October 13, 2015

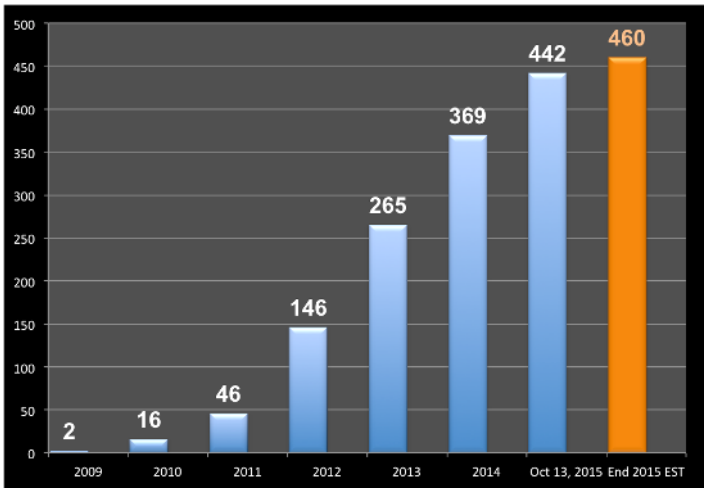
4G MARKET & TECHNOLOGY UPDATE

Introduction

LTE (Long Term Evolution) is a global success with 755 million subscriptions by Q2 2015. LTE is specified by 3GPP as a single global standard for paired and unpaired spectrum users. The vast majority of the standard is the same for FDD & TDD.

The **Evolution to LTE** report provides GSA's independent assessment and analysis of the LTE market status, supported by key facts and metrics, and confirms the trends. The report is regularly updated and free to download by over 70,000 registered users on the GSA website.

In this report:



LTE network commercial launches: 2009 – 2015

Charts and maps are also provided in JPEG file format and some are available as PDF files (for higher resolution). A series of shorter "Snapshot" reports are also published – see www.gsacom.com

LTE Market Status

GSA's Evolution to LTE report – OCTOBER 13, 2015

692 operators investing in LTE in 181 countries

- 657 operator commitments in 177 countries
- 35 pre-commitment trials in 4 more countries

442 commercially launched LTE or LTE-Advanced networks in 147 countries

incl. 62 LTE TDD (TD-LTE) launched in 37 countries

GSA forecasts 460 commercially launched LTE networks by end 2015

3,253 LTE user devices announced

(GSA - June 2015)

755 million LTE subscriptions globally: Q2 2015

LTE is the fastest developing mobile system technology ever

192 operators (43.4%) commercially launched LTE networks using 1800 MHz (LTE1800)

111 operators in 52 countries investing in VoLTE deployments, studies or trials

30 operators commercially launched VoLTE-HD voice in 21 countries

LTE-Advanced is a key industry trend

142 LTE operators are investing in LTE-Advanced deployments, studies or trials in 62 countries

95 commercially launched LTE-A networks in 48 countries

GSA's definition of commercial launch:

The phase in which a public telecommunications operator is carrying commercial traffic on its LTE network, or offers to provide public service. Only licensed operators with spectrum assigned for use in public LTE communications networks are considered. MVNOs are not included. The LTE operator's business model may be retail or wholesale. Devices compatible for use on the LTE network may be sold direct by the operator to the customer, or via distributors, resellers or other third parties, or already be owned by persons wishing to use the service.

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442 commercially launched LTE networks in 147 countries

Country	Operator	Launch
Norway	TeliaSonera (NetCom)	14.12.09
Sweden	TeliaSonera	14.12.09
Uzbekistan	UCell	09.08.10
Poland	Aero2 (LTE FDD and TDD)	07.09.10
USA	T Mobile US	21.09.10
Austria	A1 Telekom	05.11.10
Sweden	Telenor Sweden	15.11.10
Sweden	Tele2 Sweden	15.11.10
Hong Kong	CSL	25.11.10
Finland	TeliaSonera	30.11.10
Germany	Vodafone	01.12.10
USA	Verizon Wireless	05.12.10
Finland	Elisa	08.12.10
Denmark	TeliaSonera	09.12.10
Estonia	EMT	17.12.10
Japan	NTT DoCoMo	24.12.10
Germany	Deutsche Telekom	05.04.11
Philippines	Smart Communications	16.04.11
Lithuania	Omnitel	28.04.11
Latvia	LMT	31.05.11
Singapore	M1	21.06.11
South Korea	SK Telecom	01.07.11
South Korea	LG Uplus	01.07.11
Germany	O2***	01.07.11
Canada	Rogers Wireless	07.07.11
Austria	T-Mobile	28.07.11
USA	Mosaic Telecom	07. 2011
Canada	Bell Mobility FDD later LTE TDD	14.09.11
Saudi Arabia	Mobily (LTE TDD) later FDD	14.09.11
Saudi Arabia	STC (LTE TDD) later FDD	14.09.11
Saudi Arabia	Zain	14.09.11
USA	AT&T Mobility	18.09.11
UAE	Etisalat	25.09.11
Australia	Telstra	27.09.11
Denmark	TDC	10.10.11
Austria	3	18.11.11
Puerto Rico	AT&T Mobility	20.11.11
Puerto Rico	Claro	24.11.11
Kyrgyzstan	Saima Telecom	09.12.11
Brazil	Sky Brazil (LTE TDD)	13.12.11
Finland	DNA	13.12.11
Uruguay	Antel	13.12.11
USA	Cricket	21.12.11
Singapore	SingTel	22.12.11
Kuwait	Viva	27.12.11
Armenia	Vivacell-MTS	28.12.11
Bahrain	Viva	01.01.12
Hungary	Magyar Telekom	01.01.12
South Korea	KT	03.01.12
Russia	Megafon/Yota* FDD and TDD	15.01.12
Canada	TELUS FDD later TDD	10.02.12
USA	Peoples Telephone Co-op	14.02.12
Japan	Softbank Mobile XGP/LTE TDD later FDD	24.02.12
Portugal	Meo	12.03.12
Portugal	Vodafone	12.03.12
Portugal	Nos	15.03.12
Japan	Ymobile Corp	15.03.12
USA	US Cellular	22.03.12
Croatia	T Mobile/T-Hrvatski Telekom	23.03.12
Croatia	VIPNet	23.03.12
USA	Panhandle (PTCI)	03.2012
Australia	NBN Co (LTE TDD)	02.04.12
India	Bharti Airtel (LTE TDD)	10.04.12
Angola	Movicel	14.04.12
Puerto Rico	Open Mobile	19.04.12
Moldova	IDC	21.04.12
Sweden	3 (LTE FDD and TDD)	23.04.12
Hong Kong	CM HK (LTE FDD later TDD)	25.04.12
USA	Cellcom	30.04.12
USA	Pioneer Cellular	30.04.12
Netherlands	Vodafone	01.05.12
Hong Kong	3 HK	02.05.12
Netherlands	Ziggo	03.05.12
Netherlands	Tele2	08.05.12
Netherlands	KPN	11.05.12
Netherlands	T-Mobile	11.05.12
Namibia	MTC	16.05.12
Tanzania	Smile	30.05.12
UAE	Du	12.06.12
Colombia	Une-UPM**	14.06.12
Azerbaijan	Azercell	19.06.12
Czech Rep	O2 Czech Republic	19.06.12
Mauritius	Orange	21.06.12
UK	UK Broadband (LTE TDD)	28.06.12
Guam	IT&E	28.06.12
Hungary	Telenor Hungary	05.07.12
Dominican R.	Orange Dominicana	09.07.12
Slovenia	Si.mobil	12.07.12
USA	Sprint LTE FDD later TDD	15.07.12
Oman	Omantel LTE TDD later FDD	16.07.12
USA	Infrastructure Networks	25.07.12
Australia	Optus FDD – later TDD	31.07.12
Mauritius	Emtel	July 2012
Slovak Republic	O2 Slovakia	02.08.12
USA	Big River Broadband	07.08.12
Hong Kong	Smartone	28.08.12
Poland	Polkomtel Plus	Sept
USA	Chariton Valley	Sept
USA	Nortex Communications	Sept
Russia	MTS LTE TDD later FDD	01.09.12
USA	C Spire Wireless	10.09.12
Singapore	StarHub	19.09.12
Japan	KDDI	21.09.12
Japan	Softbank Mobile	21.09.12
Canada	MTS	25.09.12
Denmark	3 Denmark	28.09.12
Philippines	Globe	28.09.12
Luxembourg	Tango	01.10.12
Guam	DoCoMo Pacific	04.10.12

Tajikistan	Babilon-Mobile	06.10.12
Norway	Telenor	10.10.12
South Africa	Vodacom	10.10.12
USA	Alaska Communications	12.10.12
Mexico	Telefonica Movistar	15.10.12
Luxembourg	Orange	29.10.12
UK	EE	30.10.12
Uganda	Smile	Oct 2012
Belgium	Belgacom / Proximus	05.11.12
USA	Bluegrass Cellular	05.11.12
Antigua-Barb	Digicel	06.11.12
Mexico	Telcel	06.11.12
Italy	Vodafone	06.11.12
Italy	TIM	07.11.12
Montenegro	Telenor	08.11.12
USA	Sprocket Wireless	09.11.12
Greece	Cosmote	16.11.12
Moldova	Moldcell	16.11.12
USA	Strata Networks	19.11.12
Moldova	Orange Moldova	20.11.12
Romania	Vodafone	20.11.12
Kuwait	Zain	21.11.12
France	Orange	22.11.12
USA	Shentel	23.11.12
Estonia	Tele2	27.11.12
France	SFR	28.11.12
Switzerland	Swisscom	29.11.12
South Africa	MTN	01.12.12
Romania	Orange	12.12.12
Brazil	Claro	13.12.12
Angola	Unitel	16.12.12
Bolivia	Entel Movil	16.12.12
Greece	Vodafone	17.12.12
Puerto Rico	Sprint	18.12.12
Kazakhstan	Altel	25.12.12
Sri Lanka	Dialog LTE TDD later FDD	30.12.12
Sri Lanka	Mobitel	31.12.12
USA	GCI	2013
Malaysia	Maxis	01.01.13
USA	Thumb Cellular	13.01.13
Canada	Sasktel LTE FDD later TDD	31.01.13
USA	Evolve Broadband	02.13
Italy	3 Italia	01.02.13
Paraguay	Personal	08.02.13
Estonia	Elisa	14.02.13
Canada	Eastlink	15.02.13
Oman	Ooredoo LTE FDD later TDD	17.02.13
Paraguay	Vox	18.02.13
Bahrain	Batelco	27.02.13
New Zealand	Vodafone	28.02.13
Brazil	On (LTE TDD)	03.13
Lithuania	Tele2	03.13
Spain	COTA (Murcia4G) (LTE TDD)	01.03.13
USA	MiSpot	14.03.13
Dominican R.	Tricom	18.03.13
Denmark	Telenor	20.03.13
Guam	iConnect	20.03.13
Slovenia	Telekom Slovenije	20.03.13
Iceland	Nova	04.04.13
USA	United Wireless	09.04.13
Qatar	Ooredoo	16.04.13
USVI	Sprint	17.04.13
Bahrain	Zain	18.04.13
South Africa	Telkom Mobile / 8ta (LTE TDD)	21.04.13
Malaysia	Celcom Axiata	22.04.13
Uganda	MTN Uganda (LTE TDD)	25.04.13
Brazil	Oi	25.04.13
Maldives	Ooredoo	28.04.13
Romania	Cosmote	29.04.13
Brazil	TIM Brasil	30.04.13
Brazil	Vivo	30.04.13
USA	Adams NetWorks	05.2013
France	Bouygues Telecom	06.05.13
Thailand	True Move	08.05.13
USA	NorthwestCell	13.05.13
Lebanon	Alfa	15.05.13
USA	PVT/Fuego Wireless	17.05.13
Lebanon	Touch	22.05.13
USA	Chat Mobility	23.05.13
Switzerland	Salt (formerly Orange)	26.05.13
Russia	Vimpelcom	27.05.13
Spain	Vodafone	29.05.13
Spain	Neo-Sky LTE TDD	06.2013
Russia	Rostelecom	03.06.13
Nigeria	Smile Communications	06.06.13
Iraq	Fastlink (Regional Telecom)	10.06.13
USA	Appalachian Wireless	10.06.13
Australia	Vodafone	12.06.13
Switzerland	Sunrise Communications	19.06.13
Chile	Claro	27.06.13
USA	MTA	mid-2013
USVI	AT&T Mobility	02.07.13
Iceland	Fjarskipti (Vodafone)	04.07.13
Malaysia	DiGi	05.07.13
Spain	Orange	08.07.13
Kuwait	Ooredoo	09.07.13
Puerto Rico	T Mobile	11.07.13
Spain	Yoigo	18.07.13
USA	Custer Telephone	26.07.13
Uganda	Orange	31.07.13
Venezuela	Digitel	31.07.13
USA	ETC	08.13
Nigeria	Spectranet (LTE TDD)	20.08.13
South Africa	Neotel	21.08.13
Zimbabwe	Econet Wireless	22.08.13
UK	O2	29.08.13
UK	Vodafone	29.08.13
Kiribati	TSKL	02.09.13
Liechtenstein	Orange	02.09.13
Russia	Vainakh Telecom (LTE TDD)	03.09.13
Poland	Orange Polska	10.09.13
Turkmenistan	TMCELL	18.09.13
Ireland	Meteor	26.09.13
USA	Copper Valley Telecom	30.09.13

Belgium	BASE	01.10.13
Czech Rep	T Mobile	01.10.13
Monaco	Monaco Telecom	01.10.13
Luxembourg	POST	10.13
Spain	Movistar	10.13
USA	Syringa Wireless	10.13
Guam	GTA	11.10.13
Ireland	Vodafone	14.10.13
Bhutan	Bhutan Telecom	24.10.13
Japan	UQ (LTE TDD)	31.10.13
Nigeria	Swift Networks (LTE TDD)	11.13
USA	Flat Wireless d.b.a. ClearTalk	11.13
Malta	Vodafone	01.11.13
Aruba	Setar NV	06.11.13
New Zealand	Spark	12.11.13
Poland	Play	13.11.13
Chile	Movistar	14.11.13
Indonesia	PT Internux (LTE TDD)	14.11.13
Brunei	DST	15.11.13
Slovak Republic	Slovak Telecom	15.11.13
USA	S and R Communications	17.11.13
Bahrain	Menatelecom (LTE TDD)	19.11.13
Costa Rica	Kölbi (ICE)	25.11.13
Namibia	TN Mobile	27.11.13
USA	Nex-Tech Wireless	27.11.13
Montenegro	Crnogorski Telekom	28.11.13
Cayman Isles	Digicel	28.11.13
Cayman Isles	LIME	29.11.13
France	Free	01.12.13
Greenland	Tele-Post	01.12.13
Colombia	Movistar	02.12.13
Macedonia	T Mobile	02.12.13
UK	3 UK	02.12.13
Fiji	Vodafone Fiji	05.12.13
USA	Mid-Rivers Communications	09.12.13
Czech Rep	Vodafone	10.12.13
Malaysia	U Mobile	17.12.13
China	China Mobile (LTE TDD)	18.12.13
Ecuador	CNT EP	12.13
Latvia	Tele2	12.13
USA	Colorado Valley	12.13
USA	nTelos Wireless	12.13
Ghana	Vodafone	02.01.14
Peru	Telefonica Movistar	02.01.14
Italy	Wind	12.01.14
Iceland	Siminn	15.01.14
Zambia	MTN	16.01.14
Sri Lanka	SLT (LTE TDD)	19.01.14
Zambia	Zamtel	21.01.14
Cambodia	Smart Axiata	22.01.14
Ireland	3 Ireland****	27.01.14
Ghana	NITA (LTE TDD)	02.14
Sri Lanka	Lanka Bell (LTE TDD)	04.02.14
Bahamas	BTC	13.02.14
Colombia	Claro	13.02.14
Uruguay	Claro	13.02.14
China	China Telecom (LTE TDD)	14.02.14
China	China Unicom (LTE TDD)	18.03.14
Papua New Guinea	Digicel PNG	26.03.14
Chile	Entel PCS	28.03.14
Belgium	Mobistar	31.03.14
Madagascar	Blueline (LTE TDD)	04.14
Costa Rica	Claro	01.04.14
Vanuatu	WanTok (LTE TDD)	01.04.14
Côte d'Ivoire	YooMee (LTE TDD)	04.04.14
Tajikistan	Tcell	15.04.14
Belgium	b•lite (LTE TDD)	22.04.14
Canada	ABC Communications (LTE TDD)	23.04.14
Philippines	PLDT (LTE TDD)	29.04.14
Algeria	Algérie Télécom	01.05.14
USA	KPU (Alaska)	05.05.14
Kyrgyzstan	O!	08.05.14
Thailand	DTAC	10.05.14
Bulgaria	Max	20.05.14
Peru	Claro	21.05.14
Taiwan	Chunghwa Telecom	29.05.14
Qatar	Vodafone	03.06.14
Taiwan	FarEasTone	03.06.14
Taiwan	Taiwan Mobile	04.06.14
Abkhazia	A-Mobile	04.06.14
Poland	T-Mobile Polska S.A	05.06.14
Brazil	Nextel	16.06.14
Russia	Tattelecom	27.06.14
New Zealand	2degrees	30.06.14
USA	VTel	01.07.14
Macedonia	Vip	02.07.14
Costa Rica	Movistar	04.07.14
Slovak Republic	Orange Slovensko	07.07.14
NMI	IT&E	14.07.14
Israel	Partner – Orange	15.07.14
India	Aircel (LTE TDD)	16.07.14
Bolivia	Tigo	17.07.14
Dominican R.	Claro	17.07.14
Colombia	DirecTV (LTE TDD)	25.07.14
Isle of Man	Manx Telecom	29.07.14
Israel	Cellcom	03.08.14
Israel	Pelephone	04.08.14
Abkhazia	Aquafon	06.08.14
Malaysia	Telekom Malaysia	08.08.14
Fiji	Digicel	14.08.14
Colombia	Avantel	19.08.14
Ghana	Surfline Communications	19.08.14
Taiwan	Taiwan Star	25.08.14
Macedonia	ONE	29.08.14
USA	Si Wireless / Mobile Nation	09.2014
Uzbekistan	Beeline	04.09.14
Uruguay	Movistar	05.09.14
USA	BIT Communications	09.09.14
Canada	Videotron	10.09.14
Chad	Tigo	10.09.14
Pakistan	ZONG	27.09.14
Lesotho	Vodacom	02.10.14
Colombia	ETB	07.10.14
Mexico	AT&T (Nextel de Mexico)	13.10.14

Peru	Americatel / Entel (LTE TDD)	13.10.14
Ghana	BLU (LTE TDD)	14.10.14
Dominica	LIME	16.10.14
Gabon	Gabon Telecom	20.10.14
Andorra	Andorra Telecom	21.10.14
USA	Rock Wireless	23.10.14
Maldives	Dhiraagu	28.10.14
Guatemala	Movistar	29.10.14
USA	Carolina West Wireless	03.11.14
Russia	MOTIV	06.11.14
Rwanda	Airtel	11.11.14
Rwanda	MTN	11.11.14
Finland	Ukko Mobile FDD: TDD later	17.11.14
Antigua-Barb	LIME	20.11.14
Iran	MTN Irancell	24.11.14
USA	Silver Star Communications	24.11.14
Seychelles	Airtel	26.11.14
Canada	Xplornet (LTE TDD)	03.12.14
Italy	Linkem (LTE TDD)	03.12.14
Kenya	Safaricom	04.12.14
Indonesia	Telkomsel	08.12.14
Honduras	Tigo	10.12.14
Kosovo	IPKO	11.12.14
Russia	Tele2 Russia	17.12.14
Trinidad&Tobago	TSTT (LTE TDD)	18.12.14
Argentina	Personal	19.12.14
Argentina	Movistar	22.12.14
Indonesia	Indosat	22.12.14
Indonesia	XL Axiata	22.12.14
Taiwan	Asia Pacific Telecom	24.12.14
Pakistan	Warid Telecom	26.12.14
Canada	CCI Wireless (LTE TDD)	12.2014
Rwanda	Tigo	08.01.15
Liechtenstein	FL1	01.02.15
Georgia	Magticom	01.02.15
Georgia	Mobitel	01.02.15
Uganda	Vodafone (LTE TDD)	09.02.15
Botswana	Orange	13.02.15
Jersey	JT	13.02.15
Jordan	Zain	15.02.15
New Caledonia	OPT	16.02.15
Dominican R.	WIND Telecom (LTE TDD)	19.02.15
Venezuela	Movistar	19.02.15
Gambia	Netpage (LTE TDD)	03.2015
Romania	Idilis/2K Telecom (LTE TDD)	03.2015
Isle of Man	SURE	02.03.15
Åland Islands	Ålcom	03.03.15
Greece	Wind Hellas	03.03.15
Liechtenstein	Swisscom	05.03.15
Cyprus	MTN	10.03.15
Cyprus	PrimeTel	10.03.15
Panama	C and W	11.03.15
Slovak Republic	Swan Telecom	13.03.15
Georgia	Geocell	15.03.15
Ehtiopia	Ethio Telecom	21.03.15
Canada	Tbaytel	23.03.15
Serbia	VIP Mobile	24.03.15
Serbia	Telenor	25.03.15
Turks & Caicos	Digicel	25.03.15
Panama	Movistar	27.03.15
Uzbekistan	EVO (LTE TDD)	01.04.15
Serbia	MTS	03.04.15
Malawi	Access Communications	08.04.15
Laos	Lao Telecom	09.04.15
Lithuania	Bite	15.04.15
South Africa	Afrihost	22.04.15
Tanzania	Tigo	24.04.15
Kosovo	Vala	28.04.15
Guatemala	Tigo	04.05.15
Azerbaijan	Bakcell	05.05.15
Latvia	Bite	05.05.15
Taiwan	Ambit Microsystems	15.05.15
USA	Speedconnect (LTE TDD)	19.05.15
Mauritius	MTML	20.05.15
Ecuador	Movistar	22.05.15
Jordan	Orange	26.05.15
Guernsey	Sure	31.05.15
Jersey	Sure	31.05.15
USA	Redzone Wireless (LTE TDD)	03.06.15
Morocco	Meditel	08.06.15
Bonaire	UTS	17.06.15
Curaçao	UTS	17.06.15
Morocco	Inwi (Wana)	17.06.15
Bonaire	TELBO	19.06.15
Madagascar	Telma	19.06.15
Laos	Unitel	23.06.15
Argentina	Claro	06.2015
Guaernsey	JT	06.2015
Indonesia	3 Indonesia	06.07.15
Indonesia	Smartfren (LTE FDD & TDD)	07.07.15
Morocco	IAM (Maroc Telecom)	13.07.15
Albania	Telekom Albania	22.07.15
Nigeria	MTN HyNet (LTE TDD)	22.07.15
Bolivia	Viva	24.07.15
Cambodia	Seatel	26.07.15
Ecuador	Claro	28.07.15
Turks & Caicos	LIME	31.07.15
Albania	Vodafone Albania	07.2015
Guernsey	Airtel-Vodafone	07.2015
Jersey	Airtel-Vodafone	07.2015
Panama	Claro	06.08.15
Tanzania	Smart Telecom (LTE TDD)	27.08.15
Albania	Eagle Mobile	01.09.15
South Africa	Cell C	23.09.15
Nicaragua	Claro	01.10.15

** Includes Yota which was acquired by Megafon*
*** Includes Tigo which merged with UNE-UPM*
**** Includes E Plus which was acquired by Telefonica O2 Germany*
***** Includes O2 Ireland which was acquired by 3 Ireland*
BendBroadband exited the LTE market and is deleted from the above table
Following the sale of CSL to HKT (owner of PCCW Mobile) the new merged company adopted the name CSL as the mobile services identity.

The drive towards LTE and LTE-Advanced for operators is more capacity, performance management and improved efficiencies to lower delivery cost. LTE is a big step in the user experience, enhancing demanding apps such as interactive TV, video blogging, advanced gaming, and professional services. Deployment of LTE-Advanced carrier aggregation technology is the major industry trend.

LTE is a full IP network and harmonizes with other radio access technologies and is the natural evolution choice for GSM/HSPA, CDMA and WiMAX™ operators, enabling a single unifying global standard supporting with TDD & FDD modes.

Spectrum for LTE deployments

Pressure for spectrum is high and operators should deploy the most efficient technologies using paired spectrum where available. LTE can be deployed in existing 2G or 3G bands and in new bands e.g. 2.6 GHz or digital dividend spectrum (700/800 MHz) for greater geographical coverage and improved in-building performance. 2.6 GHz is the capacity band in most regions.

There is high interest in refarming 2G spectrum for LTE and most regulators have adopted a technology-neutral approach. 1800 MHz is the mainstream choice for LTE deployments in most regions.

700 MHz (bands 12, 13, 14 and 17) and 800 MHz (band 20) are firmly established, according to region, as the main LTE bands arising as the "digital dividend" from the migration of TV broadcasters from analogue to digital transmission. Adoption of the APT700 MHz band plan by 40+ countries across the APAC and Latin America regions and in Europe represents a major opportunity for near-global spectrum harmonization for LTE deployments, paving the way for ensuring the greatest economies of scale for devices and capacity for mobile broadband services, and for roaming. The FDD plan configuration (band 28) has attracted most support and several mobile networks use APT700 band 28 in commercially launched networks; see later section in this report. GSA is not aware of any country or regulator anywhere in the world firmly adopting or recommending allocation of spectrum in the TDD (band 44) arrangement.

In some regions of the world the 450 MHz band is attracting interest for rural coverage, and for M2M service applications. LTE450 is commercially launched in Finland.

LTE radio network products incorporate several features to simplify building and management of next-generation networks. Plug-and-play, self-configuration and self-optimization simplify and reduce network rollout and management cost. LTE is being deployed alongside simplified, IP-based core and transport networks that are easier to build, maintain and introduce services on. The 3GPP core network has also undergone System Architecture Evolution, optimized for packet mode and the IP-Multimedia Subsystem (IMS) to support all access technologies, including fixed access. This allows:

- Improvements in latency, capacity, throughput
- Simplification of the core network, and optimization for IP traffic, services, and growth
- Simplified support and handover to non-3GPP access technologies

The resulting evolved packet system comprizes the core network, evolved packet core (EPC) and radio network. The whole system is often called LTE.

Category 4 (Cat 4) is a popular evolutionary step, enabling 150 Mbps peak downlink data throughput by allocating 20 MHz of LTE transmission bandwidth. Several Cat 4 networks are listed in this report.

Deployment of LTE-Advanced is the major industry trend. 1 in 3 LTE operators have launched, or are deploying or trialing LTE-Advanced technologies. Carrier aggregation is the first LTE-Advanced feature to be commercialised and facilitates higher data throughput rates, the most efficient use of spectrum assets for network operators, and an enhanced user experience of mobile broadband. There is strong and growing support for Cat 6 (300 Mbps) devices.

The introduction of HD voice services for LTE users enabled by VoLTE technology is developing quickly. 1 in 4 LTE operators are investing in VoLTE.

Commercialization of LTE Broadcast, enabled by eMBMS technology, continues to progress well with several trials and service launches planned in 2015/6.

LTE TDD (TD-LTE) systems

LTE is an open standard developed by 3GPP. The advanced technological performance of LTE came with in-built flexibility to operate in either paired (FDD, or Frequency Division Duplexing, mode) or unpaired (TDD, or Time Division Duplexing mode) spectrum and various channel bandwidths – all with a single technology. Companies from around the globe contributed to the LTE standard and its evolution. The emphasis was always to leverage synergies between the two duplex modes to the largest extent possible. This allows operators to best utilize their current network assets, spectrum allocations and various bandwidth needs, while securing support, choice and economies of scale from the global vendor ecosystem, and limit potential market fragmentation. The result is major commonality of the LTE specifications for the FDD and TDD modes – in fact the vast majority of the LTE standard is identical for both modes, and the huge global success of LTE.

Most current LTE deployments use paired spectrum (FDD). The LTE TDD mode is complementary and the perfect choice for providing high-speed mobile broadband access in unpaired spectrum. Several operators have deployed both the FDD and TDD modes in their networks. LTE TDD also provides a future-proof evolutionary path for TD-SCDMA, another 3GPP standard, as widely deployed in China. LTE TDD is an integral part of the 3GPP standard, implementing a maximum of commonalities with LTE FDD and offering comparable performance characteristics and similar high spectral efficiency.

Within globally assigned IMT bands for mobile services, significant resources are suitable for LTE TDD. The largest contiguous bands are 2.3 GHz (100 MHz) and within the 2.6 GHz band. There are also substantial deployments using 1.9 GHz spectrum and 3.5 GHz (bands 42/43) offers significant future potential. LTE TDD has been selected by most WiMAX™ operators as their path to business growth.

LTE TDD operator commitments, system maturity and the devices ecosystem are covered in this report.

LTE networks, developments global round-up

Americas

USA

On September 21, 2010 regional carrier **MetroPCS** became the 1st US operator to launch LTE. MetroPCS offered the world's first commercially available LTE handset, the Samsung SCH-R900/Craft™. Service launched in Las Vegas, then Dallas/Forth Worth, Detroit, Boston, Sacramento and New York. The Craft was also the first multi-mode CDMA-LTE handset. MetroPCS later merged with T Mobile USA (see below).

Verizon Wireless commercially launched LTE using 700 MHz (band 13) on December 5, 2010. LTE is available to 98% of the population in over 500 markets (July 2015, company website). Verizon is also deploying LTE in AWS spectrum and on May 19, 2014 announced its launch, branded as "XLTE". Compatible user devices select either 700 MHz or AWS spectrum where available. XLTE is available in 400 markets. Verizon deployed VoLTE and key LTE-Advanced features in 2014. Verizon Wireless' Advanced Calling 1.0 service with HD voice over LTE (VoLTE and video calling support commercially launched on September 15, 2014. In July 2014 Verizon announced plans to partner with Qualcomm and Ericsson on a supplemental LTE downlink trial in 3.5 GHz spectrum. LTE-Advanced combining its band 13 and AWS spectrum is in deployment for commercial launch in 2015.

Through its "LTE in Rural America" program Verizon is working with partners to collaboratively build and operate an LTE network that covers over 2.6 million people in rural communities over 82,000 square miles by sharing its 700 MHz Upper C block spectrum. The "LTE in Rural America" participants include:

- Appalachian Wireless – Kentucky
- Bluegrass Cellular - Kentucky
- Cellcom – Wisconsin and Michigan
- Chariton Valley – Missouri
- Chat Mobility - Iowa

- Carolina West Wireless - North Carolina
- Convergence Technologies – Indiana
- Copper Valley Telecom - Alaska
- Cross Telephone - Oklahoma
- Custer Telephone Cooperative – Idaho
- KPU - Alaska
- Matanuska Telephone Association – Alaska
- Mid-Rivers Communications - Montana
- MTPCS – Montana, Louisiana, Texas
- NorthwestCell – Missouri
- Pioneer Cellular – Oklahoma
- Sagebrush Cellular (Nemont) – Dakota, Montana
- S and R Communications - Indiana
- Strata Networks – Utah
- Thumb Cellular - Michigan

Verizon Wireless is refarming 1900 MHz band 2 spectrum for LTE deployments.

Verizon Wireless is trialling LTE Broadcast (known as LTE Multicast) and showcased the technology at SuperBowl 2014 and Indy 500, planning service launch in 2015. At CES 2015 a connected vehicle equipped with Verizon's LTE Multicast technology showed the vehicle hub communicated with an embedded automotive telematics module to receive over the air firmware updates via LTE Multicast.

Pioneer Cellular commercially launched LTE service on April 30, 2012.

Cellcom launched commercial LTE service on April 30, 2012 in Green Bay, Sturgeon Bay, Appleton, Oshkosh, Wausau, Oconto and Marinette Counties.

Chariton Valley commercially launched LTE service for CPEs and personal hotspots in September 2012.

Bluegrass Cellular launched commercial LTE service on November 5, 2012 covering 348,000 population. Build out is planned to be completed by end 2015.

Sprocket Wireless (brand of Cross Telephone) commercially launched its first phase of 4G LTE service including portions of the Muskogee and Pittsburg counties in Eastern Oklahoma on November 9th, 2012.

