006	Telekom Srbija, Telenor, mobilkom Austria
Slovakia	2	3	3	Auction – assigned	July 2002	EuroTel, Orange, Profinet.sk[32]
Slovakia	2	1	1	Tender	August 2006	Telefónica
Slovenia	3	3	1	Auction – assigned[4]	Nov 2001[11]	Mobitel
Slovenia	3	3	2	Auction	September 2006	Si.mobil, T-2
Slovenia	3	1	1	Assigned	April 2008	Tušmobil
Spain	3	4	4	BC	March 2000	AirTel, Amena, Telefónica, Xfera
Sweden	4	4	4	BC	December 2000	Europolitan, Hi3G Access, Orange Sverige[33], Tele2
Switzerland[2]	3	4	4	Auction	December 2000	Dspeed, Orange, Swisscom, Team 3G[34]
Turkey[2]	3	4	3	Auction – assigned[4]	December 2008	Avea, Turkcell, Vodafone
UK	4	5	5	Auction	May 2000	BT3G, Hutchison 3G, One-2-One, Orange, Vodafone
Ukraine[2]	5	1	1	Assigned	November 2005	Ukrtelecom

Notes: [1]The number of 2G licences is that ruling at the time of the event; the determination of method is complicated in a number of cases; some of these are commented on in the footnotes but space does not allow for a full exposition; other sources may accordingly give a different version; licensees are cited under the names used when the licence was first issued; [2]not an EU Member State; [3]two of the 2003 licences had been returned by the original licensees–Broadband Mobile in August 2001 and Tele2 in November 2002 (which became the licence acquired by Hi3G Access), with the other returned licence being bought by Mobile Norway (50 per cent owned by Tele2) which had recently acquired a GSM licence; [4]the initial intended licensing method was abandoned in favour of an assignment given the shortage of applicants; [5]the three licences were not awarded at the same time or through the same method; MobilTel was awarded its licence in March 2005 after a tendering process was completed, while Viva Ventures and GloBul were assigned their licences in April 2005; [6]the award of two licences in December 2001 was actually the third occasion on which the Czech Republic had attempted to award 3G licences. The previous two attempts at a tender, in September and October 2001, both failed to attract bidders; [7]the three licences were not awarded at the same time; Eesti Telecom and Radiolinja received their licences in July 2003 and Tele2 in August 2003; [8]the three licences were not awarded at the same time; Hutchison 3G Ireland received its licence in June 2002, mmO_2 in August 2002 and Vodafone Ireland in September 2002; [9]the three licences were not awarded at the same time; Viag Europlattform finally accepted its licence in March 2001, while Tele2/Tango and mobilkom received their licences in July 2001; [10]Telecom FL initially refused the offer of a licence; its owner, Swisscom, then sold the company to the government in July 2003 and when the transfer was completed in October, the now re-named Liechtenstein TeleNet accepted the licence; [11]at the second attempt; an auction planned for May 2001 attracted no bidders; [12]as a condition for its acquisition of tele.ring in April 2006, T-Mobile was obliged to dispose of tele.ring's two sets of 5-MHz paired 3G spectrum, of which at least one had to go to existing licensee Hutchison 3G Austria; [13]3G Mobile sold its Austrian licence to mobilkom Austria in December 2003; half of the spectrum (5-MHz paired) was sold on to T-Mobile; [14]after several warnings about its failure to roll out a network, the regulator was finally authorised in July 2014 to revoke this licence and to reallocate it either among the incumbents or via an auction during 2015; [15]when TeliaSonera acquired Orange Denmark, it was obliged to return one of its two 3G licences which was re-auctioned; [16]originally awarded to Grosson Capital in November, which failed to pay so, it was subsequently offered to Renberg Investments (which declined), RealGroup (which failed to pay) and ProGroup Holding; [17]the licence held by Tele2 was revoked in July 2005; [18]this presents problems because Telekom Invest won the only licence on offer, yet there is no information at all about the company that can be gleaned from the Internet; for its part, Geocell is clearly stated to have won a licence during 2006 but specifically when is never stated; possibly, it is the same licence; [19]MobilCom returned its licence in December 2003; [20]it is difficult to pin down details; what is clear is that CTS Gibraltar and Shine Mobile were each awarded a technology-neutral 2G/3G licence; [21]the launch used spectrum in the existing 900 -Hz band; [22]the tender was cancelled due to adverse market conditions; [23]one licence was awarded in April; [24]the licence acquired by Smart was finally revoked in November 2006 and offered to eircom which had bought 2G incumbent Meteor; [25]the licence returned by IPSE 2000 was split into three blocks and offered to incumbents (1 or 2 blocks) and new entrants (up to 3 blocks); no new entrants applied and incumbents were awarded one block apiece; [26]offered for sale in November 2014; [27]offered for sale in November 2014; [28]orange (which had yet to roll out its 2G network) returned its licence in December 2004; [29]the licence, acquired by KPN when it bought Telfort, was returned in July 2009; [30]the licence was revoked in January 2003 and the spectrum divided up among the other licensees; [31]the first instalment was not paid until January 2007 when the award became official; TeleMobil (Zapp Mobile) was sold with its licence to OTE in June 2009; [32]although it technically won the licence, Profinet.sk did not make the required down-payment and the licence was revoked in August 2002; [33]Orange Sverige sold its licence to Svenska UMTS-nät in December 2003, but this was not sanctioned by the regulator; in November 2004, the regulator recalled the licence; [34]the licence was revoked in April 2006 and handed back in April 2007

part because of the timetable for the launch of 3G laid down by the EU. Since 2001, 3G licensing has steadily permeated the rest of Europe.

A second observation that can be made is that 24 countries opted to increase the number of companies in the mobile market by issuing more 3G licences than there were 2G incumbents at the time. Most countries increased the number of 2G mobile licences by one when choosing how many 3G licences to issue, although Austria, Germany, Jersey, Luxembourg and Norway opted to issue (up to) two additional 3G licences.

It is possible to identify 46 3G new entrants across Europe. A new entrant is defined here either as a 3G licensee that does not have already a 2G licence, a licensee that is awarded a technology-neutral 2G/3G licence or a bidding consortium not majority-owned by a 2G licensee in the market where it is bidding for a 3G licence. On this basis, listed by country and using (where relevant) the current controlling owners' names (in brackets), the 3G new entrants are:

- *Austria*: Hutchison 3G, 3G Mobile (Telekom Austria);
- *Belgium*: Telenet Tecteo Bidco;
- *Bulgaria*: Bulsatcom, Max Telecom (Daniel Kupsin), 4G Com;
- *Croatia*: Treca Sreca (Tele 2);
- *Cyprus (South)*: Investcom (MTN);
- *Denmark*: Hi3G Denmark (Hutchison);
- *Estonia*: Bravocom;
- *Finland*: Telia Finland (Finnet Group);
- *France*: Free Mobile (Iliad);
- *Georgia*: Argotex, Telekom Invest;
- *Germany*: Group 3G, MobilCom Multimedia;
- *Gibraltar*: CTS Gibraltar, Shine Mobile;
- *Guernsey*: Wave Telecom, Guernsey TeleNet (Bharti Airtel);
- *Iceland*: Nova;
- *Ireland*: Hutchison 3G, Smart Telecom;
- *Italy*: Hutchison 3G, IPSE 2000;
- *Jersey*: Jersey Airtel;
- *Latvia*: Bité;
- *Luxembourg*: LuXcommunications (Orange), Orange;
- *Malta*: 3G Telecoms (Melita Mobile);
- *Moldova*: Moldtelecom (State of Moldova);
- *Montenegro*: m:tel;
- *Norway*: Broadband Mobile, Hi3G Access (Hutchison);
- *Poland*: P4 (Tollerton Investments/Novator Partners);
- *Portugal*: ONI-Way;
- *Romania*: RCS&RDS;
- *Serbia*: Vip Mobile (Telekom Austria);
- *Slovakia*: Profinet.sk;
- *Slovenia*: T-2, Tusmobil (Telemach);

- *Spain*: Xfera (TeliaSonera branded as Yoigo);
- *Sweden*: Hi3G Access, Orange Sverige;
- *Switzerland*: 3G Mobile Suiza; and
- *UK*: Hutchison 3G.

In addition, it should be borne in mind that one 2G/3G licensee in Liechtenstein, Telekom FL, was sold to the government and, re-launched as Liechtenstein TeleNet, took over the 3G licence. Further, that when Smart Telecom in Ireland forfeited its 3G licence, it was acquired by Eircom, which had recently acquired the 2G licensee Meteor. Neither are accordingly treated here as 3G new entrants. A final exception is Zapp Mobile in Romania which, at the time it acquired a 3G licence, was already operating CDMA in the 450-MHz band – it (and its licence) is currently owned by OTE.

A closer inspection of the 46 new entrants allows a clear distinction to be made between those that have been able to launch their 3G services and those that have, for whatever reason, failed (so far) to do so. As shown in Table III, just 25 of the 46 3G new entrants had launched their 3G services by the end of 2014 and, as the footnotes to Table I demonstrate, a significant proportion of the sample no longer have licences and hence never will launch. However, this table also highlights the fact that four companies – Sonera (now part of TeliaSonera), Telefónica, France Télécom/Orange and Hutchison Whampoa – originally set out to use the 3G licensing process to enter new markets.

The tribulations of Sonera, Telefónica and France Télécom/Orange during the initial period of 3G licensing are set out in detail in Curwen and Whalley (2006). It is evident from Table III that of the above, only Hutchison Whampoa remains as a major active 3G new entrant – Hutchison Whampoa is present as a new entrant in seven European markets and has launched networks in all cases bar Norway.

