

2.1 Introduction

The case studies which follow are based upon information supplied by a wide variety of internet websites, all of which have been cross-checked. There is only one alternative source for this information in the public domain which is the Global mobile Suppliers Association (GSA) at <http://www.gsacom.com>. However, it uses a somewhat different system for recording LTE launches. For example, it identifies many of the networks differently, it includes certain of the launches itemised as excluded in footnote 1 to Table 2.1—in particular wholesalers (see Global mobile Suppliers Association 2012)—and its case studies are prepared independently from those below and hence differ considerably in their emphasis and level of detail—for example, they do not contain detailed information about licensing—in addition to the fact that they are not written as a continuous narrative. It may be added that there is (inevitably) ambiguity about the definition of a launch. For the purposes of Table 2.1, launch dates are (insofar as it can be ascertained) those when a network goes ‘commercial’ even though the area/population covered may be quite small. If the launch is explicitly stated to be a ‘trial’, ‘test’, ‘pilot’ or equivalent, then that is simply noted in the table and case studies.

Overall, the above clearly raises the need to warn readers about the interpretation of any aggregated data that are reported in the media. In particular, the number of declared launches can be altered significantly by variations in the treatment of regional operators, MVNOs and wholesalers. Hopefully, Table 2.1 is set out in such a way as to allow readers to make any adjustments for themselves.

Readers are also strongly advised that second-hand versions of the GSA database are not to be trusted. For example, that available at <http://www.teleco.com>, the major mobile telecommunications site for Latin America, has at various times introduced numerous errors including the following: MTS (Armenia) listed as launching in both February 2011 and December 2011; Yota Belarus listed as launching in both December 2011 and May 2012; Glo Mobile (Niger) listed as launching in January 2011 although it does not exist—it exists in Nigeria but has

Table 2.1 LTE launches and commitments.^a June 2013

Country	Operator	MHz Band ^b	Launch	Comment
Afghanistan	Etisalat	–	–	<i>See case study Chap. 6</i>
Algeria	–	–	–	<i>See case study Chap. 7</i>
Andorra	Andorra Telecom	2,600	–	–
Angola	Movicel	1,800	04/12	(See TeleGeography 2012b)
Angola	Unitel	2,100	12/12	(See Engineering news 2013)
Anguilla	Digicel	–	–	Marketing HSPA + as ‘4G’
Antigua	Digicel	700	11/12	<i>See case study Chap. 7</i>
Argentina	Personal	n/a	–	<i>See case study Chap. 7</i>
Argentina	Telefónica	AWS	2013	
Armenia	MTS	2,600	01/12	Awarded spectrum 11/10 ^c
Armenia	VimpelCom	698–806	–	Based on tests in Kazakhstan
Armenia	Orange	n/a	–	
Australia	Optus	1,800/2,300	07/12	<i>See case study Chap. 6</i>
Australia	Telstra	1,800/2,600	09/11	
Australia	VHA	1,800	06/13	
Austria	Hutchison 3G	2,600	11/11	<i>See case study Chap. 5</i>
Austria	Orange	2,600	–	
Austria	Telekom Austria	2,600	11/10	
Austria	T-Mobile	2,600	07/11	
Azerbaijan	Azerfon	n/a	–	<i>See case study Chap. 7</i>
Azerbaijan	Bakcell	n/a	2013	
Azerbaijan	TeliaSonera	1,800	05/12	
Bahamas	BTC	700	–	<i>See case study Chap. 7</i>
Bahamas	C&W	700	–	
Bahrain	Zain	n/a	04/13	<i>See case study Chap. 7</i>
Bahrain	Batelco	1,800	02/13	
Bahrain	STC	1,800	–	
Bangladesh	–	–	–	<i>See case study Chap. 6</i>
Belarus	Turkcell	2,600	–	<i>See case study Chap. 7</i>
Belarus	MTS	2,600	–	
Belgium	Belgacom	1,800/2,600	11/12	<i>See case study Chap. 5</i>
Belgium	KPN	2,600	–	
Belgium	Orange	1,800/2,600	–	
Belgium	BUCD	2,600	–	
Belize	Belize Telecom	Existing	–	–
Benin	MTN	n/a	–	3G/4G licence awarded in March 2012
Bhutan	Bhutan telecom	1,800	2013	<i>See case study Chap. 6</i>
Bolivia	Entel	700	12/12	<i>See case study Chap. 7</i>

(continued)

Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Bosnia & Herz.	Telekom Srpske	n/a	–	<i>See case study Chap. 7</i>
Bosnia & Herz.	BH Telekom	–	–	
Botswana	MTN (Mascom)	n/a	–	<i>See case study Chap. 7</i>
Brazil	Oi	2,600	04/13	<i>See case study Chap. 7</i>
Brazil	Telefónica	2,600	04/13	
Brazil	América Móvil	2,600	12/12	
Brazil	TIM	2,600	07/13	
Br. Virgin Isles	–	–	–	<i>See case study Chap. 7</i>
Brunei	–	1,800	–	<i>See case study Chap. 6</i>
Bulgaria	Telekom Austria	1,800	01/12	<i>See case study Chap. 5</i>
Bulgaria	Vivacom	–	–	
Bulgaria	Max Telecom	1,800	2013	
Bulgaria	Bulsatcom	1,800	2013	
Cambodia	Digital Star Media	n/a	2013	Plans launch by acquiring excell
Canada	Bell Canada	AWS/2,600	09/11	<i>See case study Chap. 7</i>
Canada	Rogers	AWS/2,600	07/11	
Canada	Telus	AWS	02/12	
Chile	América Móvil	2,500	01/13	<i>See case study Chap. 7</i>
Chile	Telefónica	2,500	2013	
Chile	Entel	2,500	2013	
China	China Mobile	2,570–2,620	2014	<i>See case study Chap. 6</i>
China	China Telecom	n/a	2014	
Colombia	UNE-EPM	2,600	06/12	<i>See case study Chap. 7</i>
Colombia	América Móvil	1,900	–	
Colombia	Telefónica	1,900	–	
Colombia	Millicom	1,900	–	
Costa Rica	ICE	2,600	06/13	<i>See case study Chap. 7</i>
Costa Rica	América Móvil	2,600	–	
Croatia	T-Mobile	1,800/800	03/12	<i>See case study Chap. 5</i>
Croatia	Telekom Austria	1,800	03/12	
Cyprus South	–	–	–	<i>See case study Chap. 5</i>
Czech Rep.	Telefónica	1,800	06/12	<i>See case study Chap. 5</i>
Czech Rep.	T-Mobile	Multiple	2013	
Czech Rep.	Vodafone	Multiple	2013	
Denmark	TDC	2,600/800	10/11	<i>See case study Chap. 5</i>
Denmark	Telenor	1,800/2,600	2013	

(continued)

Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Denmark	TeliaSonera	Multiple	12/10	
Denmark	Hutchison ‘3’	1,800/2,600	09/12	
Djibouti	Djibouti Telecom	n/a	01/13	In practice, HSPA + (TeleGeography 2013a)
Dominican Rep.	Orange	1,800	01/13	See case study Chap. 7
Dominican Rep.	Tricom	800/1,900	03/13	
DR Congo	Smile Comms	790–862	–	
DR Congo	Millicom	–	05/13	In practice HSPA + (TeleGeography 2013d)
Ecuador	América Móvil	n/a	–	See case study Chap. 7
Ecuador	CNT	700/AWS	–	
Egypt	Vodafone	Existing	–	Testing
Egypt	MobiNil	Existing	–	Testing
Egypt	Etisalat	Existing	–	Testing
Estonia	Elisa	Multiple	02/13	See case study Chap. 5
Estonia	Tele2	2,600/1,800	11/12	
Estonia	TeliaSonera	2,600/1,800	12/10	
Ethiopia	Ethio Telecom	n/a	–	Rolling out network (Cellular-news 2012b)
Fiji	Fiji Telecom	–	–	See case study Chap. 6
Fiji	Digicel	–	–	
Fiji	Vodafone	–	–	
Finland	DNA	2,600/1,800	12/11	See case study Chap. 5
Finland	Elisa	2,600/1,800	12/10	
Finland	TeliaSonera	2,600/1,800	11/10	
France	Orange	800/2,600	11/12	See case study Chap. 5
France	Vivendi	800/2,600	11/12	
France	Bouygues	800/2,600	05/13	
France	Iliad	800/2,600	–	
Fr. Polynesia	–	–	–	Vendors testing feasibility of 4G
Georgia	VimpelCom	1,800	–	Testing commenced November 2011
Germany	KPN	2,600/1,800	–	See case study Chap. 5
Germany	Telefónica	800/2,600	07/11	
Germany	T-Mobile	Multiple	12/10	
Germany	Vodafone	800/2,600	09/10	
Ghana	Glo Mobile	n/a	–	See case study Chap. 7
Greece	OTE	900/1,800	11/12	See case study Chap. 5
Greece	Vodafone	900/1,800	12/12 ^d	
Greece	Wind	900/1,800	–	
Greenland	TELE Greenland	800	2012Q4	See case study Chap. 7
Guam	IT&E	700	08/12	See case study Chap. 6

(continued)

Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Guam	DoCoMo	700	10/12	
Guam	iConnect	700	03/13	
Guatemala	–	Multiple	–	<i>See case study Chap. 7</i>
Haiti	Digicel	–	–	<i>See case study Chap. 7</i>
Hong Kong	CSL	1,800/2,600	11/10	<i>See case study Chap. 6</i>
Hong Kong	Hutchison	1,800/2,600	05/12	
Hong Kong	PCCW	1,800/2,600	04/12	
Hong Kong	China Mobile	2,600/2,300	04/12	
Hong Kong	SmarTone	1,800	08/12	
Hungary	Vodafone	900/2,600	2013	<i>See case study Chap. 5</i>
Hungary	Telenor	1,800/2,600	02/13	
Hungary	T-Mobile	1,800/900	01/12	
Iceland	Novator	1,800/800	04/13	<i>See case study Chap. 5</i>
India	Aircel	2,300	2013	<i>See case study Chap. 4</i>
India	Bharti Airtel	2,300	04/12	
India	BSNL	2,300	–	
India	MTNL	2,300	–	
India	Qualcomm	2,300	2013	
India	Reliance Ind.	2,300	2013	
India	Tikona Digital	2,300	2013	
India	Videcon	1,800	2013	
Indonesia	Axiata	–	–	<i>See case study Chap. 6</i>
Indonesia	Indosat	1,800	–	
Indonesia	Telkomsel	–	–	
Iraq	–	–	–	<i>See case study Chap. 7</i>
Ireland	–	2,600	–	<i>See case study Chap. 5</i>
Isle of Man	Manx Telecom	2,600	–	Trials from November 2011
Israel	–	–	–	<i>See case study Chap. 7</i>
Italy	Telecom Italia	1,800/2,600	11/12	<i>See case study Chap. 5</i>
Italy	Vodafone	1,800/2,600	10/12	
Italy	Wind	1,800/2,600	2013	
Italy	Hutchison	1,800/2,600	11/12	
Jamaica	–	700	–	<i>See case study Chap. 7</i>
Japan	DoCoMo	2,100/1,500	12/10	<i>See case study Chap. 6</i>
Japan	KDDI	Multiple	09/12	
Japan	eMobile	1,700	03/12	
Japan	SoftBank Mobile	Multiple	02/12 ^e	
Jersey	Clear Mobitel	2,600	–	<i>See case study Chap. 5</i>
Jordan	Zain	Existing	–	<i>See case study Chap. 7</i>
Kazakhstan	VimpelCom	700–799	–	<i>See case study Chap. 7</i>
Kazakhstan	Kazakhtelecom	1,800	12/12	
Kenya	Various	n/a	–	<i>See case study Chap. 7</i>