Strata Networks commercially launched service on November 19, 2012.

Thumb Cellular commercially launched 700 MHz LTE service on January 13, 2013.

KPU Telecommunications (Alaska) i.e. Ketchikan Public Utilities leases a 22 MHz block from Verizon Wireless and commercially launched its LTE network for data users on May 5th, 2014. **KPU** plans to launch VoLTE in 2015.

Chat Mobility commercially launched LTE service on May 23, 2013.

Appalachian Wireless commercially launched its LTE service on June 10, 2013.

Matanuska Telephone Association (MTA) commercially launched LTE service in mid-2013.

Custer Telephone Cooperative commercially launched 4G LTE service on July 26, 2013.

Copper Valley Telecom commercially launched service on September 30, 2013 in Valdez, Prince William Sound, and Cordova.

S and R Communications commercially launched in Indiana on November 17, 2013.

Mid-Rivers Communications commercially launched LTE service on December 9, 2013 in 12 communities across the eastern half of Montana.

NorthwestCell commercially launched on May 13, 2013.

Carolina West Wireless commercially launched 4G/LTE on November 3, 2014.

AT&T Mobility commercially launched LTE on September 18, 2011 in 700 MHz (band 17) in Atlanta, Chicago, Dallas, Houston and San Antonio. The LTE network covers 308 million people (company website, July 2015). AT&T plans to close its GSM network by 2017 latest and re-farm the band to support its 3G and 4G networks. 1900 MHz band 2 was introduced in some regions since by end 2013. In January 2013 AT&T announced plans to pay Verizon Wireless US$ 1.9 billion for 700 MHz B band spectrum covering 42

million people in 18 states, plus AWS spectrum in markets including Phoenix, Los Angeles, Fresno, and Portland. All of this spectrum is earmarked for LTE. AT&T launched LTE-Advanced in Chicago in March 2014, using carrier aggregation of 700 MHz and AWS spectrum (GSA assumption 110 Mbps peak downlink speed). VoLTE was commercially launched on May 23, 2014 in Illinois, Indiana, Minnesota and Wisconsin and has since been extended.

AT&T is trialling LTE Multicast (LTE Broadcast) technology including at the Ohio State Buckeyes v. Oregon Ducks College Football National Championship in Arlington, Texas, January 12, 2015. Commercial service launch is expected in 2015.

In December 2013 **AT&T** announced LTE roaming with **Rogers Communications** (Canada) and **EE** (UK). Many more partners are now offered.

In April 2014 AT&T announced plans to use its 2.3 GHz WCS C and D block spectrum for the air to ground component of LTE-based in-flight connectivity services for airlines and passengers within the United States, from end 2015, subject to FCC approval.
FCC filing http://apps.fcc.gov/ecfs/comment/view?id=6018260948

AT&T also stated that the company would start deploying LTE in its 2.3 GHz WCS spectrum from Summer 2015 to support extra capacity requirements in main population centres and urban areas. AT&T is a major holder of WCS spectrum.

T-Mobile USA commercially launched LTE on March 26, 2013 in AWS spectrum. By February 2015 coverage reached over 265 million people nationwide. With the MetroPCS merger completed the new single company trades as **T Mobile US**, and *MetroPCS* continues in the market as a brand operated by T Mobile US. VoLTE was commercially launched with HD voice on May 22, 2014 initially in Seattle and across its whole network within 2 months. **T Mobile** is increasing bandwidth for LTE service, allocating different amounts in different markets. Spectrum totaling 20 MHz paired was deployed in parts of North Dallas in late 2013. T-Mobile has announced plans to re-use most of the 1900 MHz PCS spectrum used in its EDGE network for LTE by mid 2015. Also, the company brought into service in Q4 2014 the 700 MHz A block spectrum (band 13) acquired from Verizon Wireless and others (Actel and I-700 A Block LLC). Band 12 spectrum was brought into commercial use in 2015.

MiSpot, a subsidiary of **Agri-Valley Communication**, commercially launched 700 MHz LTE service on March 14, 2013 in 37 counties in northern and central Michigan.

Adams NetWorks (western Illinois) commercially launched fixed broadband LTE service in band 17 C block spectrum in May 2013.

Big River Broadband (SE Missouri) commercially launched LTE in AWS spectrum on August 7, 2012.

Bay Area Regional Interoperable Communications System (BayRICS) vision was established by the 10 Bay Area Counties and 3 core cities, San Francisco, Oakland, and San Jose in 2006 through the creation of a strategic plan with the goal of providing voice and data interoperability throughout the Bay Area region. BayRICS is a state of the art communications system-of-systems. Bay Area Wireless Enhanced Broadband (BayWEB) is the broadband component of BayRICS which has acquired 700 MHz in which an LTE-based public safety system is intended to be deployed. In April 2011, the first public-safety LTE pilot network in the San Francisco Bay Area was tested. These tests were commissioned by the East Bay Communications System Authority, which oversaw the pilot LTE network deployment.

BendBroadband was the first carrier in Central Oregon to offer commercial LTE service but later sold its 700 MHz Block B and AWS spectrum to AT&T and exited the wireless market. BendBroadband discontinued its LTE service as of July 25, 2014. *BendBroadband has been removed from our LTE network deployment lists.*

C Spire Wireless holds 700 MHz band 12 spectrum for most of Mississippi, Tennessee and Alabama and commercially launched LTE service on September 10, 2012 in McComb, Brookhaven, Meridian and Greenville. Due to limited device support for band 12, C Spire initially used band 25 (1850 – 1915 / 1930 - 1995 MHz) for LTE. VoLTE is planned.

CenturyLink plans to deploy LTE in 700 MHz, after spending USD 149 million in the 700 MHz auction on 69 A and B block concessions.

Colorado Valley Communications (Texas), a member of the NetAmerica Alliance, commercially launched LTE service in 700 MHz band 12 in December 2013 in Ellinger, Fayetteville, Flatonia, La Grange, Schulenburg and Weimar.

Enhanced Telecommunications Corporation (ETC) commercially launched 4G LTE using 700 MHz in August 2013, initially serving Decatur and Ripley counties. Coverage now includes Jefferson, Jennings, Ohio, Scott and Switzerland counties.

Leap Wireless' **Cricket** subsidiary commercially launched LTE on December 21, 2011 in Tucson in AWS spectrum. On July 12, 2013 AT&T Mobility announced plans to acquire Leap Wireless. FCC approval was secured in March 2014. On March 13, 2014 AT&T announced that the company had closed its acquisition of Leap Wireless and is in the process of integrating Cricket into AT&T's operations. The new Cricket is an independently operated, wholly owned subsidiary of AT&T.

Syringa Wireless (Eastern Idaho) commercially launched LTE service in October 2013.

CDMA operator **Alaska Communications (ACS)** commercially launched LTE on October 12, 2012 in Anchorage, Fairbanks and Juneau in AWS spectrum.

Alaska Communications and **General Communication, Inc. (GCI)** announced on July 23, 2013 that the companies had completed the transaction to form **The Alaska Wireless Network, LLC ("AWN").** AWN provides the latest wireless services, including LTE, to its owners Alaska Communications and GCI, intended to independently sell these services to their respective retail customers and continue to operate as competitors in Alaska. In December 2014 **Alaska Communications** announced it would sell its wireless subscriber base and interest in AWN to **GCI**; the deal is expected to close in Q1 2015.

CDMA operator **Nex-Tech Wireless** commercially launched LTE on November 27, 2013 using 700 MHz B Block spectrum (band 12) acquired in May 2012.

Sprint commercially launched LTE FDD service on July 15, 2012 in 10 MHz of existing 1900 MHz spectrum (band 25) in 15 cities: Atlanta, Athens, Calhoun, Carrollton, Newnan and Rome, Ga.; Dallas, Fort Worth, Granbury-Hood County, Houston, Huntsville, San Antonio and Waco, Texas; and St. Joseph and Kansas City, Mo.. Following its buyout of **Clearwire**, **Sprint** additionally commercially launched LTE TDD service in band 41 on July 19, 2013. As of January 2015, Sprint offered LTE service in over 470 markets. Sprint stopped selling WiMAX™ service after 2012 and is deploying LTE-Advanced technology in 800 MHz (ESMR/iDEN spectrum) from 2013 using 3GPP Release 10 in a 10x10 configuration. iDEN service closed in 2013. The Sprint Spark tri-band service (bands 25, 26, and 41), using LTE-Advanced carrier aggregation, was launched on March 17, 2014 in 18 markets, and serves 48 markets (February 2015). VoLTE is in deployment. In early 2014 it was reported that **Sprint,** together with its infrastructure vendor, had demonstrated 2.6 Gbps throughput over a single sector by aggregating 120 MHz of TDD spectrum.

Sprint has negotiated several rural LTE roaming partners including:

All West Wireless (Wyoming and Utah)
Bluegrass Cellular (Kentucky)
Blue Wireless (New York and Pennsylvania)
Breakaway Wireless (Utah)
Carolina West Wireless
C Spire Wireless
CTC Telecom (Idaho)
Custer Telephone Wireless (Idaho)
Flat Wireless d.b.a Clear Talk
Illinois Valley Cellular
Inland Cellular
James Valley Telecommunications
Nex-Tech Wireless (Kansas, Colorado)
NNTC (Colorado)
nTelos
Pine Belt Wireless (Alabama)
Pioneer Cellular (Oklahoma and Kansas)
Phoenix Wireless
Public Service Wireless (Alabama and Georgia)
SI Wireless / Mobile Nation
Silver Star Wireless (Wyoming and Idaho)
Snake River PCS (Oregon)
South Central Communications (Utah)
SouthernLINC Wireless
Strata Networks (Utah, Wyoming and Colorado)
Syringa Wireless (Idaho)
VTel Wireless

Softbank (Japan) now owns approximately 72% of **Sprint.** Sprint Nextel Corporation and SoftBank Corp. announced on July 10, 2013 the completion of their merger. SoftBank invested approximately $21.6 billion in Sprint Sprint stockholders voted to approve the transaction at a special meeting of stockholders held on June 25, 2013. The new publicly traded entity is named **Sprint Corporation**.

Shenandoah Telecommunications (**Shentel**) is an affiliate of Sprint having access to the latter's 800 and 1900 MHz spectrum in return for building a compatible LTE network. **Shentel** launched commercial LTE service on November 23, 2012 in Maryland, Pennsylvania, Virginia and West Virginia. In May 2013 the company confirmed that LTE coverage had reached 75% of its network footprint.

As part of a $32.1 million stimulus grant, **Commnet Wireless, LLC** (subsidiary of Atlantic Tele-Network Inc.) will develop and operate an LTE network in the Navajo Nation. The grant, plus partial matching funds, will provide broadband infrastructure access to the Navajo Nation across Arizona, New Mexico and Utah, enabling fixed and mobile service for over 30,000 households (c.135,000 people) and 1,000 businesses in 15 of the largest communities in the Navajo Nation, including Window Rock, Shiprock, Kayenta, Chinle, and Tuba City. The project will also provide high-capacity connectivity on the combined middle-mile backbone to 49 more tribal communities. Atlantic Tele-Network was the subject of a takeover by AT&T Mobility which completed in September 2013.

Satellite TV provider **DISH Network** applied to the FCC in August 2011 for approval to deploy LTE-Advanced in S-band Mobile Satellite Services (MSS) spectrum bought from TerreStar, added to spectrum acquired from the purchase of satellite company DBSD North America, for a total of 40 MHz (2000-2020 MHz and 2180-2200 MHz). This spectrum is now known as AWS-4. FCC granted formal approval to DISH on December 11, 2012 subject to specific power level restrictions to avoid interference to the adjacent AWS-H spectrum. AWS-H spectrum comprises 1915 – 1920 MHz (uplink) and 1995 – 2000 MHz (downlink), and is adjacent to the PCS-G spectrum occupied by Sprint. DISH acquired all 176 H block licences auctioned (known as Auction 96) by the FCC at end February 2014 after more than a month of bidding.

DISH Network and **Sprint** wholesale partner nTelos Wireless are understood to be planning to launch a fixed wireless LTE TDD service using a portion of nTelos band 41 spectrum.

SI Wireless/Mobile Nation commercially launched LTE in September 2014.

Silver Star Communications commercially launched LTE on November 24, 2014 (date to be confirmed).

In March 2012 the FCC issued a Notice of Proposed Rulemaking for stand-alone terrestrial services using 2 GHz MSS spectrum. If the waiver is allowed, LTE-Advanced service is not anticipated before 2016.

Illinois Valley Cellular is preparing to launch LTE service in 2H 2015, understood to be in band 12, for the 250,000+ population in its service area, via a partnership with a network host provider.

iWireless, a partnership between T-Mobile USA and Iowa Network Services (INS) serving Iowa, eastern Nebraska and western Illinois, is deploying an LTE network and selected a system provider. Initial market entry, expected in 2H 2015, is expected to be as an MVNO with launch on its own network to follow.

Greenfield operator **Lightsquared** planned to deploy the first US wholesale-only LTE network, and selected its infrastructure supplier for deployment using 46 MHz in the range 1.4 to 1.6 GHz (mostly in L-Band). However the company must work through major regulatory obstacles because the FCC ruled that its proposed operating frequency interferes with GPS and aircraft flight safety systems. Lightsquared filed for bankruptcy in May 2012 in order to try to continue operations, and has control over its Chapter 11 status as the company continues its reorganization efforts and tries to emerge from bankruptcy.

Rural CDMA operator **Mosaic Telecom** (NW Wisconsin) holds 700 MHz and AWS spectrum and commercially launched LTE service in July 2011.

NetAmerica Alliance LLC aims to help bring LTE mobile broadband services to 700 MHz and AWS spectrum holders for consumers and businesses in smaller markets and rural areas, under the service brand Bonfire™. NetAmerica joins forces with rural independent license holders deploying new

converged 4G mobile/fixed networks and provide them with business and network services including combined buying power, nationwide branding, 24x7 network monitoring, core networking elements, apps development and other key services. www.netAmericaAlliance.com

Network operators **Etex Telephone Cooperative, Panhandle Telephone Cooperative, Peoples Telephone Cooperative**, and **S&T Telephone Cooperative/Communications** are committed to LTE network deployments and joined NetAmerica Alliance. On October 26, 2011, NetAmerica Alliance announced a live LTE pilot network. Alliance members use the pilot network to develop, test and refine operating methodologies prior to turn-up of service.

Flat Wireless, LLC, d.b.a **Clear Talk**, providing wireless telecommunication services in West Texas, also joined the Alliance. In 2013 the company bought 10 lower 700 MHz B-block licenses from Verizon Wireless. Flat Wireless doing business as Clear Talk commercially launched at end November 2013 using AWS-1 i.e. band 4 spectrum. 1900 MHz spectrum is used in one market.

Peoples Telephone Cooperative commercially launched LTE in rural Texas on February 14, 2012 replacing its WiMAX™ offer with LTE in 700 MHz.

Panhandle (PTCI) has spectrum in 6 counties covering 45,000 people, 20,000 households over 7,500 square miles and commercially launched LTE in March 2012 in rural Oklahoma with a network of 45 towers covering 5,000 square miles and 30,000 population.

Buggs Island Telephone Cooperative (BIT Communications) joined NetAmerica Alliance on January 6, 2014 and is deploying an LTE network using 700 MHz C band. On September 9, 2014 NetAmerica Alliance, LLC announced that **BIT Communications** commercially launched LTE broadband service with 9 live sites using the NetAmerica Alliance service brand, Bonfire™.

Immix Wireless, which serves Pennsylvania, is building an LTE network in 700 MHz spectrum.

Union Wireless, serving Wyoming and adjacent areas of northwest Colorado and northeast Utah, is building an LTE network.

O2 Secure Wireless, an Internet communications company, has embarked on phase one of its LTE network strategy. The company plans to provide coverage to over 500,000 customers in under-served or unserved markets in Florida, Kentucky, Mississippi, Alabama, North Carolina, and South Carolina.

Public Service Wireless is deploying a 700 MHz LTE network in central and southwest Georgia.

SRT Communications (North Dakota) is committed to introducing LTE service. NewCore Wireless will host SRT's LTE network.

Nortex Communications commercially launched LTE using 700 MHz band 17 in September 2012 in a 2-county area of Texas.

South Georgia Regional Information Technology Authority is deploying a 700MHz LTE system.

WiMAX™ operator **SpeedConnect** commercially launched LTE TDD in the Quad Cities using band 41 spectrum on May 19, 2015.

Infrastructure Networks, a Houston-based provider of broadband wireless networks to critical infrastructure industries, commercially launched LTE service in the Permian Basin area of West Texas on July 25, 2012 using 700 MHz.

Former CDMA operator **Rock Wireless** commercially launched LTE using 700 MHz band 12 spectrum on October 23, 2014 serving the Standing Rock Sioux Reservation in remote parts of the Dakotas region.

Texas Energy Network (TEN) committed to deploy an LTE network targeting the oil and gas industries beginning with the Eagle Ford Shale region.

Evolve Broadband (Texas) commercially launched LTE in 700 MHz band 17 in February 2013, extended to 35% coverage area by March 2014.

CDMA operator **United Wireless** commercially launched BWA LTE service using 700 MHz band 12

on April 9, 2013. Support for LTE mobile phones was introduced on May 12, 2014.

Redzone Wireless launched an LTE-Advanced TDD network in Portland, Waterville and Great Diamond Island on June 3, 2015 leasing band 41 spectrum from University of Maine (GSA ssumption 100 Mbps).

US Cellular in partnership with King Street Wireless commercially launched 700 MHz LTE on March 22, 2012 in selected cities in Iowa, Maine, North Carolina, Oklahoma, Texas and Wisconsin. VoLTE is being trialled in 3 markets for expected launch in 2015.

VTel Wireless commercially launched LTE in rural Vermont on July 1, 2014. 700 MHz (band 17) and AWS (band 4) are used. Spectrum owned within BRS band 41 (2496 MHz - 2690 MHz) will be used later. VTel Wireless says it is the first 4G/LTE-only network in the USA. Vtel is also deploying VoLTE. By mid-2015, VTel planned to cover 95% of Vermont households with 180 sites.

West Central Wireless, subsidiary of Central Texas Telephone Cooperative, is deploying LTE. The company also uses LTE for fixed wireless services using 700 MHz, though not used by its mobile subscribers, but will be offered on a wholesale basis to other carriers.

US CDMA regional operator **Penasco Valley Telecommunications (PVT)** commercially launched LTE under the Fuego Wireless brand using 700 MHz band 12 spectrum on May 17, 2013.

CDMA operator **nTelos Wireless**, which serves Kentucky, Maryland, North Carolina, Ohio, Virginia, and West Virginia commercially launched LTE service in selected areas using band 2 spectrum in late December 2013. nTelos Wireless also owns spectrum in band 41. Sprint and nTelos have a network sharing agreement until 2022.

On September 10, 2013 IDEN™ operator **SouthernLINC** announced plans to build a regional network for Southern Company electric utilities. Construction will start in 2015 and the network should be fully operational by 2018.

On January 25, 2011 the **FCC** mandated LTE for first responders (public safety communications). Mandating of a single technology by the FCC was unprecedented. The Order and FNPRM requires all 700 MHz public safety mobile broadband networks to use a common air interface, specifically LTE, to support roaming and interoperable communications.

The **City of Charlotte Council** awarded a contract in October 2011 for an LTE Public Safety Network in the dedicated Public Safety 700 MHz band.

On April 26, 2012 two key members of the House Energy and Commerce Committee's Subcommittee on Communications and Technology - Congressman Cliff Stearns and Congresswoman Doris Matsui, introduced a bill (H.R 4817) calling for re-purposing and pairing of the 1755-1850 MHz band with the internationally harmonized 2155 – 2180 MHz band (FCC's AWS-3). H.R. 4817 would require pairing and auction within three years of February 22, 2012. The President would be required to clear 1755-1780 MHz within 5 years unless it could be shown that relocation of a particular government assignment is not possible "without jeopardizing essential military capability." The auction, known as Auction 97, started November 13, 2014 with a USD 10.5 billion reserve. 1,614 licenses were offered on a geographic area basis to 70 prequalified bidders. Bidding went much higher than expected. The AWS-3 auction closed on January 29, 2015. The total of spectrum bids reaching USD 44,899,451,600.

PUBLIC SAFETY – Band 14 (788-798/758-768 MHz)

- **Las Vegas Metropolitan Police Department** (LVMPD) trialling LTE in band 14.
- **Miami-Dade police** trialling LTE in band 14

The Iowa Statewide Interoperable Communications System Board (**ISICSB**) issued a request for proposals (RFP) for industry-funded, LTE public safety broadband network proof-of-concept demonstrations (LTE PSBND), to educate public safety and officials at federal, state, county, local, and tribal levels about LTE statewide public safety wireless communications systems. Proposals were requested by June 19, with Iowa State planning to award a contract running July 1, 2012-June 30, 2013.

The FCC adopted revised rules to enable Wireless Communications Service (WCS) licensees' to use up to 30 MHz of underutilized 2.3 GHz spectrum for wireless broadband services. 20 MHz may be used for mobile broadband, leaving 10 MHz for fixed broadband, which in future may be used as a downlink path for mobile broadband users.

The FCC delayed the start of the 600 MHz broadcast TV spectrum incentive auctions to March 29, 2016 (previously scheduled for 2014). Under the FCC's proposals, broadcasters would submit bids to give up their spectrum subject to payment by the FCC. The proposed process is voluntary.

Canada

Rogers Wireless commercially launched LTE service on July 7, 2011 in Ottawa. Coverage was planned to cover 95 markets in 2103. In April 2013 the company said it would be first to launch the BlackBerry Q10 smartphone on its 2.6 GHz LTE spectrum. 2.6 GHz is little used in Canada, and is facilitated by Rogers and Bell in their partnership company **Inukshuk Wireless** which built a network using pre-WiMAX© technology but was later shelved. Rogers statement: "The Rogers LTE 2600 MHz bandwidth is in all markets where we offer LTE AWS 2100." In May 2013 Rogers launched its dual-band AWS/2.6 GHz LTE network as "LTE Max". 700 MHz was brought into commercial use in Calgary, Toronto and Vancouver in April 2014 following the auction (see below). LTE-Advanced was commercially launched in 12 markets on October 24, 2014 using carrier aggregation. On January 26, 2015 Rogers announced its launch of 225 Mbps LTE-Advanced in Guelph, Toronto, Vancouver and Victoria, with further rollouts planned. Carrier aggregation is used to combine 10 MHz of 2.1 GHz (band 4 AWS) and 20 MHz 2.6 GHz (band 7) spectrum. VoLTE HD voice service was commercially launched across Canada on March 31, 2015 with sale of the LG G3 Vigor smartphone.

Bell Mobility commercially launched LTE in Toronto, Mississauga, Hamilton, Kitchener-Waterloo and Guelph on September 14, 2011. 150 Mbps downlink (peak) was enabled in some locations with 2.6 GHz band 7 spectrum from 2012. Users outside LTE coverage use DC-HSPA+ or HSPA+. Following acquisition of 700 MHz Lower C block spectrum, Bell also uses 700 MHz since April 2014. Bell additionally commercially launched LTE TDD fixed wireless Internet service in some areas on October 1, 2014 using 3.5 GHz (band 42) spectrum. LTE network coverage reached 86% of the population by February 2015. LTE service has been extended to remote Northwest Territories communities via satellite links.

In February 2015, **Bell Mobility** launched LTE-Advanced allowing for theoretical peak download speeds up to 183 Mbps. 220 Mbps LTE-Advanced using a combination of Band 7, Band 4 and Band 2 Is launched. On August 13, 2015 **Bell Mobility** announced the commercial launch of tri-band LTE-Advanced service (believed to be using bands 4, 7 and 17) with a theoretical peak downlink speed of 290 Mbps, and available from August 21, 2015.

EastLink simultaneously commercially launched HSPA+ and LTE services using 2.1 GHz spectrum (AWS) on February 15, 2013.

Telus commercially launched LTE on February 10, 2012. Coverage reached over 81% population (December 2013). In April 2014 Telus commercially launched LTE TDD service in Quebec (3.5 GHz band 42), British Columbia and Alberta (2.3 GHz band 40). Telus is deploying VoLTE. Telus has received regulatory approval to acquire CDMA operator **Public Mobile** and use its 1900 MHz G-block spectrum. In July 2015 the company website indicated peak downlink speeds up to 110 Mbps and plans to introduce 150 Mbps later with LTE-Advanced.

MTS Allstream commercially launched LTE on September 25, 2012 in Manitoba. Coverage is also provided in Winnipeg and Brandon. On June 13, 2013 **MTS** and **Rogers Wireless** announced an LTE network sharing agreement in Manitoba.

SaskTel commercially launched LTE on January 31, 2013 in AWS band 4 spectrum in Regina, Saskatoon, Clavet, Dundurn, Langham, Lumsden, Martensville, Osler, Pense, Vanscoy, Warman and White City. In 2013 coverage expanded to Dalmeny, Balgonie, Estevan, Moose Jaw, North Battleford, Prince Albert, Swift Current, Weyburn and Yorkton; future phases dependent on SaskTel's success in the 700 MHz auction (see below). VoLTE is being deployed. Sasktel ran an LTE TDD trial to help determine the feasibility of wireless broadband and voice services in predominantly rural locations. On September 23,

2013 SaskTel announced commercial launch of its High Speed Fusion Internet Service in band 41. EV-DO service has closed and 850 MHz spectrum is being refarmed for LTE.

ABC Communications commercially launched LTE TDD in British Columbia using 3.5 GHz on April 23, 2014 according to information provided to GSA by the operator, who advised that coverage is commercially available in a specific geographic region around the community of Quesnel at its first rollout stage.

WiMAX™ operator **CCI Wireless** offers broadband high speed internet to rural Alberta and commercially launched an LTE TDD network in December 2014 using 3.5 GHz band 42. According to the company's website (March 2015) towers are enabled with LTE TDD at Rockyford, Dickson, Leslieville, Eckville, Innisfail, Markerville, Rocky North, Caroline, and Cremona, with more to follow.

Tbaytel commercially launched its LTE network and service for customers in the Thunder Bay area on March 23rd, 2015 with plans to expand to the Dryden, Fort Frances and Kenora areas throughout 2015.

Rural ISP **Core Broadband** is deploying LTE for a fixed wireless broadband service in Muskoka, Ontario and has selected its system supplier.

Wind Mobile confirmed its LTE trial February 2011.

In May 2013 Videotron announced an agreement with **Rogers Wireless** to jointly deploy an LTE network in Quebec and Ottawa. **Videotron** commercially launched 150 Mbps LTE using AWS spectrum in Quebec on September 10, 2014. Videotron may sell unused AWS spectrum in the Greater Toronto area to Rogers, subject to regulatory approval.
Rural WiMAX™ operator **Xplornet Communications** announced on December 8, 2011 completion of LTE TDD tests in 2.6 GHz and 3.5 GHz bands. The trials demonstrated a seamless LTE TDD option over existing WiMAX infrastructure, offering a smooth migration path from WiMAX™ to LTE TDD. The 3.5 GHz trial used the same band that Xplornet uses for WiMAX™. Xplornet is deploying an LTE fixed-wireless network and will activate two state of the art next generation satellites in 2016 with the aim of making 25 Mbps broadband service available at affordable prices to 100% of Canadian homes and businesses outside of the big urban cities. Commercial LTE TDD service was launched on December 3, 2014 initially in New Brunswick. Regulatory approval has been given for a transfer of 81 2.3 GHz licences from NextWave to Xplornet.

Industry Canada started an auction of 700 MHz, aligning with US band plan, on January 14, 2014. 97 licences were auctioned raising almost USD 5 billion. Spectrum came into use from mid-April 2014.
Results: http://news.gc.ca/web/article-en.do?nid=816869

Three auctions are planned in 2015. The first was for licences for Advanced Wireless Services in the bands 1755-1780 MHz and 2155-2180 MHz (AWS-3); this is adjacent to the existing AWS band. The list of 10 qualified bidders was announced on February 13, 2015. Sealed bids were required by March 3, 2015. The results were announced on March 6, 2015 and raised C$2.11 billion.

- WIND acquired spectrum in British Columbia, Alberta and Ontario, they now have 180% more spectrum where they provide services;
- Eastlink acquired spectrum in Newfoundland and Labrador, Nova Scotia, New Brunswick, Prince Edward Island and Northern Ontario, they now have 77% more spectrum
- Videotron acquired spectrum in Quebec and Eastern Ontario, they now have 65% more spectrum
- TELUS acquired spectrum in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec, they now have 16% more spectrum
- Bell acquired spectrum in Newfoundland and Labrador, Nova Scotia, Prince Edward Island, New Brunswick, Northern Quebec, Ontario, Nunavut, Northwest Territories and Yukon, they now have 4% more spectrum

Rogers did not participate in the bidding.

An auction of BRS spectrum (2500–2690 MHz, 3GPP band 7) started on April 14, 2015 and ended on May 5, 2015, with over 300 blocks raising C$ 755 million. The winning companies were:

- Bell Mobility Inc.
- Bragg Communications Inc.
- Corridor Communications Inc.

- MTS Inc.
- Rogers Communications Partnership
- TBayTel
- TELUS Communications Company
- Vidéotron s.e.n.c.
- Xplornet Communications Inc.

Final results:
http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf11030.html

The third auction, of unallocated spectrum from the recent 700 MHz and AWS auctions, was concluded in September 2015. AWS blocks were sold but left over 700 MHz spectrum remained unsold.

Antigua and Barbuda

Digicel commercially launched fixed LTE service in 700 MHz (band 17) on November 6, 2012.

LIME commercially launched LTE using AWS spectrum (band 4) on November 20, 2014.

Argentina

Personal commercially launched LTE using AWS spectrum on December 19, 2014 in Buenos Aires, Córdoba and Rosario. No additional charges applied until March 1, 2015. 84 sites were operational at launch. 35% population coverage is planned by end 2015. All major cities will be covered by mid 2016.

Movistar completed lab and field trials of LTE in in 2010 in Buenos Aires, using AWS spectrum and commercially launched LTE service on December 22, 2014 in parts of Buenos Aires.

Claro commercially launched LTE in June 2015 using 1720-1730 MHz and 2120-2130 MHz, within band 4. From launch LTE was available in Buenos Aires, Mendoza, Cordoba and Rosario. By end of 2015 coverage will reach Mar del Plata, Salta, Santiago del Estero, Bariloche, Neuquen, San Luis, San Juan, Formosa, Resistance, Comodoro Rivadavia, La Rioja, Tucumán, Santa Fe, Posadas, Paraná, Jujuy, Corrientes and Bahia Blanca.

Regulator SECOM announced on September 5, 2012 it would allocate to state-owned operator **Arsat** all the 850 MHz and 1900 MHz spectrum returned by Movistar when parent Telefonica bought some of the assets of former operator Movicom from Bell South.

The government announced an auction of 120 MHz of AWS and 90 MHz of APT700 spectrum for 4G/LTE deployments on October 31, 2014. Claro Argentina, Telecom Personal, Movistar, and Arlink (Grupo Uno) obtained documentation. The results were announced on November 3, 2014 with bids totaling 2.23 billion USD for 3G and 4G spectrum. In the LTE AWS band:

- **Claro** gained 10 MHz paired AWS
- **Movistar** gained 10 MHz paired AWS
- **Personal** gained 15 MHz paired AWS

Movistar and **Airlink** were each awarded 2 x 10 MHz of APT700 spectrum.

Aruba

Setar NV commercially launched with 20 MHz of LTE1800 spectrum on November 6, 2013.

Bahamas

The Utilities Regulation and Competition Authority (URCA) on August 13, 2012 awarded a 15 years 700 MHz license (24 MHz) with coverage obligations to **BTC** who commercially launched LTE service on February 13, 2014. BTC plans coverage to reach 99% of the population using 107 sites by March 2015. Cable TV operator **Cable Bahamas Limited (CBL)** is also expected to receive a license. An enquiry has been made by GSA to URCA for confirmation.

Belize

BTL (DigiCell) is deploying an LTE network.

Bermuda

Fixed telecoms operator **North Rock Communications** has requested an LTE license.

Bolivia

Entel Movil commercially launched a USB modem-based post-paid LTE service on December 16, 2012 in La Paz, Cochabamba and Santa Cruz in 700 MHz.