Hutchison Whampoa is clearly an oddity within the European mobile industry. First of all, it is axiomatic that, as initially Hutchison Whampoa had no installed 2G customer base to fund its expansion into 3G, it had to rely on other sources for funds. The foray into 3G was financed by a very deep-pocketed parent company that appeared to be willing to suffer huge short-term losses and to persevere despite an environment that led incumbents like Sonera and Telefónica to abandon most or all of their 3G new entrant investments. Secondly, the roll-out strategy for 3G adopted by Hutchison Whampoa was almost diametrically opposite to that of every incumbent. By and large, incumbents decided early on that they were earning massive revenues from their 2G networks, that the 3G technology was immature and that handsets were either unavailable and/or clunky and hence that if one incumbent was holding back, there was every incentive for the others to follow suit. In contrast, Hutchison Whampoa needed to obtain a revenue flow as early as possible and hence chose to be the first to launch in every market if humanly possible.

Such a strategy was, and remains, very risky, not least because it assumes that the initial outlays can be recouped once a subscriber base has been accumulated. But Hutchison's subscriber base remains relatively small in global terms at roughly 20 million, of which a handful of countries account for the majority. What this means in practice is that the market share of Hutchison in those European markets where it competes is relatively low. Between 2002 – when it first launched its services in Europe – and 2012, the market share of Hutchison in Europe steadily increased such that by 2012, it ranged from 8 per cent in Italy to almost 15 per cent in the UK. The position in 2013 was complicated by M&A activity. France Télécom sought to exit Austria where it held a stake in a small network with no growth. The bidder for the company was the even smaller Hutchison, with the deal completed in early 2013 subject to onerous conditions imposed by the European Commission. As a result of this purchase, Hutchison's share of the Austrian market increased from 10 per cent in 2012 to almost 24 per cent in 2013. In June 2013, Hutchison made another bid of up to €850 million for Telefónica's network in Ireland – a somewhat unusual move in that Telefónica was the second-largest and Hutchison

Table III European 3G new entrants, 31 December 2014

Country	*Operator*	*Date service launched*[1]	*No. of subscribers 31/12/12*	*Main shareholders at time of licence issue*
Austria	Hutchison 3G	April 2003	1,290,000	Hutchison Whampoa
Austria	3G Mobile	Never[2]	–	Telefónica
Belgium	Telenet Tecteo	Never[3]	–	Telenet, Tecteo
Bulgaria	Bulsatcom	Never[4]	–	Ramen Genchev
Bulgaria	Max Telecom	Never[4]	–	Krasimir Stuychev
Bulgaria	4G Com	Never[5]	–	Ultra Com
Croatia	Tele2	December 2008	780,000	Tele2
Cyprus (S)	MTN	December 2004	315,000	MTN
Denmark	Hi3G Denmark	November 2003	830,000	Hutchison Whampoa, Investor
Estonia	Bravocom	–[6]	–	ProGroup Holding
Finland	DNA Finland	October 2004	2,420,000	Finnet Group
France	Free Mobile	January 2012	4,800,000	Iliad
Georgia	Argotex	Never[7]	–	Argotex
Georgia	Telekom Invest	Never	–	Not known
Germany	Group 3G	Never[8]	–	Sonera, Telefónica
Germany	MobilCom Multimedia	Never[9]	–	France Télécom, MobilCom
Gibraltar	CTS Gibraltar	Never[10]	–	CTS Gibraltar
Gibraltar	Shine Mobile	September 2013	n/a	Eazi Telecom
Guernsey	Wave Telecom	July 2004	11,000	Jersey Telecom Group
Guernsey	Guernsey Airtel	March 2008	12,000	Bharti Group
Iceland	Nova	December 2007	111,000	Novator Partners
Ireland	H3G Ireland	July 2005	470,000	Hutchison Whampoa
Ireland	Smart Telecom	Never[11]	–	Private investors
Italy	H3G Italy	March 2003	6,900,000	Hutchison Whampoa
Italy	IPSE 2000	Never[12]	–	Sonera, Telefónica
Jersey	Jersey Airtel	June 2007	60,000	Bharti Group
Latvia	Bité	June 2006	400,000	TDC
Luxembourg	LuXcommunications	March 2004	105,000	Mobistar (Orange)
Luxembourg	Orange	Never[13]	–	Orange
Malta	3G Telecoms	February 2009	70,000	Melita
Moldova	Moldtelecom	December 2009	33,000	State of Moldova
Montenegro	m:tel	July 2007	270,000	Telekom Srbija, Ogalar
Norway	Broadband Mobile	Never[14]	–	Sonera, Enitel
Norway	Hi3G Access	–	–	Hutchison Whampoa, Investor
Poland	P4	March 2007	8,450,000	Novator Partners
Portugal	ONI-Way	Never[15]	–	ONI, Telenor
Romania	RCS&RDS	December 2007	1,510,000	RCS&RDS
Serbia	Vip Mobile	July 2007	1,840,000	Telekom Austria
Slovakia	Profinet.sk	Never[16]	–	Profinet
Slovenia	T-2	–[17]	–	Zvon Ena Holding
Slovenia	Tušmobil	June 2008	270,000	Tuš
Spain	Yoigo	December 2006	3,610,000	Vivendi Universal, Sonera, ACS
Sweden	Hi3G Access	April 2003	1,470,000	Hutchison Whampoa, Investor
Sweden	Orange Sverige	Never[18]	–	Orange
Switzerland	3G Mobile (Suiza)	Never[19]	–	Telefónica
UK	Hutchison 3G	March 2003	8,950,000	Hutchison Whampoa, NTT DoCoMo

Notes: [1]"Launch" is taken here to be the date when the service is first made available, sometimes only to corporate customers, sometimes only via data cards/dongles; [2]the regulator was authorised to revoke the licence due to non-compliance in June 2014; [3]the licence was sold to mobilkom Austria, a subsidiary of Telekom Austria, in December 2003; [4]although these technology-neutral licences permit the roll-out of a 3G network, they are in practice being used to roll out LTE; [5]licence revoked in September 2014; [6]ProGroup Holding, trading as Bravocom, was reported to have passed its subscribers to Elisa in November 2010; this move may also be interpreted as adopting the role of a MVNO on the Elisa network but Bravocom does not own mobile infrastructure; [7]the licence was transferred to Magti in November 2006; [8]shut down in 2002; [9]licence returned to regulator in 2003; [10]shut down in 2013; [11]the licence was revoked and offered to eircom in 2007; [12]licence revoked in 2006; [13]licence returned in 2004; [14]licence returned in 2001; [15]licence revoked in 2003; [16]licence never formally issued due to licence condition breach; [17]T-2 began life as a MVNO, switching to the Telekom Austria (Si-mobil) network; it escaped bankruptcy proceedings in 2010 and entered debt restructuring in February 2012; it was put into receivership in September 2014 but was released in November. Telekom Austria interested in takeover; [18]licence revoked in 2004; [19]licence revoked in 2006

the smallest of the four operators. The European Commission authorised the takeover in May 2014 (Lennighan, 2014), again subject to onerous conditions.

As these purchases alleviated the competitive pressures faced by Hutchison, the company has been able to turn its attention towards improving its financial position in Europe. Table IV details the average revenue per user (ARPU) across Europe. In Austria and Italy, ARPU more than halved between 2006 and 2013, though less dramatic declines are evident in Denmark, Sweden and the UK, albeit over a shorter period. Ireland stands out as the sole country where APRU increased between 2010 and 2014, though it could tentatively be argued that after peaking in 2013, ARPU is now on a downward trend similar to elsewhere in Europe. The generally negative picture that emerges highlights the scale of the challenges faced by Hutchison, and the need for substantial and continued financial support from its parent company in Hong Kong – for an indication of the scale of this support, see Whalley and Curwen (2012).

Given the huge cost of rolling out networks, it was Hutchinson Whampoa's intention to float minority stakes in the more promising networks, but this plan was effectively abandoned in early 2006 when it was finally acknowledged that, with little product differentiation, investors would not find the strategy of buying market share a particularly attractive prospect. True, a 10 per cent stake in the Italian business was sold to an investment bank for €420 million in February 2006, but only after a €7 billion ($8.3 billion) float was cancelled – the original valuation was €12 billion (Guerrera and Lau, 2006; Michaels, 2006). By the year-end, the outlook appeared to be so poor that commentators were touting the prospect that Hutchison Whampoa might either merge with incumbents or exit the European market (Cellular-news, 2006; TelecomDirectNews, 2006).

The former process has not gone smoothly. In the first place, Hutchison Whampoa attempted unsuccessfully to acquire Ireland's eircom in 2012. Secondly, in July 2013, it was announced that a proposed merger between the Italian networks of Telecom Italia and Hutchison H3G was no longer on the cards due to a dispute over the valuation placed on the country's (much the) smallest network. In early 2014, Hutchison Whampoa decided to try again, but this time it engaged in talks with VimpelCom with a view to merging their respective Italian networks (3 Italia and Wind Telecomunicazioni). The most recent version of this tie-up envisaged the much smaller 3 Italia effectively taking over its rival with VimpelCom retaining a small equity interest. The merger would have created a third network similar in size to Telecom Italia and Vodafone, but this was unlikely to have been popular with the regulatory authorities.