(continued)

Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Kiribati	TSKL	700	–	<i>See case study Chap. 6</i>
Kuwait	Viva	1,800	12/11	<i>See case study Chap. 7</i>
Kuwait	Zain	1,800	11/12	
Kuwait	Qatar Telecom ^f	1,800	07/13	
Kyrgyzstan	Saima Telecom	2,600	12/11	<i>See case study Chap. 7</i>
Laos	LTC	n/a	–	<i>See case study Chap. 6</i>
Laos	VimpelCom	1,800/2,600	–	
Latvia	Tele2	2,600	2013	<i>See case study Chap. 5</i>
Latvia	TeliaSonera	1,800/2,600	05/11	
Latvia	Bité	2,600	–	
Latvia	Baltkom	2,600	–	
Latvia	Triatel	790–862	–	
Lebanon	Alfa Telecom	800/2,600	05/13	<i>See case study Chap. 7</i>
Lebanon	MTC	800/2,600	05/13	
Liberia	Cellcom	n/a	–	<i>See case study Chap. 7</i>
Libya	Al Madar	–	–	Government mulling over licence issue
Libya	Libyana	–	–	
Lithuania	TeliaSonera	1,800	05/11	<i>See case study Chap. 5</i>
Lithuania	Bité	2,600	–	
Lithuania	Tele2	2,600	03/13	
Luxembourg	Orange	1,800	11/12	<i>See case study Chap. 5</i>
Luxembourg	Belgacom	1,800	10/12	
Macedonia	T-Mobile	800/1,800	–	<i>See case study Chap. 5</i>
Macedonia	Telekom Austria	800/1,800	–	
Macedonia	Telekom Slovenije	800/1,800	–	
Malaysia	Maxis	2,600	01/13	<i>See case study Chap. 6</i>
Malaysia	Axiata	2,600	04/13	
Malaysia	DiGi	2,600	07/13	
Maldives	Qatar Telecom ^f	–	2013	On trial
Mauritius	Orange	1,800	06/12	<i>See case study Chap. 7</i>
Mauritius	Millicom	1,800	05/12	
Mexico	América Móvil	AWS	11/12	<i>See case study Chap. 7</i>
Mexico	Telefónica	AWS	11/12	
Moldova ^g	Moldtelecom	2,600/3,700	–	<i>See case study Chap. 7</i>
Moldova	Orange	2,600/3,700	11/12	
Moldova	TeliaSonera	2,600/3,700	11/12	
Monaco	Monaco Telecom	2,600	2013	<i>See case study Chap. 5</i>
Montenegro	Telenor	2,600	11/12	<i>See case study Chap. 5</i>
Morocco	–	n/a	2013	<i>See case study Chap. 7</i>
Mozambique	–	–	–	<i>See case study Chap. 7</i>

(continued)

Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Myanmar	–	–	–	<i>See case study Chap. 6</i>
Namibia	MTC	1,800	05/12	<i>See case study Chap. 7</i>
Nepal	Ncell	n/a	–	Has requested licence and spectrum from regulator
Nepal	Nepal Telecom	2,300	–	TD-LTE
Netherlands	KPN	2,600/800	05/12 ^d	<i>See case study Chap. 5</i>
Netherlands	T-Mobile	2,600/1,800	05/12 ^d	
Netherlands	Vodafone	2,600	05/12 ^d	
New Zealand	TNZ	698–806	–	<i>See case study Chap. 6</i>
New Zealand	Vodafone	1,800	02/13	
Nicaragua	–	–	–	<i>See case study Chap. 7</i>
Nigeria	Globacom	Existing	–	<i>See case study Chap. 7</i>
Norway	Arctic Wireless	2,600	–	<i>See case study Chap. 5</i>
Norway	Craig Wireless	2,600	–	
Norway	Telenor	1,800/2,600	10/12	
Norway	TeliaSonera	1,800/2,600	12/09	
Oman	Omantel	1,800/2,300	–	<i>See case study Chap. 7</i>
Oman	Qatar Telecom ^f	1,800	02/13	
Pakistan	–	–	–	<i>See case study Chap. 6</i>
Paraguay	Millicom	1,900	–	<i>See case study Chap. 7</i>
Paraguay	Copaco	AWS	02/13	
Paraguay	Personal	1,900	02/13	
Peru	Telefónica	n/a	–	<i>See case study Chap. 7</i>
Peru	Entel	AWS	–	
Peru	América Móvil	n/a	–	
Philippines	Globe	1,800	09/12	<i>See case study Chap. 6</i>
Philippines	Smart	Multiple	08/12	
Poland	Aero2 (Mobyland)	1,800	09/10	<i>See case study Chap. 5</i>
Poland	Orange/Netia P4	–	–	
Poland	Polkomtel	900/2,600	12/11	(as MVNO)
Poland	T-Mobile	–	–	
Portugal	Portugal Telecom	Multiple	03/12	<i>See case study Chap. 5</i>
Portugal	Vodafone	Multiple	03/12	
Portugal	Sonae.com	Multiple	03/12	
Puerto Rico	América Móvil	700	11/12	<i>See case study Chap. 7</i>
Puerto Rico	AT&T	700/AWS	11/11	
Puerto Rico	Open Mobile	700	04/12	
Puerto Rico	Sprint Nextel	1,900	12/12	
Puerto Rico	T-Mobile	700	07/13	
Qatar	Qatar Telecom ^f	800/2,600	04/13	<i>See case study Chap. 7</i>