Tigo acquired 2 x 12 MHz of 700 MHz for LTE and also acquired spectrum in 1900 MHz and AWS bands

in 2013. **Tigo** commercially launched LTE in 700 MHz on July 17, 2014 in 7 capital cities. By June 2015 coverage had been extended to 26 cities including at least 1 city in each of the country's 11 Departments.

NuevaTel PCS (Viva) commercially launched LTE service using AWS band 4 spectru on July 24, 2015.

Bonaire

UTS (Chippie) commercially launched LTE using 1800 MHz band 3 on June 17, 2015.

TELBO (Telefonia Bonairiano NV**)** commercially launched an LTE network on June 19, 2015.

Brazil

The auction of 2.6 GHz LTE spectrum by regulator Anatel was concluded on June 12, 2012 with the winners being (2 x 20 MHz MHz), **Claro** (2 x 20 MHz), **TIM** (2 x 10 MHz) and **Oi** (2 x 10 MHz). As no separate bids for 450 MHz spectrum were made, regulator Anatel bundled the unsold channels with the new 2.6 GHz concessions. The auction included spectrum suitable for TDD deployments, acquired by **Sky Brasil Servicos** and **Sunrise Telecomunicacoes**, the latter for Sao Paulo state.

Sky Brasil Servicos commercially launched 2.6 GHz LTE TDD (band 38) in Brasilia on December 13, 2011. 85 municipalities were covered by May 2015.

Sunrise changed its name to **On Telecomunicacoes** and commercially launched 2.6 GHz LTE TDD service in band 38 in Itatiba, Louveira, Valinhos and Vinhedo in March 2013 and has since been extended to cover several cities in Sao Paulo state.

Claro commercially launched LTE FDD service on December 13, 2012 in Recife, Campos do Jordao, Buzios and Parat, using 2.6 GHz spectrum. Service was opened in Curitiba on January 29, 2013 and Porto Alegre on March 7, 2013. By October 2014 service had reached 93 markets.

Oi commercially launched LTE on April 25, 2013 in Rio de Janeiro. **Oi** and **Portugal Telecom** are merging. Oi plans to deploy an LTE450 network in rural areas (see section *LTE: 450 MHz band* below).

TIM commercially launched LTE on April 30, 2013 in Confederations Cup venues.

TIM and **Oi** shared LTE network infrastructure in cities hosting the Confederations Cup matches.

TIM is deploying LTE1800 in Rio de Janeiro state and was soft launched in Búzios on January 17, 2015. Similar soft launches are planned in Angra dos Reis, Cabo Frio and Campos dos Goytacazes.

It was announced in early 2015 that **TIM** has trialled VoLTE in a laboratory environment.

Vivo commercially launched LTE on April 30, 2013 in Sao Paulo and the 6 Confederations Cup venues. Coverage was available in 127 cities (77 million population) by November 2014.

Algar Telecom (**CTBC**) conducted LTE trials in 850 MHz and 1800 MHz and is deploying a commercial network using 700 MHz (APT700) spectrum.

Nextel commercially launched an LTE1800 network on June 16, 2014 in 19 regions of Rio de Janeiro and plans to extend service to Sao Paulo in 2016. Anatel has approved the change in use for Nextel's 800 MHz licence to allow LTE to be deployed.

Anatel auctioned 15 lots of spectrum on December 6, 2011 for USD 132.7 million. 39 lots were not auctioned, including 29 for WiMAX™. **TIM, Oi** and **Sercomtel** bought spectrum in the 1800 MHz band but issues have arisen over usage rights.

Claro bought spectrum in the 800 MHz band.

Anatel adopted the APT700 FDD band plan in February 2013 and agreed terms of the auction to take place on September 30, 2014. Oi and Nextel decided not to participate in the tender. **TIM, Claro** and **Vivo** secured nationwide APT700 spectrum blocks. **Algar Telecom** won spectrum for its service area in the states of Goiás, Minas Gerais, Mato Grosso do Sul and São Paulo

APT700 spectrum will most likely be available for use for LTE for 60% of the population by end 2017, nationwide by November 2018.

3.5 GHz plus additional 1800 MHz, 1900 MHz and 2.5 GHz spectrum may be auctioned in 2015.

Anatel will auction 2.5 GHz TDD spectrum formerly owned by Net Servicos but had to be surrendered to participate in an earlier auction. The spectrum is for use in Curitiba, Porto Alegre, and Recife.

Sao Paulo military police force is testing LTE in 700 MHz with 5 base stations. **Brazil Army** is testing LTE in 700 MHz for public security solutions. With two sites in Brasilia covering Esplanada dos Ministérios, and Communications Center and the Army Electronic Warfare (CCOMGEX).

LTE in 450 MHz (3GPP band 31)

In June 2012 ANATEL auctioned licences for the 450 MHz (and 2.6 GHz bands) for 4G systems. The 450 MHz band was split over 4 geographical areas, each one assigned to a main carrier already operating in the Brazilian market. The winning bidders accepted technology performance (data rates) and coverage obligations. The Ministry of Communications has approved projects worth USD197 million to bring LTE mobile internet to 14 States using the 450 MHz band. LTE450 is standardized by 3GPP as band 31.

Wireless Technologies for the 450 MHz band
http://450alliance.org/wp-content/uploads/2014/05/WhitePaper_Wireless_Tech_for_450MHz_band.pdf

Case study of Brazil: LTE 450 MHz technology for broadband services in rural and remote areas
https://itunews.itu.int/en/4618-LTE-450MHz-technology-for-broadband-services-in-rural-and-remote-areas-BR-Case-study-of-Brazil.note.aspx

UKKO MOBILE: World's first LTE450 network commercially launched in Finland (presentation)
http://www.gsacom.com

Oi is deploying LTE450 in Goiás and the Federal District.

Claro is approved to deploy LTE450 in the states of Amazonas, Amapá, Maranhão, Roraima, Pará, Acre, Rondonia and Tocantins, and Bahia.

Cayman Islands

Digicel commercially launched LTE using 1800 MHz (LTE1800) on November 28, 2013. The company also has 700 MHz band 13 spectrum.

LIME Cayman commercially launched LTE using 700 MHz (band 17) on November 29, 2013. Rollout to 100% of the islands was completed in May 2014.

Chile

Regulator Subtel announced in July 2012 **Movistar**, **Entel** and **Claro** had each won 2 x 20 MHz in the 2.6 GHz auction. Nextel and MVNO VTR did not bid.

Claro commercially launched LTE on June 27, 2013 using 2.6 GHz. Nationwide coverage was achieved by October 2013.

Movistar commercially launched LTE in 2.6 GHz on November 14, 2013 in regional capital cities. By February 2015 Movistar had 300,000 LTE subs. APT700 spectrum will be brought into use shortly.

Entel PCS commercially launched LTE on March 28, 2014 using 2.6 GHz across 803 sites.

On Spetember 22, 2015 **Entel PCS** demonstrated LTE-Advanced carrier aggregation combining spectrum in band 28 (APT700) with band 7 using a commercial terminal, and achieved downlink speed of 250 Mbps.

Claro, **Entel** and **Movistar** each won APT700 band spectrum auctioned in February 2014. **Entel PCS** announced completion of LTE trials using APT700 spectrum on 10 sites in December 2014 and will start deploying APT700 sites when frequency permits are granted. At time of writing this report (September 2015) allocations were anticipated very soon.

Nextel (now called **WOM**) trialled LTE in AWS spectrum in Santiago, Providencia, and Macul area. Nextel was sold in August 2014 and sold again 5 months later to European telecoms investment company Novator, planning to launch LTE in 2016 with the WOM brand, and is trying to trade AWS spectrum for preferred APT700 channels.

Colombia

UNE-EPM launched commercial LTE service on June 14, 2012 in 2.6 GHz in Bogotá and Medellín. Coverage extended to 40 cities by end 2013 by which time around 200,000 subscriptions were activated.

The Ministry of ICT (MinTIC) auctioned new spectrum in June 2013, offering:

- 3 blocks of 30 MHz each in the AWS band; one block reserved for new players
- 3 blocks of 30 MHz and 1 block of 40 MHz in 2.6 GHz spectrum; 1 block for new players
- 5 MHz of 3G/1.9 GHz also offered

- Movistar won 30 MHz in AWS band
- ETB and Tigo consortium won 30 MHz in AWS band
- Avantel (new entrant) won 30 MHz in AWS band
- DirecTV won one 30 MHz and one 40 MHz block of 2.6 GHz spectrum
- Claro won 30 MHz in 2.6 GHz band

The auction of 1900 MHz spectrum was declared void. Future allocation of 22 MHz of 1900 MHz and 900 MHz spectrum by auction is being planned.

Movistar commercially launched LTE on December 2, 2013 in AWS spectrum. 73% population coverage was reached by early December 2014.

Tigo commercially launched LTE on December 2, 2013 in AWS spectrum. **Tigo** and **UNE-EPM** have merged; completion of the deal was announced on August 14, 2014. By February 2015 the merged operation covered 75 cities.

ETB agreed to sell a stake in **Colombia Movil** including 15 MHz of 2.6 GHz spectrum to **Tigo**. **ETB** commercially launched LTE using AWS spectrum on October 7, 2014 in 41 towns and cities.

Claro commercially launched LTE on February 13, 2014 using band 7 in Bogota. Coverage reached 95 municipalities & 28 municipal capitals (August 2014).

DirecTV commercially launched band 38 LTE TDD on July 25, 2014 in Barrancabermeja, Chía, Monteria and Palmira. By October 2015 LTE covered 18 cities.

New-entrant **Avantel** commercially launched LTE using AWS on August 19, 2014 in 20 municipalities for business users, targeting 1 million customers in the first year and coverage to 57 cities/towns by mid-2015. By October 2014 LTE coverage was available in 27 cities and 400,000 subscriptions had been achieved. VoLTE is in deployment.

Regulator **ANE** adopted the APT700 band plan on May 30, 2012.

A draft resolution proposed allocating 100 MHz of 2.3 GHz spectrum for mobile broadband services.

In 2015 MinTIC published the conditions for the proposed auction of spectrum in the 700 MHz, 900 MHz, 1,900 MHz and 2.5 GHz bands. Comments were required by June 12, 2015.

Costa Rica

ICE launched a data-only commercial service for dongles and tablets in 110 districts on November 25, 2013 under the Kölbi Ultra brand. Support for LTE smartphones was offered from March 2014. LTE was offered in over 300 districts by October 2014. Coverage continues to expand.

Claro commercially launched LTE1800 on April 1, 2014.

Movistar commercially launched LTE1800 on July 4, 2014.

Pan Latin American WiMAX™ operator **IBW International**, with operations in Costa Rica, El Salvador, Guatemala, and Nicaragua is planning to migrate to 2.3 GHz LTE TDD.

Regulator Sutel recommended adoption of the APT700 FDD band plan in 2012. Sutel is considering allocating new 1800 MHz (40 MHz) and 1900/2100 MHz (30 MHz) spectrum.

Curaçao

UTS (Chippie) commercially launched LTE using 1800 MHz band 3 on June 17, 2015.

Regulator **BTNP** adopted the APT700 band plan.

Dominica

Cable and Wireless **LIME** commercially launched 700 MHz LTE for corporate clients on October 16, 2014.

(**Digicel Dominica** launched 4G branded service in February 2015; the technology used is HSPA+)

Dominican Republic

Orange Dominicana launched commercial LTE dongle-based service in Santo Domingo on July 9, 2012, using 1800 MHz spectrum (LTE1800).

CDMA operator **Tricom** commercially launched LTE using 1900 MHz (band 2) spectrum on March 18, 2013 covering the National District, metropolitan zone of Santiago and other principal cities.
Claro commercially launched LTE using AWS (band 4) on July 17, 2014.

WiMAX™ operator **Wind Telecom** commercially launched LTE TDD in band 38 on February 19, 2015.

Regulator Indotel adopted the APT700 FDD band plan in 2013.

Ecuador

The Telecommunication and Information Society Ministry (MINTEL) announced the National Broadband Plan is to be strengthened to assist development of high speed Internet access to underserved areas. Measures include a resolution to implement LTE in all regions. Considering the benefits of the new mobile technologies, the Telecommunication and Information Society Ministry (MINTEL) and the National Secretary of Telecommunications (SENATEL) organized various events to demonstrate new mobile technologies like LTE, in order to increase the technological and social development.

CONATEL advised GSA about several LTE-focused events and trials held or planned in Ecuador. With LTE comes the opportunity to deploy networks and services, in some areas for the first time. The government has developed the National Broadband Plan, whose main objective is to provide Internet services in underserved areas and technologically isolated amongst the main goals, to achieve by 2017 at least 75% of Ecuador's population with access to broadband. To help fulfill these goals and objectives, CONATEL approved the re-allocation of frequency bands for the introduction of IMT systems as follows:

- 700 MHz band: 90 MHz
- AWS band: 120 MHz
- 2.5/2.6 GHz band: 190 MHz

CONATEL confirmed its adoption of the APT 700 MHz FDD band plan in October 2012.

State-owned operator **CNT** was allocated 30 MHz of APT700 spectrum (band 28) and 40 MHz in the AWS band for its LTE network. **CNT** commercially launched LTE in the main cities of Quito and Guayaquil in December 2013 in AWS spectrum, ahead of a wider launch for data customers in March 2014. Packages for smartphones were launched in August 2014. VoLTE deployment began in April 2014. CNT's CDMA network was closed down in 2014.

After negotiations began in September 2014 the regulator confirmed AWS spectrum awards for LTE deployments to **Movistar** and **Claro** in addition to some 1900 MHz 3G spectrum.

Movistar commercially launched LTE in Quito on May 22, 2015 using band 2 spectrum. The network will additionally be deployed in AWS spectrum later.

Claro commercially launched LTE in Quito and Guayaquil on July 28, 2015 using AWS (band 4).

Utility company **Etapa** is seeking LTE spectrum.

El Salvador

Pan Latin American WiMAX™ operator **IBW International**, operating in Costa Rica, El Salvador, Guatemala, and Nicaragua, is planning to migrate its operations to 2.3 GHz LTE TDD technology.

Regulator SIGET plans to auction AWS and 1900 MHz spectrum.

French Guiana

Only (Outremer Telecom) is preparing to introduce LTE.

Orange plans to launch LTE in 2016 subject to regulatory approval and has been testing since 2014.

Guadeloupe

Arcep has awarded a test licence to **Dauphin Telecom** to trial 800 MHz LTE at Sainte-Anne.

Outremer Telecom is committed to deploy LTE.

Guatemala

Regulator SIT said suitable bands for LTE include 800 MHz, 900 MHz, 1800 MHz, AWS, and 2.1 GHz.
Pan Latin American WiMAX™ operator **IBW International**, operating in Costa Rica, El Salvador, Guatemala, and Nicaragua is planning to migrate its operations to 2.3 GHz LTE TDD technology.

Movistar commercially launched LTE in Guatemala City on October 29, 2014 in 1900 MHz band 2.

Tigo commercially launched LTE on May 4, 2015 in the city of Guatemala, plus Mixco, Villa Nueva, Amatitlán, San José Pinula, Santa Catarina Pinula, Fraijanes and San Miguel Petapa.

Honduras

Regulator CONATEL awarded AWS spectrum to **Claro**, **Hondutel** and **Tigo**. LTE coverage must reach 15% of territory by 2016, equivalent to major cities.

Tigo commercially launched LTE using AWS on December 10, 2014 in the main cities of Tegucigalpa, San Pedro Sula, and La Ceiba.

Claro is deploying an LTE network.

Hondutel plans to launch LTE in in the metropolitan area Valle de Sula in Summer 2015.

CONATEL adopted the APT700 FDD band plan. Potential bidders had to register by September 26, 2014; the APT700 auction is expected in 2015.

Jamaica

Digicel bought 700 MHz spectrum and is deploying LTE.

LIME acquired AWS spectrum and is deploying LTE.

Martinique

Outremer Telecom committed to deploy LTE.

Mexico

On September 21, 2012 regulator **COFETEL** confirmed adoption of the APT700 FDD band plan.

Telefonica Movistar commercially launched LTE in band 4 on October 15, 2012 in Ciudad de México, later in Guadalajara and Monterrey for post-paid users. Service to pre-paid users from January 2015.

Telefónica and **Iusacell** have a network sharing arrangement.

Nextel de Mexico commercially launched LTE on October 13, 2014 in Guadalajara, Mexico City, and Monterrey using AWS spectrum. The company is now owned by **AT&T**. **AT&T** also acquired **Iusacell** in 2015.

Telcel commercially launched LTE in band 4 for post-paid customers on November 6, 2012 in Mexico City, Guadalajara, Monterrey, Queretaro, Puebla, Ciudad Juarez, Tijuana, Hermosillo and Merida. Service for pre-paid users was launched in February 2015. By June 2015 LTE covered 65.5% of the population.

Regulator IFT plans to allocate 700 MHz (APT700) and 2.6 GHz (2500 – 2690 MHz) spectrum. A single open-access APT700 LTE network is planned. The network will be known as “Red Compartida”. Industry interest is high. The aim is to award the project in 1H 2016 and to begin the deployment also in 2016. A field trial has been conducted in Acapulco using APT700 band spectrum during which 120 Mbps downlink speed was reached.

AWS band 4 spectrum is planned to be auctioned in January 2016 for LTE deployments.

Nicaragua

Claro commercially launched LTE using AWS band 4 spectrum on October 1, 2015, initially in the cities of Esteli, Leon, Managua and Matagalpa.

Movistar is deploying an LTE network targeting Q4 2015 commercial launch.

Pan Latin American WiMAX™ operator **IBW International**, operating in Costa Rica, El Salvador, Guatemala, and Nicaragua is planning to migrate its operations to 2.3 GHz LTE TDD technology.

Panama

C and W Panama has 700 MHz (APT700), 850 MHz, and 1900 MHz spectrum. C and W commercially launched LTE in band 28 on March 11, 2015 in parts of Panama City and the city of San José de David.

Movistar commercially launched LTE in band 28 on March 27, 2015 for data users in the capital Panama City and the international airport.

Claro commercially launched LTE on August 6, 2015 using 700 MHz (APT700) and 1900 MHz spectrum.

Panama confirmed its adoption of the APT700 FDD band plan in October 2012.

Paraguay

Personal commercially launched LTE service in refarmed 1900 MHz on February 8, 2013 in Asuncion and surrounding areas. Network expansion depends on access to more spectrum.

Vox (Copaco) commercially launched LTE service in AWS spectrum on February 18, 2013. Initially Vox launched service with 109 sites of which 89 served Asuncion and the metro area, 14 were in Ciudad del Este, 5 in Encarnación and 1 in Pilar.

Tigo plans to deploy LTE when allocated AWS spectrum.

Regulator CONATEL plans to auction AWS spectrum and bidding terms are being finalised. An auction of 700 MHz spectrum may be held in December 2015.

Peru

Ministerio de Transporte y Comunicaciones del Perú auctioned 2 blocks of AWS spectrum for LTE, won by **Telefonica Moviles** and **Americatel Peru** (**Entel).** Coverage conditions include a requirement to cover 234 district capitals within 6 years, and to ensure coverage in a number of cities by mid-2016.

Telefonica Movistar commercially launched LTE in parts of Lima on January 2, 2014 in AWS spectrum. Over 300,000 LTE subscriptions were connected by October 2014. **Telefonica** is also deploying LTE for fixed wireless internet access in the Peruvian Amazon region, initially targeting public sector entities including schools and healthcare centres.

Claro commercially launched LTE in existing 1900 MHz spectrum on May 21, 2014. Claro is also deploying a fixed wireless LTE TDD service in 2H 2015 to provide connectivity to rural and remote areas of the country.

Entel (subsidiary of **Americatel)** commercially launched LTE TDD on October 13, 2014 in Lima using band 40 spectrum, targeting medium and small companies using outdoor CPEs.

DirectTV acquired WiMAX™ operator Digital Way, S.A. de C.V and is deploying an LTE TDD system using its 2.3 GHz spectrum for launch in 2015.

WiMAX™ operator **Olo** plans to migrate to LTE TDD, deploying 1,000 base stations over 5 years.

Bitel (Viettel) is reported to be seeking APT700 spectrum to support deployment of an LTE network.

3 blocks of paired 15 MHz spectrum according to the APT700 band plan are to be auctioned in Q1 2016 (according to the latest timetable) for LTE deployments:

Block A: 703 MHz-718 MHz, 758 MHz-773 MHz;
Block B: 718 MHz-733 MHz, 773 MHz-788 MHz,
Block C: 733 MHz-748 MHz, 788 MHz-803 MHz

Puerto Rico

AT&T Puerto Rico commercially launched LTE service in 700 MHz on November 20, 2011 in San Juan then Guayama, San German and Yauco in 2012. AT&T also owns 2.6 GHz spectrum.

Claro commercially launched 700 MHz LTE on November 24, 2011.

CDMA operator **Open Mobile** launched 700 MHz commercial LTE service on April 19, 2012.

Sprint announced commercial launch on December 18, 2012 using 1900 MHz spectrum.

T Mobile USA commercially launched LTE in AWS spectrum on July 11, 2013.

Aeronet Wireless Broadband is leasing band 41 spectrum and deploying LTE TDD for backbone and customer access for service launch in 2015.

Saint Maarten (Saint-Martin)

Regulator Bureau of Telecommunication and Post of Saint Maarten launched a consultation on the use of LTE and which bands to allocate. Comments were due by November 1, 2013. In 2013 French regulator ARCEP granted 800 MHz LTE test spectrum covering the islands of Saint Martin, Guadeloupe and Saint Barthelemy to **Dauphin Telecom**. Applications for 4G LTE licences are to be invited in 2014.

Saint Helena, Ascension and Tristan da Cunha

Saint Helena, Ascension and Tristan da Cunha is a British Overseas Territory. **Sure South Atlantic** is deploying an LTE network on St Helena and Ascension Island.

Trinidad and Tobago

TSTT announced launch on April 16, 2014 of its Blink Wireless Broadband Pilot Project using LTE technology in rural communities. **TSTT** commercially launched LTE TDD (TD-LTE) in Tobago on December 18, 2014 with two 20 MHz carriers of band 41. All former WiMAX™ sites are migrated to LTE TDD. Fixed/nomadic wireless broadband service is offered for use with CPEs, USB dongles and personal hotspots/MiFi devices. Service across Trinidad was expected to be completed by early 2015 at which time there will be 350+ LTE TDD sites in service.

Regulator TATT issued an RFP initiating a competitive authorization process including:

a) Provision Of A Public Domestic Mobile Telecommunications Network And Public Telecommunications Services By A Potential 3rd Mobile Operator;
b) Award Of 800 MHz and 1900 MHz spectrum To Eligible Mobile Operator(s); and
c) Award Of 700 MHz spectrum To Mobile Operators

There were 6 applicants by the deadline of April 30, 2014. **Digicel T&T** plans to be the first LTE operator. **CWC** confirmed it had applied for the new licence.

Turks & Caicos Islands

In February 2013 **Digicel** (700 MHz Lower B and C) and **Islandcom** (700 MHz Upper C) received licences to deploy LTE networks. **LIME** did not win a licence. On February 26, 2015 **LIME** announced it had reached an agreement to acquire the assets of **Islandcom** and plans to offer customers 4G/LTE service. The proposed acquisition has been submitted to the regulatory authorities for approval. During the approval process both companies will continue to operate as separate distinct entities.

Digicel commercially launched its LTE700 network on March 25th, 2015 with 94% population coverage.

LIME commercially launched its LTE700 network on July 31st, 2015 with close to 100% coverage across Provo, Grand Turk and South Caicos.

Uruguay

Antel commercially launched LTE on December 13, 2011 using AWS in Montevideo and Punta del Este.

In May 2012 the government passed a Decree governing DTT implementation. Analog switch off is planned to take place on November 21, 2015.

In March 2013 regulator URSEC announced that an award of spectrum had been made to the 3 incumbent mobile operators following a tender process for 900 MHz, 1900 MHz and AWS spectrum.

- **Movistar** won 4 blocks of 1900 MHz spectrum
- **Claro** won 2 blocks of 1900 MHz and 2 blocks of AWS spectrum
- No bids were made for 900 MHz.

Antel did not take part in the auction and had to pay for reserved spectrum of 1 block in 900 MHz and 4 blocks of AWS.

Claro commercially launched LTE in Montevideo in AWS spectrum on February 13, 2014.

Movistar commercialy launched LTE in 1900 MHz band 2 on September 5, 2014 in Montevideo.

Wireless broadband company **Dedicado** is planning to invest US$ 5 million in deployment of “4Motion” network using WiMAX™ and LTE TDD in 3.5 GHz.

British Virgin Islands

On June 11, 2015 regulator Telecommunications Regulatory Commission (TRC) announced a consultation from end June 2015 on a proposed spectrum award in the 450 MHz, 700 MHz, 1800 MHz, 1900 MHz, 2100 MHz, and 2500 MHz bands by comparative tender. "Of particular importance is the 700 MHz band which is the main band for 4G services based on LTE technology in the United States (and its territories in the Caribbean) and which has now been assigned in a number of Caribbean states e.g. Anguilla, Antigua and Barbuda, Jamaica, Trinidad and Tobago, and Turks and Caicos" is stated in the consultation document.
http://www.trc.vg/images/Draft_ITA_and_Consultation.pdf

Comments are required by July 28, 2015. The 700 MHz spectrum could be allocated in late October 2015 and TRC wants commercial LTE services to be launched in 1H 2016.

Incumbent operators **CCT**, **Digicel** and **LIME** have all expressed interest in deploying LTE services.

US Virgin Islands

Sprint commercially launched its band 25 LTE network on April 17, 2013.

AT&T Mobility commercially launched band 17 LTE on St Croix and St Thomas on July 2, 2013.

Choice Wireless is deploying an LTE network.

Venezuela

Regulator Conatel issued an invitation for the allocation of 35 MHz paired spectrum bands:

1930-1940 MHz paired with 1850-1860 MHz (band 2)
1945-1955 MHz paired with 1865-1875 MHz (band 2)
1810-1825 MHz paired with 1715-1730 MHz (band 3)

Digitel was awarded 30 MHz of spectrum in 1800 MHz and 1900 MHz.

Movilnet and **Movistar** each received 20 MHz of extra spectrum in those bands.

Digitel commercially launched LTE with 1800 MHz (LTE1800) on July 31, 2013 for post-paid consumers and business users. Full commercial launch was on September 9, 2013. In mid-July 2014 the LTE network comprised over 900 base stations with coverage to 108 towns and cities in 21 states and over 80,000 subscriptions. Digitel is testing VoLTE.

WiMAX™ operator **Movilmax** has a nationwide licence with 48 MHz of 2.6 GHz spectrum and announced the company is migrating to LTE.

On December 2, 2013 Conatel launched an auction for 80 MHz paired comprising 4 blocks of 2.6 GHz and 2 blocks of AWS spectrum that may be used for LTE. Bids were due by December 30, 2013 but the auction stalled; procedures restarted in August 2014.

Three LTE-suitable licences were awarded in December 2014 to **Movilnet**, **Movistar** and **DirecTV** (via its Galaxy Entertainment subsidiary). Services must be launched by June 2015 and coverage exceed 70% of population by 2019.

Movistar switched off its CDMA system in April 2014 and commercially launched LTE using AWS spectrum on February 19, 2015 with initial coverage in the metropolitan area of Caracas and Puerto la Cruz, to be expanded during 2015.

Movilnet is deploying LTE.

Cofetel adopted the APT700 FDD band plan in April 2013.

Asia Pacific and Oceania

Afghanistan

Etisalat Afghanistan has completed an LTE trial.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

Australia

Telstra commercially launched LTE1800 service on September 27, 2011 in capital city CBDs (central business districts) and more than 30 regional and metropolitan centers. The NextG network upgrade uses Telstra's existing 1800 MHz spectrum refarmed to deliver LTE to areas where traffic demand is most

concentrated and is integrated with Telstra's existing HSPA+ service in the 850 MHz band. Telstra has 5.2 million LTE subscriptions (2014 Annual Report). Telstra offers dual mode LTE/HSPA+ mobile broadband devices for seamless operation across 1800 MHz and 850 MHz. The company is trialling IMS but says it will not rush into voice until coverage is ubiquitous on the LTE layer.

In February 2013 Telstra announced plans to deploy LTE in re-farmed 900 MHz spectrum – some sites are running now. In July 2014 Telstra announced plans to close its 2G/GSM network by end 2016. In July 2013 Telstra demonstrated carrier aggregation using 900 MHz and 1800 MHz spectrum. Telstra successfully demonstrated speeds up to 300 Mbps with LTE-Advanced carrier aggregation using 40 MHz of 1800 MHz and 2600 MHz spectrum on its live commercial network. In May 2014 Telstra demonstrated 450 Mbps speed using LTE-Advanced carrier aggregation technology in its commercial network by combining three 20 MHz carriers (20 MHz 1800 MHz plus two 20 MHz 2.6 GHz carriers). 2100 MHz spectrum has been refarmed for LTE in some locations. Telstra also acquired new APT700 and 2.6 GHz spectrum in the auction.

Telstra commercially launched APT700 (band 28) service on July 25, 2014 in Perth, Freemantle, Griffith, Esperance, Mount Isa and Mildura. Each site is equipped with:
* 2 x 20 MHz of APT700 (enabling theoretical peak speeds on Cat 4 devices of 150 Mbps) and
* 2 x 20 MHz of LTE1800 (enabling theoretical peak speeds on Cat 6 devices of 300 Mbps)

Telstra's 300 Mbps LTE-Advanced service, marketed as "4GX", uses 700 MHz and 1800 MHz spectrum and is commercially available in parts of Adelaide, Brisbane, Darwin, Hobart, Melbourne, Perth, Sydney, and selected regional areas. Telstra now has 4G/LTE coverage to over 90% of the population, and 4GX/APT700 services over 1,000 Australian towns and suburbs. In February 2015 Telstra confirmed over 1 Million APT700 enabled devices operational on their 4GX network.

APT700 spectrum was obtained with early release to enable services to be started in Sydney and Adelaide central business districts in mid-September 2014. On September 11, 2014 Telstra announced population coverage for LTE would expand to 90% by end January 2015. APT700 coverage was extended to selected areas of Sydney, Adelaide, Darwin, Bundaberg, Yamba and Sarina in September 2014. All top end devices now support APT700 band 28.

Telstra, together with its network and devices partners, demonstrated 450 Mbps downlink speed (Category 9) using carrier aggregation to combine three 20 MHz carriers in Bands 3 (LTE1800), 7 (2.6 GHz) and 28 (APT700). First sites were activated in April 2015; compatible devices were launched in August 2015.

On February 26, 2015 Ericsson in cooperation with Qualcomm and observed by Telstra, announced that 600 Mbps (Category 11) had been demonstrated in their labs. The first Cat 11 device (Telstra WiFi 4GX Advanced III Mobile Broadband Hotspot) came onto the Telstra market in September 2015.

In October 2013 Telstra announced completion of the world's first LTE Broadcast session on a commercial LTE network. LTE Broadcast technology is being deployed across the LTE network by May 2015, ahead of commercial trials and the customer launch planned later in 2015.

Telstra commercially launched VoLTE on September 16, 2015 to postpaid users with compatible terminals.

Optus conducted an LTE1800 trial in Newcastle and Hunter Valley areas of New South Wales. Commercial LTE service launch for small business, enterprise and government customers in Sydney and Perth was confirmed on July 31, 2012 using LTE1800, before a wider launch on September 4, 2012. The Optus 4G (LTE1800) network now covers 75% population in metropolitan areas and 90% population coverage is planned by April 2015. Optus is trialling HD voice and VoLTE. **Optus** acquired **Vivid Wireless** obtaining access to 98 MHz of 2.3 GHz spectrum and commercially launched LTE TDD service in the Canberra area on June 6, 2013. Dual mode (FDD and TDD) devices were offered by the company at launch. The company has since added LTE TDD coverage for Melbourne, Brisbane, Sydney and Adelaide. On December 19, 2013 Optus announced in tests they had paired two 20 MHz channels of 2.3 GHz spectrum in Melbourne. Optus claimed the test is "the first time in the world that 4G

carrier aggregation has been introduced into a live LTE TDD network, not a lab". Optus 4G Plus LTE-Advanced (theoretical peak downlink of 220 Mbps TDD) is live in parts of Adelaide, Brisbane, Canberra, Melbourne & Sydney. Customers with compatible terminals can connect in either FDD 1800 MHz or TDD 2300 MHz modes.