Finally, it appeared that there would be no coming together of Hutchison and Telefónica in the UK since it was ruled out in April 2014 on the grounds that 3 UK would be successful if it remained as an independent network. However, when fixed-wire operator BT decided in January 2015 that it would proceed with a takeover of EE, owned jointly by Deutsche Telekom and Orange, rather than a takeover of Telefónica UK, Hutchison moved quickly to table its own bid for Telefónica UK at a cost of £10.25 billion (Reuters, 2015). Whereas the

Table IV Average revenue per user, Hutchison Whampoa's European operations

	Year							
Country, currency	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*
Austria, €	51.22	45.33	33.04	23.87	21.80	22.35	22.57	20.60
Denmark, DKK	–	–	–	–	–	263.68	216.08	172.52
Italy, €	33.99	29.30	25.34	23.49	23.60	19.86	18.44	14.71
Ireland, €	–	–	–	–	25.41	30.96	32.22	28.93
Sweden, SEK	–	–	–	–	–	307.82	298.90	295
UK, £	–	–	–	–	22.60	21.87	21.19	20.74
UK & Ireland, £	46.57	43.40	33.57	26.46	–	–	–	–
Sweden & Denmark, SEK	404.33	430.80	379.18	347.55	–	–	–	–

Source: Annual reports of Hutchison Whampoa

BT/EE deal will only slightly affect the mobile market structure in the UK, as BT is already a mobile virtual network operator (MVNO), the takeover of Telefónica UK will reduce the number of network operators from four to three and is accordingly likely to attract considerably more scrutiny from the European Commission, which will almost certainly impose several conditions requiring, for example, the giving up of spectrum and an increase in the wholesale access for MVNOs. Nevertheless, it is likely to allow the takeover to proceed given the precedents previously set in Austria and Ireland, not to mention the merger of Telefónica and KPN's E-Plus network in Germany.

As for disposals, the fundamental issue is, understandably, that Hutchison wants to exit at an acceptable price but that is difficult to determine when a potential buyer may be primarily interested in accumulated losses that can be set against taxes that have yet to be quantified. After all, it is not as though it is providing that many subscribers even in Italy – and especially not in Denmark which is effectively for sale but deemed to be over-priced – as it is the smallest surviving network in every case.

A final factor which has been seen by the likes of the GSMA (GSMA, 2014, p. 22) to be significant is that although Hutchison has gone ahead with the roll-out of LTE in countries where it has existing networks, it has failed to acquire spectrum in the newly licensed 800-MHz band in Croatia – where it did not even bid – and in Austria, Denmark, Ireland and Italy. It may be argued, however, that it has acquired Telefónica's 800-MHz spectrum in Ireland and that it gained additional sub-1-GHz spectrum when taking over Orange in Austria, so it is not altogether clear that Hutchison has no interest in competing via LTE.

Hutchison aside, two operators appear to have made a significant impact exclusively upon their home markets, namely, Iliad (Free Mobile) in France and P4 (formerly Netia P4) in Poland. At the end of 2007, the three-firm concentration ratio in France was 100 per cent and the smallest operator, Bouygues Télécom, had only a 17 per cent market share. Iliad was awarded its 3G licence in December 2009 and launched in January 2012 – it was also awarded a GSM licence in January 2013. Clearly, there was little opportunity for a new entrant to grow through the acquisition of new subscribers in competition with incumbents. Nevertheless, after only 11 months in operation, Free Mobile had garnered a 7.2 per cent market share, almost entirely at the expense of market leader Orange.

In essence, by combining cut-price 3G services with the existing non-mobile services of parent Iliad, the bundles could be made very attractive compared to those offered by the three incumbents. With all four operators acquiring spectrum suitable for LTE in late 2011 – even though Iliad failed to obtain a licence in the 800 MHz band – further downward pressure on prices was likely to ensue with Free Mobile offering a LTE plan at €9.99 for 20 gigabytes. Buckling under fierce competitive pressures, Bouygues Télécom itself became the subject of a takeover bid from the Altice Group – currently under regulatory review – which would itself be well-placed to offer attractive bundles of services including mobile.

The situation in France remains volatile – in May 2014, for example, SFR and Bouygues, among others, sought to acquire Virgin Mobile which was operating as a MVNO (inclusive of LTE) and had two million subscribers. As things stand, therefore, Iliad has certainly made its presence felt as a new entrant, but whether it can make a decent return on capital employed has yet to be seen.

At the end of 2007, Poland was the most balanced market in Europe, having three major operators dividing up 98 per cent of the subscribers into almost identical shares. Five years on and the overall market had grown by 30 per cent. The market shares of the "big three" were roughly 2 per cent separated from one another, so none had been disproportionately affected by the arrival of P4 which had acquired a 17.2 per cent market share. However, the fact that it had prospered at the expense of all the major incumbents arguably makes P4's performance all the more impressive. LTE licensing is not as yet making much difference, as all operators are using the re-farmed 1,800-MHz band for their initial launches.

The lesson from the above is straightforward: only Hutchison Whampoa has made real inroads as a new entrant across a number of markets, but its subscriber numbers are significant only in Italy and the UK where the markets are very large, so even there it is not significant in terms of market share. As a result, it is constantly seeking to restructure its operations via M&A activity. The other relatively successful new entrants, Iliad in France and P4 in Poland, look likely to become established forces in their respective home markets. However, while all of these examples do show that new entry can be successfully pursued, the only workable strategy appears to be to undercut the incumbents by some margin and the financial consequences of this strategy may prove to be unsustainable in the longer term.

5. New entry via 4G licensing

In Table V, the networks are identified by their controlling shareholder wherever it is an operator with multiple stakes across Europe. This has the advantage that it is possible to view the development of new technologies from the standpoint of the main international operators. However, it should be noted that these networks may be identified by one or more other names – particularly the brand by which its services are marketed – when reported on in the media.

As is evident, the situation is far more complicated where LTE is concerned compared to 2G and 3G because 2G is basically the 900- and 1,800-MHz bands and 3G has dedicated bandwidth, although it can also (in principle) be provided over the GSM bands. By the late 2000s, the GSM and 3G bands were more or less fully utilised and the main driving forces behind the introduction of LTE were the need to open up new spectrum bands and to re-farm the GSM bands using a more efficient technology.

Table VI takes a more detailed look at the licences issued during the five-year period commencing in late 2009. Although this period has seen some disposals of unallocated GSM bandwidth, the main sales have consisted of spectrum in the 800-MHz (digital dividend) band and the less-valuable (because higher frequency) 2.6-GHz band. It was always clear from the off that these bands would be given over to the launch of LTE. Furthermore, it was always intended that LTE-Advanced would subsequently be rolled out by combining two or more carriers – that is, two or more spectrum blocks, each initially of roughly 10 MHz, in different spectrum bands – via a process known as Carrier Aggregation which would result in a theoretical maximum downlink of between 150 and 300 Mbps (megabits per second).

As noted previously, there were 46 operators that achieved new entry by obtaining 3G licences, of which 25 had launched by the end of 2014. In contrast, leaving aside Russia where Scartel briefly provided capacity as a wholesaler before being acquired by MegaFon, Table VII shows that there were only 14 operators that achieved new entry by obtaining 4G licences despite the opening up of multiple bands for LTE, and of these only two had launched by the end of 2012 – there have subsequently been no further launches to end-2014. It is also noteworthy that many of these new entrants are owned by rather obscure companies and individuals with, presumably, limited resources, so it seems to be very unlikely that, in comparison to at least some 3G new entrants, they truly expect to provide any kind of real competition for incumbents.

There is one obvious reason for this. Anyone examining the record of 3G new entry cannot but conclude that, without a backer with the ability to withstand significant short-term losses such as Hutchison Whampoa, it is not possible to take on 2G/3G incumbents across a number of markets, while an established business in a related field, as in the case of Iliad in France, is probably a prerequisite for success even if entering an individual market. In principle, a potential new entrant with extensive access to finance can achieve entry by picking up part or all not only of individual networks but preferably of entire groups of network operations, although that approach