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Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Qatar	Vodafone	Existing	–	
Romania	Orange	1,800	12/12	<i>See case study Chap. 5</i>
Romania	OTE	Multiple	04/13	
Romania	Vodafone	1,800	11/12	
Romania	RCS&RDS	Multiple	–	
Russia	MegaFon	800/2,600	06/13	<i>See case study Chap. 4</i>
Russia	MTS	800/2,600	09/12	
Russia	VimpelCom	800/2,600	05/13	
Rwanda	–	–	–	<i>See case study Chap. 7</i>
Samoa	Digicel	n/a	03/12	Probably HSPA+
Saudi Arabia	Etisalat	2,600	09/11	<i>See case study Chap. 7</i>
Saudi Arabia	STC	2,300–2,390	09/11	
Saudi Arabia	Zain	1,800	09/11	
Singapore	MobileOne	1,800/2,600	06/11	<i>See case study Chap. 6</i>
Singapore	SingTel	1,800/2,600	12/11	
Singapore	StarHub	1,800/2,600	09/12	
Slovakia	Orange	1,800/2,600	–	<i>See case study Chap. 5</i>
Slovakia	Telefónica	1,800/2,600	–	
Slovakia	T-Mobile	1,800/2,600	–	
Slovenia	Telekom Slovenije	1,800	03/13	<i>See case study Chap. 5</i>
Slovenia	Telekom Austria	1,800	07/12	
South Africa	Cell C	Existing	–	<i>See case study Chap. 7</i>
South Africa	MTN	1,800	12/12	
South Africa	Vodacom	1,800	10/12	
South Africa	Telkom	1,800/2,300	04/13	
South Korea	KT Corp.	1,800	01/12	<i>See case study Chap. 6</i>
South Korea	LG Uplus	800/2,100	07/11	
South Korea	SK Telecom	800/1,800	07/11	
Spain	Orange	Multiple	06/13	<i>See case study Chap. 5</i>
Spain	Telefónica	Multiple	09/11 ^d	
Spain	Vodafone	Multiple	09/11 ^d	
Spain	TeliaSonera	1,800	07/13	
Sri Lanka	Etisalat	n/a	–	<i>See case study Chap. 6</i>
Sri Lanka	Mobitel	1,800	12/12	
Sri Lanka	Axiata	1,800	04/13	
St Kitts & Nevis	Digicel	–	–	Marketing HSPA + as ‘4G’
Sweden	Tele2	900/2,600	11/10	<i>See case study Chap. 5</i>
Sweden	Telenor	900/2,600	11/10	
Sweden	TeliaSonera	Multiple	12/9	
Sweden	Hi3G Access	2,600	12/11	

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Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Switzerland	Swisscom	Multiple	11/12	<i>See case study Chap. 5</i>
Switzerland	Sunrise	Multiple	06/13	
Switzerland	Matterhorn Mobile	Multiple	05/13	
Taiwan	Chunghwa telecom	700/2,600	2013	<i>See case study Chap. 6</i>
Taiwan	FarEasTone	698–806	2015	
Tajikistan	MegaFon	1,800	–	Trials in early 2011
Tajikistan	Babilon-Mobile	1,800/2,100	10/12	(See Telecom.paper 2012b)
Tanzania	Smile Comms	790–862	06/12 ^h	<i>See case study Chap. 7</i>
Tanzania	Vodacom	n/a	–	
Thailand	True Move	2,100	05/13	<i>See case study Chap. 6</i>
Trinidad & Tob.	TSTT	n/a	–	<i>See case study Chap. 7</i>
Turkey	Turkcell	n/a	–	<i>See case study Chap. 7</i>
Turkey	Avea	1,800	–	
Turkey	Vodafone	n/a	–	
Turks & Caicos	Digicel	700	–	<i>See case study Chap. 7</i>
Turks & Caicos	Islandcom	700	–	
UAE	Du	1,800	07/12	<i>See case study Chap. 7</i>
UAE	Etisalat	1,800/2,600	12/11	
Uganda	Smile Comms	790–862	06/13	<i>See case study Chap. 7</i>
Uganda	MTN	2G	04/13	
UK	EE	Multiple	10/12	<i>See case study Chap. 4</i>
UK	Hutchison	1,800/800	2013	
UK	Vodafone	800/2,600	08/13	
UK	Telefónica	800	2013	
Ukraine	MTS	n/a	–	<i>See case study Chap. 7</i>
Ukraine	VimpelCom	GSM	–	
Uruguay	Ancel	AWS	12/11	<i>See case study Chap. 7</i>
USA	AT&T	698–806	09/11	<i>See case study Chap. 3</i>
USA	Verizon Wireless	700/AWS	12/10	
USA	Sprint Nextel	1,900/850	07/12	
USA	T-Mobile US	AWS	03/13	
US Virgin Isles	Sprint Nextel	1,900	2013	<i>See case study Chap. 7</i>
US Virgin Isles	AT&T	698–806	07/13	
Uzbekistan	MTS	2,600	07/10	<i>See case study Chap. 7</i>
Uzbekistan	TeliaSonera	2,600	08/10	