Optus acquired APT700 and 2.6 GHz spectrum in the 2013 auction, see below, and was granted Australia's first outdoor metro trial licences for 4G in 2.6 GHz spectrum. Optus has undergone testing for compatibility of the new spectrum with the latest devices and with television broadcasters. The trials using APT700 and 2.6 GHz were extended to Darwin and Perth. **Optus** commercially launched LTE service using APT700 spectrum in Perth and Darwin on July 23, 2014. APT700 coverage for Canberra was activated on December 8, 2014, supplementing previous TDD only coverage before that date. APT700 spectrum is available for commercial use nationally from January 1, 2015. 2.6 GHz spectrum could be used in most areas from October 1, 2014. Optus plans for LTE services serving over 200 regional and holiday destinations by April 2015, thus reaching 90% of the population.

Optus commercially launched 2-carrier aggregation (2 x CA, Category 6) and 3-carrer aggregation (3 x CA, Category 9), claiming a world first for the latter for 1x FDD + 2x TDD carrier aggregation according to a company announcement on August 14, 2015. Optus activated 3x CA in the Newcastle NSW suburbs of Lambton, Mayfield and Mayfield West ahead of the first compatible category 9 devices being released commercially in Australia. Customers with the latest category 9 smartphones, such as the Samsung Galaxy S6 edge+ and Samsung Galaxy Note 5 can experience significantly maximized mobile download speeds compared to a single 4G channel. Mobile data download speeds of 317 Mbps were achieved using a category 9 device at Mayfield West in Newcastle. Optus deployed 3x CA technology in the Melbourne CBD in early September and will roll out to the Sydney CBD early 2016, followed by the Brisbane and Adelaide CBDs from mid-2016.

3x Carrier Aggregation on Optus 4G Plus uses a unique combination of 20 + 20 MHz of 2300 MHz and 15 MHz paired of 1800 MHz spectrum.

2x CA is available on the Optus 4G Plus network in selected areas of Sydney, Melbourne, Brisbane, Adelaide, Canberra, Hobart and Darwin as well as 20 major regional centres.

2x CA on Optus 4G Plus uses several combinations of spectrum bands including 2300 MHz and 2300 MHz in selected capital cities, 700 MHz and 1800 MHz in selected capital cities and major metropolitan areas and 700 MHz and 2600 MHz in major regional town centres.

In March 2015 Optus announced it had achieved download speeds of 480 Mbps to a single user device. This was accomplished by aggregating 4 separate 4G carriers – each 20 MHz wide– to a single user device.

Separately, Optus tested carrier aggregation in conjunction with 4x4 MIMO, achieving a peak download speed of 415 Mbps in 40 MHz of spectrum.

On August 5, 2015 Optus announced the planned closure of its GSM network from April 1, 2017 allowing its spectrum to be refarmed for LTE systems.

Vodafone confirmed results of its first LTE1800 trial in Q4 2010 in Newcastle, NSW using 10 MHz of 1800 MHz. A second trial in Sydney followed. In September 2011 the company announced that an agreement with the Australasian Railway Association, which holds licences for 1800 MHz spectrum, to create contiguous blocks of spectrum in NSW, Victoria and South Australia, had been approved by the Australian Communications and Media Authority (ACMA).

Vodafone commercially launched LTE1800 service for existing customers already having their own compatible LTE device on June 12, 2013 in selected metro areas of Sydney, Perth, Melbourne, Adelaide, Brisbane; and Newcastle and Wollongong. The LTE service was opened to new customers on July 10, 2013. In January 2014 the company announced 1 million LTE devices were connected. Cat 4 (150 Mbps) devices were offered in January 2014 (dongle and portable hotspot). In August 2014 the company announced plans to update its core network. LTE using refarmed 850 MHz spectrum was launched in Adelaide in October 2014. **Vodafone** commercially launched 225 Mbps LTE-Advanced using carrier aggregation to combine 5 MHz of refarmed 850 MHz

(band 5) with 20 MHz LTE1800 (band 3), was launched on November 17, 2014. This configuration is used on many sites, and another 5 MHz of band 5 will be introduced in 2015. Some sites use 20 MHz + 10 MHz of 1800 MHz band 3 spectrum. 96% coverage of the metro population was achieved by mid-2015 by refarming 850 MHz spectrum previously used for 3G. LTE-Advanced coverage was launched in Brisbane, the Gold Coast, and Sydney by December 4, 2014. On February 6, 2015 the company announced completion of a successful VoLTE trial ahead of planned service launch in 2015. On the same date Vodafone confirmed more than 2 million devices were connected to its LTE network.

NBN Co was established to design, build and operate the national broadband network and launched LTE TDD commercial wholesale services on April 2, 2012. There are 15 service providers accredited to provide services over the network and NBN Co is installing services for them across four locations in Australia, expanding to a national footprint covering 4% of the population by the end of 2015. This locks in with the same product set being offered over fibre and satellite to make the total picture of 100% population coverage. Retail price packages are available from *SkyMesh, iiNet, and Activ8Me. In March 2015 NBN announced completion of an LTE TDD trial at 2 sites using a 20 MHz 3.5 GHz carrier.

EnergyAustralia's Ausgrid trialled an LTE platform at 15 sites in 2011, with intent to migrate to a full LTE network. EnergyAustralia was chosen by the Government to lead the Smart Grid, Smart City demonstration project to test Australia's first fully integrated, commercial-scale smart grid.

WiMAX™ operator **BigAir** plans to deploy LTE.

An auction by ACMA of APT700 (use from January 1, 2015) and 2.6 GHz (use from October 1, 2014 in most places) began April 23, 2013. Results were confirmed May 7, 2013. All 3 bidders won spectrum raising nearly AUS$2 billion. VHA did not bid.

APT700 band winners:
Optus 2 x 10 MHz; Telstra 2 x 20 MHz

2.6 GHz band winners:
Optus 2 x 20 MHz; Telstra 2 x 40 MHz
TPG Internet 2 x 10 MHz

TPG Internet is a nationwide fixed telecoms service provider with international assets (submarine cable) and plans to deploy LTE.

ACMA is consulting on proposals for prioritizing more spectrum for mobile broadband including changing the status of the 3.4 – 3.6 GHz band to "primary" from "secondary", and suitable for LTE.

ACMA is also evaluating the merits of using the 400 MHz band for interoperable government wireless communications.

ACMA is consulting on how to allocate the unsold block of 700 MHz and will auction regional 1800 MHz spectrum in November 2015.

Bangladesh

Regulator BTRC announced its decision in December 2013 to allow 5 companies to receive LTE licences:

- Banglalion
- Qubee
- Bangladesh Internet Exchange Limited (BIEL)
- Mango
- BTCL

WiMAX™ operators (**Banglalion, BIEL, Qubee**) are allowed to deploy LTE TDD in their 2.6 GHz spectrum subject to application and payment of additional fees.

BTCL plans a fixed wireless LTE service by June 2017 and applied for 35 MHz in 2.6 GHz TDD band.

3.5 GHz WiMAX™ operator **BIEL** (ollo brand) acquired a BWA license using 2.6 GHz spectrum allowing LTE to be deployed. BIEL trial demonstrated LTE in April 2014. **Wateen** and **Qubee** announced in December 2013 plans to merge their respective WiMAX™ operations, subject to regulatory approval.

South Asian Telecom Regulatory Council announced in May 2013 that Bangladesh adopted the APT700 FDD band plan. BTRC had proposed to auction APT700 spectrum in 2015, however the timetable may be delayed. Guidelines are being prepared to auction 450 MHz after APT700 is allocated.

Operators are seeking approval to refarm 1800 MHz for LTE systems. BTRC plans to auction unused 1800 MHz and 2.1 GHz spectrum on May 20, 2015.

Bhutan

Bhutan Telecom commercially launched its LTE1800 service on October 24, 2013 in the capital, Thimpu.

An announcement by the South Asian Telecom Regulatory Council (SATRC) in May 2013 confirmed Bhutan's adoption of the APT 700 FDD band plan.

Brunei

DST commercially launched LTE1800 service on November 15, 2013.

Regulator AITI adopted the APT700 FDD band plan in June 2013.

Cambodia

Smart Axiata commercially launched LTE1800 on January 22, 2014 in several indoor locations in parts of Phnom Penh. By June 2015 coverage had been extended to all 25 Provinces of the country.

Sotelco (Beeline Cambodia) was deploying an LTE network for launch in Phnom Penh by 2015. Sotelco was sold to **Viettel** (**Metfone**) in March 2015.

South East Asia Telecommunication Holdings (SEATEL) commercially launched its LTE network on July 26, 2015. At launch the service was available in 17 provinces, including the capital Phnom Penh, Kandal, Sihanoukville and Siem Reap, and will cover the remaining provinces by year-end.

SEATEL acquired CDMA operator **Excell**.

WiMAX™ operator **EMAXX** is deploying an LTE TDD network using 2.6 GHz band 41.

Chuan Wei Ltd is deploying a commercial LTE network and VoLTE solution and has selected its infrastructure suppliers.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

China

China Mobile built its TD-SCDMA network so that sites and other elements are reusable for LTE TDD.

China Mobile ran a pilot of LTE TDD technology until September 2011 using 850 base stations in 6 cities in Phase 1. This followed a large-scale showcase trial network during the 2010 World Expo in Shanghai. The second phase of trials involved 15 cities and 7 suppliers. In June 2013, 5,000 users begin testing the newly deployed LTE TDD network in Shanghai where 1,000 base stations - 700 outdoors and 300 indoors – were deployed covering the Inner Ring region, later extending to the whole city. China Mobile has 1.9 GHz, 2.0 GHz, 2.3 GHz and 2.6 GHz bands (the F, A, E and D bands). Trials used D and F bands.

210 MHz of LTE TDD spectrum is allocated in China:

- 130 MHz for 326 cities in 1880-1900 MHz (band 39), 2320-2370 MHz (band 40), and 2575-2635 MHz (band 41) to **China Mobile**
- 40 MHz for 55 cities comprising 2300-2320 MHz and 2555-2575 MHz to **China Unicom**
- 40 MHz for 42 cities comprising 2370-2390 MHz and 2635-2655 MHz to **China Telecom**

LTE TDD operating licences were issued by MIIT to **China Mobile**, **China Telecom** and **China Unicom** on December 4, 2013.

China Mobile commercially launched LTE TDD on December 18, 2013 in Beijing, Guangzhou and Chongqing in bands 39, 40, and 41. The company announced 100 million LTE subscriptions by end January 2015, at which time over 700,000 TDD (TD-LTE) bases stations were deployed covering over 1 billion people. China Mobile anticipates its LTE subscriptions base will be 250 million by end 2015.

China Mobile conducted carrier aggregation trials in 2014 achieving 220 Mbps on the downlink. Uplink carrier aggregation has been trialled over Jiangsu Mobile's network. LTE-Advanced carrier aggregation on the downlink is being deployed. 3 carrier CA LTE TDD using band 41 spectrum is being trialled to achieve up to 330 Mbps i.e. Category 9. The test cluster in Guangzhou is largely comprised of 2-carrier CA sites and a few sites support 3-carrier. On July 16, 2105 it was announced that Shanghai Mobile, a subsidiary of China Mobile, had deployed what its supplier claimed to be the world's first intra-band (3.5 GHz and 2.6 GHz TDD bands) TD-LTE-Advanced small cell carrier aggregation in its commercial

network to achieve 220 Mbps peak downlink data transmission rates.

China Telecom commercially launched LTE TDD service in bands 40 and 41 on February 14, 2014, initially offering service in almost 100 cities.

China Unicom commercially launched LTE TDD service in bands 40 and 41 on March 18, 2014 in 25 cities. LTE-Advanced is in deployment, to deliver 300 Mbps by end 2015 and 330 Mbps in 2016 with tri-band carrier aggregation. VoLTE will be deployed in 2106.

China Telecom and **China Unicom** both received FDD trial licences from MIIT in June 2014. China Unicom plans to deploy FDD-TDD technology in 16 cities: Shanghai, Guangzhou, Shenzhen, Chongqing, Zhengzhou, Wuhan, Chengdu, Xi'an, Changsha, Jinan, Hangzhou, Shenyang, Harbin, Fuzhou, Nanjing and Shijiazhuang. China Telecom will also trial FDD in 16 cities: Shanghai, Xi'an, Chengdu, Hangzhou, Wuhan, Nanjing, Jinan, Hefei, Shijiazhuang, Haikou, Zhengzhou, Chongqing, Shenzhen, Nanchang, Nanning and Lanzhou. Both China Unicom and China Telecom were subsequently authorized in August 2014 to extend trials using FDD from the original 16 cities to 40 cities. Subsequently China Unicom and China Telecom gained approval to extend trials to 56 cities. China Unicom deployed 90,000 FDD and 10,000 LTE TDD base stations by end 2014 for continuous 4G coverage in most urban areas. 150 Mbps downlink data rate has been achieved on its network.

China Telecom claimed the world's first FDD-TDD carrier aggregation demonstration including a user device chipset. A peak download speed of 260 Mbps was achieved using 20 MHz of 1.8 GHz FDD band 3 and 20 MHz of 2.6 GHz TDD band 41 spectrum.

On February 27, 2015, MIIT awarded LTE FDD commercial licences to China Telecom and China Unicom, as follows:

- **China Telecom** received an additional 2x20 MHz band 3 licence, and permission to refarm 2x15 MHz of its band 1 spectrum for LTE FDD
- **China Unicom** received an additional 2x10 MHz band 3 licence for LTE FDD

Following receipt of its LTE FDD licence **China Unicom** has confirmed plans to invest over USD 16 billion in 4G, targeting 100 million subs by end 2015.

China Telecom is deploying LTE FDD across 12 Provinces in 40 cities including Shanghai, Jiangsu, Shandong, Zhejiang, Hunan, Hubei, Guangxi, Fujian, Jiangxi, Shaanxi, Inner Mongolia and Liaoning. The company plans to deploy 460 LTE base stations by end 2015. **China Telecom** is deploying LTE-Advanced carrier aggregation combining FDD and TDD. **China Telecom** launched its "Tianyi 4G+" 300 Mbps LTE-Advanced service on August 1, 2015. China Telecom plans to trial VoLTE in 2015 after which deployment will start, targeting service launch in 2018.

China Mobile has applied for an FDD licence in support of its LTE TDD network and to showcase convergence, according to reports.

On November 13, 2013 **China Mobile**, working with SK Telecom, completed the first FDD – TDD VoLTE interoperability tests. **China Mobile** has deployed VoLTE supporting eSRVCC on its LTE TDD network in Guanghzou. China Mobile commercially launched VoLTE HD voice service in Zhejiang, the first province in China to enter into the VoLTE era. In April 2014 results of FDD/TDD LTE-Advanced carrier aggregation trials were announced. Air interface tests achieved 250 Mbps.

Qatar Ooredoo and **China Mobile** trialled FDD-TDD 10-carrier CA.

The government is also considering 1.4 GHz and 3.5 GHz spectrum for TD-LTE allocation, as well as exploring the application of 50 GHz and beyond to meet future demand of mobile broadband. Band 42 (3.5 GHz) is an important future band for China.

MIIT announced that the number of LTE subscriptions reached 200.774 million with 22.8 million being added in May 2015.

In **Hong Kong SAR**, 2 x 15 MHz blocks of 2.6 GHz spectrum were obtained via auction each by China Mobile HK (**Peoples Phone**), Genius Brand (**Hutchison Telecom/HKT** JV) and **CSL Limited**.

Telstra sold **CSL Limited** to **Hong Kong Telecom (HKT)** owner of **PCCW Mobile** for US$2.4 billion. HKT. **HKT** is the company entity for telecom services and **CSL** is the new mobile services identity.

Genius Brand has deployed a city-wide LTE network on which **Hutchison** and **CSL** operate their respective commercial LTE services.

On November 25, 2010 **CSL** commercially launched its combined LTE2600/1800/DC-HSPA+ network for corporate services, extended to all customers on May 16, 2011. Although the first LTE1800 site was on air at the initial launch, LTE1800 is widely available in several in-building locations and in general commercial use (shown in this report to be from November 2011 as advised to us by CSL). On July 3, 2013 CSL announced it had brought into service more 1800 MHz spectrum across most of the network, expanding in-service 1800 MHz LTE bandwidth to 2×15 MHz. CSL also uses 20 MHz of paired 2.6 GHz spectrum for LTE. LTE-Advanced carrier aggregation using 20 MHz of LTE1800 (B3) and 20 MHz of LTE2600 (B7) was commercially launched on December 22, 2014. VoLTE was soft-launched on December 5, 2013 and commercially launched on May 15th, 2014. In June 2013 the network was upgraded to Cat 4 operation (theoretical peak downlink 150 Mbps). CSL commercially launched VoLTE on May 15, 2014 including eSRVCC delivering totally seamless handover of voice calls from 4G to 3G. On April 23, 2015 CSL's owner HKT announced successful demonstration of 3-carrier LTE-Advanced technology, achieving 435 Mbps. This technology is now being deployed for commercialisation in 2016.

Hutchison 3 HK is deploying an LTE FDD and TDD network and in the first phase launched commercial LTE FDD service using 2.6 GHz spectrum on May 2, 2012. LTE using 1800 MHz (LTE1800) was brought into commercial service in October 2012. LTE TDD is not commercially launched though this is expected later in 2015. 3 HK commercially launched VoLTE on May 15, 2014. 3HK is currently deploying LTE-Advanced arrier aggregation using 10 MHz of band 3 with 20 MHz of band 7 to achieve a theoretical peak downlink data rate of 225 Mbps. The company has demonstrated an FDD and TDD LTE-Advanced configuration using carrier aggregation and plans to launch a 2 component carrier (2CC) FDD TDD LTE-Advanced network in early 2016. 3CC is also in development. The company has committed to deploying a 5CC LTE-Advanced network.

SmarTone announced commercial LTE1800 launch on August 28, 2012 with service available to selected customers by invitation, then generally available to customers on September 11. The company confirmed that LTE coverage would be available at the first MTR underground station (at Admiralty) on October 15, 2012. Rollout has been extended across all MTR stations and adjoining tunnels. LTE-Advanced technology was commercially launched in July 2014 for up to 150 Mbps. Dual band combines two from bands 3 (2x10 MHz), 7 (2x10 MHz) and 8 (2x 5 MHz). Tri-band is being deployed using all these bands.

On February 6, 2012 regulator OFCA announced the auction results after 6 bidding rounds for 90 MHz of 2.3 GHz spectrum for BWA services, divided into 3 x 30 MHz blocks. 30 MHz blocks were won each by Hutchison Telephone Company Limited, China Mobile Hong Kong Company Limited, and new entrant **21 ViaNet Group Limited.**

China Mobile HK commercially launched LTE FDD in 2.6 GHz on April 25, 2012 and 2.3 GHz LTE TDD in December 2012. The world's first bi-directional handover between LTE FDD and TDD on a live network was announced by Ericsson and China Mobile HK on June 20, 2012. LTE1800 was deployed in 2013. VoLTE is in deployment.

China Mobile HK is trialling 3CC LTE-Advanced technology, combining 15 MHz Band 7, 20 MHz B40 and 10 MHz Band 40. A maximum downlink data speed of 272 Mbps has been achieved.

OFCA auctioned spectrum in the 2.6 GHz range, offering five blocks of 2 x 5 MHz in the 2515 – 2540 MHz and 2635 – 2660 MHz range. The auction involved 5 bidders: China Mobile Hong Kong, China Unicom (Hong Kong), CSL Limited, Genius Brand, and SmarTone, beginning on March 18, 2013 and ending on March 19, 2013 after 18 rounds of bidding. China Unicom failed to gain any spectrum.

Fiji

800 MHz and 1800 MHz LTE spectrum was auctioned In July 2013. Results:

- **Vodafone**: 30 MHz paired 1800 MHz
- **Digicel**: 15 MHz paired APT700 and 15 MHz paired 1800 MHz
- **TFL**: blocks in APT700 and 1800 MHz

Vodafone Fiji commercially launched LTE1800 on December 5, 2013 with coverage available in most parts of Suva, Lami and parts of Nasinu. Over 6,000 subscriptions were signed up in the first 2 months surging to 100,000 subscriptions by August 2014. Service is offered in 12 cities (January 2015).

Digicel commercially launched LTE on August 14, 2014 covering Nadi, Suva and Lautoka.

Guam

IT&E announced launch of LTE commercial services on June 28, 2012 – initially for business only, using 700 MHz, extended to other users in early July 2012 as "4G LTE Wireless Data Network for the Home".

DoCoMo Pacific announced launch of LTE commercial services in 700 MHz on October 4, 2012.

iConnect commercially launched LTE service using 700 MHz spectrum on March 20, 2013.

GTA commercially launched LTE service using AWS spectrum on October 11, 2013. Sites are located in the villages of Agana, Agana Heights, Asan, Agat, Barrigada, Chalan Pago, Dededo, Mangilao, Sinajana, Tamuning, Tumon and Yigo. Expansion to 95% of population is targeted by September 2015. GTA is in the process of being acquired by PT Telekomunikasi Indonesia (Telkom).

India

The 2.3 GHz BWA auction began with 11 companies bidding for 2 blocks in each of the 22 circles. The government had earlier allocated one 20 MHz unpaired spectrum block each to **MTNL** and **BSNL**.

Tikona Digital Networks won spectrum in 5 circles and is committed to deploy LTE TDD. Commercial launch is expected in 2016.

Qualcomm and **Bharti Airtel** won 4 circles each. Qualcomm gained spectrum in the key circles of Delhi, Mumbai, Haryana and Kerala, announced Global Holding Corporation and Tulip Telecom as initial shareholders for its LTE venture for network deployment, and started trials. In May 2012 it was announced that **Bharti Airtel** would buy 49% of the Qualcomm license (Qualcomm Asia Pacific – QAP), comprising the 26% owned by Global Holding Corporation and Tulip Telecom, plus a further 23% of the company (according to reports, as a first step to taking full ownership in 2014). Bharti Airtel subsequently raised its share to 51%. **Bharti Airtel** has BWA licences in four other circles - Kolkata, Karnataka, Punjab and Maharashtra. Bharti Airtel is a member of the Global TD-LTE Initiative.

On April 10, 2012 **Bharti Airtel** commercially launched LTE TDD data-only service in Kolkata; support for mobiles was introduced in June 2014. Service opened in Bangalore on May 7, 2012 and Pune on October 18, 2012 including CSFB, then Chandigarh, Mohali and Panchkula in March 2013. In March 2015 Airtel announced it had 20,000 4G base stations which would double in the coming year. An integrated FDD and TDD LTE network entered customer trials in the Delhi NCR (National Capital Region) on June 18, 2015. A nationwide expansion was announced on August 6, 2015 with an additional 296 cities receving LTE. Airtel is trialling VoLTE.

Aircel won BWA spectrum in 8 circles and commercially launched LTE TDD on July 16, 2014 for enterprise users in 4 circles: Andhra Pradesh, Assam, Bihar and Orissa. Now offered in 6 circles, retail offers will be launched in December 2015.

Infotel Broadband was the only pan-India winner, and was later bought by Reliance Industries Ltd (RIL).

Reliance Jio Infocomm is deploying an LTE TDD BWA and FDD network targeting commercial launch in December 2015 using band 3, band 20 and band 40 spectrum, and is also trialling VoLTE.

BSNL acquired 2.6 GHz BWA spectrum licences in band 41 in 22 circles for $1.6 billion and expects to launch LTE TDD service by March 2016.

MTNL bought 2.6 GHz and is studying introducing LTE TDD in addition to current WiMAX deployments.

Videocon is deploying a commercial LTE1800 network in 6 circles targeting launch in 2015, and also

plans to deploy VoLTE. Plans to invest more than INR12 billion (USD 192.56 million) in the LTE network over the next 3 years and covering 29 cities in 3 circles have been announced.

SSTL bidding under the name of **MTS** secured 800 MHz (ex-CDMA) spectrum and technology neutral licences in 8 circles by auction in November 2012. The company intends to migrate LTE but considers its current spectrum assets insufficient. SSTL is now in exclusive merger talks with Reliance Jio Infocomm, whose spectrum assests also include 800 MHz.

Regulator Telecom Regulatory Authority of India (TRAI) is consulting on 700 MHz spectrum and IMT-Advanced/LTE-Advanced systems.

In March 2013 TRAI recommended adoption of the APT700 FDD band plan.

In January 2014 the Indian government agreed a refund to BSNL and MTNL in exchange for return of the unused 2.6 GHz spectrum.

The DoT started an auction of technology-neutral 900 MHz and 1800 MHz spectrum on February 3, 2014 that concluded and provisional results being announced on February 13, 2014. Bharti Airtel, Vodafone and Idea were the biggest spenders. Reliance Jio Infocomm bought contiguous spectrum 1800 MHz spectrum in 14 circles but did not buy any 900 MHz spectrum. Other winners were **Telenor** (via Telewings), **Aircel** and **RCOM**.

Vodafone India is deploying LTE1800 targeting service launch by end 2015 beginning in Mumbai, Delhi, Kolkata, Bengaluru and Kochi.

Bharti Airtel is deploying LTE1800 alongside its existing 2.3 GHz LTE TDD deployments to establish a pan-India 4G/LTE footprint. **Idea Cellular** will deploy a LTE1800 system. **Reliance Jio Infocomm** will deploy LTE1800 alongside its existing 2.3 GHz LTE TDD deployments to establish a pan-India 4G/LTE footprint through an integrated ecosystem.

An auction of 800 MHz, 900 MHz, 1800 MHz and 2.1 GHz spectrum concluded on March 25th, 2015 after 19 days and 115 rounds of bidding, raising about 17.6 billion USD.

A further spectrum auction could take place in 2016 that may include APT700 spectrum.

Operators have expressed interest in L-Band allocations for mobile service.

Indonesia

Indosat trialled 2.6 GHz LTE in 2010 and in October 2011 announced completion of an LTE1800 trial using 10 MHz in Surabaya and Denpasar in Bali. **Indosat** launched a pre-commercial trial service capable of theoretical peak 185 Mbps downlink/41 Mbps uplink in November 2014 in 1800 MHz. LTE in 5 MHz of 900 MHz spectrum was commercially launched in Jakarta on December 22, 2014. Commercial service using 1800 MHz (LTE1800) was launched on July 5, 2015 in Balikpapan, East Kalimantan.

The CDMA network operated by Indosat (StarOne) was turned off end June 2015.

Telkomsel and **XL Axiata** each launched an LTE network trial in Nusa Dusa, Bali in advance of the APEC summit in October 2013.

The parent company of **Axiata** has government approval to take over **Axis,** which owns 15 MHz of 1800 MHz and plans to deploy LTE1800 service.

Telkomsel commercially launched LTE using 5 MHz paired refarmed 900 MHz spectrum on December 8, 2014 with over 200 base stations in Jakarta and Bali. By 2019 the company plans to cover all 22 provinces. Commercial service using 1800 MHz (LTE1800) was launched on July 5, 2015 in Makassar, South Sulawesi. Manado, Jakarta, Bali, Bandung, Medan, Surabaya and Lombok have since been covered.

Telkomsel tested NFV-based VoLTE in 2015.

The CDMA network operated by Telkomsel (Flexi) will be closed down by end 2015.

XL Axiata commercially launched LTE initially using refarmed 900 MHz spectrum on December 22, 2014 in Jakarta, Medan, and Yogyakarta. LTE1800 was commercially launched in Mataram, Lombok on July 6, 2015. 1800 MHz is the main band for expansion. The LTE1800 network also supports VoLTE service.

3 Indonesia commercially launched its LTE1800 network in Banjarmasin, Senin on July 6, 2015.

850 MHz CDMA operator **Smartfren** has 30 MHz of 2.3 GHz TDD spectrum, 10 MHz band 5 and 1800 MHz band 3 spectrum and commercially launched LTE1800 (band 3) and TDD 2300 (band 40) in Batam city on July 7, 2015. Smartfren is deploying VoLTE targeting Q4 2015 launch. The network is LTE-Advanced with 20 MHz band 3 + 10 MHz TDD band 40 support now, and will support 3 carrier aggregation 20 MHz + 10 MHz TDD band 40 + 10 MHz FDD spectrum in future. LTE-Advancd using 850 MHz and 2.3 GHz was launched in Jakarta in August 2015. Smartfren is targeting 1.5 million LTE subscriptions by end 2015.

CDMA operator **Bakrie Telecom** is merging with **Smartfren** and will take a 6% share in Smartfren to become a minority shareholder, and lease part of Smartfren's network.

Government agency SDPPI is consulting on use of 2300 – 2360 MHz spectrum (part of Band 40) for BWA, which may lead to licence awards. Some operators called for new 700 MHz spectrum for LTE following analog to digital TV migration. SDPPI adopted the APT700 FDD band plan in June 2013.

PT Indosat Mega Media (IM2), subsidiary of PT Indosat Tbk (ISAT), selected LTE TDD for 2.3 GHz spectrum won in a BWA license auction in 2009.

WiMAX™ operator **PT Internux** commercially launched LTE TDD on November 14, 2013 using the BOLT brand in Jakarta, Bogor, Depok, Tangerang, and Bekasi, using 15 MHz of 2.3 GHz (band 40).

WiMAX™ operator **First Media** is migrating to LTE TDD having 15 MHz of 2.3 GHz (band 40). A Strategic Alliance with PT Internux has been agreed.

2.3 GHz WiMAX™ operator **Berca Hardayaperkasa** is deploying LTE1800, targeting service launch in Bali, Makassar and Pekanbaru in October 2015.

Japan

NTT DoCoMo launched Japan's first commercial LTE system on December 24, 2010 in 2.1 GHz spectrum under the "Xi™" brand, in Tokyo, Nagoya and Osaka. DoCoMo aims to cover 98% of population with LTE by March 2015 and is targeting 30 million LTE subscriptions by this date. DoCoMo claimed almost 22 million LTE subscriptions by Q1 2014. NTT DoCoMo has also launched LTE in 1.5 GHz (band 21) and plans to begin installing APT700 FDD compatible base stations in readiness as this band is allowed for commercial LTE use in 2015. **NTT DoCoMo** also deployed LTE in 1800 MHz band 3 from September 2013.

150 Mbps downlink was first introduced in Kawasaki on July 30, 2013 and extended Tokyo, Nagoya and Osaka that year. An outdoor Advanced C-RAN trial leveraging carrier advanced technology was completed in early 2015 and achieved 240 Mbps using 35 MHz of paired spectrum. NTT DoCoMo launched its Premium 4G 225 Mbps LTE-Advanced service on March 27, 2015 using carrier aggregation to combine spectrum in bands 3 and 19, and bands 1 and 21. The peak downlink speed will increase to 300 Mbps towards the end of the next fiscal year ending in March 2016. The maximum uplink speed is 50 Mbps. The LTE-Advanced network launched in 22 prefectures, including Tokyo, Nagoya and Osaka. Nationwide availability is expected by March 2016.

VoLTE was commercially launched end June 2014. In February 2015 DoCoMo announced successful testing of VoLTE roaming with KT, South Korea.

NTT DoCoMo announced on August 21, 2014 a successful demonstration of *Licensed Assisted Access* technology using LTE in unlicensed spectrum in the 5 GHz band. Company press release https://www.nttdocomo.co.jp/english/info/media_center/pr/2014/0821_00.html

NTT DoCoMo has announced LTE roaming service from March 31, 2014 for its customers travelling to the US, Canada, France, Hong Kong, Puerto Rico and the US Virgin Islands. Roaming to Malaysia was activated in April 2014.

KDDI launched commercial LTE service on September 21, 2012. The LTE service was launched in 2.1 GHz spectrum (band 1) to align with the LTE band support offered by the iPhone 5, which KDDI also introduced on the same day. 800 MHz (band 18) spectrum is also now used for commercial LTE service and APT700 (band 28) will be introduced later. LTE-Advanced carrier aggregation, combining

bands 1 and 18 spectrum, was launched in May 2014. KDDI claims the biggest number of international LTE roaming partners among the local carriers, through partnerships with SK Telecom, CSL, M1, Bouygues Telecom, Swisscom, Orange Spain, AT&T, Rogers, VIVO, and Claro. KDDI commercially launched VoLTE in early December 2014.