Table V European mobile networks based on GSM, 31 December 2014

Country	*GSM*[1]	*UMTS*[2,3]	*Licence*	*Launch*	*LTE*[3]	*Licence*	*Launch*
Albania	OTE	OTE	09/11	01/12	OTE	–	–
	Eagle Mobile	Eagle Mobile	10/12	02/13	Eagle Mobile	–	–
	Vodafone	Vodafone	11/10	01/11	Vodafone	–	–
Andorra	STA	STA	01/05	12/06	STA	–	10/14[57]
Austria	–	Hutchison	11/00	04/03[15]	Hutchison	09/10	11/11
	Telekom Austria	Telekom Austria	11/00	04/03	Telekom Austria	09/10	11/10
	T-Mobile	T-Mobile	11/00	07/04	T-Mobile	09/10	07/11
Belarus	Turkcell	Turkcell	08/09	11/09	Turkcell	–[18]	–
	Telekom Austria	Telekom Austria	02/10	03/10	Telekom Austria	–[18]	–
	MTS	MTS	12/09	05/10	MTS	–[18]	–
Belgium	KPN	KPN	02/01	06/08	KPN	11/11	09/13
	Orange	Orange	02/01	09/06	Orange	11/11	03/14
	Belgacom	Belgacom	02/01	04/04	Belgacom	11/11	11/12
	–	Telenet Tecteo	07/11	–[16]	–	–	–
	–	–	–	–	BUCD[17]	11/11	–
Bosnia Herzegovina	HT MK	HT MK	03/09	04/10	HT MK	–	–
	GSM BiH	GSM BiH	03/09	07/09	GSM BiH	–	–
	Mobilna Srpske	Mobilna Srpske	03/09	05/09	Mobilna Srpske	–	–
Bulgaria	Vivacom	Vivacom	04/05	04/07	Vivacom	–[19]	–
	Telenor	Telenor	04/05	09/06	Telenor	–[19]	–
	Telekom Austria	Telekom Austria	03/05	03/06	Telekom Austria	–[19]	–
	Bulsatcom	Bulsatcom	01/13[14]	–	Bulsatcom	01/13[14]	–
	Max Telecom	Max Telecom	01/13[14]	–	Max Telecom	01/13[14]	05/14[58]
Croatia	Tele2	Tele2	12/04	12/08	Tele2	–[20]	–
	T-Mobile	T-Mobile	10/04	06/06	T-Mobile	–[20]	03/12
	Telekom Austria	Telekom Austria	10/04	01/05	Telekom Austria	–[20]	03/12
	–	–	–	–	Hrvatski Telecom	10/13	–
Cyprus (South)	CyTA	CyTA	12/03	03/06	CyTA	–[21]	–
	MTN	MTN	12/03	01/05	MTN	–[21]	–
	PrimeTel	PrimeTel	02/14	–	PrimeTel	–[21]	–
Czech Repub.	PPF Group	PPF Group	12/01	12/05	PPF Group	nsl[22]	06/12
	T-Mobile	T-Mobile	12/01	12/06	T-Mobile	nsl[22]	10/13
	Vodafone	Vodafone	02/05	03/09	Vodafone	nsl[22]	12/13
Denmark	Hutchison	Hutchison	09/01	10/03	Hutchison	05/10[23]	09/12
	Telenor	Telenor	12/05	09/06	Telenor	05/10[23]	03/13
	TDC	TDC	09/01	10/05	TDC	05/10[23]	10/11
	TeliaSonera	TeliaSonera	09/01	12/07	TeliaSonera	05/10[23]	12/10
	–	–	–	–	TT-Netværket	06/12[24]	–
Estonia	Elisa	Elisa	07/03	06/06	Elisa	–[25]	02/13
	TeliaSonera	TeliaSonera	07/03	10/05	TeliaSonera	–[25]	12/10
	Tele2	Tele2	08/03	11/06	Tele2	–[25]	11/12
Faroe Islands	Føroya Telecom	Føroya Telecom	n/a	10/09	Føroya Telecom	–	–
	Kall-GSM	Kall-GSM	n/a	n/a	Kall-GSM	–	–
Finland	Elisa	Elisa	03/99	11/04	Elisa	11/09	12/10
	DNA	DNA	03/99	12/05	DNA	11/09	12/11
	TeliaSonera	TeliaSonera	03/99	10/04	TeliaSonera	11/09	11/10
	–	–	–	–	Finnet Group	11/09[26]	–
France	Bouygues Télécom	Bouygues Télécom	09/02	05/07	Bouygues Télécom	10/11[27]	05/13
	Orange	Orange	07/01	12/04	Orange	10/11[27]	11/12
	SFR	SFR	07/01	06/04	SFR	10/11[27]	11/12
	Iliad	Iliad	12/09	01/12	Iliad	10/11[27]	12/13
Georgia[4]	TeliaSonera	TeliaSonera	05/06	12/06	TeliaSonera	–	–
	Magti	Magti	08/05	07/06	Magti	–	–
	VimpelCom	–	–	–	–	–	–
	–	Telekom Invest	05/06	–	–	–	–
	Aquafon[6]	Aquafon	n/a	12/08	Aquafon	07/13	–
	A-Mobile[6]	–	n/a	n/a	–	–	–
	Ostelecom[6]	Ostelecom	n/a	n/a	Ostelecom	n/a	05/13
Germany	KPN	KPN	07/00	06/04	KPN	05/10[28]	03/14
	Telefónica	Telefónica	07/00	05/04	Telefónica	05/10[28]	07/11
	T-Mobile	T-Mobile	07/00	01/04	T-Mobile	05/10[28]	12/10
	Vodafone	Vodafone	07/00	01/04	Vodafone	05/10[28]	09/10
Gibraltar	GibTel	GibTel	Nsl	07/08	GibTel	–	–
	Shine Mobile	Shine Mobile	Nsl	09/13	Shine Mobile	–	–
Greece	OTE	OTE	07/01	05/04	OTE	–[29]	11/12
	Vodafone	Vodafone	07/01	08/04	Vodafone	–[29]	12/12[59]
	Wind	Wind	07/01	01/04	Wind	–[29]	–
Greenland	Tele Greenland	–	nsl	08/10	–	–	12/13
Guernsey	Bharti Airtel	Bharti Airtel	09/06	03/08	Bharti Airtel	07/14	–
	Batelco	Batelco	09/09	11/09	Batelco	07/14	–
	JT	JT	03/03	07/04	JT	07/14	–

(*continued*)

Table V

Country	*GSM*[1]	*UMTS*[2,3]	*Licence*	*Launch*	*LTE*[3]	*Licence*	*Launch*
Hungary	Telenor	Telenor	12/04	10/05	Telenor	01/12[30]	02/13
	T-Mobile	T-Mobile	12/04	08/05	T-Mobile	01/12[30]	01/12
	Vodafone	Vodafone	12/04	12/05	Vodafone	01/12[30]	–
	RCS&RDS	–	–		RCS&RDS	09/14[30]	–
Iceland	Amitelo	–	–	–	–	–	–
	IceCell	–	–	–	–	–	–
	IMC Iceland	–	–	–	–	–	–
	–	Nova	03/07	12/07	Nova	03/13	04/13
	Fjarskipti	Fjarskipti	04/07	01/07	Fjarskipti	03/13	07/13
	Síminn	Síminn	03/07	09/07	Síminn	03/13	01/14
	–	–	–	–	365 Media	03/13[31]	–
Ireland	–	Hutchison	06/02	07/05	Hutchison	11/12[32]	01/14
	Eircom	Eircom	03/07	03/09	Eircom	11/12[32]	09/13
	Telefónica	Telefónica	08/02	03/05	Telefónica	11/12[32]	–
	Vodafone	Vodafone	09/02	07/04	Vodafone	11/12[32]	10/13
Isle of Man	Batelco	Batelco	05/06	nyl	Batelco	10/13	–
	Manx Telecom	Manx Telecom	04/99	11/05	Manx Telecom	10/13	–
Italy	–	Hutchison	11/00	03/03	Hutchison	08/11[33]	11/12
	Telecom Italia	Telecom Italia	11/00	05/04	Telecom Italia	08/11[33]	11/12
	VimpelCom	VimpelCom	11/00	10/04	VimpelCom	08/11[33]	–
	Vodafone	Vodafone	11/00	02/04	Vodafone	08/11[33]	10/12
Jersey	Bharti Airtel	Bharti Airtel	02/06	06/07	Bharti Airtel	07/14	–
	Batelco	Batelco	12/05	09/06	Batelco	07/14	–
	JT	JT	12/05	06/06	JT	07/14	–
Kosovo	Ipko-Net	Ipko-Net	12/13	12/13	–	–	–
	Vala900	Vala900	12/13	–	–	–	–
	Axos Capital	Axos Capital	12/13	–	–	–	–
Latvia	Bité	Bité	05/05	06/06	Bité	–[34]	–
	TeliaSonera	TeliaSonera	09/02	12/04	TeliaSonera	–[34]	05/11
	Tele2	Tele2	09/02	12/05	Tele2	–[34]	12/13
	–	–	–	–	Baltkom	01/14	–
Liechtenstein	Tele Liechtenstein	Telekom Austria	03/01	02/07	Telekom Austria	–[35]	–
	Orange	Orange	03/01	02/07	Orange	–[35]	09/13
	Unify Nederlands	Unify Nederlands	07/01	nyl	–	–	–
	TeleNet	TeleNet	10/03	05/07	TeleNet	–[35]	–
Lithuania	Bité	Bité	02/06	06/06	Bité	03/12[36]	–
	TeliaSonera	TeliaSonera	02/06	02/06	TeliaSonera	03/12[36]	05/11
	Tele2	Tele2	02/06	03/07	Tele2	03/12[36]	03/13
Luxembourg	POST Telecom	POST Telecom	05/02	06/03	POST Telecom	06/12[37]	10/13
	Orange	Orange	07/03	03/04	Orange	06/12[37]	11/12
	Belgacom	Belgacom	05/02	07/04	Belgacom	06/12[37]	10/12
	–	–	–	–	JOIN Experience	2013[37]	06/14
Macedonia	Telekom Slovenije	Tele Slovenije	01/08	09/08	Tele Slovenije	07/13[38]	–
	T-Mobile	T-Mobile	12/08	06/09	T-Mobile	07/13[38]	12/13
	Telekom Austria	Telekom Austria	08/12	09/12	Telekom Austria	07/13[38]	07/14
Malta	Mobisle	Mobisle	08/05	03/06	Mobisle	–	–
	Vodafone	Vodafone	08/05	08/06	Vodafone	–[39]	11/13
	–	Melita Mobile	08/05	02/09	Melita Mobile	–	–
Moldova[5]	TeliaSonera	TeliaSonera	09/08	10/08	TeliaSonera	11/12	11/12
	Orange	Orange	08/08	11/08	Orange	11/12	11/12
	–	Moldtelecom	01/09	12/09	Moldtelecom	–	–
Monaco	Monaco Telecom	Monaco Telecom	06/00	06/06	Monaco Telecom	11/11	10/13
Montenegro	m:tel	m:tel	03/07	07/07	m:tel	–	–
	Telenor	Telenor	05/07	06/07	Telenor	–40	11/12
	T-Mobile	T-Mobile	05/07	06/07	T-Mobile	–[40]	12/13
Netherlands	KPN	KPN	07/00	07/04	KPN	04/10[41]	05/12[59]
	T-Mobile	T-Mobile	07/00	01/06	T-Mobile	04/10[41]	05/12[59]
	Vodafone	Vodafone	07/00	02/04	Vodafone	04/10[41]	05/12[59]
	–	T-Mobile/Orange[12]	–	11/06	–	–	–
	–	–	–	–	Tele2	04/10[41]	05/12
	–	–	–	–	Ziggo4	04/10[41]	05/12
Norway	–	Hutchison	09/03	nyl	Hutchison	–	–
	Tele2[7]	Tele2	12/07	04/08	Tele2	–	07/14[60]
	TeliaSonera	TeliaSonera	12/00	06/05	TeliaSonera	11/07[42]	12/09
	Telenor	Telenor	12/00	12/04	Telenor	11/07[42]	10/12
	–	–	–	–	Telco Data	12/13[42]	–
	–	–	–	–	Arctic Wireless	11/07[42]	–
	–	–	–	–	Craig Wireless	11/07[42]	–
	–	–	–	–	Hafslund Telecom	11/07[42]	–
	–	–	–	–	Inquam	11/07[42]	–