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Table 2.1 (continued)

Country	Operator	MHz Band ^b	Launch	Comment
Uzbekistan	VimpelCom	2,600	12/11	
Venezuela	Digitel	1,800	—	<i>See case study Chap. 7</i>
Venezuela	Móvilnet	n/a	—	
Venezuela	Telefónica	n/a	—	
Vietnam	—	n/a	—	<i>See case study Chap. 6</i>
Zambia	Zamtel	n/a	—	<i>See case study Chap. 7</i>
Zimbabwe	Econet	Existing	—	<i>See case study Chap. 7</i>

^aData that cannot be reliably confirmed have been excluded. Comments in italics refer to country as a whole, otherwise to the individual operator. Operators are identified wherever possible by the name of the main shareholder in order to reduce confusion and to allow for easy comparison of where the main international operators are rolling out LTE. To ensure comparability, the table includes only those operators with national mobile licences used for retail purposes while certain of the other companies listed below are also discussed in the case studies. MVNOs are excluded unless they are national operators with their own 2G networks. Among those excluded for one reason or another are Aquafon (controlled by MegaFon) which received a licence to operate a LTE network in the 800 MHz band in July 2013 (Abkhazia/Georgia); NBN Co (which launched TD-LTE in April 2012), Virgin Mobile (which launched as a MVNO in September 2012 over the Optus network), iiNet [which launched in October 2012 over the Optus network—see Telecom.paper (2012c)], Exetel (which launched as a MVNO over the Optus network in February 2013; Internode (which launched as a MVNO in July 2013 over the Optus network) (Australia); Scartel/Yota (which launched in May 2012 but announced in June that it would terminate services) (Belarus); Clearwire (Belgium); CTBC Cellular and Sky Brasil (which launched TD-LTE in the 2.6 GHz band in December 2011), On (which launched TD-LTE in the 2.6 GHz band in March 2013) (Brazil); Eastlink [which launched in February 2013—see TeleGeography (2013c)], MTS Allstream [which launched in September 2012—see TeleGeography (2012h)], Sasktel (which launched in January 2013) and Wind Mobile (Canada); VelaTel/NGSN (China); Pirkanmaan (Finland); DiscoveryTel (Ghana); Augere, Tikona Digital (India); Regional Telecom [which launched in June 2013—see TeleGeography (2013f)] (Iraq); Japan Communications (MVNO which launched in March 2013) (Japan); InterDnestrCom (see footnote 3) (Moldova); Tele2 (which launched in May 2012), Ziggo4 (which launched in May 2012) (Netherlands); Hafslund Telekom (Norway); Cyfrowy Polsat (which launched as a MVNO in August 2011), Milmex (which launched in the 3.5 GHz band in August 2011) (Poland); Osnova, Rostelecom [which launched in June 2013—see TeleGeography (2013e)], Scartel/Yota [which launched a wholesale operation in April 2012 hosting MegaFon from April (TeleGeography 2012f) and VimpelCom from December (Telecom.paper 2012d)], Skytel and Vainakh (which launched in Chechnya in January 2013 only to run into objections from the regulator—see TeleGeography 2013b) (Russia); Canal Digital [which launched as a MVNO over parent Telenor's network in December 2012—see TeleGeography (2012m)] (Sweden); UK Broadband (which launched TD-LTE in the 3.5 GHz band in October 2012) (UK); Agri-Valley Broadband (and subsidiary miSpot which launched in March 2013), Alaska Communications [which launched in October 2012—see TeleGeography (2012i)], Appalachian Wireless [which launched in June 2013—see TeleGeography 2013g], BendBroadband [which launched in May 2012—see TeleGeography (2012e)], Big River Broadband (which launched in May 2012); Bluegrass Cellular (which launched in November 2012); Cellcom (which launched in April 2012), C Spire Wireless [which launched in September 2012—see Cellular-news (2012a)], FreedomPop (MVNO on the Sprint Nextel network); Leap Wireless (which launched in December 2011), MetroPCS (which launched in the 1,900 MHz and AWS bands in September 2010), Mosaic Telecom (which launched in July 2011), Panhandle (which launched in March 2012), Penasco Valley Telecommunications, Peoples Telephone Cooperative (which launched in February 2012), Pioneer Cellular [which launched in April 2012—see

TeleGeography (2012d)], Shenandoah Telecommunications [which launched in November 2012—see TeleGeography (2012i)], Sprocket Wireless (which launched in November 2012), Strata Networks [which launched in November 2012—see TeleGeography (2012k)], Thumb Cellular (which launched in December 2012), Ting [which launched as a MVNO on the Sprint Nextel network in August 2012—see TeleGeography (2012g)], US Cellular (which launched in March 2012) and the NetAmerica Alliance [see TeleGeography (2012c)] (USA). In November 2012, Space Data Corp. and Lemko Corp. launched in Alaska what was claimed to be the world's first satellite-based LTE network (TeleGeography 2012j). In December 2011, Saima Telecom launched in Bishkek, Kyrgyzstan over what appears to be a fixed wireless network. On the TD-LTE front, Zoda Fones announced that it would be launching a network in Abuja, Nigeria in January 2012 (Telecom.paper 2012a)