WiMAX™ operator and KDDI subsidiary **UQ Communications Inc.** which has 50 MHz of 2.5 GHz (band 41) spectrum, commercially launched LTE TDD service (branded WiMAX 2+) using band 41 in Tokyo on October 31, 2013. Nationwide service was announced on November 1, 2014. LTE-Advanced carrier aggregation and 4x4 MIMO are being deployed across the network and 4x4 MIMO compatible devices were introduced in March 2015.

Ymobile Corporation (formerly eAccess) launched commercial LTE service using 1.7 GHz on March 15, 2012 (i.e. band 9, which is within LTE1800 band 3. A band 9 device will not work on all band 3 networks). Coverage is scheduled to cover 99% of population of Tokyo, Osaka and Nagoya by end June 2012. Ymobile Corp announced in September 2013 the results of its first trials of LTE-Advanced Carrier Aggregation technology and has applied to the regulator for additional 1700 MHz FDD and 80 MHz of 3.5 GHz TDD spectrum for further CA trialling.

Softbank Mobile, a member of the Global TD-LTE Initiative, commercially launched XGP/LTE TDD services on February 24, 2012 via its affiliated company **Wireless City Planning** following a pre-commercial pilot service starting on November 1, 2011. The network is deployed in 20 MHz of 2.5 GHz spectrum (band 41) bought from Willcom (PHS operator) and had over 2.6 million subscriptions by December 2013, with 50,000 eNodeBs deployed.

A 3.5 GHz LTE-Advanced trial was held in the Ginza area of Tokyo (4 x 20 MHz carriers 2480 – 3560 MHz) in 2014.

In September 2015 a trial of 3-band LTE-Advanced carrier aggregation using 10 MHz band 8, 10 MHz band 3, and 15 MHz on band 1 achieved 262.5 Mbps.

Softbank Mobile also owns licences to operate mobile systems in 2.1 GHz FDD (band 1), 1.5 GHz (band 11) and 900 MHz (band 8), and commercially launched LTE FDD service in band 1 on September 21, 2012 when introducing iPhone 5.

Softbank Mobile commercially launched HD voice enabled by VoLTE and SRVCC on December 12, 2014 with launch of a compatible handset, the Aquos Crystal X. At the same time, HD voice was launched on Softbank's 3G network.

Softbank Corp. acquired domestic rival eAccess Ltd. through a stock swap deal valued at $2.3 billion, which will provide Softbank not only with more subscribers, but additional radio spectrum (band 9) which e-Access currently uses for its services. eAccess is now known as **Ymobile Corporation**.
In August 2013 **Softbank** demonstrated 5-carrier Carrier Aggregation for LTE TDD using 3.5 GHz spectrum and achieved 770 MBps downlink speed in Tokyo. Carrier Aggregation (CA), Coordinated Multi-Point (CoMP) and Cloud BB (Baseband) LTE-Advanced technologies and VoLTE were employed in the trial.

NTT DoCoMo, **KDDI** and **eAccess** (now called ***Ymobile Corporation***) were granted APT700 FDD spectrum in June 2012 for LTE, which can be brought into use from early 2015.

The Ministry of Internal Affairs and Communications (MIC) launched a consultation on expansion of regional BWA systems by assigning a band in the 2.6 GHz range to the AXGP standard, which is LTE TDD compliant. Comments were required by 26 July 2013.

MIC confirmed 3.5 GHz TDD licenses on December 19, 2014 would be granted to KDDI, NTT DoCoMo and SoftBank each being allocated 40 MHz. Widescale commercial launches are expected during 2016. The 3 operators shall start the 3.5 GHz LTE base station operation from March 31, 2016 and commercial service in 2016. All committed to over 50-55% coverage population by 2018, for a total 5-year investment commitment of 428.4 Billion Yen (US$3.6 Billion) on base stations by 2019. MIC said its goal is to achieve 1 Gbps of superfast wireless broadband with 3.5 GHz, meaning the 3.5 GHz band in Japan is applicable to LTE-Advanced for operators to carrier aggregate with other band(s) to achieve this goal.

The MIC announcement also showed that Japan supports global TDD ecosystem harmonization by

using the current TDD frame configuration, rather than creating a new configuration or other standard. In the MIC announcement, UL/DL 1:3 is the choice accepted by all 3 operators; this is the current global mainstream configuration for commercial LTE TDD.

Kiribati

Telecom Services Kiribati Ltd (TSKL) commercially launched LTE for CPE business users in August 2013 using 700 MHz band 12 spectrum. Wider service launch followed on October 29, 2013.

Laos

Unitel (Star Telecom Company) commercially launched LTE on June 23, 2015 in Vientiane, Champassak, Savannakhet and Lu ang Prabang provinces.

Lao Telecom commercially launched 2.6 GHz LTE network on April 9, 2015 (date and frequency bandsubject to confirmation).

On May 15, 2012 the Ministry of Post and Telecommunication awarded an LTE licence to **Beeline Lao**. Testing in Vientiane, where coverage will open, uses 1800 MHz and 2.6 GHz spectrum. Commercial launch may be in 2015.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

Macau

6 companies applied for 4G licences (LTE FDD and/or TDD): incumbents CTM, China Telecom Macau, Hutchison 3, and Smartone Macau, and 2 potential market entrants. The winners were announced in March 2015:

- Companhia de Telecomunicacoes de Macau (CTM)
- China Telecom Macau
- SmarTone Macau
- Hutchison Telecom Macau (3Macau)

Winners accepted coverage obligations of 50% of population by end 2015, 100% in 2016.

Companhia de Telecomunicacoes de Macau (CTM) plans to launch Macau's first 4G/LTE service on October 20, 2015.

SmarTone Macau indicated commercial launch will be in November 2015.

3Macau plans LTE commercial launch in 2015.

China Telecom Macau plans LTE commercial launch in 2015.

Malaysia

Regulator MCMC named 9 recipients of 20 MHz (2x 10 MHz) of 2.6 GHz spectrum: **DiGi, Celcom Axiata, Maxis, U Mobile,** WiMAX operators **Asiaspace, P1, REDtone International, YTL Communications** (Yes brand) and **Puncak Semangat Sdn Bhd (Altel)** which received 40 MHz (2x 20 MHz). A number of parties have enquired about access to 700 MHz, which MCMC is considering. MCMC is also consulting on re-farming 850/900/1800 MHz.

Maxis commercially launched LTE on January 1, 2013 in 2.6 GHz. 1800 MHz (LTE1800) was added mid-April 2013. In October 2011 **Maxis** and **U Mobile** signed a RAN sharing agreement covering LTE.

Celcom Axiata commercially launched its LTE service using 2.6 GHz spectrum in the Klang Valley on April 22, 2013. Celcom planned to have 620 live sites by end 2013, and nearly double that figure by Q1 2014. The current LTE network expansion deployment program includes using 2.6 GHz and refarmed 1800 MHz (LTE1800) spectrum.

In July 2013 Celcom Axiata and Altel announced an agreement to jointly develop, establish, build, operate and manage shared infrastructure. Each will pool 2 x 10 MHz of 2.6 GHz bandwidth for LTE deployment. In addition, Altel will consider Celcom's request for the remaining 2 x 10 MHz spectrum owned by Altel. The agreement allows for Altel to appoint Celcom as the exclusive infrastructure and wholesale provider to enable Altel to operate as an MVNO and for other services that are under consideration.

In December 2013 Celcom and DiGi announced they had entered entered into agreement with **Telekom Malaysia** for provision of backhaul services for LTE.

DiGi commercially launched LTE in high traffic spots in the Klang Valley on July 5, 2013 using 2.6 GHz.

U Mobile commercially launched LTE service using 2.6 GHz on December 17, 2013 in strategic areas within the Klang Valley, namely Bandar Sunway, Subang Jaya, Puchong and Berjaya Times Square as well as Taman Molek in Johor Bahr.

WiMAX™ operator **Packet One Networks P1** (Malaysia) is upgrading its 2.3 GHz network with an LTE TDD overlay. P1 planned to have 4,000–5,000 LTE TDD sites by 2015. **Telekom Malaysia** confirmed in March 2014 its purchase of 57% of P1.

Telekom Malaysia commercially launched LTE service branded TMgo in 850 MHz band 5 on August 8, 2014 in Alor Setar, Kedah. TM plans to convert 1,200 CDMA sites to LTE. 2.6 GHz band 7 spectrum will be deployed in dense population areas.
WiMAX™ operator **Asiaspace** is deploying LTE TDD in 2.3 GHz.

WiMAX™ operator **YTL** plans to launch LTE TDD in 2015 using 2.3 GHz. YTL also has 2.6 GHz spectrum.

Maxis and **REDtone** agreed infrastructure and spectrum sharing in July 2012. In addition to newly-acquired 2.6 GHz spectrum, **REDtone** has 2.3 GHz band 40 spectrum which it uses for WiMAX™ service.

MCMC adopted the APT700 FDD band plan in June 2013 and in December 2013 said that its auction would be delayed until 2018, as broadcasters need to vacate the band before it can be allocated for mobile.

Maldives

Ooredoo commercially launched LTE using 700 MHz in Male for data users on April 28, 2013. Smartphone service was enabled in December 2013. Maafushi received service August 2014. Ooredoo announced on October 23, 2014 successful testing of LTE-Advanced technology.

Dhiraagu commercially launched LTE1800 in Male' City, Hulhumale', Villimale & Ibrahim Nasir International Airport on October 28, 2014. By end 2014, 50% of the population was covered. Dhiraagu commercially launched 300 Mbps LTE-Advanced combining band 7 and band 3 spectrum on September 10, 2015.

Mongolia

3.5 GHz WiMAX™ operator **Ulusnet** plans to migrate to LTE TDD in the same band. The company also 50 MHz in 3.5 GHz and 20 MHz in 2.5 GHz band.

Mongolia Telecom is deploying an LTE network in cooperation with KT for commercial launch in 2015.

The government is understood to be considering allocating 1800 MHz for LTE FDD service (LTE1800).

Myanmar

Myanmar Posts and Telecommunications (MPT) advised GSA that 1800 MHz (20 MHz) is standardized for LTE FDD service. MPT launched a trial service in 2013 for the SEA Games.

Ooredoo is deploying an LTE network.

Telenor is deploying an LTE network.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

Nepal

Ncell approached the Nepal Telecom Authority for a license and spectrum for LTE. Shareholder TeliaSonera is keen to proceed if permission granted.
WiMAX™ operator **Nepal Telecom** has trialled LTE TDD and FDD modes and plans to deploy a commercial LTE-Advanced network from 2015. Infrastructure system suppliers are announced.

The Nepal Telecom Authority plans to auction 2.3 GHz spectrum in two tranches.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

New Caledonia

OPT commercially launched LTE service with 55 sites on February 16, 2015, rising to over 80 by end April 2015. The launch followed a user trial phase beginning on January 12, 2015. Spectrum in 800 MHz band 20, 1800 MHz band 3 and 2.6 GHz band 7 is utilized according to the sites. Coverage to over 85% of the population is targeted by end 2016.

New Zealand

Vodafone New Zealand launched LTE commercial service on February 28, 2013 in Auckland using 1800 MHz (LTE1800). Service reached Christchurch on May 29, 2013 and 6 more cities including Wellington by July 2013. Over 60,000 customers signed up for LTE in the first 3 months and exceeded over 300,000 after one year. The LTE network is available to 3.56 million people (over 85% of population - September 2015, increasing from 74% in February 2015). Public demonstrations of LTE-Advanced carrier aggregation were made in May 2013. The network now supports Cat 4 devices. In February 2015 Vodafone announced completion of a successful trial of VoLTE in Auckland. Vodafone is deploying APT700 spectrum for rural coverage which Vodafone first brought into service on July 18, 2014.

Spark commercially launched Cat 4 LTE service in Auckland, Wellington and Christchurch on November 12, 2013 using 1800 MHz (band 3 LTE1800). LTE-Advanced carrier aggregation (CA) was deployed on 6 initial sites in May 2014, combining 20 MHz band 3 with 20 MHz band 7. Cat 6 devices were not offered immediately. APT700 band 28 spectrum was brought into service for rural coverage on August 28, 2014 on 12 sites in the Waikato region. By mid-2015 expanded from the main cities of Auckland, Wellington, Christchurch & Dunedin to more than 130 locations around the country. Spark is trialling VoLTE though has not committed to commercialization of a VoLTE-based service.

2degrees commercially launched LTE1800 Cat 4 in Auckland on June 30, 2014. Coverage extended to Christchurch, Hamilton and Wellington by end 2014.

The government adopted the APT700 FDD band plan and attempted to auction spectrum in 9 paired 5 MHz blocks. Bidding started on October 29, 2013. Spectrum was usable from January 1, 2014.

- Vodafone NZ obtained three lots (2 x 15 MHz)
- Spark obtained three lots (2 x 15 MHz)
- 2degrees obtained two lots (2 x 10 MHz)

The remaining 2 x 5 MHz block was auctioned and won by Spark with a bid of NZ$ 83 million.

Kordia is considering upgrading its 2.3 GHz rural mobile network to LTE TDD. **Woosh** owns rights to 93 MHz of spectrum including 35 MHz of 2.3 GHz. Woosh is a member of the Global TD-LTE Initiative.

Northern Mariana Islands (NMI)

IT&E commercially launched LTE (and HSPA+) on July 14, 2014.

Pakistan

The Pakistan Telecommunication Authority auctioned 30 MHz of 3G 850 MHz and 20 MHz of 4G 1800 MHz spectrum in April 2014. **China Mobile Pakistan (CMPak)**, which operates under the **ZONG** brand name, was the only winner of 4G spectrum and commercially launched LTE1800 in 7 cities on September 27, 2014. The remaining 10 MHz of 850 MHz and 10 MHz of 1800 MHz will be sold in 2015.

Warid Telecom commercially launched LTE1800 on December 26, 2014 in selected metro areas of Karachi, Lahore, Islamabad, Rawalpindi, Gujranwala and Faisalabad, with remaining cities to be covered “soon”, using `refarmed spectrum.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

Papua New Guinea

Digicel PNG was allocated APT700 FDD spectrum (2 x 22.5 MHz) in April 2012 and commercially launched 4G/LTE (the world’s first APT700 service) on March 26, 2014 for postpaid customers using Huawei CPE and MiFi products offered by Digicel. Five monthly data plans were offered. Ten sites provide coverage to Gordons, Savannah Heights, Ela Beach, Hanuabada, Touaguba Hill, Ela Makana, Konedobu, and at downtown BSP, ANG Haus and Deloittes. A CPE and MiFi are offered.

Telikom PNG and **bmobile** are deploying a joint 3G/4G network.

The Philippines

Following a period of limited commercial LTE service beginning in Boracay in April 2011 then extended to additional locations including Cebu and Davao, **Smart Communications** commercially launched

wider LTE service on August 25, 2012 in Metro Manila using 2.1 GHz (band 1). Commercial LTE service was also launched using 1800 MHz (LTE1800 – band 3) on September 5, 2012. To further extend coverage, 850 MHz spectrum (band 5) was brought into use on September 14, 2012. By end September 2014 over 1,400 LTE sites were active. Smart conducted trials of LTE-Advanced technology in Metro Manila, Davao City and Boracay. LTE-Advanced is activated in some locations. Smart is also conducting LTE TDD trials. In November 2013 Smart announced completion of LTE Multicast (eMBMS) trials for delivery of multimedia content.

Smart's owner **PLDT** commercially launched LTE TDD BWA service branded *HOME Bro Ultera* on April 29, 2014 alongside its WiMAX™ service. PLDT launched with 200 LTE TDD band 42 capable base station sites and plans to deploy 5,000 new sites to achieve 50% geographical coverage. Over 400 sites were activated by end September 2014.

Globe Telecom launched commercial LTE1800 service under the Tattoo brand on September 28, 2012 in Makati City, with plans to quickly expand to cover Manila, Cebu, Davao and select regions. Globe demonstrated up to 230 Mbps LTE-Advanced carrier aggregation in 2014 using 20 MHz paired spectrum which is now in deployment, and announced plans to launch LTE Broadcast service in 2015 in select areas. Globe is also migrating its WiMAX™ network to LTE TDD and FDD in Visayas and Mindanao.

Bayan Telecommunications indicated interest to deploy LTE in existing 1800 MHz spectrum. However the company is a takeover target of Globe Telecom.

Singapore

M1 launched commercial 75 Mbps LTE services in the financial district on June 21, 2011 using 2.6 GHz, later adding LTE1800. Nationwide coverage using dual band was announced on September 15, 2012. M1 network speed was raised to 150 Mbps peak in early 2014. 300 Mbps LTE-Advanced was commercially launched on December 2, 2014 and available in more than 95% of indoor areas and most outdoor areas. VoLTE was commercially launched on April 8, 2015 at no extra charge for LTE subscribers.

StarHub tested LTE in 2.6 GHz and 1800 MHz. An LTE1800 network in refarmed 1800 MHz was commercially launched September 19, 2012 in the Central Business District, Changi Airport and Singapore Expo. 2.6 GHz band 7 spectrum was brought into use in 2013. StarHub launched VoLTE-enabled HD Voice+ service on June 28, 2014 for its SmartSurf HD subscribers. Parts of the network were upgraded to 150 Mbps in mid 2014. 300 Mbps Cat 6 LTE-Advanced was launched in December 2014 with carrier aggregation combining B3 and B7 spectrum. On May 27, 2015 Starhub announced that 600 Mbps using 4X4 MIMO with LTE-Advanced carrier aggregation technology had been demonstrated.

SingTel launched commercial LTE1800 service on December 22, 2011 with 2.6 GHz spectrum. SingTel also trialled LTE overseas with carriers in which it holds stakes i.e. SingTel Optus (Australia), Telkomsel (Indonesia), Globe Telecom (Philippines). SingTel announced in May 2013 the company had achieved nationwide coverage and upgraded its network to Cat 4 (peak downlink speed of 150 Mbps). On May 28, 2014 SingTel unveiled its 300 Mbps Cat 6 LTE-Advanced network, which combines 20 MHz band 3 and 20 MHz band 7 spectrum and in February 2015 announced that the 300 Mbps service will be available nationwide from March 2015. A Cat 6 MiFI hotspot device manufactured by Huawei was offered in SingTel retail outlets from July 24, 2014. 260 Mbps was achieved using carrier aggregation combining 20 MHz of FDD & 20 MHz of TDD spectrum. 900 MHz was brought into use on July 28, 2015 as part of a 337 Mbps tri-band LTE-Advanced system. SingTel is deploying 3-band 450 Mbps LTE-Advanced. VoLTE was commercially launched on May 31, 2014 using the brand name "4G ClearVoice".

In December 2013 **SingTel** confirmed the launch of LTE data roaming in 6 countries within the region: Australia (Optus), Hong Kong (CSL Limited), Indonesia (Telkomsel), Malaysia (Maxis), South Korea (SK Telecom) and The Philippines (Globe Telecom). SingTel trialled eMBMS LTE Broadcast in 2014. A further LTE Broadcast trial was held at the South East Asian (SEA) Games, Singapore 5-16 June 2015.

In June 2013 regulator IDA auctioned additional 1800 MHz and 2.6 GHz spectrum to all three incumbent mobile operators – SingTel Mobile, StarHub and M1 –

which will be used for LTE. IDA adopted the APT700 FDD band plan in June 2013.

Operators' rights to use 900 MHz band 8 expires in April 2017. IDA plans to auction this spectrum and also 700 MHz (APT700). Incentives are proposed to encourage a new 4th player. A consultation paper was published on July 7,2015. Bidding is expected to take place in early 2016.

In February 2015 the IDA confirmed that all 3 mobile operators achieved nationwide outdoor 4G coverage ahead of schedule.

Fibre broadband provider **MyRepublic** is bidding to become the country's fourth mobile operator and is trialling LTE technology.

M1, Singtel and StarHub announced they will close 2G/GSM services in Singapore from April, 2017 with spectrum to be refarmed for 3G/HSPA and 4G/LTE.

South Korea

LG Uplus commercially launched LTE on July 1, 2011 using 10 MHz of 850 MHz (band 5), achieving nationwide coverage by April 2012. Multi-carrier services were commercialized in July 2012 and released in 84 cities by July 18, 2013, with 10 MHz paired 2.1 GHz spectrum (band 1). LTE-Advanced Carrier Aggregation technology was commercialized on July 18, 2013, supporting up to 150 Mbps peak download by combining two paired 10 MHz frequencies (850 MHz and 2.1 GHz bands) creating an effective bandwidth of 20 MHz paired. Results of a 3-carrier aggregation trial (850, 2100, 2600 MHz) with 300 Mbps downlink were announced in June 2014. Single-mode LTE service was commercially launched on July 20, 2013 and claimed to be a world first for commercialization of single-mode LTE delivering data and HD voice (VoLTE) without WCDMA support.

LG Uplus gained 40 MHz of 2.6 GHz in August 8, 2013. In all, **LG Uplus** has secured a total of 80 MHz paired LTE spectrum made from 20 MHz of 800 MHz, 20 MHz of 2.1 GHz, and 40 MHz of 2.6 GHz. Since December 30, 2013 LG Uplus claims to be the top operator servicing the broadest LTE bandwidth in the world at 80 MHz and offers LTE, LTE-Advanced and 20 MHz wideband LTE services using this full bandwidth. **LG Uplus** launched Carrier Aggregation in wideband LTE mid-2014, supporting up to 225 Mbps peak download by combining two different 20 MHz bandwidth frequencies (800 MHz and 2.6 GHz).

LG Uplus claimed to be the first South Korean operator to deploy a tri-band multicarrier LTE system which automatically handles both voice and data traffic, by using 850 MHz, 2.1 GHz and 2.6 GHz spectrum. This service was initially available in Seoul and selected Greater Seoul areas, and rolled out to nationwide coverage by July 2014. Tri-band LTE-Advanced carrier aggregation service using 2x10 MHz 800 MHz + 2x10 MHz 2.1 GHz + 2x20 MHz 2.6 GHz was commercially launched on January 11, 2015 with the Cat 6 compatible LG G Flex 2 phone.

LG Uplus successfully conducted a field test of uplink CA service providing theoretical uplink speed of 100 Mbps and claimed as the world's first such test. Using wideband LTE service in 2.6 GHz spectrum, paired with 800 MHz band nationwide LTE service, **LG Uplus** demonstrated the field test in June 2014. As stated in the previous paragraph, LG Uplus commercially launched 3-band carrier aggregation. In the area where **LG Uplus** provides 2x20 MHz wideband service ein 2.6 GHz spectrum, the company has presented uplink speed of 50 Mbps, which the company claims as the fastest uplink speed in the country. Combining the 300 Mbps downlink speed with the uplink speed of 50 Mbps in South Korea **LG Uplus** is the sole telecommunication company offering the fastest downlink and uplink speed simultaneously where the wideband LTE has been deployed.

SK Telecom commercially launched LTE service in Seoul on July 1, 2011 in 10 MHz in Band 5 (850 MHz). The company reached nationwide (84 cities) coverage by April 1, 2012. In December 2011 SK Telecom started deploying dual-mode femtocells with LTE and Wi-Fi that, according to the Small Cell Forum, were the first LTE femtocells on a commercial network. In May 2012 SK Telecom announced multi-carrier trials (LTE-Advanced) to allow combining of Band 5 and Band 3 spectrum. A multi-carrier LTE service was launched on July 1, 2012, extending across all of Seoul by end 2012 and to 23 other major cities by early 2013. SK Telecom said that this was the world's first commercialization of Multi Carrier.

SK Telecom launched commercial VoLTE HD Voice (W-AMR) service in August 2012. SK Telecom informed GSA that the company had 10.14 million VoLTE users as of June 9, 2014

SK Telecom announced start of international LTE roaming service with **Globe Telecom** (Philippines) on 1 April 2013, adding to existing roaming agreements with CSL Ltd (Hong Kong) from June 1, 2012 and SingTel from March 1, 2013. SK Telecom announced plans to launch quad-band LTE devices (850 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz) during Q2 2013.

LTE-Advanced (Release 10) Carrier Aggregation was commercially launched by **SK Telecom** on June 26, 2013, claiming that Carrier Aggregation had been commercialized for the first time in the world, supporting up to 150 Mbps peak downlink by combining two 10 MHz carriers (1.8 GHz and 800 MHz bands) to create an effective bandwidth of 20 MHz. SK Telecom began offering LTE-Advanced in Seoul and central areas of Gyeongg-do and Chungcheong-do, and expanded LTE-Advanced to 84 cities nationwide. The LTE-Advanced service was launched with the world's first LTE-Advanced phone, Samsung Galaxy S4 LTE-A and 7 different LTE-Advanced smartphones were introduced in 2H 2013.

SK Telecom won 20 MHz of 1800 MHz (LTE1800) in the August 2013 auction and began offering 150 Mbps LTE service using this wider bandwidth in 1800 MHz on September 30, 2013 with plans to expand nationwide by July 2014. 225 Mbps (20 MHz 1800 MHz + 10 MHz 800 MHz spectrum combined using carrier aggregation) peak downlink service was commercially launched on June 19, 2014 together with a new Samsung Galaxy S5 for 225 Mbps.
http://www.sktelecom.com/en/press/detail.do?idx=1075

SK Telecom began building LTE base stations using 2.1 GHz spectrum in Q2 2014. The world's first tri-band LTE-Advanced service was commercially launched by SK Telecom on December 29, 2014 combining 20 MHz in 1800 MHz band, 10 MHz in 800 MHz band, and 10 MHz in the 2.1 GHz band for theoretical peak downlink of 300 Mbps. Tri-band LTE-Advanced is offered in areas where coverage of all 3 component carriers intersect.

SK has also trialled FDD-TDD carrier aggregation. In April 2014 **SK Telecom** claimed the world's first commercialization of Uplink CoMP (Uplink Cooperative Multi-Point), and plans to apply the feature across its network.

On June 11, 2014 at Mobile Asia Expo 2014 in Shanghai, **SK Telecom** working with its infrastructure partner and using LTE-Advanced carrier aggregation to combine 200 MHz bandwidth (9 TDD carriers and 1 FDD carrier) achieved a peak downlink throughput of 3.8 Gbps, which was claimed at the time as a world record.

SK Telecom with its system partner has demonstrated 4x4 MIMO technology, which has the potential to double maximum downlink speeds, achieving 600 Mbps downlink speed using carrier aggregation of two 20 MHz bandwidths.

SK Telecom announced on January 28, 2015 that together with its infrastructure partner the company had commercialized a core LTE-Advanced technology called 'Enhanced Inter-Cell Interference Coordination (eICIC)' which it claimed was for the first time in the world. eICIC technology controls signal interference between macro and micro base stations to enhance the quality of the LTE-Advanced network. With the deployment of eICIC, SK Telecom expects to provide its customers with enhanced experience by reducing inter-cell interference by 15% in traffic congested areas where macro and micro cells are concentrated. SK Telecom has applied eICIC to its LTE-Advanced network located in Gwangju Metropolitan City and plans to apply the technology to the rest of its nationwide LTE-Advanced network by the first half of 2016. Company press release
http://www.sktelecom.com/en/press/detail.do?idx=1100

KT commercially launched LTE services in Seoul on January 3, 2012 in re-farmed 1800 MHz (Band 3) (LTE1800). KT announced on April 23, 2012 LTE coverage in 84 cities.

VoLTE service was commercially launched October 8, 2012 nationwide on the whole KT LTE network. In February 2015 DoCoMo announced successful testing of VoLTE roaming with KT.

KT has delivered a 20 MHz wideband 1800 MHz LTE service since mid-September 2013 by adding the additional 1800 MHz frequency bought by auction in August 2013 (see below). Therefore the peak

downlink throughput is 150 Mbps at 1800 MHz (LTE1800) supporting Cat 4 devices and KT believes this was the first 20 MHz wideband LTE service in the Korean market. By bringing into service an additional 5 MHz, a total of 15 MHz was allocated for the uplink.

In the area where KT provides 20 MHz wideband LTE services, KT also provides 10 MHz multicarrier service by bringing into use 10 MHz of 900 MHz band 8 spectrum. In addition KT is using Carrier Aggregation to combine 10 MHz B3 and 10 MHz B8 in the other area where 20 MHz wideband is not used. KT plans to support 20 MHz B3 combined with 10 MHz B8, subject to availability of UE terminals. **KT** has confirmed its successful demonstration of FDD-TDD carrier aggregation.

KT announced on June 16, 2015 its plan to commercialise its GiGA-LTE network which combines 3-band carrier aggregation LTE with WiFi to offer a theoretical maximum downlink speed of 1.17 Gbps. KT operates over 200,000 LTE base stations and 140,000 WiFi hotpsots nationwide. GiGA-LTE service was immediately offered to Samsung Galaxy S6 and S6 Edge users. The service is non-standard since a device implementation is required (firmware update). GiGA-LTE is to be extended to other smartphone models, all of which need firmware upgrades.

KT announced commercial launch of the world's first eMBMS-enabled LTE Broadcast service on January 27, 2014. The service is branded ***Olleh LTE Play*** and targets consumers using Samsung Galaxy Note 3 devices who have downloaded the Olleh eMBMS application to stream 2 major channels. By January 2015 MBMS service covered hot spots areas including the No. 1 subway line in Seoul and most baseball stadiums in South Korea. eMBMS is supported by Galaxy Note 3, Note 4 and S5 devices.

Regulator **KCC** conducted an auction in August 2011 of spectrum in 800, 1800 MHz and 2.1 GHz bands. SK Telecom and KT were barred from bidding for 2.1 GHz spectrum. **SK Telecom** won 20 MHz of 1800 MHz spectrum. **KT** won 10 MHz of 800 MHz spectrum. **LG Uplus** won 20 MHz in 2.1 GHz for LTE deployments.

After around 50 rounds of bidding in August 2013, KT won 15 MHz of new 1800 MHz spectrum next to its current holding used in its LTE network. This allocation will enable introduction of Cat 4 (150 Mbps). SK Telecom also acquired more 1800 MHz channels. **LG Uplus** won 2.6 GHz spectrum on August 8, 2013, thereby securing 800 MHz, 2.1 GHz & 2.6 GHz LTE spectrum totaling 40 MHz paired.

KT announced commercial launch of 3-band 300 Mbps LTE-Advanced service in the major areas of 85 cities with availability of commercial Cat 6 compatible Samsung Galaxy Note 4 phones on January 23, 2015. The LG G Plex2 Cat 6 phone was offered from January 30, 2015. The 300 MBps service had been available from December 28, 2014 for users with non-commercial terminals to experience the tri-band carrier aggregation performance. The service combines 10 MHz B1 + 20 MHz B3 + 10 MHz B8.

SK Telecom, KT and LG Uplus announced the world's first national commercial interconnected VoLTE service in June 2015.

In 2013 MSIP set out a policy to assist WiBro operators migrate to LTE TDD systems and committed to release in 2014 a national plan for LTE TDD market development.

Korea Mobile Internet (KMI), a consortium of local MVNOs, has repeatedly applied for permission to deploy an LTE TDD network. If approved, KMI plans to launch services in all 85 major cities by October 2015. KMI would operate a wholesale model to MVNOs to retail services to their customers.

South Korea has allocated 2 x 20 MHz bandwidth in accordance with the APT700 FDD band plan. Spectrum may be auctioned in 2H 2015.

Sri Lanka

Dialog Axiata commercially launched LTE TDD in 2.3 GHz (band 40) via its DBN subsidiary on December 30, 2012 in Colombo. Dialog later acquired 10 MHz of 1800 MHz by auction and commercially launched LTE1800 on April 2, 2013 in Colombo. The LTE TDD system continues to be developed for fixed wireless services. In May 2013 the company announced it had gained an extra block of 2.3 GHz following the acquisition of a pay TV operator. On Jily 14, 2015 Dialog Axiata announced the commencement of its LTE-Advanced Pilot Network

that will provide data speeds exceeding 100Mbps for Home Broadband users in the City of Colombo.

Mobitel (subsidiary of Sri Lanka Telecom) launched commercial LTE1800 service on December 31, 2012.

Etisalat is deploying a commercial LTE network.