(*continued*)

Table V

Country	*GSM*[1]	*UMTS*[2,3]	*Licence*	*Launch*	*LTE*[3]	*Licence*	*Launch*
Poland	CenterNet[8]	–	–	–	–	nsl[8]	09/10
	Orange	Orange	12/00	01/06	Orange	–	–
	P4	P4	05/05	03/07	P4	–	11/13
	Polkomtel	Polkomtel	12/00	09/04	Polkomtel	–	09/12[61]
	T-Mobile	T-Mobile	12/00	04/05	T-Mobile	–	06/14
	Aero2[8]	Aero2	01/09[8]	11/09	Aero2	11/09[43]	09/10
Portugal	Sonae.com	Sonae.com	12/00	06/04	Sonae.com	11/11[44]	03/12
	Portugal Telecom	Portugal Telecom	12/00	04/04	Portugal Telecom	11/11[44]	03/12
	Vodafone	Vodafone	12/00	02/04	Vodafone	11/11[44]	03/12
Romania	OTE	OTE	01/07	04/10	OTE	11/12[45]	04/13
	Orange	Orange	11/04	06/06	Orange	11/12[45]	12/12
	–	RCS&RDS	01/07	12/07	RCS&RDS	11/12[45]	–
	Vodafone	Vodafone	11/04	04/05	Vodafone	11/12[45]	11/12
	–	–	–	–	2K Telecom	11/12[45]	–
Russia	MegaFon	MegaFon	04/07	10/07	MegaFon	–[46]	06/13
	MTS	MTS	04/07	05/08	MTS	–[46]	09/12
	VimpelCom	VimpelCom	04/07	09/08	VimpelCom	–[46]	05/13
	VTB Group[9]	–	–	–	VTB Group	–[46]	–
	–	–	–	–	Scartel	07/12[46,47]	04/12
	–	–	–	–	Rostelecom	–[46]	–
	–	–	–	–	SMARTS Group	07/12[46]	–
	–	–	–	–	Osnova Telecom	02/12[46]	–
San Marino	San Marino Tel	San Marino Tel	nsl	08/07	–	–	–
Serbia	Telekom Austria	Telekom Austria	08/06	07/07	Telekom Austria	–	–
	Telekom Srbija	Telekom Srbija	08/06	12/06	Telekom Srbija	–	–
	Telenor	Telenor	08/06	03/07	Telenor	–	–
Slovakia	Orange	Orange	07/02	03/06	Orange	12/13[48]	07/14
	PPF Group	PPF Group	08/06	07/11	PPF Group	12/13[48]	–
	T-Mobile	T-Mobile	07/02	01/06	T-Mobile	12/13[48]	11/13
	–	–	–	–	SWAN	12/13[48]	–
Slovenia	Telekom Slovenije	Tele Slovenije	12/01	12/03	Tele Slovenije	04/14[49]	03/13
	Telekom Austria	Telekom Austria	09/06	09/07	Telekom Austria	04/14[49]	07/12
	Tušmobil	Tušmobil	04/08	12/08	Tušmobil	04/14	–
	–	T-2	09/06	07/08	–	–	–
Spain	Orange	Orange	03/00	10/04	Orange	06/11[50]	07/13
	Telefónica	Telefónica	03/00	02/04	Telefónica	06/11[50]	10/11[59]
	Vodafone	Vodafone	03/00	02/04	Vodafone	06/11[50]	09/11[59]
	–	TeliaSonera	03/00	12/06	TeliaSonera	06/11[50]	07/13
Sweden	3 Sweden	Hutchison[13]	12/00	04/03	Hutchison	05/08[51]	12/11
	Tele2	Tele2[13]	12/00	03/04	Tele2	05/08[51]	11/10
	Telenor	Telenor[13]	12/00	12/04	Telenor	05/08[51]	11/10
	TeliaSonera	TeliaSonera[13]	12/00	03/04	TeliaSonera	05/08[51]	12/09
Switzerland	Matterhorn[10]	Matterhorn	12/00	09/05	Matterhorn	02/12[52]	05/13
	Swisscom	Swisscom	12/00	07/04	Swisscom	02/12[52]	11/12
	Sunrise (CVC)	Sunrise (CVC)	12/00	12/05	Sunrise (CVC)	02/12[52]	06/13
Turkey	AVEA	AVEA	12/08	07/09	AVEA	–[53]	–
	Turkcell	Turkcell	12/08	12/09	Turkcell	–[53]	–
	Vodafone	Vodafone	12/08	07/09	Vodafone	–[53]	–
UK	Telefónica	Telefónica	05/00	09/04	Telefónica	–[55]	08/13[62]
	Orange	Orange	05/00	07/04	Orange	–[54]	–
	T-Mobile	T-Mobile	05/00	07/04	T-Mobile	–[54]	–
	Vodafone	Vodafone	05/00	04/04	Vodafone	–[55]	08/13
	–	Hutchison	05/00	03/03	Hutchison	–[55]	12/13[62]
	–	–	–	–	EE	–[54]	10/12
	–	–	–	–	Niche Spectrum	–[55]	–
Ukraine	Astelit	–	–	–	–	–[56]	–
	VimpelCom[11]	–	–	–	–	–[56]	–
	MTS	–	–	–	–	–[56]	–
	Ukrtelecom	Ukrtelecom	12/05	11/07	–	–[56]	–

Notes: n/a = not available; nsl = no separate licence needed; nyl = not yet launched; [1]the entries, which with the exception of LTE refer only to national licensees, consist of name of operator and the month when its service was first licensed and launched during the period to end-April 2014; further details about LTE can be found in Curwen and Whalley (2013); [2]UMTS is the name used for W-CDMA technology in the EU; it is also known as 3GSM; [3]the term "launch" in the context of UMTS or LTE can mean many things, but often refers to the launch of a service for corporate customers via data cards inserted in laptops; a consumer service via handsets–sometimes referred to as a "commercial" launch–usually follows months later but may be simultaneous; launch dates can vary widely across sources because of such differences; this table lists the first relevant date even if not "fully commercial"; [4]the situation in Georgia is confusing; Mobitel was awarded a PCN licence in December 2003 but nothing happened until it was part- acquired by VimpelCom in 2006, eventually launching in February 2007; Argotex won a W-CDMA licence in April 2006, but transferred it to Magti in November; there are references to a launch of a "3G" network by Geocell in 2006 but it does not appear to have a licence; [5]Eventis was declared bankrupt in April 2010; [6]Aquafon-GSM and A-Mobile are present only in Abkhazia which Georgia regards as an autonomous region but which regards itself as an independent state that is recognised by Russia and is self-governing; the same applies to South Ossetia where Ostelecom has a network; both Aquafon and Ostelecom are majority owned by Russia's MegaFon

(*continued*)