^bAWS varies according to region but normally includes spectrum in the 1,700 MHz band paired with spectrum in the 2,100 MHz (2.1 GHz) band. 2,600 MHz (2.6 GHz) signifies the 2,500–2,690 MHz band (but is often referred to as the 2,500 MHz band). A useful discussion of how this band developed from its origins as the IMT-2000 expansion band can be found in Shah (2010). The 700 MHz band is stated in full elsewhere in the table as 698–806 MHz (digital dividend band in the Americas)—but note that it is divided into several sub-bands (see Chaps. 3 and 8)—while 800 MHz represents the 790–862 MHz (digital dividend) band in Africa, Europe and the Middle East. It is hoped that there will be agreement to add a 700 MHz digital dividend band comprising 703–733 MHz paired with 758–788 MHz. The digital dividend band in Asia spans 470–960 MHz although many individual countries have selected the 700 MHz band as specified by the Asia-Pacific Telecommunity (APT) as 703–748 MHz paired with 758–803 MHz—see Global mobile Suppliers Association (2010); 4G Americas (2011: pp. 64–9) and the Mexico case study. The 850 MHz band was used for iDEN in the USA but is being switched to other technologies. The 900 MHz band combines an uplink of 880–915 MHz with a downlink of 925–960 MHz. The 1,800 MHz band combines an uplink of 1,710–1,785 MHz with a downlink of 1,805–1,880 MHz. The 1,900 MHz band combines an uplink of 1,850–1,910 MHz with a downlink of 1,930–1,990 MHz. The 2,100 MHz band combines an uplink of 1,920–1,985 MHz with a downlink of 2,110–2,170 MHz. The 2.3 GHz band spans 2,300–2,390 MHz. The 3.5 GHz band spans 3,400 MHz to 3,600 MHz. The 3.7 GHz band spans 3,600 MHz to 3,800 MHz. For further information specifically on GSM frequency bands see Wikipedia (2012)

^cAwarded a 9 year licence, costing \$2.7 million for 40 MHz paired. Technically the launch needed to be before 03/11 (MTS 2010) but did not take place until January 2012 (TeleGeography 2012a)

^dThese launches were for corporate clients rather than trials, but whether they should be considered as 'commercial' is debatable as discussed in the relevant case studies. The alternative dates for Vodafone are the Netherlands in February 2013, Spain in May 2013 and Greece in June 2013. KPN's launch in the Netherlands becomes February 2013

^eAs shown in the case study, SoftBank could be said to have launched two independent networks—the second in September 2012—as one was its own and the other obtained when it bought Willcom

^fIn late June 2013, Qatar Telecom officially changed its registered name to Ooredoo. However, given that Ooredoo is unlikely to become commonly used in the public domain for some time to come, the text uses the previous name to avoid confusion

^gInterDnestrCom (Mobilink), which operates in the breakaway province of Transnistria, launched in the 800 MHz band in April 2012 (LteWorld 2012). The downlink only provided 10 Mbps

^hIt later stated that this had been a 'soft' launch with the 'commercial' launch taking place in May 2013

Source: Compiled by authors

not launched there; numerous roll-outs/trials such as those by Qatar Telecom, Telekom Austria (Bulgaria) and Telenor (Montenegro) listed as commercial launches; and TMN (Portugal) listed twice in March 2012.

2.2 Use of Multiple Bands

It is important to bear in mind that whereas 3G was largely allocated bandwidth not already in use for 2G—which in any event was often too congested to cope with the additional demands of data-rich downloads—the situation with respect to 4G is far more ambiguous. Certainly, the intention was always there to open up new spectrum bands, in particular the 2.6 GHz and digital dividend bands, but a widespread failure to make these available in good time meant that, with 3G provision operating independently, there was an opportunity to re-farm 2G bandwidth for 4G. In practice, this has so far primarily involved the 1,800 MHz band as shown in Table 2.1. As a consequence, the case studies often involve multiple spectrum bands any one, or indeed all, of which may be brought into play for LTE at some point.

2.3 Auction Methods

Historically, spectrum was mostly assigned without much regard to how demand for what is ultimately a finite band of frequencies useful for mobile communications was likely to develop. Hence, broadcasters and the military took possession of wide swaths of spectrum at zero or negligible cost and it became increasingly obvious that this initial set of assignments was not economically efficient. Market mechanisms became increasingly pervasive with the liberalisation of telecommunications commencing in the 1980s, and these were particularly associated with a switch to the use of auctions for assigning spectrum (Antonie and Colino 2011).

A brief comment about auction methods is accordingly needed at this point given that, unlike in the case of 3G spectrum, virtually all bandwidth suitable for 4G is being sold off—for an exhaustive discussion see DotEcon (2009: pp. 52–65). In essence, auctions can take three main forms as follows:

- Simultaneous multi-round ascending (SMRA)
- Combinatorial clock (CCA)
- Sealed bid

A SMRA can also come in a variant with augmented switching. The key point about a combinatorial clock auction is that bidders can make mutually exclusive package bids, and hence it is clearly suitable for occasions where spectrum in several bands is being sold simultaneously.

An idea of how these methods have been used can be seen in relation to the award of 800 MHz licences in Europe as follows:

- Germany 2010, Italy 2011, Portugal 2011, Spain 2011—SMRA as part of multi-band auction.