WiMAX™ and CDMA operator **Lanka Bell** commercially launched LTE TDD in band 40 on February 4th, 2014 in parts of Colombo and Greater Colombo.

SLT commercially launched fixed wireless access LTE TDD in band 38 (2.6 GHz) on January 19, 2014.

Analog to digital TV transmission is expected to be completed by 2020, after which 700 MHz spectrum could be allocated for LTE.

Taiwan

Chunghwa Telecom trialled LTE in 2.6 GHz and 700 MHz, completed FDD and TDD tests on the high-speed rail system using 2.6 GHz, and commercially launched the country's first LTE network on May 29, 2014 using 900 MHz and 1800 MHz spectrum. LTE-Advanced with carrier aggregation of 15 MHz band 3 + 10 MHz band 8 spectrum was activated on December 29, 2014, for theoretical peak downlink speed of 180 Mbps for users with compatible devices. The company announced 1.33 million LTE subs by end 2014 and forecasts 2 million by end March 2015.

FarEastone commercially launched LTE using APT700 FDD band 28 on June 3, 2014 and added 1800 MHz band 3 in August 2014 with LTE-Advanced carrier aggregation (GSA assumption 150 Mbps). Deployment using 2.6 GHz is planned in 2015. VoLTE will be launched in 1H 2015.

Taiwan Mobile commercially launched its LTE network using 700 MHz APT700 FDD band 28 spectrum (15 MHz) on June 4, 2014 and introduced 5 MHz of 1800 MHz band 3 spectrum (LTE1800) and LTE-Advanced carrier aggregation on September 1, 2014. Initial coverage was in six metropolitan areas covering about 80% of the corresponding population, and 1.1 million LTE subscritpions were signed by end 2014. At launch the network comprised over 1,500 base stations, to rise to over 4,000 by end 2014. Taiwan Mobile is targeting 3 million LTE subscriptions by end 2015 and plans to launch VoLTE in Q1 2015.

FarEasTone and **China Mobile** co-operated on an LTE TDD trial in Taipei. The **National Chiao Tung University** conducted an LTE TDD trial in 2010. BWA operators **Global Mobile, Tatung, FET and VMAX** have technology-neutral licences and can apply to deploy different technologies.

2.6 GHz WiMAX™ operator **Global Mobile** has received approval to switch to LTE TDD and has begun testing.

PHS and WiMAX™ operator **Fitel** trialled LTE TDD for a year from July 1, 2011 in Taoyuan, and is expected to request the NCC to allow migration from WiMAX to LTE if their trial proves successful.

NCC began an auction on September 3, 2013 for APT700, 900 and 1800 MHz bands totaling 135 MHz x 2, ending the following month. Results:

- **Chunghwa Telecom** won spectrum in the 900 MHz and 1800 MHz bands
- **FarEasTone** won APT700 and 1800 MHz
- **Taiwan Mobile** won APT700 and 1800 MHz
- **Hon Hai** won APT700 and 900 MHz
- **Taiwan Star Mobile** won 900 MHz
- **Asia Pacific Telecom** won APT700

http://www.ncc.gov.tw/english/content_field_detail.aspx?site_content_sn=215&is_history=0&pages=0&sn_f=69

CDMA operator **Asia Pacific Telecom** commercially launched LTE on December 24, 2014 with a range of band 28 compatible phones by HTC, InFocus, LG, Samsung, and Sony. VoLTE is in deployment.

Hon Hai (trading as Foxconn) is backing **Ambit Mircosystems** which is deploying the LTE network. Ambit is pursuing a merger with APT. Taiwan Mobile is purchasing 14.9% stake in Ambit and has been approved to purchase an additional 5 MHz block of APT700 spectrum from Ambit.

Ambit Microsystems commercially launched LTE on May 15, 2015 using APT700 and 900 MHz spectrum together with VoLTE service.

Taiwan Star Mobile commercially launched LTE using 900 MHz on August 25, 2014 claiming 85%

coverage at launch. The company acquired 3G/HSPA operator **VIBO** in June 2014.

NCC is planning to auction 190 MHz of 2.6 GHz spectrum, covering FDD (140 MHz) and TDD (50 MHz) bands. The auction is expected to be held in Q3 2015. Spectrum in the band 5.7 – 6.4 GHz has been identified for operators wishing to deploy LTE small cells, for which no charge will be made to applicants, according to reports. 1900 MHz, 2.3 GHz and 3.5 GHz spectrum may be auctioned after 2015.

Thailand

Regulator NBTC approved trialling of LTE in 2.3 GHz and 1800 MHz. **TOT** partnered with its concession holder **AIS** to trial 2.3 GHz LTE TDD in 20 MHz of its total 64 MHz allocation with 20 sites in central Bangkok in January 2012. Further co-operation had been planned but has since ended.

Softbank has a partnership with TOT, which will focus on joint development of a 2.3 GHz LTE TDD network using TOT's allocation of 64 MHz bandwidth. The first test phase ran until May 2012.
AIS subsidiary **Digital Phone Co** joined with **CAT Telecom** to test LTE1800 from mid-January 2012 in Maha Sarakham. The trial had 8 sites and ran until March 2012. TOT planned new trials involving up to 400 sites using 30 MHz of 2.3 GHz spectrum. AIS is preparing to deploy an LTE network using 900 MHz and 1800 MHz spectrum which AIS will bid for at the auction in November 2015.

True Move commercially launched LTE service on May 8, 2013 using 2100 MHz spectrum. 250,000 subscriptions were gained by April 2014. The company is targeting coverage expansion to 80% of population by mid-2015.

DTAC, rebranded as **TriNet**, commercially launched LTE in 2.1 GHz on May 10, 2014 in inner Bangkok with major business and residential districts covered. DTAC subscribers with compatible devices and SIMs automatically connect to the LTE network when in coverage. 1800 MHz spectrum will be refarmed for LTE deployment beginning in October 2015. DTAC plans nationwide LTE coverage in 2016. VoLTE is being trialled ahead of its planned deployment.

On August 14, 2015 **DTAC TriNet** and **AIS** announced their partnership to share telecommunications towers.

NBTC is preparing to auction LTE-suitable 900 MHz and 1800 MHz licences. Until then, **True Corp** and **AIS** may continue using 1800 MHz for GSM services, while **AIS** is allowed to continue using its 900 MHz spectrum. 900 MHz licences are scheduled to be auctioned on December 15, 2015.

The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

Tonga

The APT700 FDD band plan was adopted in 2012.

Vanuatu

WanTok (formerly Can'l) commercially launched 2.3 GHz (band 40) LTE TDD in Port Vila on April 1, 2014.

On April 30, 2014 regulator TRR launched a consultation on allocation of APT700 FDD spectrum for LTE. TRR proposed to offer the spectrum as lots of 2 x 5 MHz (up to a maximum per operator of two 20 MHz paired licenses made up of four 5 MHz pairs). Comments were required by June 13, 2014. TRR published its Decision on August 14, 2014. TRR has decided to allocate this spectrum according to APT700 band 28 and also stated its plans to call for Expressions of Interest. See TRR Decision http://www.trr.vu/attachments/article/369/decision_1_of_2014.pdf

Vietnam

Regulator MIC authorized trials by **VNPT, Viettel, FPT Telecom, CMC, VTC, EVN Telecom** and **Gtel**. **RusViet Telecom** also trialled LTE in 2010 in Hanoi. **Viettel** said in May 2011 it was testing LTE in Hanoi and HCM City, offering dongles to 240 friendly users.

700 MHz spectrum will be allocated after digital TV switchover, scheduled to begin in 2015 in big cities. The APT700 band plan has been adopted for frequency allocations in the 700 MHz band.

The government said in June 2012 state-owned **Vinaphone** & **MobiFone** would merge subject to approvals being obtained.

WiMAX™ operator **Indochina Telecom** is studying migration to LTE TDD and is a member of the Global TD-LTE Initiative (GTI).

Viettel plans to deploy a pilot LTE network in selected rural areas beginning in October 2015

The government said LTE licences will be offered in 2016.

Europe

May 8, 2015: EC adopts L band 1452-1492 MHz

Member States *should make the spectrum available within six months*. The Decision allows the 1452-1492 MHz band to be used for advanced mobile services such as audiovisual streaming or high speed downloading and introduces the technical conditions for wireless broadband use as downlink-only supplemental downlinks (SDL) for aggregation with other LTE carriers.
European Commission press release, May 8, 2015: http://ec.europa.eu/digital-agenda/en/news/commission-decision-opens-new-frequency-band-advanced-mobile-services

Abkhazia

A-Mobile commercially launched LTE using band 20 spectrum on June 4, 2014 in Sukhumi and Gagra.

Aquafon, a subsidiary of **Megafon,** commercially launched LTE on August 6, 2014 in Sukhumi and other cities. In July 2013 Aquafon confirmed receipt of a licence to deploy LTE with 800 MHz.

Åland Islands

Both **Ålcom** (Ålands Telekommunikation Ab) and **TeliaSonera** have licences to deploy LTE networks using 800 MHz, 1800 MHz or 2.6 GHz spectrum.

Ålcom commercially launched LTE1800 on March 3, 2015 covering 42% of the population. 800 MHz band 20 also commercially used since April 13, 2015.

Albania

Eagle Mobile commercially launched a 150 Mbps LTE1800 network on September 1, 2015.

Telekom Albania (formerly **AMC)** commercially launched 150 Mbps LTE on July 22, 2015 using 2.6 GHz band 7 spectrum. LTE-Advanced service was commercially launched on September 1, 2015 initially in 7 main cities of Albania (Tirana, Durres, Elbasan, Shkodra, Fier, Vlora and Korça), with carrier aggregation of spectrum in the 1800 MHz and 2.6 GHz bands.

Vodafone Albania commercially launched LTE in July 2015 using 2.6 GHz spectrum. LTE-Advanced "4G+" service was launched on September 1, 2015.

Plus Communication is trialling LTE technology.

In August 2014 regulator Electronic and Postal Communications Authority AKEP approved the refarming of GSM bands (900 MHz, 1800 MHz) for LTE. 2 x 6 MHz of technology neutral 1800 MHz spectrum was sold in March 2015 to Telekom Albania, Vodafone Albania and Eagle. Vodafone and Telekom Albania also have 2.6 GHz spectrum. 2.1 GHz spectrum is now also technology neutral.

Andorra

Andorra Telecom commercially launched LTE using 800 MHz band 20 spectrum on October 21, 2014, initially covering 50% of the territory.

Armenia

VivaCell-MTS commercially launched LTE in Yerevan on December 28, 2011 in 2.6 GHz spectrum. Coverage was later extended to Armavir, Dilijan, Echmiadzin, Gyumri, Tsakhnadzor and Vanadzor.

Orange Armenia organized a public demonstration of LTE at the Orange Flagship Store November 4-5, 2010 but did not commit to network deployment. On August 7, 2015 the Orange Group announced Orange Armenia is to be sold to local ISP **Ucom**.

Ucom plans a pilot network in Yerevan in 2015.

ArmenTel (Beeline/Vimpelcom) plans to deploy LTE**.**

Austria

Regulator RTR completed a 2.6 GHz auction on September 20, 2010, raising €39.5m from **A1**

Telekom, Hutchison 3, T-Mobile and **Orange**. 14 paired and 9 unpaired blocks were sold.

A1 Telekom commercially launched LTE in Vienna and St. Pölten on November 5, 2010. The company announced in June 2013 it had successfully demonstrated the LTE-Advanced carrier aggregation feature and launched 300 Mbps service using 800 MHz and 2.6 GHz spectrum in Graz on November 25, 2014. A1 Telekom launched an LTE data roaming service with Swisscom in December 2013. The company announced on January 29, 2014 that 800 MHz spectrum (band 20) was in service on over 200 sites. Telekom Austria Group, owner of A1 Telekom, is majority-owned by **America Movil**.

T-Mobile Austria commercially launched LTE service using 2.6 GHz spectrum on July 28, 2011. In March 2014 the LTE network covered 2.1 million population. 150 Mbps (Category 4) was launched in March 2014. The company has tested carrier aggregation with 2.6 GHz and 1800 MHz spectrum, and is testing VoLTE.

3 Austria (Drei) commercially launched LTE FDD service in Vienna using 2.6 GHz on November 18, 2011. LTE TDD deployment in (band 38) is under study. LTE1800 was commercially introduced in Q3 2014 after approval to refarm GSM spectrum bands for LTE (see below). 85% population coverage was achieved by early May 2015. The network had 98% population coverage by July 2015. The company will gain additional 900 MHz spectrum in early 2016 which will be used for coverage enhancement. 300 Mbps LTE-Advanced combining 1800 MHz and 2.6 GHz spectrum was commercially launched in 2015.

Orange Austria tested LTE and won 2 x 10 MHz of 2.6 GHz in the 2010 auction. Orange was taken over by Hutchison Group (January 3, 2013).

RTR auctioned 28 blocks in the 800 MHz, 900 MHz and 1800 MHz bands and announced the results in October 2013:

- A1 won 800 MHz, 900 MHz and 1800 MHz
- T-Mobile won 800 MHz, 900 MHz, 1800 MHz
- H3G Austria won 900 MHz and 1800 MHz

On July 28, 2014 RTR approved proposals by the incumbent mobile operators to refarm their existing GSM spectrum for 3G and 4G/LTE use. On August 12, 2015 RTR confirmed its approval for 3G 2100 MHz spectrum to be refarmed for 4G/LTE systems with immediate effect. 700 MHz, the second digital dividend, will be auctioned for bringing into mobile use from year 2020.

Azerbaijan

Azercell commercially launched LTE1800 on June 19, 2012. Over 260 sites were deployed by end 2013.

Azerfon (Nar Mobile) is reported to have deployed LTE1800 at 130 base station sites in Baku for corporate customers only to use the network from April 2015. The network is considered by GSA to currently be at the pre-commercial testing stage.

Bakcell commercially launched LTE1800 on May 5, 2015 using the 4th Sür@ brand name, with a peak speed of 150 Mbps. Coverage is initially in several areas of Baku, the network had 373 activated base stations by August 2015 and plans to activate over 1,000 by Q1 2016.

WiMAX™ operator **Sazz** (Azqtel) has 60 MHz of 3.5 GHz spectrum (bands 42, 43) and is deploying LTE TDD. Service launch is anticipated in 2015.

Regional 850 MHz CDMA operator **Naxtel** has a licence to deploy an LTE network.

WiMAX™ operator **Delta Telecom** is upgrading its infrastructure for an LTE TDD system launch in 2016.

On June 27, 2015 the Ministry of Communications and High Technologies (MCHT) announced it will allow the country's mobile operators to use new frequency bands to expand their LTE network. According to a statement on its website, operators will be allowed to use band 20 spectrum from end 2015 for LTE network deployments.

Belarus

MTS (with **Beltelcom**) and **BeST (Life)** completed LTE trials by May 1, 2011.

BeST (Life) has 2 x 15 MHz in 2.6 GHz for commercial network deployment.

Start-up operator **beCloud** has a license with 1800 MHz (LTE1800) and 2.6 GHz spectrum and, with

MTS, tested LTE-Advanced in Minsk achieving 250 Mbps in advance of planned launch in Q4 2015.

800 MHz band 20 may be available by end 2015. More 900 and 1800 MHz is expected to be allocated.

Belgium

Belgacom (Proximus) commercially launched LTE1800 service on November 5, 2012. 300 Mbps LTE-Advanced was introduced initially in Ghent, Antwerp, Leuven and Bredene at end 2014.

Base commercially launched LTE1800 on October 1, 2013. By May 2014 coverage was available to 50% of population, including in Brussels. Shortly 800 MHz spectrum will also be brought into use. Base confirmed data speed of over 250 MBps in trials of LTE-Advanced carrier aggregation.

Mobistar has 800 MHz, 1800 MHz (LTE1800) and 2.6 GHz that can be used for LTE. On November 25, 2013 Mobistar opened access to its network in 30 cities and towns to existing mobile data customers to try out LTE technology if they had an LTE-compatible device and were on a compatible tariff plan. Mobistar later confirmed its commercial offer allowing 4G access at no extra cost from March 31, 2014; at that time population coverage was 50%. Mobistar uses 800 MHz (band 20) and 1800 MHz (band 3/LTE1800). Coverage was extended to Brussels in May 2014 and covered 91% of the population by March 2015. Mobistar undertook LTE-Advanced carrier aggregation testing by combining 20 MHz of 1800 MHz and 10 MHz of 800 MHz reaching 213 Mbps downlink and 41 Mbps uplink speeds. Full-scale commercial trials of LTE-Advanced were launched in Brussels, Mechelen and Mons on May 15, 2015 enabling theoretical peak download speeds of up to 213 Mbps and peak uploads up to 43 Mbps. The 4G+ service covers over 85% of the population in Brussels, 91% in Mons, and 99% in Malines.

Telenet trialled LTE in 2010 and in June 2011 acquired 900, 1800, and 2100 MHz spectrum. Telenet agreed to buy **Base** from its owner, **KPN**, subject to regulatory approval. The merged company would be able to offer fixed and mobile services.

b•lite Telecom BVBA commercially launched an LTE TDD fixed wireless access network in 3.5 GHz (band 42) spectrum in the city of Aalst on April 22, 2014.

Regulator BIPT auctioned 4G licences for 77 million Euros, comprising 45 MHz of 2.6 GHz TDD spectrum and 3 x 20 MHz paired blocks in 2.6 GHz for FDD systems. The auction ended November 28, 2011. New licences run for 15 years from July 1, 2012. LTE FDD spectrum was acquired by the three mobile incumbents and TDD spectrum was won by new entrant **BUCD** (backed by Asian investors). The technology choice is understood to be TD-LTE.

BIPT auctioned 3 x 10 MHz paired blocks of 800 MHz band 20 spectrum starting and finishing on November 12, 2013. The 3 incumbent mobile networks each bid 120 million Euros (the reserve price) for a 10 MHz paired block. There was no new market entrant.

Bosnia and Herzegovina

Telekom Srpske (m:tel) tested 4G LTE technology in Banja Luka. **BH Telecom** is preparing for testing.

Bulgaria

Selected **Mtel** customers in Sofia, Varna, Rousse and Dobrich have been testing a LTE1800 pilot network free of charge since January 2012. 900 MHz and 1800 MHz spectrum can be used for LTE and LTE1800 is being deployed, however a target commercial launch date has not been announced. VoLTE is planned.

On January 6, 2012 **VIVACOM** confirmed receipt of permission from regulator CRC to start LTE testing for which a network using 1800 MHz was built in Sofia for trials up to June 2012. An LTE1800 commercial network is now being deployed.

The Communications Regulation Commission (CRC) stated December 15, 2011 that 3 technology-neutral licences for vacant 1800 MHz spectrum had been granted to **Max Telecom** (2x 8 MHz), **4G Com EAD** (2 x 8 MHz) and **Bulsatcom** (2 x 5 MHz).

WiMAX™ operator **Max** (formerly Max Telecom) commercially launched LTE1800 on May 20, 2014 in Sofia, Ruse, Stara Zagora, Sliven, and Bansko. The service was initially positioned for tablet users. On

July 1, 2015 Max announced that its LTE network covered 31 cities and towns, equivalent to about 50% of the urban population. VoLTE has been demonstrated and is in deployment.

Bulsatcom stated commercial launch of LTE is planned by end 2015.
Telenor Bulgaria (formerly GloBul) announced its network is LTE-ready, pending allocation of 1800 MHz spectrum expected to be auctioned in 2H 2015.

Start-up **4G Com EAD** is reported to be for sale.

CRC is planning to auction 2.6 GHz spectrum blocks:

- Three 2 × 20 MHz paired blocks (FDD)
- One 2 x 10 MHz paired block (FDD)
- Five 10 MHz unpaired blocks (TDD)

Interested bidders had to register by September 15, 2015.

Croatia

T-Hrvatski Telekom commercially launched LTE in 10 MHz of 1800 MHz spectrum (LTE1800) on March 23, 2012 in Zagreb with free mobile data access on its LTE network until October 1, 2012. Osijek, Rijeka and Split are now covered as well as 50% of Zagreb. Commercial LTE service using 800 MHz spectrum was introduced in December 2012 in Drenovaca, Josipdola, Koprivnice, Otocca, Ozlja and Petrinje. On May 14, 2014 the company announced completion of LTE-Advanced carrier aggregation testing, which combined 10 MHz paired of 1800 MHz and 10 MHz paired of 800 MHz sprectrum to achieve 136 Mbps.

VIPNet demonstrated LTE in 800 MHz in March 2011 and launched a trial for 20 consumers on September 1 2011 in Novi Zagreb using 800 and 1800 MHz spectrum. VIPNet commercially launched LTE1800 service on March 23, 2012 with free mobile data access on its LTE network until end June 2012.

Velatel (Novi-net) holds 42 MHz spectrum in 3.5 GHz and is deploying an LTE TDD network since Q2 2012.

In October 2012 regulator HAKOM announced results of the 800 MHz band 20 auction. Three blocks were offered. VIPNet and T-Hrvatski Telekom were the only bidders, as Tele2 did not submit a bid. The total raised from the auction was about €40 million. VIPNet acquired 2 x 10 MHz. The winners are required to achieve geographical coverage of 50% in five years. The remaining two blocks of 2 x 5 MHz were later auctioned in a sealed bid process; 2 bids were opened on October 28, 2013. HAKOM awarded the spectrum to bidders VIPNet and T-Hrvatski Telekom.

HAKOM launched a consultation into use of 900 and 1800 MHz for mobile broadband, including LTE. **Tele2** and **T-Hrvatski Telekom** requested and received additional 1800 MHz technology-neutral spectrum in December 2014. **T-Hrvatski Telekom** subsequently increased the theoretical peak downlink speed from 75 Mbps to 150 Mbps using the additional 1800 MHz spectrum acquired.

The 2.1 GHz band is now technology neutral.

Cyprus

The Department of Electronic Communications published tender documents for an auction of 2.6 GHz spectrum by August 31, 2013. On offer were:

- Three 20 MHz paired blocks (FDD)
- One 40 MHz unpaired block (TDD)

No bids were made and the auction was cancelled.

Formerly an MVNO-only operator, **PrimeTel** applied for and secured the third mobile network operator license with technology neutral 900, 1800 and 2100 MHz spectrum. **PrimeTel** commercially launched LTE1800 on March 10, 2015 with 50% population coverage. (3G/HSPA service was launched February 23, 2015).

MTN commercially launched its LTE1800 service on March 10, 2015 in Famagusta, Larnaca, Limassol, Nicosia and Paphos.

CYTA is deploying an LTE1800 network for commercial launch nationwide in 2015.

A public consultation regarding the proposed sale of spectrum in 800 MHz (band 20), 1470 MHz (L-Band), 2.6 GHz (band 7) and 3.4-3.8 GHz (bands 42 and 43) requires comments by October 2, 2015.

Czech Republic

O2 Czech Republic commercially launched LTE1800 in Jesenice (west district of Prague) on June 19,

2012. Service is being extended to more areas of the city in May 2013 and Brno was covered in October 2013. On July 15, 2014 the company announced availability of higher LTE speeds (peak 110 Mbps uplink, 55 Mbps downlink) as a result of increasing the bandwidth allocated for its LTE service. LTE-Advanced service combining 10 MHz of 800 MHz and 20 MHz of 1800 MHz spectrum (achieving 185 Mbps) has been introduced in the town of Černovice.

On February 26, 2015 **O2** announced successful testing of VoLTE and start of deployment phase targeting commercial launch by end 2015. A fixed wireless service, Air Internet, enabled on its LTE network was launched in June 2015.

T-Mobile commercially launched 150 Mbps LTE1800 on October 1, 2013 in Prague and Mlada Boleslav and using 800 MHz in rural areas. In May 2014 T-Mobile launched 800 MHz LTE in Plzeň-jih Pilsen Region and start of a two-month trial phase. By end 2014 T-Mobile targets for 51% population and 73% geographic coverage with LTE. T-Mobile launched LTE-Advanced service combining 10 MHz of 800 MHz and 20 MHz of 1800 MHz with peak downlink speed of 225 Mbps in Mlada Boleslav. A 4x4 MIMO test using 800 MHz spectrum was completed and announced in March 2015. VoLTE was commercially launched on May 4, 2015 initially for customers using the Samsung Galaxy S5.

T-Mobile and **O2 Czech Republic** extended network sharing to include 4G/LTE and LTE-Advanced.

On June 4, 2013 **Vodafone** announced launch of a 20-site LTE1800 trial Karlovy Vary in Carlsbad. On December 10, 2013 **Vodafone** announced commercial launch of LTE using 900 MHz in areas around Litoměřice, the northern part of the Plzeň region and some areas in the Liberec region. 92% population coverage was achieved by end 2014. LTE1800 is in service in Karlovy Vary. On March 4, 2014 Vodafone announced launch of dual carrier (for Category 4 devices) i.e. theoretical 150 Mbps peak downlink speed, using part of the spectrum obtained in the November 2013 auction (see below). LTE tests with 800 MHz band 20 began in June 2014. LTE-Advanced carrier aggregation was launched in 2014 combining 15 MHz B3 and 15 MHz B20 spectrum in Karlovy Vary enabling 225 Mbps peak speed. Vodafone also launched LTE service using 2.1 GHz (band 1) spectrum in Kladno, Olomouc and Slaný in December 2014. 1800 MHz and 800 MHz is deployed in Prague.

To achieve a theoretical speed of up to 375 Mbps per second when downloading and 50 Mbps when sending data, Vodafone uses a combination of three radio bands - 800 MHz, 1,800 MHz and 2,600 MHz and is preparing for its commercial introduction.

By September 2015, Vodafone covered 92% of the population and 83% of the country with LTE.

In September 2011, regulator CTU issued terms and conditions for a planned auction of 800, 1800 and 2600 MHz. CTU said that the 1800 MHz spectrum was reserved for a possible new entrant. The auction started on November 12, 2012 with 4 bidders (three incumbents plus **PPF Mobile Services**) but was cancelled on March 8, 2013 due to “excessively high prices” which was felt could lead to high prices for consumers. The auction was replayed according to new rules, starting on November 11, 2013. 800 MHz spectrum was reserved for new entrants however no new player came forward and the replayed auction resulted in spectrum being allocated to incumbents. 1800 MHz and 2.6 GHz can also be used for LTE.

Denmark

Regulator Telestyrelsen concluded an auction of 2500-2690 MHz and 2010-2020 MHz spectrum on May 10, 2010, awarding spectrum to **Hi3G Denmark ApS**; **TDC A/S**; **Telia Nättjänster Norden AB**; and **Telenor A/S**. On October 12, 2010 Telestyrelsen announced that **Hi3G Denmark** had been granted 900 and 1800 MHz spectrum, which could be used to deploy 2G, 3G or LTE technologies nationally.

Telia launched the country’s first commercial LTE system on December 9, 2010 in Copenhagen, Aarhus, Odense and Aalborg in 2.6 GHz (20 MHz). On October 10, 2011 LTE commercial service was introduced using 10 MHz of 1800 MHz (LTE1800) as a complement to 2.6 GHz. Tri-band 800/1800/2600 MHz LTE dongles and routers are available. In August 2015 Telia announced start of deployment of 300 Mbps LTE-Advanced carrier aggregation technology using band 3 and band 7 spectrum.

Telenor commercially launched LTE1800 and 2.6 GHz on March 20, 2013, covering 192 towns and cities, representing 75% of the population. 90% population coverage is targeted by end 2015. In January 2014 the company announced rebranding of its 3G/4G networks to "NU" (meaning Now). LTE-Advanced carrier aggregation will be deployed in 2015. VoLTE is in deployment.

Telenor and **Telia** attempted to merge 4G/LTE, 3G and 2G networks into a JV called TT-Netværket P/S. 4G sharing uses LTE1800 and LTE800, but cancelled it due to regulatory requirements.

TDC launched commercial 2.6 GHz LTE service on October 10, 2011 in Copenhagen, Aarhus, Odense, Aalborg, Esbjerg, Randers, Kolding, Horsens, Vejle, Roskilde. 800 MHz was brought into service in early 2013. TDC announced on July 3, 2015 that the company is deploying 300 Mbps LTE-Advanced across its network and is enabled currently on approaching 500 sites. A 3 Component Carrier trial, Carrier Aggregation (3CC CA) has been completed on the network achieving a peak throughput rate up to 440 Mbps.

3 Denmark is deploying an LTE FDD network combined with 25 MHz of TDD spectrum, and launched its commercial LTE FDD service using 1800 (LTE1800) and 2600 MHz spectrum on September 28, 2012, at the same time introducing the iPhone 5. 150 Mbps LTE-Advanced was commercially launched in Q4 2014 with carrier aggregation combining 1800 MHz and 2.6 GHz spectrum.

TDC and **TT-Netværket P/S** were awarded 800 MHz spectrum in the auction which closed on June 26, 2012. TDC won 2 x 20 MHz and TT-Netværket won 2 x 10 MHz. 739.3 million Danish Kr (approx USD 124.3 million) was paid for 5 blocks of spectrum on offer (four 2 x 5 MHz blocks, one 2 x 10 MHz block).

On November 27, 2014 **TDC** announced the company was testing VoLTE technology.

Net1 is deploying a nationwide LTE450 network.

Estonia

Regulator TJA awarded LTE licences in 2.6 GHz spectrum to incumbent mobile operators **EMT**, **Elisa** and **Tele2** plus fixed-line operator **Elion Enterprises**. TJA announced on December 16, 2011 that **EMT, Elisa** and **Tele2** are permitted to deploy mobile broadband technologies e.g. LTE in 1800 MHz band. A consultation was simultaneously launched on the procedures for allocating digital dividend spectrum.

EMT launched the first commercial LTE service in Estonia on December 17, 2010 in 2.6 GHz in Tallinn, Tartu, Kohila, and at the IT College of Tallinn University of Technology. On December 19, 2011 EMT announced start of LTE network deployment in 1800 MHz. Commercial service is now delivered using 2.6 GHz, 1800 MHz (LTE1800) and from June 2013, 800 MHz helped the company to achieve 95% population coverage six months ahead of schedule, and has since reached 99% population coverage. EMT launched Cat 6 300 Mbps peak downlink LTE Advanced service in August 2014 using a combination of 20 MHz band 3 (1800) and 20 MHz band 7 (2600) spectrum in Kiisa and near the Tallin TV tower where mobile traffic is heaviest.

Tele2 Estonia commercially launched LTE in Tallinn using 1800 MHz (LTE1800) and 2.6 GHz on November 27, 2012. 8.3 MHz of additional 1800 MHz spectrum was acquired at end 2011. On March 11, 2014 Tele2 announced the company had doubled its 2.1 GHz holding, which can be used immediately for 3G and can be used later in its LTE network. The company is deploying 300 Mbps LTE-Advanced in a number of cities. The first 800 MHz (band 20) site was launched on May 9, 2014. Tele2 may also deploy LTE in 450 MHz, 900 MHz, 2.1 GHz and 2.3 GHz spectrum. 300 Mbps LTE-Advanced service was launched in December 2014 and Tele2 is deploying 375 Mbps capability. Tele2 plans to provide 90% population coverage with LTE by end 2015. On July 14, 2015 Tele2 announced it is now also using 2.1 GHz on its LTE network. 90% LTE population coverage has been achieved (September 2015).

Elisa commercially launched LTE on February 14, 2013 using 1800 MHz (LTE1800), plus 2.6 GHz in urban areas. Commercial service was extended using 800 MHz acquired in August 2013. By end 2013 LTE covered 95% of territory and 97% of the population and the company is progressing towards its 99% population coverage target. Elisa has trialled 300 Mbps LTE-Advanced in Tallinn using carrier aggregation combining 20 MHz of 800 MHz and 20

MHz of 2.6 GHz spectrum. LTE roaming services were launched in Q1 2015 initially with Telenor (Norway), Elisa (Finland) and Vodafone (Romania).

Tele2 beat cable operator **Starman** for the remaining block of 800 MHz. Tele2 plans 95% geographical coverage by mid-2014.

Finland

20-year 2.6 GHz licences were auctioned by regulator FICORA on 23 November 2009:

- **Elisa** obtained 50 MHz, and launched a pre-commercial trial in Helsinki on June 2, 2010
- **TeliaSonera** acquired five blocks of 2 x 5 MHz and launched an LTE network on June 2, 2010 for pre-commercial use in the city of Turku
- **DNA** obtained 40 MHz

Finland was the first country in Europe to allow 1800 MHz spectrum to be used for LTE deployments.