Table V

[7]Mobile Norway was bought by Tele2 during 2011; [8]Mobyland received a 2G licence in November 2007 but was bought by Aero2 in July 2009; Aero2 uses its 1,800-MHz spectrum for 3G; Mobyland and CenterNet, in which Aero2 has an indirect 30 per cent stake, amalgamated their LTE networks using the 1,800-MHz band. In May 2014, after deliberating for over five years, the Supreme Administrative Court upheld an earlier court ruling that the GSM licences awarded to CenterNet and Mobyland should be revoked; [9]Tele2 was acquired by VTB Group in April 2013; [10]Orange was bought by Matterhorn Mobile (Apex Partners) in March 2012; ot was subject to a takeover bid by NJJ Capital (Xavier Niel) in December 2014; [11]Kyivstar was merged with VimpelCom April 2010; [12]the Orange licence was acquired by T-Mobile; in 2009, the spectrum regulator demanded that T-Mobile operate the 3G network independently of its own and meet all roll-out requirements; after being fined for failure to do so in June 2010, T-Mobile managed to satisfy the regulator's requirements in August 2010; [13]Svenska UMTS-nät Holding, the licensee, is a 50/50 joint venture between Tele2 (the original licensee) and TeliaSonera (which initially operated as a MVNO); for their part, Hutchison and Telenor have set up 3GIS, a 50/50 joint venture to provide some common network elements outside the cities of Stockholm, Gothenburg and Malmö; [14]these 1,800-MHz band licences were technology-neutral; a third licence was issued to 4G Com but was revoked in September 2014 due to non-payment of the licence fee; [15]Hutchison bought Orange in January 2013 and sold part of the spectrum it acquired to Telekom Austria; [16]Telenet Tecteo BidCo was given a launch deadline of 15 January 2013; in April 2013, it was warned for non-compliance, and in August, it was fined and given six further months in which to launch or suffer a potential licence default; in June 2014, the regulator was authorised to reclaim the 14.8 MHz paired of spectrum allocated to Telenet and either to re-allocate it to the three incumbents or to conduct an auction subject to interest from a new entrant; [17]it is thought that BUCD is Asian-owned, possibly by China Mobile; [18]in September 2012, Belarusian Cloud Technologies (beCloud) was awarded a licence to act as a wholesaler of LTE capacity with the three incumbents acting as MVNOs; [19]pending the sale of spectrum in the 2.6-GHz band specifically for LTE use, all of the incumbents intend to launch using their existing 1,800-MHz band spectrum, although none seems to be in any hurry to do so; [20]the initial launches involved the existing 1,800-MHz band spectrum; in October 2012, T-Mobile was awarded a licence for LTE in the 800-MHz band and launched using this in December; Telekom Austria also won a licence; in October 2013, further 800-MHz licences were awarded to Telekom Austria and Hrvatski Telecom; [21]neither incumbent tabled a bid when spectrum in the 2.6-GHz band for LTE use was auctioned in July 2013; PrimeTel secured a 2G/3G technology-neutral licence in February 2014 for which it was the only bidder; [22]the three incumbents all used re-farmed 1,800-MHz band spectrum for their initial roll-outs; in November 2013, the three incumbents won spectrum for LTE use in the 800-MHz and 2.6-GHz bands; Telefónica then sold almost all its majority stake in its network to the PPF Group; [23]the four incumbents are using re-farmed 2G spectrum as part of their LTE provision; however, all four also obtained 2.6-GHz licences for LTE use in May 2010, and in September 2010, Hutchison was awarded new spectrum in the 900-MHz and 1,800-MHz bands; in June 2012, TDC was awarded a licence for LTE provision in the 800-MHz band; in December 2014, TeliaSonera and Telenor announced that they intended to merge in a new 50/50 joint venture subject to regulatory authorisation; [24]Telenor and TeliaSonera have formed an infrastructure-sharing company called TT-Netværket which obtained a licence for LTE provision in the 800-MHz band in June 2012; this would be affected by a merger between TeliaSonera and Telenor; [25]in December 2010, TeliaSonera, Elisa and Tele2 were awarded spectrum in the 2.6-GHz band for LTE provision; in December 2011, TeliaSonera and Tele2 were given permission to re-farm the 1,800-MHz band for LTE provision; in May 2013, TeliaSonera was awarded spectrum in the 800-MHz band for LTE provision as was Elisa in August 2013 and Tele2 in January 2014; [26]all three incumbents together with Finnet Group subsidiary Pirkanmaan Verkko, were awarded licences in the 2.6-GHz band in November 2009, although the incumbents are also using re-farmed 1,800-MHz band spectrum for their LTE networks; [27]all four incumbents were awarded licences in the 2.6-GHz band in October 2011 and all bar Iliad were awarded licences in the 800-MHz band in November 2011; [28]in May 2010, Telefónica and Vodafone were awarded spectrum in the 800-MHz, 2.0-GHz and 2.6-GHz bands; T-Mobile was awarded spectrum in the 800-MHz, 1,800-MHz and 2.6-GHz bands; and KPN was awarded spectrum in the 1,800-MHz, 2.0-GHz and 2.6-GHz bands; the European Commission approved the takeover bid by Telefónica for KPN in August 2014; both companies will be shareholders in the post-merger Telefónica Deutschland; [29]the incumbents are using re-farmed GSM spectrum; [30]in July 2011, the incumbents were authorised to use re-farmed GSM spectrum for LTE; in January 2012, the incumbents won additional spectrum in the 900-MHz band specifically set aside for LTE services; the state-owned MPVI consortium was also awarded a 900-MHz licence, but this was annulled by the courts in September; in September 2014, all outstanding spectrum in the 800-MHz, 900-MHz, 1,800-MHz and 2.6-GHz bands was sold for LTE services; DIGI Telecoms (a subsidiary of RCS&RDS of Romania) won a licence in the 1,800-MHz band; [31]the spectrum on offer was in the 800-MHz and 1,800-MHz bands; the four winners all obtained different combinations; [32]all bar Hutchison obtained spectrum in the 800-MHz, 900-MHz and 1,800-MHz bands, whereas Hutchison did not obtain any in the 800-MHz band; in July 2014, a takeover bid by Hutchison for Telefónica was completed; [33]all bar VimpelCom (Wind) obtained spectrum in the 800-MHz, 1,800-MHz and 2.6-GHz bands, whereas VimpelCom did not obtain any in the 1,800-MHz band; [34]re-farming of GSM spectrum for LTE is permitted; licences for the provision of LTE in the 800-MHz band were won by the three incumbents (TeliaSonera, Tele2 and Bité) in November 2013, while licences in the 2.6-GHz band were handed over in January 2014 to the three incumbents and cable operator Baltkom; in October 2012, TeliaSonera and Bité had been awarded spectrum in the 2.3-GHz band; [35]the spectrum used for the Orange launch was not specified, so must be assumed to have been re-farmed GSM bandwidth; in August 2014, Telecom Liechtenstein (Telenet), acting as a mobile MVNO at the time, confirmed that it had merged its network with that of Telekom Austria, with the merged entity to be known as Telecom Liechtenstein; [36]spectrum in the 2.6-GHz band was awarded in March 2012 to the three incumbents, and in August 2013, spectrum in the 800-MHz band was awarded to the three incumbents; [37]when Belgacom's 15-year 2G licence was renewed in June 2012, it was extended to include permission to launch LTE; Orange and state-owned POST Telecom (formerly EPT trading as LuxGSM) received their LTE licences at the same time, together with the additional 1,800-MHz spectrum awarded to all three incumbents; in October 2013, Post Telecom announced that it had launched and stated in December that it had set up a 50/50 joint venture with start-up Blue Communications (trading as JOIN Experience), which in turn claimed that it had previously been awarded a LTE licence; the situation is a bit confusing; JOIN uses the Post Telecom network, effectively as a MVNO, even though it has a separate licence and claims to have launched in June 2014; its main objective is to serve customers near the borders with other countries; [38]all licences were for spectrum in the 800-MHz and 1,800-MHz bands; Telekom Austria (Vip) and Telekom Slovenije (ONE) agreed to merge in 2015Q1; [39]details are sketchy, so this must be presumed to be using re-farmed GSM spectrum; [40]using re-farmed spectrum in the 1,800-MHz band; [41]the initial auction in April 2010 was for spectrum for LTE provision in the 2.6-GHz band–this was used for the claimed launches in May 2012; in October 2012, spectrum in the 800-MHz, 900-MHz, 1,800-MHz, 1900-MHz and 2.1-GHz bands was made available; all was won by the three incumbents aside from a block of 800-MHz spectrum won by Tele2; Ziggo was fully acquired by Liberty Global in November 2014; [42]the auction in November 2007 was for spectrum in the 2.6-GHz band but some divided up into regional blocks; the two incumbents that won some spectrum in this band launched LTE by combining it with existing spectrum in the 1,800-MHz band; the auction in December 2013 was for spectrum in the 800-, 900- and 1,800-MHz bands; TeliaSonera and Telenor won spectrum in all three bands as did Telco Data (Ice.net), which has made provisional arrangements with Tele2 to set up as the third incumbent as Tele2 failed to win a licence and is subject to a take-over bid by TeliaSonera–objected too by the anti-trust regulator in December 2014; [43]the situation is complex but, in essence, the only licence in the 2.6 GHz band is held by Aero2 even though it launched using the 1,800-MHz band; in June 2013, P4 and T-Mobile bought additional spectrum in the 1,800-MHz band and this appears to be favoured, as is infrastructure sharing, for launches by all parties; [44]in November 2011, both Portugal Telecom and Sonae.com won spectrum in the 800-MHz, 1,800-MHz and 2.6-GHz bands, whereas Vodafone won spectrum in these plus the 900-MHz band; [45]in November 2012, incumbents Orange, OTE and Vodafone won spectrum in the 800-MHz, 900-MHz, 1,800-MHz and 2.6-GHz bands; RCS&RDS won spectrum in the 900-MHz band but does not intend to use it for LTE; 2K Telecom won unpaired spectrum in the 2.6-GHz band

(*continued*)