- Sweden 2011—SMRA in single band but with addition of augmented switching (see Aetha 2012: p. 22).
- Denmark 2012—combinatorial clock in single band.
- Switzerland 2012—combinatorial clock as part of multi-band auction.

As can be seen—see also the data on the 2.6 GHz auctions in Europe in Aetha (2012: p. 31)—there is far from unanimity as to which kind of method should be used, and it would serve little purpose to examine in detail the reasons why a particular method was adopted in any individual case—it may be noted that combinatorial clock auctions can be so complicated that even the bidders struggle to understand the rules as in the case of the Austrian auction in 2013 (see Chap. 5). The bottom line is that there is no clear relationship between the method used and the amount raised when expressed in dollars per MHz per head of population (\$/MHz/pop) which is the standard valuation procedure for comparing results (with the potential added refinement of adjustments to take account of inflation over time and/or the length of the licence awarded).

It is not altogether clear why auctions have been much more prominent compared to beauty contests in the case of 4G compared to 3G. Given that auctions are expected to favour incumbents, regulators have sometimes considered it desirable to take steps to encourage new entry. The two methods in common usage—as shown in the case studies—are to cap the spectrum available to incumbents and/or to reserve certain wavelengths exclusively for new entrants. These methods have drawbacks—for example, incumbents may be prevented from acquiring spectrum that they value more highly than a potential new entrant or the reserved spectrum may prove not to be optimal for a potential new entrant (Cramton et al. 2011). One evident consequence is that incumbents have mopped up the great majority of the available spectrum (Blackman et al. 2013) although in fairness there was not much significant new entry as a result of 3G allocations despite the widespread use of beauty contests (Curwen and Whalley 2006). In any event, the trend is towards a reduction in the number of incumbents and/or infrastructure sharing, at least in developed countries, so it is unlikely that new entrants would have been rushing into markets with large established incumbents.

2.4 Coverage Obligations

Individual countries have taken widely different views as to the necessity to attach coverage obligations, expressed either in terms of population or geographic area, and whether some or all licensees should shoulder the obligations. For the most part, these obligations have been introduced in order to ensure that rural communities are not neglected when LTE is rolled out, but this desire to increase social benefits necessarily conflicts with the desire to use spectrum in the most efficient manner. Furthermore, it affects the value of the spectrum itself if sold at auction. There are those who argue that the initial sale should be unencumbered, with a subsequent competition related to rural provision, and it is certainly the case that licence obligations will make spectrum trading more complicated.

2.5 LTE Launches and Commitments

Before turning in the chapters that follow to a detailed examination of progress towards LTE provision in individual countries, it is useful to provide a summary of activity on a worldwide basis. It should be borne in mind that there are roughly 225 countries/islands in the world which strictly need to be considered on an individual basis, and that on average each has roughly four operators, so the list of operators in the table is unsurprisingly growing on a weekly basis. Whether it will ever reach 1,000 entries is a moot point given the delays in introducing 3G in many countries—the total number of countries where 4G is reasonably well-advanced in June 2013 is 140, comprising a little over 60 % of the total, but the proportion of operators that are actively involved is somewhat lower. The table covers known commitments to launch during 2013H2 but does not disclose where operators have merely reached the point of expressing an eventual interest in rolling out LTE.

Certain issues need to be addressed in relation to the identification of networks in Table 2.1. Many discrepancies exist between the original names recorded as network licensees and those currently holding those licences. This complicates the data collection process, and reflects the extensive merger and acquisition activity that has occurred throughout the mobile telecommunications industry as well as operators changing their names for a variety of reasons. Operators themselves can be the source of confusion by applying for licences using the names of existing or newly-created subsidiaries or via joint ventures/consortia.

It is by no means uncommon to find multiple names being used simultaneously in the public domain in relation to a single network. These names may refer, for example, to the majority owner of the network, to a minority owner whose name is nevertheless used because it is better-known than that of the other owners, to the historic name of the original network, to the brand name of the main service(s) or to a marketing name that it is hoped will enhance brand recognition which may involve another operator without an equity stake (for example, Vodafone).

Furthermore, for a variety of reasons, the official name of an operator may evolve over time without due recognition being taken of this by the media. Thus, for example, Celtel evolved into MTC Kuwait which evolved into Zain. However, matters may be more complicated. Thus, for example, a network in Nigeria started out as Econet Nigeria (Econet being the primary owner). This was rebranded in principle as Vodacom (another African operator) when it agreed to buy Econet, but a dispute with the original owners led Vodacom to pull out and to the use of Vmobile as the brand until its purchase by MTC led to the introduction of Celtel as the brand. When MTC became Zain, it used its own name as the brand. The most recent change has resulted from the purchase of Zain Africa by Bharti Airtel in 2011 which is now using its airtel brand, although in the media the network is more often identified as Bharti rather than as airtel.

Finally, although a name may appear to have been used consistently, this may disguise a somewhat different reality—for example, the current AT&T is a quite different organisation from that which existed under the same name 10 years ago. At another level, the brand name may have been kept on after a successful

takeover—for example, Orange Switzerland is not owned by Orange but by Matterhorn Mobile.

These various factors explain why readers will struggle to marry up any two databases of LTE licences—even the authors, who keep a historical record of operator/brand names, are periodically confused by the nomenclature used in media reports. Obviously, therefore, some kind of systematic approach is needed here and in Table 2.1 the underlying principle is to cite wherever reasonable the controlling owner of the network. This has the clear advantage that it permits the reader quickly to ascertain the countries in which any given operator is involved in the launch of LTE. But because this is not the system used by the media—in fact, as indicated, there is no system used by the media, merely randomly expressed choices—the case studies often provide alternative names that readers may come across, although this has of necessity to be limited in scope in order to avoid undue complexity.