TeliaSonera launched the first commercial LTE service in Finland on November 30, 2010 in Turku and Helsinki, using 2.6 GHz spectrum. LTE1800 was commercially launched as a complement to 2.6 GHz on August 31, 2011. Results of a trial of 3-band carrier aggregation LTE-Advanced using 20 MHz band 3, 20 MHz band 7 and 10 MHz in band 20 was announced on September 2, 2015 that achieved 375 Mbps.

Elisa commercially launched a 2.6 GHz LTE network for corporate users on December 8, 2010, and announced its first client. The company launched LTE2600/LTE1800 service combined with DC-HSPA+ for consumers on November 17, 2011. LTE service reached 230 locations by October 2013. 800 MHz was brought into use in January 2014.

Elisa commercially launched 300 Mbps LTE-Advanced using carrier aggregation to combine 2 x 20 MHz of Band 3 and 2 x 20 MHz of Band 7 spectrum in 12 localities on March 31, 2015.

DNA Oy commercially launched LTE on December 13, 2011. DNA uses 1800 MHz (LTE1800) with 2.6 GHz for populated areas where extra capacity is required. 800 MHz was launched in January 2014 in Lohja. LTE coverage planned to reach 80% of the population by end 2014.

On August 20, 2014 **DNA** (49%) and **TeliaSonera** (51%) announced agreement to set up a new JV company *Suomen Yhteisverkko Oy* to build a joint 2G/3G/4G network to cover 15% of the population in 50% of Finland's geographical area in the north and east. Band 20 for LTE will be pooled in the areas covered by the JV and the new network will be configured for 300 Mbps LTE-Advanced from launch. Up to 270 Mbps has been measured in network tests.

TeliaSonera commercially launched 300 MBps LTE-Advanced carrier aggregation service in parts of Helsinki combining 2 x 40 MHz from bands 3 and 7.

An auction of 800 MHz spectrum (band 20) in six 5 MHz paired blocks (791 – 812 MHz paired with 832 – 862 MHz) started on January 24, 2013 for licences with 20 years duration. Winners DNA, Elisa and TeliaSonera were announced October 30, 2013. 800 MHz spectrum was usable from January 1, 2014.

Ukko Mobile commercially launched the world's first LTE450 (band 31) network on November 17, 2014, providing data access services only with 99.9% population coverage of Finland. 241 sites are deployed, with cell radius typically 20-50 km. Ukko Mobile is also deploying LTE-Advanced LTE TDD as a capacity layer and in hotspots using 2.6 GHz (band 38), to be commercialized according to customer demand. For further information download from http://www.gsacom.com/gsm_3g/info_papers.php4 the presentation
UKKO MOBILE: World's first LTE450 network commercially launched in Finland.

In January 2015 **Ukko** announced completion of a TDD LTE-Advanced lab demonstration which showed a peak throughput of over 507 Mbps using 2 x 20 MHz bandwidth 2.6 GHz carriers (Ukko has 50 MHz of band 38 bandwidth). UKKO commercially launched LTE TDD with limited coverage on August 14, 2015.

Fixed broadband operator **Anvia** has trialled LTE in Lapua using 700 MHz spectrum.

700 MHz spectrum will be allocated for mobile services to align with the lower duplexer arrangement of the APT700 band.

France

FT/Orange launched a pilot LTE network in Marseille in June 2012. Coverage in Lyon, Lille and Nantes was added later. Marketing to corporate customers began on November 22, 2012. Consumer services began in February 2013. Service was introduced in Paris in February 2013. 58% of the French population coverage was claimed by April 2014. The network uses 2.6 GHz and 800 MHz. LTE-Advanced technology combining 800 MHz and 2.6 GHz was commercially introduced in Strasbourg and Toulouse in July 2014. Results of trials aggregating 3.5 GHz and 2.6 GHz spectrum in FDD configuration were announced in December 2014, achieving 300 Mbps downlink speed. Speaking at the LTE World Summit 2015, Orange committed to deploy 3-carrier aggregation to enable 450 Mbps peak downlink speed by end 2017. VoLTE is planned.

SFR launched commercial LTE service on November 28, 2012 in Lyon and in Montpellier on December 18, 2012 and uses 800 MHz and 2.6 GHz spectrum. The La Defense business region of Paris went live in January 2013, Marseille in March 2013. SFR commercially launched 187.5 Mbps LTE-Advanced carrier aggregation in Toulon combining 800 MHz and 2.6 GHz spectrum on October 21, 2014, followed by launches in Lyon and Toulouse, then Marseille. SFR plans to launch VoLTE in 2015.

Bouygues Telecom trialled LTE1800 in 10 MHz using 2 x 2 MIMO at sites in Orléans and ran a pilot network in Lyon from June 2012.

Regulator ARCEP auctioned 2.6 GHz spectrum and confirmed the successful bidders and allocations:

- Bouygues: 2535-2550 MHz/2655-2670 MHz
- Free Mobile: 2550-2570 MHz/2670-2690 MHz
- FT/Orange: 2515-2535 MHz/2635-2655 MHz
- SFR: 2500-2515 MHz/2620-2635 MHz

On January 17, 2012 ARCEP announced 800 MHz spectrum had been won by Orange, SFR and Bouygues Telecom, each receiving 2 x 10 MHz.

Bouygues Telecom commercially launched LTE using 2.6 GHz on May 6, 2013 in Lyon, Strasbourg, Issy-les-Moulineaux, Vanves, Malakoff, and Toulouse. The company requested permission from ARCEP to use its 1800 MHz for LTE. Approval was given for use from October 1, 2013 subject to spectrum disposal conditions. On October 1, 2013 the company extended coverage to 63% of the population with commercial LTE launch in refarmed 1800 MHz spectrum (LTE1800). Coverage increased to 71% by March 2015. Bouygues Telecom trialled LTE-Advanced technology in October 2013 using carrier aggregation with 800 MHz, 1800 MHz and 2.6 GHz spectrum combinations. The company commercially launched 220 Mbps LTE-Advanced service in Bordeaux, Lyon, Grenoble, Vanves, Issy-les-Moulineaux, Malakoff and Rosny-sous-Bois with devices for sale from July 1, 2014, smartphones from September 2014. Different combinations of spectrum are used according to the location. At the same time Bouygues Telecom is increasing 1800 MHz spectrum allocation from 10 MHz to 15 MHz in a number of cities. Tri-band carrier aggregation using 45 MHz paired from bands 3, 7 and 20 has been demonstrated, achieving speeds higher than 300 Mbps and targeting commercial service launch by end of summer 2015. VoLTE is in deployment.

SFR and **Orange** are permitted to use some or all of their 1800 MHz holdings for LTE from May 25, 2016.

Free Mobile commercially launched LTE claiming 150 Mbps theoretical peak downlink speed, using 2.6 GHz on December 1, 2013. In November 2014 Free Mobile received 2 x 5 MHz of additional technology neutral 1800 MHz spectrum which will allows testing of LTE-Advanced carrier aggregation by combining spectrum in band 3 and band 7 in Seine-Maritime. In January 2015 ARCEP confirmed 2x5 MHz of 1800 MHz band 3 had been allocated to Free Mobile for commercial use from January 1, 2015 in all of metropolitan France except Marseille, Nice and Paris. 2 x 10 MHz 1800 MHz spectrum was allocated in September 2015 for use from May 25, 2016

Source: ARCEP

WiMAX™ operator **Bollore Telecom** plans to introduce LTE TDD system within its current allocation of 30 MHz of band 42 (3.5 GHz) spectrum and is a member of the Global TD-LTE Initiative.

ARCEP started a consulation in December 2014 on its proposed allocation of 700 MHz spectrum for mobile communications. 700 MHz will be allocated for mobile to align with the lower duplexer arrangement of the APT700 band. The auction terms are now confirmed. A call for bidding interest solicited bidding interest from the 4 incumbent operators. The auction and subsequent specrum allocations are planned to be held in November and December 2015 respectively.

Georgia

Regulator GNCC is converting 2G and 3G licences and spectrum bands to become technology neutral.

Magticom commercially launched LTE1800 on February 1, 2015 in Tbilisi and all the main cities.

Beeline (Mobitel) commercially launched LTE on February 1, 2015 in 30 cities and towns using recently acquired 800 MHz band 20 spectrum.

Geocell (Telenor) commercially launched LTE1800 in certain areas of Tbilisi on March 15, 2015.

Germany

A multiband spectrum auction was completed in May 2010, covering 360 MHz in 4 bands: 800 MHz (digital dividend), 1800 MHz, 2.1 GHz, 2.6 GHz. All 4 incumbents acquired 2.6 GHz to be used for LTE. **Telefonica O2, Vodafone** and **Deutsche Telekom** (but not **E Plus**) additionally acquired 800 MHz spectrum for LTE. The 800 MHz spectrum raised €3.576 billion, i.e. over 81.5% of the auction's total value. **E Plus** is able to use 900 MHz spectrum (in which HSPA+ will be deployed) also for LTE if it does not cause interference with other mobile networks.

E Plus completed LTE trials in 2.1 GHz, 1800 MHz, 2.6 GHz and LTE TDD 2.6 GHz. E-Plus is a member of the Global TD-LTE Initiative. Since July 2011 the E Plus HQ building has LTE1800 trial coverage and having received re-farming approval in January 2013 the company commercial launched its LTE1800 network on March 6, 2014 for customers in Berlin, Leipzig and Nürnberg. VoLTE is in deployment.

Vodafone launched the first rural LTE mobile broadband service across Germany on December 1, 2010 and plans to upgrade all base stations to LTE. In August 2013 Vodafone announced it had increased the theoretical peak downlink speed to 150 Mbps using 2.6 GHz spectrum. 225 Mbps service was launched in several cities in early 2015 by combining band 7 and band 20 spectrum. Category 8 was demonstrated at the IFA show in Berlin In September 2014, achieving 350 Mbps downlink and 50 Mbps uplink, and ping time of 7 ms. The service would use FDD and TDD bands in 2.6 GHz spectrum. By early October 2014 Vodafone had established 23 international roaming partners. Vodafone commercially launched VoLTE on March 16, 2015 during CeBIT, and is now nationwide.

On May 26, 2015 Vodafone announced its LTE network reached 77% of the population with over 5 million customers having access up to 100 Mbps, and 225 Mbps in selected locations by combining 800 MHz and 2.6 GHz spectrum. VoLTE is deployed nationwide. By mid-2016 LTE service is planned to cover 90% of the population.

Deutsche Telekom (DT) commercially launched its "Call & Surf Comfort via Funk" LTE service in 800 MHz on April 5, 2011. In February 2011 the company announced plans to launch LTE using 1800 MHz (LTE1800) and 2.6 GHz. The "Speedstick LTE" dongle was offered from Q3 2011 supporting LTE in 800, 1800 and 2600 MHz bands plus DC-HSPA+, HSPA and WCDMA in 2100 MHz, and EDGE/GPRS. The company commercially launched LTE in Cologne on July 1, 2011 in 1800 MHz (LTE1800). Peak downlink throughput was increased to 150 Mbps in September 2013 and is now in over 150 cities.

DT commercially launched 300 Mbps LTE-Advanced service on November 17, 2014 in urban areas, including Berlin, Bonn, Chemnitz, Cologne, Dortmund, Dresden, Dusseldorf, Duisburg, Leipzig, Magdeburg, Mannheim, Potsdam, Rostock and Stuttgart, using carrier aggregation to combine 2 x 20 MHz 1800 MHz and 2 x 20 MHz 2.6 GHz spectrum. 375 Mbps as achieved in a 3-band CA trial in October 2015, by aggregating spectrum in bands 3, 7 and 20.

In October 2015 **DT** announced successful testing of Inter-sector MIMO (IS-MIMO) LTE-Advanced technology in Lingen, achieving 150 Mbps at the cell edge.

DT is also deploying VoLTE.

Telefonica O2 commercially launched LTE service on July 1, 2011 in rural areas using 800 MHz band 20, marketed as "O2 LTE für Zuhause (at home). On July 3, 2012 O2 commercially launched mobile LTE service in urban areas, Nuremberg and Dresden, followed by other major cities including Berlin and Munich on March 31, 2013. LTE coverage is 62% of the population (March 2015). In November 2013 O2 Germany announced deployment of 1800 MHz and 2.6 GHz LTE-Advanced carrier aggregation in some base stations enabling theoretical downlink speed up to 225 Mbps using Cat 6 devices, and rollout continuing. VoLTE including SRVCC has been activated successfully in a trial area in the live network. **Telefonica O2** acquired **E Plus** creating Germany's biggest network. The deal completed in October 2014.

WiMAX™ operator **Deutsche Breitband Dienste (DBD)** has a licence with 42 to 70 MHz of 3.5 GHz spectrum nationwide and plans to deploy LTE TDD.

Regulator BNetz auctioned 270 MHz of 700, 900 and 1800 MHz spectrum, which started on May 27, 2015 and raised € 5,081,236,000 (approx. US$5.75 billion). The 700 MHz spectrum aligns with the lower duplexer arrangement of the APT700 band. The 700MHz band is used by broadcasters and will be available for mobile from 2017, and nationwide in mid 2018. There is a 98% population coverage condition attached to this spectrum. BNetz announced that after 16 days and 181 rounds the spectrum auction for mobile broadband ended today in Mainz. Telefónica Deutschland GmbH & Co. OHG, Telekom Deutschland GmbH and Vodafone GmbH, were successful in bidding for spectrum in line with their business models. All three operators acquired spectrum in the 700, 900 and 1800 MHz. Telekom and Vodafone each additionally obtained 20 MHz of 1.5 GHz TDD spectrum. This spectrum can be combined with existing LTE spectrum assets using carrier aggregation to increase downlink capacity, or could be used in small cell solutions, or for LTE Broadcast by deploying eMBMS.

Results:
http://www.bundesnetzagentur.de/EN/Areas/Telecommunications/Companies/FrequencyManagement/ElectronicCommunicationsServices/MobileBroadbandProject2016/project2016_node.html

The imminent implementation of smart metering regulation may drive deployments of LTE450 by some utilities for M2M critical communications.

Gibraltar

On February 24, 2015 **Gibtelecom** announced a contract had been signed with its system supplier to deploy a 150 Mbps LTE network for service launch by November 2015.

Greece

Cosmote commercially launched LTE1800 on November 16, 2012 in Athens and Thessaloniki. Coverage targeted 70% by end 2014. Cosmote also has spectrum allocations in band 20 (2x10 MHz), band 7 (2x 30 MHz) and TDD band 38 (20 MHz, studying for indoor applications) and all will be used for LTE. In November 2014 Cosmote announced progress on LTE-Advanced technology testing, combining newly-acquired 800 MHz and 2.6 GHz spectrum targeting 300 Mbps launch in selected areas in 2015. Band 7 spectrum was brought into use in January 2015. The 800 MHz band could be used from March 1, 2015. On this date 300 Mbps LTE-Advanced capabilities in the network was commercially launched. Tri-band 375 Mbps LTE-Advanced was commercially launched in October 2015, combining band 3, band 7 and band 20.

Vodafone commercially launched a limited LTE1800 service (users with dongles or personal hotspots) on December 17, 2012 in Athens. Full commercial launch was in June 2013. VoLTE has been trialled. On February 26, 2015 Vodafone commercially launched 300 Mbps LTE-Advanced in parts of Athens with user devices and using carrier aggregation of 2.6 GHz and 1800 MHz spectrum. Tri-band 375 Mbps LTE-Advanced was trialled in 2015, combining band 3, band 7 and band 20 spectrum.

WIND Hellas commercially launched its LTE1800 network on March 3, 2015 in Athens (75% coverage) with a free usage promotion until end April 2015. WIND plans to deploy LTE additionally in band 20 and band 7 specturm during 2015.

Regulator EETT completed a 900 and 1800 MHz technology-neutral auction on November 14, 2011 to incumbents Cosmote, Vodafone and Wind raising

380.5 million Euros. EETT is consulting on potential granting of technology neutral licences in 3.4-3.8 GHz spectrum. On May 30, 2014 EETT launched a consultation on 800 MHz and 2.6 GHz spectrum. Comments were required by June 30, 2014. Results were announced in October 2014; incumbents Cosmote, Vodafone and Wind each won 800 MHz and 2.6 GHz blocks for their LTE deployments.
http://www.eett.gr/opencms/opencms/EETT_EN/Electronic_Communications/Telecoms/Licensing/RoU800_2600results10.html

Greenland

Tele-Post Greenland commercially launched LTE in Nuuk on December 1, 2013 in band 20 for mobile broadband users. Coverage extended to Sisimiut on March 28, 2014 and Qaqortoq in June 2014, at which time the LTE network reached 50% of the population. Access for smartphones enabled in September 2014.

Guernsey

CICRA (the Channel Islands Competition and Regulatory Authorities) consulted in July 2013 on allocating spectrum, specifically 800 MHz (band 20) and 2.6 GHz (band 7), for LTE services in the Channel Islands (Guernsey and Jersey). CICRA later confirmed LTE-suitable spectrum had been awarded to **JT**, **Sure** and **Airtel** for Guernsey and Jersey.

JT commercially launched what the company called an LTE-Advanced network in June 2015. No further details are available.

Sure launched Channels Islands wide 4G/LTE service on May 31, 2015.

Airtel-Vodafone commercially launched LTE in July 2015.

Hungary

Magyar Telekom (MT) commercially launched LTE technology-based services using 1800 MHz on January 1, 2012 initially covering 10 districts of Budapest (over 40% of Budapest's population). By end 2014, population coverage reached 80%. 800 MHz band 20 and 2.6 GHz (band 7) spectrum were brought into use on October 16, 2014.

Magyar Telekom announced in April 2014 completion of LTE-Advanced carrier aggregation tests using 1800 MHz and 2.6 GHz. A small number of sites in downtown Budapest have deployed carrier aggregation of 20 MHz band 3 and 20 MHz band 7 but compatible devices were not then offered.

Telenor Hungary commercially launched LTE branded Hipernet 84 on July 5, 2012 using LTE1800. Telenor offers 84 Mbps maximum nominal download speed in 60 towns covering 700,000 population (July 2012), which was expanded to 76 towns by February 2013. The network was upgraded in October 2013 to support 150 Mbps peak downlink using additional 1800 MHz spectrum (total 20 MHz paired).

Vodafone Hungary announced completion of second phase trials of LTE on June 1, 2011. A commercial LTE network deployment is planned.

MVM Net is deploying a nationwide LTE network using 450 MHz (LTE450) and is reported to have selected its infrastructure supplier.

On May 22, 2014 regulator NMHH launched auction procedures for a proposed sale of 800 MHz, 900 MHz, 1800 MHz & 2.6 GHz spectrum. 4 applications were made by the June 16, 2014 deadline. Four companies submitted bid applications: **Magyar Telekom, Telenor, Vodafone** and **DiGi Telecommunications.** The auction ended on September 29, 2014 raising 130.6 billion HUF. In addition to the existing 3 mobile incumbents, **Digi** will start to develop a new, fourth network. Results:

Magyar Telekom won 800, 900, 1800 MHz & 2.6 GHz
Vodafone won 800, 900 MHz & 2.6 GHz
Telenor won 800, 900 MHz & 2.6 GHz
DiGi won 1800 MHz

Details:
http://english.nmhh.hu/cikk/164409/NMHH_Hungary_adds_new_frequencies_to_the_digital_economy

Iceland

Nova commercially launched LTE1800 on April 4, 2013 in Reykjavik and is currently testing 800 MHz. Nova won an auction for 1800 MHz and 800 MHz spectrum for LTE in March 2013, alongside **Fjarskipti** (**Vodafone**) and **Simmin.**

Fjarskipti commercially launched LTE using 800 MHz on July 4th, 2013. The company advised GSA that 1800 MHz (LTE1800) will also be used later.

Regulator PTA has approved a network sharing agreement proposed by **Nova** and **Fjarskipti**.

Siminn commercially launched LTE1800 on January 15, 2014 using 2 x 20 MHz 1800 MHz spectrum offering 100/50 Mbps data speed with CSFB voice. The peak speed increased to 150 Mbps in April 2015 when the network covered 84% of the population.

New entrant **365 Media** won 800 MHz spectrum with an obligation to cover 99.5% of the population by end 2016. The company is currently seeking a relaxation.

PTA launched a consultation in 2013 about future use of 2.6 GHz. Vodafone requested an extension to its MMDS in the band from June 2014 until 2020, however only a 2 year extension was approved.

Ireland

Regulator ComReg launched the auction process on May 25, 2012 to cover the 800, 900 and 1800 MHz bands for the period 2013-2030. In total 140 MHz of paired spectrum was offered. The results were announced on November 15, 2012. Meteor, Telefónica O2 and Vodafone were each awarded blocks in the 800 MHz band. Hutchison 3 Ireland, Meteor, Telefónica and Vodafone were each awarded spectrum in both the 900 MHz and 1800 MHz bands.

Meteor commercially launched LTE service using 800 MHz and 1800 MHz spectrum on September 26, 2013 in Dublin, Carlow and Athlone, covering 1.2 million customers, almost 30% of the population.

Vodafone commercially launched data-only LTE service in 800 MHz (band 20) on October 14, 2013 in 6 cities and 23 towns. Smartphones were supported from December 10, 2013. By February 2015 the LTE network covered 90% of the population. 150 Mbps LTE-Advanced was launched in Waterford on December 1, 2014 followed by Cork, Dublin and Limerick by end of 2014. On July 13, 2015 Vodafone announced a higher speed, 225 Mbps, introduced initially in Dublin, Cork, Galway, Limerick and Waterford.

3 Ireland commercially launched LTE1800 on January 27, 2014 at no additional charge to current data plans until July 31, 2014 with over 60% coverage initially in Galway, Limerick and Waterford.

O2 Ireland had planned commercial launch of LTE in 2014, and in September 2013 commenced trials in the cities of Dublin, Cork and Galway. Its parent **Telefonica** announced the sale of O2 Ireland to Hutchison 3 which received EU approval, subject to concessions being made. The deal was legally completed in July 2014. **3 Ireland** and **Eircom** have entered into a new network sharing agreement meeting one of the merger conditions.

Imagine Group has about 220 MHz of 3.5 GHz spectrum (bands 42, 43) in all strategic parts of the country and is currently operating a WiMAX 802.16e network nationally. The company has informed GSA of its intention to upgrade this network to LTE TDD. Imagine is a member of the Global TD-LTE Initiative.

ComReg is considering the future of the 2.6 GHz band including a review of the operation of existing licences within this spectrum which are used for the provision of Pay TV services and MMDS. All MMDS licences expire on April 18, 2014. ComReg proposes that the current MMDS licences should be renewed for 2 years i.e. to April 18, 2016 and that a competitive process be implemented to award new licences on a service and technology neutral basis – which could be used e.g. for MMDS or LTE services.
In September 2013 ComReg launched a consultation about allocating unsold 1800 MHz spectrum. In January 2014 ComReg announced that no bids had been received and the spectrum remains unsold.

Italy

Italy's spectrum auction closed with the four incumbents **TIM, Vodafone Italy, Wind** and **3 Italia** submitting bids totalling over € 3.9 billion. Spectrum was awarded in 800, 1800 and 2600 MHz bands for use from end 2011 (1800 MHz), end 2012 (2.6 GHz), and January 2013 (800 MHz).

3 Italia launched a small-scale trial in Acuto on November 6, 2012. Commercial service was launched in Milan and Rome on February 1, 2013 using 1800 MHz (LTE1800). 3 Italia plans to introduce LTE-Advanced carrier aggregation of 1800

MHz and 2.6 GHz spectrum. 3 Italia acquired TDD spectrum (band 38) for future deployment.

Wind has spectrum for LTE in 800 MHz and 2.6 GHz and commercially launched Category 4 with 800 MHz on January 12, 2014. According to Wind's Q1 2014 results, LTE is available in Rome, Milan, Bologna, Turin, Padova and main airports, and will be available in 17 largest cities by the end of 2014.

Vodafone announced it had secured 60 MHz of new spectrum, comprising 2 x 10 MHz in 800 MHz, 2 x 5 MHz in 1800 MHz, and 2 x 15 MHz in 2.6 GHz. **Vodafone** commercially launched LTE1800 service on November 6, 2012 in Milan and Rome. 225 Mbps LTE-Advanced service was launched on December 2, 2014 in 80 cities (90 cities announced on December 23, 2014), rising to 250 cities during April 2015 then 500 cities by August 2015. The service combines two of frequency bands 800 MHz, 1800 MHz and 2.6 GHz according to location. VoLTE was commercially launched on July 16, 2015 under the Call+ brand.

Telecom Italia launched its LTE program in 2009 followed by trials. A public users trial was launched in Turin February 16-22, 2012. TIM has spectrum for LTE in 800, 1800 and 2600 MHz bands. Commercial service was launched on November 7, 2012 using LTE1800 in Rome, Milan, Turin and Naples. TIM stated that LTE coverage was available in 651 municipalities by end 2013. A public trial of LTE-Advanced carrier aggregation was conducted in July 2014, combining band 3 and band 7 spectrum, followed by commercial launch of 225 Mbps LTE-Advanced (4G Plus) service in 60 cities from the beginning announced on November 5, 2014 (171 cities coverage was announced on March 5, 2015) by combining 2 frequencies from 800 MHz, 1800 MHz and 2.6 GHz used in the network for LTE. By mid-February 2015 LTE covered 80% of the population.

On 29 April 2015 **TIM** demonstrated live eMBMS (LTE Broadcast) technology in San Siro, the stadium of Milano, during their Serie A match against Genoa.

WiMAX™ operator **AFT-Linkem** commercially launched LTE TDD for residential wireless broadband access in band 42 on December 3, 2014.
WiMAX™ operator **GO Internet** is deploying 3.5 GHz LTE TDD in Marche and Emilia-Romagna.

The Italian telecoms regulator AGCOM has approved L-Band (between 1452–1492 MHz) spectrum for wireless broadband supplemental downlink use. Its auction in September 2015 generated €462 million (USD518 million) from the sale of L-Band spectrum in the 1452 -1492 MHz range to TIM and Vodafone.

Jersey

On July 23, 2014 regulator CICRA confirmed LTE-suitable spectrum had been awarded to applicants **Airtel JT**, and **Sure**.

JT commercially launched LTE-Advanced on February 13, 2015. 800 MHz and 1800 MHz are used across the island and additionally 2.6 GHz in towns. Theoretical peak downlink speeds are 150 Mbps with a Cat 4 device and 300 Mbps with a Cat 6 device.

Sure commercially launched Channel Islands wide 4G/LTE service on May 31, 2015.

Airtel-Vodafone commercially launched LTE in July 2015.

Kazakhstan

Altel (CDMA operator) (JSC Kazakhtelecom and JSC ALTEL) commercially launched LTE1800 branded ALTEL4G in Astana and Almaty on December 25, 2012. By mid-May 2015 LTE coverage was available to 56% of the population. VoLTE is in deployment. THE CDMA operation will close on July 1, 2015.

Tele2 is interested to deploy LTE. **Kcell** plans to deploy LTE and on July 29, 2010 announced installation of a base station in Astana to showcase LTE. On April 26, 2010 **Beeline** confirmed completion of LTE tests in 700 MHz, and in October 2010 announced launch of a pilot network in Almaty.

TeliaSonera acquired the WiMAX™ operations of Alem Communications including a network in 6 major cities and 2.6 GHz (band 38) spectrum, which is compatible for other technologies e.g. LTE TDD.

Frequencies to be allocated by the government for LTE include 700MHz, 800 MHz, 2.3 GHz & 2.6 GHz.

Kosovo

IPKO started a test phase on November 24, 2014 and commercially launched LTE1800 service to all its mobile users on December 11, 2014 in central parts of Prishtina and the international airport.

Vala commercially launched LTE1800 on April 28, 2015.

Regulator ARKEP is preparing to allocate additional technology neutral 1800 MHz spectrum to IPKO and Vala following requests each made earlier in 2015. ARKEP is also preparing to allocate spectrum in the 3.4 – 3.8 GHz range by auction (timescale unclear).

Kyrgyzstan

Saima Telecom launched commercial 2.6 GHz FDD LTE services in Bishkek on December 9, 2011.

The National Communications Agency allocated spectrum for LTE and WiMAX™ to 12 companies: **Asialnfo, Global Telecom Asia, ToTel, Aknet, Kurulush Invest, T-Com, Fraton Plus, Aytel, Foris Telecom, WTT, Saima Telecom** and **Intranet KG**.

Nur Telecom branded as **O!** commercially launched LTE in Bishkek on May 8, 2014 using 2.6 GHz (band 7) supporting theoretical peak downlink of 150 Mbps.

Nur Telecom (O!), Sky Mobile (Beeline) and **Megacom** are reported to have won 800 MHz band 20 spectrum in an auction held in September 2015.

Latvia

LMT commercially launched LTE1800 on May 31, 2011; population coverage reached 72% by November 2014. 150 Mbps LTE-Advanced was commercially launched on November 5, 2014, combining spectrum in bands 3 and 7.

Tele2 commercially launched LTE in December 2013 using 1800 MHz (LTE1800). Tele2 also purchased 800 MHz spectrum for use from July 1, 2015 and also uses 2.6 GHz. Tele2 achieved 90% population coverage with LTE assisted by 800 MHz spectrum, which was brought into use on July 1, 2015.

Bite commercially launched LTE and LTE-Advanced on May 5, 2015 (branded 4G and 4G+ respectively) in Riga and nearby vicinities (Marupe, Pinki, Babītes, Tīraines Bukultu, Carnikavas, Adazi, Kadaga, erection, Upesciema, Mucenieku, Ulbrokas, Sauriesi, Salaspils, Olaine, Jaunolaine, Ikšķile, Skulte, Baloži, Ķekavas) as well as Jurmala, Ogre, Sigulda and Saldus locations together covering 42% of the population, planning 70% by end 2015 and 90% by Q1 2016. Two carrier aggregation combines bands 3 and 7 for 300 Mbps peak downlink. 800 MHz is used in rural areas and as supplementary for carrier aggregation in cities. Single band 1800 MHz sites are mainly in cities. 2.6 GHz is the capacity layer.

Fixed operator **Lattelecom** is reported to be ready to offer LTE services, subject to shareholder approval and carried out tests in 850 MHz in 2011.

CDMA operator **Triatel** tested LTE in 800 MHz. Triatel owns 450 MHz spectrum.

LMT, Tele2, Bite and **Baltcom** won 2.6 GHz spectrum for use from January 1, 2014. 4.7 million Euros was raised from an auction of 800 MHz (band 20) spectrum in October 2013. **Bite**, **LMT** and **Tele2** each won 2 x 10 MHz for use from July 1, 2015.

Liechtenstein

Regulator AK has approved technology neutral use of 800, 900, 1800 MHz and 2.1 GHz spectrum.

Orange Liechtenstein commercially launched LTE1800 on September 2, 2013 with 91% population coverage. Enhancement of peak theoretical downlink speed from 100 Mbps to 150 Mbps is planned.

FL1 (Telecom Liechtenstein) commercially launched 150 Mbps LTE in band 20 on February 1, 2015.

Swisscom Liechtenstein commercially launched 150 Mbps LTE on March 5, 2015. The network uses 900 MHz, 1800 MHz and 2.1 GHz. VoLTE was commercially launched on June 10, 2015.

Lithuania

Regulator RRT confirmed its 2.6 GHz auction result on March 20, 2012. Winners were **Omnitel**, **Tele2** and **Bite**.

In October 2013 RRT announced the results of an auction of 800 MHz (band 20) licences comprising one 10 MHz paired plus 4x 5 MHz paired blocks:

Bite won 791-801 / 832-842 MHz
Omnitel: 801-806/842-847 & 806-811/847-852 MHz
Tele2: 811-816/852-857 & 816-821/857-862 MHz

Omnitel commercially launched LTE on April 28, 2011 in Vilnius, Kaunas, Klaipėda, Šiauliai and Panevėžys using 1800 MHz (LTE1800). Omnitel won 2 x 20 MHz of 2.6 GHz in the March 2012 auction. The LTE network covered 70% population (November 2014) with the use of 800 MHz spectrum, increasing to 90% by May 2015. On November 6, 2014 Omnitel announced LTE-Advanced technology had been tested, followed by commercial launch on December 5, 2014 of up to peak throughput of 200 Mbps in Vilnius, Kaunas, Klaipeda, Siauliai and Panevezys.