Table V

[46]the situation in Russia is too complex to outline fully not least because not all licences are national; for example, Scartel (Yota Networks) launched as a wholesaler having switched from WiMAX to LTE; its network was used by MegaFon acting as a MVNO but MegaFon, MTS, Rostelecom and VimpelCom all won spectrum in the 800-MHz band in February 2012 as did (separately) Osnova Telecom; MTS also won spectrum in the 2.6-GHz band in Moscow; in July 2012, the 1,800-MHz band was made technology-neutral, hence allowing SMARTS Telecom to switch to LTE–see Curwen and Whalley (2013, chapter 4); MegaFon is now the owner of Scartel; [47]MegaFon acquired Scartel in October 2013; the two networks were fully integrated in April 2014; [48]in November 2013, Orange won spectrum in the 800-MHz, 1,800-MHz and 2.6-GHz bands; T-Mobile–which had launched using re-farmed spectrum in the 1,800-MHz band–won spectrum in the 800-MHz and 2.6-GHz bands; Telefónica–taken over in January 2014 by the PPF Group–won spectrum in the 800-MHz and 1,800-MHz bands; and new entrant SWAN won spectrum in the 1,800-MHz band; [49]the launches prior to the April 2014 auction used re-farmed 1,800-MHz spectrum; [50]in June 2011, Orange (900 MHz) and TeliaSonera (1,800 MHz) won spectrum to be used for LTE in rural areas; a further auction provided Telefónica with spectrum in the 800-MHz, 900-MHz and 2.6-GHz bands and Orange and Vodafone with spectrum in the 800-MHz and 2.6-GHz bands (the latter providing national coverage); regional licences in the 2.6-GHz band were awarded to ONO, Jazztel, Euskaltel, R Cable, Telecable and Telecom Castilla La Mancha; [51]Telenor and Tele2 act via Net4Mobility, a 50/50 joint venture which initially used 900-MHz and 2.6-GHz band spectrum, the latter obtained in an auction in May 2008 when TeliaSonera and Hutchison (via majority-owned Hi3G Access) also won licences; in March 2011, Hi3G Access and Net4Mobility won spectrum in the 800-MHz band, while in October 2011, Net4Mobility and TeliaSonera won spectrum in the 1,800-MHz band; [52]The three incumbents won spectrum in the 800-MHz, 900-MHz, 1,800-MHz, 2.1-GHz and 2.6-GHz bands; [53]in April 2013, the government stated that a joint venture involving Asiesan Elekronik & Ticaret, Netas Telkomunikasyon and Turk Telecom's software subsidiary Argeia had contracted with the government to build a LTE network capable of a maximum downlink of 100 Mbps for civilian and military use; [54]EE (formerly Everything/Everywhere) is a jointly owned network with Orange and T-Mobile combining their respective networks in 2010; EE was licensed to re-farm its 1,800-MHz spectrum for LTE in September 2012; because it initially co-existed alongside the Orange and T-Mobile networks, it could arguably be considered to be a new entrant; it was placed under offer by BT in December 2014; [55]in February 2013, Hutchison and Telefónica won spectrum in the 800-MHz band, while Vodafone and EE won spectrum in the 800-MHz and 2.6-GHz bands; BT subsidiary Niche Spectrum also won unpaired spectrum in the 2.6-GHz band, but its intentions remain unclear; in December 2015, BT made a takeover bid for EE; [56]although a licence in the 1980-2,000-MHz band was issued to First Investment Alliance in June 2013, the incumbents do not yet appear to have been licensed to provide LTE; [57]it is unclear when Andorra Telecom obtained the 800-MHz spectrum that it used for this launch; [58]this company now trades simply as "Max"; [59]these launches were for business clients rather than trials, but whether they should be considered as "commercial" is debatable; the alternative dates for Vodafone are The Netherlands in February 2013, Spain in May 2013 and Greece in June 2013; KPN's commercial launch in The Netherlands was in February 2013, while that of T-Mobile becomes November 2013. Telefónica in Spain claimed to be starting the deployment of its network in September 2013, at which point it would launch over the TeliaSonera (Yoigo) network while using its own network for the first time in October; [60]information is lacking, but Tele2's launch took place via a roaming deal with Telenor which also incorporated 2G and 3G; [61]Polkomtel initially launched as a MVNO over the Aero2 network in December 2011; [62]Hutchison made a provisional offer for Telefónica UK in January 2015

is different from the new entry model discussed above. This has been the route chosen by América Móvil in the case of KPN (where it has not been able to take control) and Telekom Austria (where it is the majority shareholder but has the other shareholder, the state, looking over its shoulder). However, although AT&T is rumoured to be interested in following this route, the odds on it proceeding are slim – it is currently pre-occupied with its purchase of Iusacell in Mexico – and the number of other potential candidates is extremely small and quite possibly nil.

6. Conclusions

It would appear from the above discussion that the consequences of new entry for the state of competition in the European mobile sector have been modest at best. Over a period of roughly 15 years, the award of 3G licences in a broad range of European countries has achieved very little by way of increased competition. The only company to have had any broadly based success is Hutchison Whampoa, yet until very recently it only managed to establish itself as the smallest operator in its markets and the losses that it incurred in so doing would be unsustainable for virtually any other potential entrant. For their part, Iliad and P4 have grown rapidly at the expense of the incumbents but have yet to attain more than a 15 per cent market share.

That most of the new entrants have yet to gain more than a 15 per cent market share vividly illustrates the scale of the challenges and difficulties that they face when competing against their larger and well-established rivals. That the well-funded and doggedly persistent Hutchison Whampoa has only recently breached this threshold in two markets, even with the assistance of acquisitions, raises the question as to whether other new entrants will ever gain sufficient scale in mobile markets to be effective competitors. Sooner or later, new entrants have sought to succeed through adopting a policy of being disruptive (Baritault, 2009). This is, however, a double-edged sword – while a strategy of undercutting incumbent prices and offering better data allowances may have contributed to their growth, it is hardly the optimum route to

Table VI LTE licensing across Europe, 31 December 2014

Country	*Spectrum band MHz*	*Reserved new entry*	*Date*	*Licence winners*
Albania	–	–	–	–
Andorra	–	–	–	–
Austria	2,600	–	September 2010	Hutchison, Telekom Austria, T-Mobile
	800	10 MHz[7]	October 2013	Telekom Austria, T-Mobile
	900	–	October 2013	Hutchison, Telekom Austria, T-Mobile
	1,800	–	October 2013	Hutchison, Telekom Austria, T-Mobile
Belarus	–[1]	–	September 2012	beCloud
Belgium	2,600	–[8]	November 2011	Belgacom, BUCD, KPN, Orange
	800	–	November 2013	Belgacom, KPN, Orange
Bosnia-Herz.	–	–	–	–
Bulgaria	1,800	All[9]	January 2013[17]	Bulsatcom, Max Telecom, 4G Com
Croatia	800	–	October 2012	Telekom Austria, T-Mobile
	800	–	October 2013	Hrvatski Telecom
Cyprus (S)	–[2]	–	September 2013	PrimeTel
Czech Repub.	–[3]	–[3]	November 2013	T-Mobile, Telefónica (PPF Group), T-Mobile
Denmark	2,600	–	May 2010	Hutchison, TDC, Telenor, TeliaSonera
	900/1,800	All[10]	September 2010	Hutchison
	800	–	June 2012	TDC, TT-Netværket[20]
Estonia	2,600	–	December 2010	Elisa, TeliaSonera, Tele2
	800	–	May 2013	TeliaSonera
	800	–	August 2013	Elisa
	800	–	January 2014	Tele2
	2,100	–	Mar 2014	Tele2
Faroe Isles	–	–	–	–
Finland	2,600	–	November 2009	DNA, Elisa, Finnet Group, TeliaSonera
	800	–	October 2013	DNA, Elisa, TeliaSonera
France	2,600	–	October 2011	Bouygues, Iliad, Orange, SFR
	800	–	December 2011	Bouygues, Orange, SFR
Georgia	800	–	December 2014	VimpelCom
Germany	800	–	May 2010	Telefónica, T-Mobile, Vodafone
	1,800	–	May 2010	KPN, T-Mobile
	2,000	–	May 2010	KPN, Telefónica, Vodafone
	2,600	–	May 2010	KPN, Telefónica, T-Mobile, Vodafone
	700	–[11]	2015	–
Gibraltar	–	–	–	–
Greece	–[4]	–	November 2011	OTE, Vodafone, Wind
Greenland	800	–	–[18]	Tele Greenland
Guernsey	–	–	–	–
Hungary	900	–	January 2012	Telenor, T-Mobile, Vodafone[21]
Iceland	800	–	March 2013	Fjarskipti, Nova, Siminn, 365 Media
	1,800	–	March 2013	Fjarskipti, Nova, Siminn, 365 Media
Ireland	800	–	November 2012	Eircom, Telefónica, Vodafone
	900	–	November 2012	Eircom, Hutchison[22], Telefónica[22], Vodafone
	1,800	–	November 2012	Eircom, Hutchison, Telefónica, Vodafone
Isle of Man	–	–	–	–
Italy	800	–	August 2011	Hutchison, Telecom Italia, Vodafone, Wind
	1,800	–	August 2011	Hutchison, Telecom Italia, Vodafone, Wind
	2,600	–	August 2011	Hutchison, Telecom Italia, Vodafone, Wind
Jersey	2,600	–	–[19]	Clear Mobitel
Kosovo	–[5]	–	November 2013	Axos Capital, Ipko-Net, Vala900
Latvia	2,300	–	October 2012	Bité, TeliaSonera
	2,600	–	January 2014	Baltkom, Bité, TeliaSonera, Tele2
Liechtenstein	–	–	–	–
Lithuania	2,600	–	March 2012	Bité, TeliaSonera, Tele2
	800	–	June 2013	Bité, TeliaSonera, Tele2
Luxembourg	–[6]	–	June 2012	Belgacom, Orange, POST Telecom
Macedonia	800/1,800	–	October 2012	–
	800/1,800	–	July 2013	Telekom Austria, Telekom Slovenije, T-Mobile
Malta	–	–	–	–
Moldova	2,600	–	November 2012	Orange, TeliaSonera[23]
Monaco	–	–	November 2011	Monaco Telecom

(*continued*)