References

- 4G Americas. (2011, October). *The benefits of using LTE in digital dividend spectrum*. <http://www.4gamericas.com>
- Aetha. (2012). *Spectrum value of 800MHz, 1800MHz and 2.6GHz: A DotEcon and Aetha Report for Ofcom*. London: DotEcon.
- Antonie, G., & Colino, D. (2011). How to allocate spectrum rights efficiently. *Cudernos Económicos de ICE*, 81, 195–214.
- Blackman, C., Forge, S., & Horvitz, R. (2013). Liberating Europe's radio spectrum through shared access. *info*, 15(2), 91–102.
- Cellular-news. (2012a). *C Spire Wireless launches LTE services in Mississippi*. Accessed September 10, 2012, from <http://www.cellular-news.com>
- Cellular-news. (2012b). *Ethiopia's capital city to get LTE coverage*. Accessed December 17, 2012, from <http://www.cellular-news.com>
- Cramton, P., Kwerel, E., Rosston, G., & Skrzypacz, A. (2011). Using spectrum auctions to enhance competition in wireless services. *Journal of Law and Economics*, 54(4), 167–188.
- Curwen, P., & Whalley, J. (2006). Third generation new entrants in the European mobile telecommunications industry. *Telecommunications Policy*, 30(10–11), 622–632.
- DotEcon. (2009, December 21). Liberalisation of spectrum in the 900MHz and 1800MHz bands. ComReg Document Number: 09/99c.
- Engineering news. (2013). *Ericsson lands Unitel Angola LTE contract*. Accessed January 12, 2013, from <http://www.engineeringnews.co.za>
- Global mobile Suppliers Association. (2010). *Digital dividend update*. Accessed April 1, 2011, from <http://www.gsacom.com>
- Global mobile Suppliers Association. (2012). *Evolution to LTE Report*. Accessed September 13, 2012, from <http://www.gsacom.com>
- LteWorld. (2012). *Interdnestrom*. Accessed July 9, 2012, from <http://www.lteworld.org>
- MTS. (2010). *MTS allocated LTE frequencies in Armenia*. Accessed December 15, 2010, from <http://www.mtsgsm.com>
- Shah, N. (2010). *2.6 GHz spectrum and the next generation mobile broadband networks*. Accessed December 21, 2010, from <http://www.technowizz.wordpress.com>
- Telecom.paper. (2012a). *Zoda Fones picks Huawei to launch LTE TDD in Nigeria*. Accessed January 18, 2012, from <http://www.telecompaper.com>

- Telecom.paper. (2012b). *Babilon-Mobile launches LTE services in Dushanbe*. Accessed October 9, 2012, from <http://www.telecompaper.com>
- Telecom.paper. (2012c). *iiNet offers access to Optus LTE network*. Accessed October 10, 2012, from <http://www.telecompaper.com>
- Telecom.paper. (2012d). *Beeline secures LTE access on Yota network*. Accessed December 10, 2012, from <http://www.telecompaper.com>
- TeleGeography. (2012a). *Armenia's VivaCell-MTS switches on 4G/LTE network*. Accessed January 3, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012b). *Movicel launches LTE in Cabinda 45 days ahead of schedule*. Accessed April 16, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012c). *NetAmerica launches new programme to drive 700MHz LTE deployments*. Accessed April 30, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012d). *Pioneer Cellular launches rural LTE network in Oklahoma*. Accessed May 5, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012e). *Round the bend? Oregon telco claims LTE launch*. Accessed May 18, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012f). *Minister eyes 2013 launch for open-access LTE network*. Accessed May 21, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012g). *Ting becomes first US MVNO to offer LTE*. Accessed August 31, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012h). *MTS Allstream launches LTE network*. Accessed September 26, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012i). *Alaska Communications to launch LTE in Anchorage, Fairbanks and Juneau*. Accessed October 4, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012j). *US LTE round up*. Accessed October 30, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012k). *Strata Networks set to launch LTE in Uintah Basin*. Accessed November 8, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012l). *Sprint affiliate ShenTel launches LTE in 56 markets*. Accessed November 27, 2012, from <http://www.telegeography.com>
- TeleGeography. (2012m). *Telenor's Canal Digital offers 4G broadband to pay-TV customers*. Accessed December 18, 2012, from <http://www.telegeography.com>
- TeleGeography. (2013a). *Evatis launches 3G+ in Djibouti*. Accessed January 3, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013b). *Roskomnadzor objects to Vainakh Telecom LTE launch in Chechnya*. Accessed January 23, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013c). *Eastlink mobile service launched after five year wait*. Accessed February 15, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013d). *Tigo launches HSPA+ technology under the '4H+' banner*. Accessed May 23, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013e). *Rostelecom launches LTE in Sochi*. Accessed June 4, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013f). *Regional Telecom LTE network goes live in Kurdistan*. Accessed June 5, 2013, from <http://www.telegeography.com>
- TeleGeography. (2013g). *Appalachian Wireless unveils LTE service*. Accessed June 12, 2013, from <http://www.telegeography.com>
- Wikipedia. (2012). *GSM frequency bands*. Accessed December 12, 2012, from http://www.en.wikipedia.org/wiki/GSM_frequency_bands



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