Table VI

Country	Spectrum band MHz	Reserved new entry	Date	Licence winners
Montenegro	–	–	–	–
Netherlands	2,600	–[12]	April 2010	KPN, T-Mobile, Tele2, Vodafone, Ziggo4
	800	–[14]	October 2012	KPN, Tele2, Vodafone
	900	–[14]	October 2012	KPN, T-Mobile, Vodafone
	1,800	–	October 2012	KPN, T-Mobile, Vodafone
	1,900	–	October 2012	T-Mobile
	2,100		October 2012	KPN, Vodafone
	2,600	–	October 2012	KPN, T-Mobile
Norway	2,600	–	November 2007	Craig Wireless, Inquam, Telenor, TeliaSonera[27]
	800	–	December 2013	Telco Data, Telenor, TeliaSonera
	900	–	December 2013	Telco Data, Telenor, TeliaSonera
	1,800	–	December 2013	Telco Data, Telenor, TeliaSonera
Poland	2,600	–	November 2009	Aero2
	1,800	–	February 2012	P4, T-Mobile[25]
Portugal	800	–	November 2011	Portugal Telecom, Sonae.com, Vodafone
	900	–	November 2011	Vodafone
	1,800	–	November 2011	Portugal Telecom, Sonae.com, Vodafone
	2,600	–	November 2011	Portugal Telecom, Sonae.com, Vodafone
Romania	800	–	November 2012	Orange, OTE, Vodafone
	900	–	November 2012	Orange, OTE, RCS&RDS, Vodafone
	1,800	–	November 2012	Orange, OTE, Vodafone
	2,600	–	November 2012	Orange, OTE, Vodafone, 2K Telecom
Russia	800	–	July 2012	MegaFon, MTS, Rostelecom[26], Vimpelcom
	2,600	–	July 2012	–[27]
San Marino	–	–	–	–
Serbia	–	–	–	–
Slovakia	800	–	December 2013	Orange, Telefónica[28], T-Mobile
	1,800	15.2 MHz[15]	December 2013	Orange, SWAN, Telefónica
	2,600	–	December 2013	Orange, T-Mobile
Slovenia	800	10 MHz	April 2014	Telekom Austria, Telekom Slovenije, Tusmobil
	900	–	April 2014	Telekom Austria, Telekom Slovenije, Tusmobil
	1,800	–	April 2014	Telekom Austria, Telekom Slovenije, Tusmobil
	2,100	–	April 2014	Telekom Austria
	2,600	–	April 2014	Telekom Austria
Spain	900	–	May 2011	Orange
	1,800	–	May 2011	TeliaSonera
	800	–	June 2011	Orange, Telefónica, Vodafone
	900	–	June 2011	Orange, Telefónica, Vodafone
	2,600	–[16]	June 2011	Orange, Telefónica, Vodafone
Sweden	2,600	–	May 2008	Hutchison[28], Intel Capital[29], Telenor, TeliaSonera, Tele2
	800	–	March 2011	Hutchison, Net4 Mobility[30], TeliaSonera
	1,800	–	October 2011	Net4 Mobility, TeliaSonera
Switzerland	800	–	February 2012	Matterhorn Mobile, Sunrise, Swisscom
	900	–	February 2012	Matterhorn Mobile, Sunrise, Swisscom
	1,800	–	February 2012	Matterhorn Mobile, Sunrise, Swisscom
	2,100	–	Feb 2012	Matterhorn Mobile, Sunrise, Swisscom
	2,600	–	February 2012	Matterhorn Mobile, Sunrise, Swisscom
Turkey	–	–	–	–[31]
UK	800	–	February 2013	EE[32], Hutchison[32], Telefónica[32], Vodafone
	2,600	–	February 2013	EE, Niche Spectrum, Vodafone
Ukraine	–	–	–	–[33]

Notes: [1]Belarusian Cloud Technologies (beCloud) was awarded spectrum in the 1,710-1,730-MHz/1,805-1,825-MHz and 2,530-65/2,650-2,685-MHz bands to act as a wholesaler to the three incumbents acting as MVNOs; [2]in September 2013, technology-neutral spectrum in the 900-MHz, 1,800-MHz, 2,100-MHz and 2,600-MHz bands was put up for auction; however, only one bid–for the 2G/3G spectrum–was forthcoming, so the auction was cancelled; the spectrum appears to have been handed over in February 2014; [3]the initial auction for spectrum in the 800-MHz, 1,800-MHz (partly reserved for a new entrant) and 2,600-MHz bands which took place during March 2013 was cancelled when bids rose so high as to be uneconomic for new entrants; when a new auction took place in November 2013, no new entrants placed bids, but PPF Group immediately made a successful takeover bid for Telefónica, thereby becoming eligible to receive the licence; [4]when the soon-to-expire 2G licences were re-auctioned, they were changed to a technology-neutral status; [5]existing licences were converted to a technology-neutral basis on 1 November 2013

(*continued*)

Table VI

[6]when Belgacom's 15-year 2G licence was renewed in June 2012, it was extended to include permission to launch LTE; Orange and state-owned POST Telecom received their LTE licences at the same time, together with the additional 1,800-MHz spectrum awarded to all three incumbents; [7]no applications were forthcoming from potential new entrants; [8]however, incumbents were capped at 20 MHz paired; [9]these are technology-neutral licences; [10]these are technology-neutral licences; [11]some coverage obligations do not apply to new entrants; [12]20 MHz paired and 55 unpaired were reserved and there were also spectrum caps applied to incumbents; [13]one licence was reserved in the 800-MHz band and won by Tele2; [14]there were no applications for reserved spectrum in this band; [15]an amount designed to ensure equity with the holdings of incumbents; [16]some regional licences were also awarded to new entrants; [17]the licences were awarded in December 2011 but do not appear to have been handed over until January 2013; [18]although Tele Greenland is known to have launched LTE in December 2013, it is not possible to ascertain when it was licensed; [19]in August 2009, the Jersey regulator (JCRA) recommended to the UK's Ofcom, the ultimate regulator, that a little-known entity, Clear Mobitel, should be awarded a test licence for LTE in the 2.6-GHz band and this took place in September 2010; the JCRA withdrew its recommendation in March 2011, but Clear Mobitel was successful in having that decision struck down in the Royal Court of Jersey in September; no further reports are available; [20]50/50 owned by Telenor and TeliaSonera; [21]a further 900-MHz licence was awarded to the state-owned MPVI consortium, but this was annulled by the courts in September; [22]in July 2014, a takeover bid by Hutchison for Telefónica was completed and the assets transferred; [23]Moldtelecom announced a launch in February 2012 but this was reported elsewhere to be a demonstration and there is as yet no evidence of service provision; [24]regional licences were also won by Arctic Wireless and Hafslund Telecom; Craig Wireless sold on half of its spectrum in February 2009; [25]all the operators appear to be using their 1800-MHz band spectrum for their initial launches; [26]Rostelecom has formed a joint venture with VTB Group–which had bought Tele2–called T2 RTK Holding; [27]Scartel started out as the operator of a WiMAX network that was switched to LTE on a wholesale basis; it has been acquired by MegaFon; [28]acquired by the PPF Group in January 2014; [29]Hutchison operates via majority-owned Hi3G Access; a further licence was won by Intel Capital Corp; but this was acquired by Hi3G Access in December 2010; [30]Telenor and Tele2 had pooled their 900-MHz and 2,600-MHz spectrum into a joint venture called Net4Mobility; [31]in April 2013, the government stated that a joint venture involving Asiesan Elekronik & Ticaret, Netas Telkomunikasyon and Turk Telecom's software subsidiary Argeia had contracted with the government to build a LTE network capable of a maximum downlink of 100 Mbps for civilian and military use; [32]EE (formerly Everything/Everywhere) is a jointly owned network with Orange and T-Mobile combining their respective networks in 2010; EE was licensed to re-farm its 1800 MHz spectrum for LTE in September 2012; because it initially co-existed alongside the Orange and T-Mobile networks, it could arguably be considered to be a new entrant; EE received a takeover bid from BT (operating here as Niche Spectrum) in January 2015; Hutchison responded by making a provisional takeover bid for Telefónica UK; [33]in June 2013, a licence in the unusual 1,980-2,000-MHz band was issued to First Investment Alliance but what use will be made of it remains unclear

Table VII European LTE new entrants, 31 December 2014

Country	*Operator*	*Date service launched*	*No. of subscribers 31/12/12*	*Main shareholders at time of licence issue*
Belgium	BUCD	–	–	[4]
Bulgaria	Bulsatcom	–	–	Ramen Genchev
Bulgaria	Max Telecom	–	–	Krasimir Stuychev
Bulgaria	4G Com	–	–	Ultra Com
Iceland	365 Mobile	–	–	BSkyB
Jersey	Clear Mobitel	–	–	TRD New Zealand
Latvia	Baltkom	–	–	Ardian/Resource Partners
Netherlands	Ziggo4	05/12	c50,000	Liberty Global, Ziggo
Netherlands	Tele2[1]	05/12	c50,000	Tele2
Norway	Telco Data[2]	–	–	Ice.net
Romania	2K Telecom	–	–	Alexandru Ghita
Slovakia	SWAN	–	–	DanubiaTel
Spain	–[3]	–	–	–
UK	Niche Spectrum	–	–	BT

Notes: [1]Tele2 was already operating as a MVNO but it was now in a position to roll out its own network; [2]Spectrum was awarded on a regional basis to Arctic Wireless, Craig Wireless, Hafslund Telecom and Inquam; [3]some regional licences were also issued; [4]it is thought that BUCD is Asian-owned, possibly by China Mobile

achieving a decent return on capital. Without either the necessary scale or return on capital, the (smaller) new entrants are unlikely to remain in the market.

Most of the LTE licences in Europe have now been issued and predictably mopped up by incumbents, but it is notable how little effort was put in across the board to reserve spectrum for new entrants. In effect, this constitutes an admission by regulators that they are more interested in rolling out high-speed data networks – a policy best left in the hands of incumbents

to execute if speed and reach are of the essence – than in fostering potential new entry that they anyway suspect will not emerge in practice, at least not on a scale to provide effective competition for incumbents.

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