Tele2 won 2 x 20 MHz of 2.6 GHz and commercially launched LTE in Alytus, Jonava, Marijampole, Mazeikiai, and Utena in March 2013. 1800 MHz was used from September 2013. 800 MHz is also used. Tele2 may also deploy LTE in 900 MHz, 2.1 GHz and 2.6 GHz spectrum. 90% LTE population coverage has been achieved (September 2015). LTE-Advanced entered commercial service in January 2015 with 10 MHz band 20 and 15 MHz band 3 for theoretical peak downlink speed of 210 Mbps. On August 3, 2015 Tele2 announced commercial launch of LTE-Advanced in 12 cities, representing 20% of the country's population. The initial cities with coverage were Vilnius, Kauno, Klaipėdos, Šiaulių, Panevėžio, Jonavos, Mažeikių, Alytaus, Marijampolės, Nidos, Palangos and Šventosios.

Bite Lithuania commercialy launched a 300 Mbps LTE-Advanced network on April 15, 2015. Two carrier aggregation is deployed with 2 main combinations: 800 + 1800 MHz (225 Mbps) and 1800 MHz + 2.6 GHz (300 Mbps). Single 800 MHz LTE sites are deployed in rural areas, with 1800 MHz mainly in the cities. 2.6 GHz is the capacity layer. Initially the network served 46% of the population in the 5 largest cities: Vilnius, Kaunas, Klaipeda, Siauliai and Panevezys, as well as the coastal resorts of Palanga and Nida. The company plans to reach 75% population coverage by end 2015 & 90% by Q1 2016.

WiMAX™ operator **LRTC (Telecentras)** is upgrading to a TDD LTE-Advanced system. The infrastructure supplier has been selected. Telecentras is currently testing LTE-Advanced technology.

Luxembourg

Regulator Institute Luxembourgeois de Régulation (ILR) introduced technology neutral licences for POST, Orange and Tango and granted extra 1800 MHz spectrum at their request.

- **Tango** commercially launched LTE1800 on October 1, 2012, 150 Mbps theoretical peak
- **Orange** commercially launched LTE1800 on October 29, 2012. 85% population coverage was achieved by mid-December 2014.
- **POST** (formerly P&T) commercially launched LTE1800 in October 2013.

Tango launched 225 MBps LTE-Advanced (branded 4G+) on December 15, 2014 using bands 3 and 20.

Macedonia

Regulator AEC held an auction for 800 MHz (band 20) and 1800 MHz spectrum. In August 2013 **VIP mobile, ONE** (Telekom Slovenije Group) and **T-Mobile** were each awarded blocks of 2 x 10 MHz in 800 MHz and 2 x 15 MHz in 1800 MHz spectrum.

T-Mobile commercially launched LTE service using 800 MHz and 1800 MHz on December 2, 2013 in most of Skopje and Mavrovo for customers owning LTE devices and the appropriate type of SIM. By March 2015 coverage extended to 50% of population.

VIP commercially launched LTE service using 800 MHz and 1800 MHz spectrum on July 2, 2014.

ONE commercially launched LTE service using 800 MHz and 1800 MHz spectrum on August 29, 2014.

AEC is consulting on allocating 2.6 GHz for mobile systems.

Malta

Vodafone commercially launched LTE1800 on November 1, 2013 in Valletta, Sliema and St. Julians.

On January 18, 2015 Vodafone announced 70% population coverage.

GO plans to launch its fully fibre connected 4G/LTE service in 2015.

Regulator Malta Communication Agency (MCA) plans an auction of 800, 1800 MHz, and 2.6 GHz bands.

Moldova

Following receipt of a 2.6 GHz license from regulator ANRCETI a few days earlier, **Orange** commercially launched LTE on November 20, 2012 in Chișinău. By November 2013 LTE reached 10 cities i.e. 30% of the population. 150 Mbps (Cat 4) was offered in 12 major cities from February 28, 2014. International LTE roaming has been established between partner networks in France, Romania and Spain.

Moldcell commercially launched LTE for corporate users using 2.6 GHz on November 16, 2012; commercial service was extended to all customers on December 24, 2012. Moldcell acquired new licences & spectrum for use from November 6, 2014 continuing use of 900 MHz and buying new technology-neutral band 3 & band 20 spectrum. Moldcell will abandon using 2.1 GHz and 2.6 GHz.

Moldtelecom (Unite) is expected to receive new 900 MHz and 1800 MHz spectrum shortly.

CDMA operator **InterDnestrCom (IDC)** commercially launched LTE in 800 MHz in Trans-Dniester in Tiraspol, connecting its first customer April 21, 2012.

ANRCETI offered 4G licences to each of the 3 mobile networks in the ranges 2500-2690 MHz and 3400-3800 MHz. In July 2015 ANRCETI launched a consultation on its intended allocation of 2500-2690 MHz and 3400-3800 MHz spectrum and a separate consultation about 800 & 900 MHz spectrum for LTE. ANRCETI subsequently invited applications for licences. 16 licences will be auctioned, comprising 1 in band 20 (800 MHz), 2 in band 8 (900 MHz), 2 in band 1 (2.1 GHz), 3 in band 7 (2.6 GHz), and 8 licences in bands 42 and 43 (3.4-3.8 GHz). Applications to be submitted by November 13, 2015.

Monaco

Monaco Telecom commercially launched 2.6 GHz LTE on October 1, 2013 in 98% of the Principality. 223 Mbps LTE-Advanced adding 800 MHz band 20 spectrum was launched as 4G+ in January 2015.

Montenegro

Telenor commercially launched 2.6 GHz LTE on November 8, 2012 in Podgorica, Bar, Niksic, Cetinje.

Crnogorski Telekom commercially launched LTE1800 on November 28, 2013 with 18 new base stations in Podgorica, Nikšić, Budva, Bar, Kotor, Tivat and Herceg Novi for 38% population coverage. By November 2014 LTE covered every city, equivalent to 62% population coverage. 150 Mbps has been introduced in parts of the network. 300 Mbps LTE-Advanced technology is being trialled.

Velatel (Montenegro Connect) has 40 MHz in 3.5 GHz and is deploying an LTE TDD network.
Regulator EKIP is considering auctioning 80 MHz band 20 and unused 2.6 GHz spectrum during 2015.

Netherlands

2.6 GHz FDD spectrum was auctioned in April 2010, and awarded to **KPN**, **Vodafone**, **T-Mobile**, **Ziggo 4** and **Tele2**. TDD spectrum was unsold.

Vodafone NL commercially launched LTE using 2.6 GHz in Eindhoven on May 1, 2012. Amsterdam, The Hague, Rotterdam, and Utrecht followed on August 5, 2013 using 800 MHz and LTE1800. Nationwide coverage (95% of population) was confirmed on September 30, 2014. LTE-Advanced was launched in Amsterdam on September 30, 2014, combining 20 MHz Band 3 and 10 MHz Band 20 spectrum. Vodafone plans to launch VoLTE in 2015.

Ziggo commercially launched LTE on May 3, 2012 for Internet Plus business users in Breda, Oss, and Zwolle.

Tele2 commercially launched its LTE-only network in 2.6 GHz band 7 on May 8, 2012 in Amstelveen, Amsterdam, Haarlem, Lelystad and Tilburg. 800 MHz was brought into use in January 2015. On December 12, 2014 Tele2 announced a “Pioneer Package” tariff for LTE-Advanced service from March 2015 initially

available in the Randstad; nationwide planned by 2016. Tele2 is deploying VoLTE.

KPN commercially launched LTE in 2.6 GHz on May 11, 2012 in The Hague and Utrecht for business users. Commercial service using 800 MHz was launched in Amsterdam in February 2013. Refarmed 1800 MHz (LTE1800) was brought into use in 2014. The LTE network now covers over 95% population. Over 2 million LTE subscriptions were connected by end 2014. Several international roaming partnerships have been announced. KPN trialled LTE Broadcast technology during an Ajax soccer game in Amsterdam on May 3rd, 2014. KPN commercially launched LTE-Advanced carrier aggregation combining band 3 and band 20 spectrum on July 1, 2014 in Amsterdam, Schiphol, Rotterdam, Utrecht, The Hague and Eindhoven where a large portion of KPN's 4G customers live. A trial of carrier aggregation combining 800 MHz, 1800 MHz and 2.6 GHz spectrum achieved 297 Mbps in Delft in February 2015. 225 Mbps carrier aggregation (20 MHz B3 + 10 MHz B20) was introduced on the live network in April 2015.

A VoLTE trial was started in July 2014, and international VoLTE roaming trials are being conducted with China Mobile.

T-Mobile commercially launched LTE on May 11, 2012 for business users in Delft, Gorinchem, Leiden, Rotterdam and The Hague in 2.6 GHz. LTE1800 was launched for the consumer launch on November 18, 2013. The company brought 900 MHz spectrum into use in mid-2015 and plans to cover the Randstad by mid-August 2015 with rollout extending beyond that afterwards. The company pledged nationwide LTE coverage using 1800 MHz by October 2015. 150 MBps peak is now supported using LTE1800. **T-Mobile** has an active site sharing agreement with **Tele2** using 800 MHz and 2.6 GHz spectrum.

T-Mobile NL plans to launch VoLTE by mid-2016.

Regulator OPTA auctioned 800, 900 and 1800 MHz spectrum on October 31, 2012. 2 x 10 MHz of 800 MHz and 2 x 5 MHz of 900 MHz was reserved for new entrants. The sale to KPN, Vodafone and T-Mobile earned 3.8 billion Euros. Ziggo-UPC withdrew.

Norway

Norway held Europe's first 2.6 GHz spectrum auction in 2007, Awards were made to **TeleNor** and **TeliaSonera** (**NetCom**); total allocation 2 x 90 MHz.

TeliaSonera launched the world's first LTE networks in Oslo (NetCom) and Sweden using 2.6 GHz spectrum in December 2009. TeliaSonera also commercially used refarmed 1800 MHz (LTE1800) in its NetCom network from Q4 2011. 800 MHz was used to reach 65% pop coverage by end April 2014.

TeleNor deployed its LTE network initially using 2.6 GHz. Commercial service launch was confirmed on October 10, 2012 for customers in 11 cities and towns: Oslo, Bergen, Trondheim, Stavanger, Lørenskog, Sandnes, Lillestrøm, Asker, Bærum, Lofthus. Longyearbyen. Fredrikstad, Sarpsborg, Skien, Porsgrunn, Drammen and Kristiansand were covered by end 2012. LTE1800 is now also used in Tromsø. Telenor also brought 800 MHz into service, and plans for LTE to reach 90% pop coverage by 2015 and 99% by end 2016. 300 Mbps LTE-Advanced was launched in over 200 municipalities on April 10, 2015 combining band 3 either with band 20 or band 7 depending on location.

In December 2014 Telenor conducted its first public demonstration of a call using VoLTE. Rollout is planned in 2016.

Telenor commercially launched its 4G+ 300 Mbps LTE-Advanced service on April 10, 2015 in over 200 municipalities.

Tele2 Norge offered LTE to its customers in 2014 as an MVNO on the Netcom network. Tele2 was not successful in acquiring spectrum to support deployment of its own LTE network and in July 2014 announced the company's sale to TeliaSonera. The Norwegian Competition Authority Nkom (formerly NPT) approved the sale.

Nkom held a spectrum auction starting on December 2, 2013. Results:

Telenor won 2 x 10 MHz of 800 MHz, 2 x 5 MHz of 900 MHz and 2 x 10 MHz of 1800 MHz.

TeliaSonera won 2 x 10 MHz of 800 MHz, 2 x 10 MHz of 1800 MHz and 2 x 5 MHz of 900 MHz.

Telco Data (Access Industries, owner of Ice.net) won 2 x 10 MHz of 800 MHz and 2 x 5 MHz of 900 MHz and 2 x 20 MHz of 1800 MHz.

Ice.net (formerly Telco Data AS) is deploying a nationwide LTE450 network in 2015, replacing its CDMA system. LTE will also be deployed later in 800, 900, and 1800 MHz spectrum. VoLTE will be trialled.

Maritime telecommunications operator **Maritime Communication Partner (MCP)** is deploying an LTE network on the Norwegian Continental Shelf MCP, in addition to its existing GSM-based phone and internet access service for offshore companies. MCP obtained 800 MHz band 20 spectrum from Nkom in August 2014.

Nkom plans to auction the unsold 2x15 MHz of 1800 MHz spectrum and published a preliminary timeline:

- 20 April 2015: Public consultation of draft auction rules etc.
- 1 June 2015: Deadline for consultation responses
- 29 June 2015: Final auction rules will be published
- 1 October 2015: Open for registration as a bidder in the auction
- 26 October 2015: Deadline for registration as a bidder in the auction
- 9 November 2015: Auction start

900 MHz spectrum licences currently allocated to Telenor and Teliasonera will expire in 2017. Nkom opened a consultation in June 2015 concerning the planned spectrum sale in mid-2016.

Poland

The world's first LTE1800 network was deployed by Aero2 and commercially launched on September 7, 2010 by **Mobyland** and **CenterNet**. The primary customer is **Cyfrowy Polsat** – an MVNO, who launched commercial services on August 30, 2011. *(GSA does not categorize MVNOs as "networks" - therefore Cyfrowy Polsat is not included in GSA's list of commercially launched LTE networks).*

In November 2009 **Aero2,** a member of the Global TD-LTE Initiative, acquired 50 MHz in Band 38 for LTE TDD. After testing in Aleksandrów Łódzki and Łódź, Aero2 announced launch of their LTE TDD network in May 2011 and start of availability of their dual LTE network, since Aero2 had already deployed an LTE1800 network. Aero2 brought 800 MHz band 20 spectrum into service on March 24, 2015.

Polkomtel was acquired on June 30, 2011 by Spartan Capital Holdings, which is indirectly controlled by Zygmunt Solorz-Zak, chairman/founder of Cyfrowy Polsat, and who controls Aero2, owner of Mobyland. Polkomtel operates a GSM 900/1800 and 3G/2100 network. Polkomtel launched commercial LTE services as an MVNO on November 29, 2011 under its **Plus** brand, utilizing the LTE 1800 and HSPA+900 networks of Aero2 and Mobyland/Centernet in 16 major cities, representing 22% population coverage.

Polkomtel's LTE1800 network was commercially launched in September 2012. The company's Plus LTE network covers two thirds of the population (January 2014). **Polkomtel** and **Cyfrowy Polsat** have trialled LTE-Advanced using 20 MHz B3 and 20 MHz B7 spectrum, reaching 225 Mbps downlink data speed. Tri-band carrier aggregation has been trialled. In September 2014 Polkomtel confirmed completion of VoLTE trials. Polkomtel trialled eMBMS-enabled LTE Broadcast at a World Volleyball Championship match in Warsaw on August 30, 2014.

Sferia held 850 MHz spectrum (band 5) in which LTE technology was being deployed as part of their co-operation with NFI Midas for constructing their existing LTE network, used by Polkomtel and by MVNO Cyfrowy Polsat. NFI Midas is a private equity fund focused on the telecommunication, media and technologies sectors and forms a capital group committed to provision of LTE technology. As a result of legal arguments where it was stated Sferia could not use this band as intended, Sferia was instead allocated a 5 MHz paired block of 800 MHz digital dividend spectrum (band 20) for LTE deployment for use from January 1, 2015 in return for handing back some of the 850 MHz spectrum. LTE 850 is now being eployed, and the company plans to launch VoLTE.

6 companies including Sferia made bids for 5 lots of 1800 MHz auctioned by regulator UKE, which ended mid-February 2013. Winners: **Play** and **T-Mobile.**

Orange Polska commercially launched LTE1800 service on September 10, 2013. By July 2015 coverage was available to around 30 million people.

Tri-band LTE-Advanced carrier aggregation has been trialled. Two spectrum combinations were tested and in both cases a download speed of 296 Mbps was achieved:
- 10 MHz band 20 + 10 MHz band 3 + 20 MHz band 7
- 10 MHz band 20 + 10 MHz band 7 + 20 MHz band 7

Play commercially launched 150 Mbps LTE1800 in 13 cities on November 11, 2013. After one year Play covered 64% population across 1,500 cities and towns. Launch of international roaming services was announced in December 2014 using a wholesale IPX platform roaming partner.

Orange Polska (PTK Centertel) and **P4** (Play) are deploying a shared LTE network and this JV was allowed to bid in the 2.6 GHz auction.

T-Mobile (formerly PTC/ERA) commercially launched LTE1800 on June 5, 2014 under the "Jump" brand with initial coverage of 45% of the population, planned to rise to over 50% by the end of June 2014.

WiMAX™ operator **Milmex** in southern Poland, plans to launch 3.5 GHz LTE TDD and also seeks LTE-suitable 800 MHz and 2.6 GHz spectrum.

On December 30, 2013 regulator UKE announced plans to auction 800 MHz (band 20) and 2.6 GHz (band 7). Bids were required by February 13, 2014. The auction was cancelled because a technical problem meant that clarifications about the auction rules were unavailable for a time. The auction restarted on February 10, 2015. Polkomtel withdrew from bidding for band 20 spectrum. Orange withdrew from bidding for one 2.6 GHz block in March 2015. The auction was still running at the time of writing of this report, with bids passing 7.39 billion Polish Zloty (almost 2 billion US dollars).

Portugal

Regulator **ANACOM** announced the results of its auction on December 12, 2011 after 9 bidding rounds. 800 MHz, 1800 MHz and 2.6 GHz spectrum was sold to the 3 incumbents. **Vodafone** also acquired 2 x 5 MHz of new 900 MHz spectrum, but another block was not sold. Spectrum in 450 MHz and 2.1 GHz was not sold.

Meo launched commercial LTE service on March 12, 2012 in 2.6 GHz. Population coverage passed 80% in April 2012 when 800 MHz spectrum was brought into use. 1800 MHz was brought into commercial use in September 2012. 300 Mbps LTE-Advanced was commercially launched in October 2014. To achieve this 20 MHz B7 and 20 MHz B3 is used with carrier aggregation. Some sites have 225 Mbps service which is achieved using 20 MHz B7 and 10 MHz B20.

Vodafone commercially launched LTE FDD service on March 12, 2012 in 2.6 GHz and 800 MHz. LTE1800 was brought into service in October 2012. Current peak speed is theoretical 150 Mbps peak. On December 16, 2013 the company announced it had achieved 300 Mbps downlink in an LTE-Advanced trial using carrier aggregation combining 1800 MHz and 2.6 GHz spectrum, which was commercially launched on October 20, 2014. The first Cat 6 device (CPE Vodafone 4G B4000) went on sale on June 9, 2014. In November 2014 Vodafone announced improved trial speeds up to 450 Mbps. On July 27, 2015 Vodafone announced results of another trial, where 600 Mbps was achieved using three 20MHz blocks and 256 QAM equipment. Vodafone is also trialling FDD-TDD convergence combining 20 MHz Band 38 (2.6 GHz) and 15 MHz Band 3 (1800 MHz).

Vodafone commercially launched VoLTE HD voice service on September 28, 2015.

Nos (formerly **Optimus)** commercially launched LTE on March 15, 2012 using LTE1800 plus 2.6 GHz in more dense areas. 800 MHz is used in rural areas. Nos trialled 300 Mbps LTE-Advanced in 2013.

ANACOM launched a public consultation about the use of 3.5 GHz, to which comments were required by May 25, 2015.

Romania

On July 2, 2012 regulator ANCOM published the rules for the auction of 800 MHz, 900 MHz, 1800 MHz and 2.6 GHz spectrum for mobile communications services in the 2013-2029 timeframe. The auction was held on September 10, 2012.

Orange acquired new spectrum in the 800, 900, 1800 and 2.6 GHz bands in the auction. Orange commercially launched LTE1800 service on

December 12, 2012 in Bucharest and holiday resorts. Coverage now exceeds 90 cities and over 1,000 localities representing 45% of the population. Theoretical peak downlink speed was increased from April 7, 2014 to 150 Mbps. Testing of 300 Mbps Cat 6 was undertaken in April 2014 in selected locations and commercially launched using 20 MHz band 3 combined with 20 MHz band 7 spectrum on September 22, 2014 in Bucharest, Brasov, Cluj-Napoca, Galati, Iasi and Timisoara. VoLTE HD voice service was launched on September 14, 2015.

Vodafone acquired additional 800, 900, 1800 and 2.6 GHz spectrum for EUR 228.52 million. On October 31, 2012 Vodafone announced pilot LTE1800 networks had been deployed. Commercial LTE1800 service was launched in 10 cities (Arad, Bacau, Brasov, Bucharest, Cluj, Constanta, Craiova, Iasi, Galati and Timisoara) on November 20, 2012. The LTE network covered 19 cities representing 90% of population by June 2014. **Vodafone** announced it has raised theoretical downlink peak speed to 150 Mbps (Cat 4) under its Supernet brand, and testing of 300 Mbps Cat 6 ahead of planned launch in 2015. On November 5, 2014 Vodafone announced launch of a test phase of its Call+ service using VoLTE.

Vodafone has enabled LTE roaming in 15 countries, the latest additions being Austria, Belgium, South Korea, Switzerland, France, Germany, Norway, New Zealand, The Netherlands, Taiwan and the UK.

Orange and **Vodafone** formed a network JV company (Ovidiu) for expansion and rural coverage.

Cosmote acquired 1 block in 800 MHz, 2 blocks in 900 MHz, 5 blocks in 1800 MHz & 2 blocks in 2.6 GHz. Comsote commercially launched LTE1800 data service on April 29, 2013 in Bucharest, Otopeni, Ploiesti, Cluj, Iasi, Sinaia, Busteni, & Predeal. Theoretical peak downlink speed has been increased to 150 Mbps.

RCS & RDS (Digi) initially planned to deploy LTE in newly acquired 900 MHz spectrum, though 3G had been the priority, and acquired **2K Telecom** in August 2015. **2K Telecom** won 2 blocks of 15 MHz of 2.6 GHz TDD spectrum (band 38) and commercially launched using the Idilis service brand in March 2015.

In October 2012 ANCOM published a draft Decision proposing to allow use of 900 and 1800 MHz for 4G (including LTE). 4G systems may also be deployed using 800 MHz and 2.6 GHz from 2014. Operators may choose whether to implement new technologies in these frequencies, deployment timescale, and date of commercial service launch. The draft decision is subject to consultation before becoming effective.

In January 2014 ANCOM opened a consultation regarding one 5 MHz block of 800 MHz (band 20) and eight 5 MHz blocks of 2.6 GHz (band 7) spectrum left unsold in the September 2012 auction.

3.4-3.8 GHz spectrum will be offered in 2015. The deadline for applications was October 5, 2015. Orange, Vodafone, RCS&RDS (Digi), National Radiocommunications Company (SNR) and 2K Telecom submitted bids. 10-year concessions will commence on January 1, 2016. The 3.410 - 3.6 GHz band is currently allocated to Orange, Vodafone, UPC and 2K Telecom (Idilis). Radicom has the only 3.6 – 3.8 GHz licence.

Russia

MTS, Vimpelcom, Tele2, MegaFon and **Rostelecom** are committed to deploying LTE. The Regulator in principle admits that technology neutrality can be applied to 900/1800MHz spectrum. However, to avoid GSM service quality deterioration if LTE is launched alongside GSM frequencies this topic was examined further in a study in 2012.

On February 2, 2012 **MTS** announced the company had been awarded the first license to provide LTE services in Moscow and the Moscow region. The license granted is for LTE TDD deployment in the 2595 – 2620 MHz range (in band 38) and is valid until December 29, 2016. **MTS** announced commercial launch of its LTE TDD service (replacing its WiMAX™ service) on September 1, 2012 initially covering most of Moscow and 40 population centers in the surrounding Moscow region. **MTS** has tested VoLTE in St Petersburg and in May 2014 announced completion of the first VoLTE call using Cloud infrastructure.

Tele2 Russia requested permission to deploy LTE1800. In October 2011 Tele2 indicated it would conduct an independent trial of LTE technology in the

1800 MHz band, and applied to the State Commission for Radio Frequencies (SCRF) for permission to run tests in Pskov and Omsk, setting aside 5 MHz of spectrum in 1800 MHz for the tests. Tele2 has already provided the results of earlier research commissioned by themselves as well as from reports by leading global manufacturers of telecommunication equipment showing that GSM and LTE networks can operate simultaneously in the 1800 MHz frequency band. The efficiency of this solution was clearly demonstrated by research carried out and published in a report by the Global mobile Suppliers Association (GSA) – this free report "Embracing the 1800MHz opportunity: Driving mobile forward with LTE in the 1800MHz band" may be downloaded by registered GSA website site users at http://www.gsacom.com/lte1800

Tele2 Russia announced successful completion of tests by end March 2012 in trial zones in Omsk and Pskov. Tests were performed according to a method developed by the State Radio Institute and with the assistance of its experts, and intended to demonstrate that LTE and GSM technologies can share the same frequencies without degrading the quality of end user service. Tele2 showed that the test results confirmed that there was no service quality degradation in the GSM network, while the data transmission rate in the LTE network reached 75 megabits per second. A detailed report on the LTE technology testing in the 1800 MHz band was prepared by NIIR and submitted to the State Commission for Radio Frequencies.
www.en.tele2.ru/news.html?year=2012&month=3&news_id=6170

Tele2's then-owners exited from Russia with the announcement on April 4, 2013 that the business had been sold to Russian bank VTB Group following receipt of FAS approval. VTB purchased 100% of the business for subsequent resale.

On June 20, 2013 Tele2 announced launch of LTE testing in 1800 MHz in its network in Kaluga Region. The tests comply with the methodology drafted by NIIR and aim to confirm that the use of LTE and GSM technologies in the same frequency range is efficient and does not entail deterioration of quality. Tele2 and NIIR completed the tests by 24 June 2013. NIIR produced the detailed report on LTE tests in 1800 MHz for the State Commission for Radio Frequencies (GKRCh). The GKRCh confirmed on December 11, 2013 that technology neutrality is allowed, allowing LTE to be deployed in 1800 MHz (LTE1800).

In December 2013 the board of **Rostelecom** approved the plan to contribute its mobile assets into a joint venture with **Tele2 Russia**. The new company will be known as LLC **T2 RTK Holding** (with Tele2 brand). A Tele2 Russia press release on March 28, 2014 stated that *"Tele2 and Rostelecom have closed the first stage of the deal on integrating Rostelecom's mobile assets into the Tele2 structure. On March 28, Tele2 got Rostelecom's seven mobile subsidiaries under its operational and financial control: SkyLink, Nizhniy Novgorod Mobile Networks, Baykalvestkom, BIT, Volgograd GSM, Enisey Telecom and AKOS. Tele2 is actively working on integrating all Rostelecom mobile business into its structure. Tele2 business processes will be introduced at Rostelecom assets, their organizational model will be correlated with the one accepted in Tele2. Rebranding of subsidiary companies will be held as a part of their integration into the Tele2 structure. Setting up the new company will be legally completed following the second stage of the deal (scheduled to be closed over the year) and after 100% of CJSC RT Mobile shares have been transferred into the joint venture. After the integration of all mobile assets VTB Group structures and its partners will owe at least 55% of the new operator whereas the share of Rostelecom will amount to 45%. The new company will provide services in over 60 Russian regions with a subscriber base of over 38 million people."*
Tele2 Russia commercially launched LTE1800 on December 17, 2014 in Tula and settlements of the Leninsky district, Shchekin, Novomoskovsk, knots, Don, North Zadonsk, Sokolniki and Aleksinon. Rollouts in major cities are planned during 2015. Coverage was launched in St Petersburg in June 2015.

MegaFon and **Rostelecom**, general partners of the Sochi 2014 Winter Olympic Games, successfully tested LTE networks close to the key Sochi site of Roza Khutor. The Defence Ministry has reportedly given **Rostelecom** approval to deploy LTE TDD in 2.3 GHz spectrum. **MegaFon** showcased LTE at the IX International Investment Forum (Sochi) in Sept 2010. **Rostelecom** activated LTE sites in Krasnodar and in Sochi for the Winter Olympics.

Megafon acquired WiMAX™ operator **Synterra** in 2010, and commercially launched LTE TDD using 2.6 GHz (band 38) spectrum in Moscow on September 1, 2012. **Megafon** also had an agreement with Yota and since 1H 2012 had been operating as an MVNO over Yota's LTE network in Moscow and other cities.

In September 2011 SCRF issued an authorization for **Yota** (Skartel) to deploy an LTE FDD network in 2.6 GHz spectrum in 180 cities. **Yota** is shifting from WiMAX™ to LTE and launched commercial LTE FDD service in Novosibirsk, Siberia on January 15, 2012 following a friendly-launch test phase that began on December 20, 2011. **Yota** launched commercial LTE service in Moscow on May 10, 2012, Krasnodar (also on May 10), and Sochi (May 11) and plans to deploy 1,550 LTE-enabled base stations instead of current WiMAX™ equipment. Service has since been launched in several other locations. In October 2012 Yota announced that a test LTE-Advanced network had been deployed in Moscow, featuring Carrier Aggregation (Release 10 feature). Yota is also implementing VoLTE with SRVCC. *See information below about the company's acquisition by Megafon.*

In September 2011, **VimpelCom** announced an LTE network-sharing deal with rival **MTS**.

Military operator **OJSC Osnova Telecom** has a license for 2.3 GHz LTE TDD. On November 28, 2013 the company announced technical readiness to launch LTE but commercial launch has been delayed indefinitely due to legal/regulatory issues. The company has trialled TDD LTE-Advanced in its laboratory achieving a downlink speed of 226.1 Mbps.

Vainakh Telecom deployed a commercial LTE TDD network in 2.3 GHz (band 40) in Chechnya. Commercial service launch in Grozny was delayed from early 2013 because of a dispute about local equipment manufacturer certification. Commercial service was officially launched on September 3, 2013.

GSM1800 regional operator **MOTIV** commercially launched LTE1800 on November 6, 2014 after 6 weeks of public user trials in 4 Russian Regions: Sverdlovskaya, Kurganskaya, Khanty-mansiskiy AO, and Yamalo-nenetskiy AO.

SMARTS Group has deployed a pilot LTE trial network in Ufa comprising at least 7 base stations and re-uses SMARTS' existing 1800 MHz spectrum. The trial involved cooperation of the NIIR and the findings were presented to SCRF. SMARTS has committed to deploy a commercial LTE1800 system.

Regional operator **JSC Tattelecom** (Republic of Tatarstan) commercially launched LTE on June 27, 2014using 1800 MHz acquired from the purchase of SMARTS-Kazan. Tattelecom is the first operator to commercially launch an LTE1800 network in Russia, and at launch operated 228 LTE base stations.

3.5 GHz WiMAX™ operator **Enforta,** providing services to business users in 172 cities, tested LTE TDD in Kemerovo. A commercial network will not be built as the company has agreed to give up these frequencies for use by others for LTE deployments.

Smoltelecom is planning to introduce LTE TDD and is a member of the Global TD-LTE Initiative.

On May 3, 2012 Russian regulator Roskomnadzor published the conditions for application for and subsequent awarding of LTE licences in 791-862 MHz spectrum, comprising four lots, each consisting of two 7.5 MHz blocks in the range of 791-862 MHz. Recipients of each of the lots would also be awarded two 7.5 MHz blocks in the 720-791 MHz range and two 10 MHz blocks in the 2500 – 2690 MHz range. All licences are nationwide. Eight companies submitted bids to participate in the auction, **MegaFon, Vimpelcom, MTS, Rostelecom, Summa Telecom, TTK, Tele2-Voronezh, and Tele2-Omsk.** LTE licences were granted to **MTS, Vimpelcom, Megafon,** and **Rostelecom** with the conditions that the networks must be launched by mid 2013, annual investment targets must be met (RUB 15 billion), and nationwide coverage by 2019. Each operator was granted spectrum within band 20 (720-750 MHz and 761–791 MHz) plus 2,500–2,690 MHz spectrum.

TTK owns 3.5 GHz spectrum and is deploying WiMAX™. TTK launched a LTE test network in the Voronezh region in May 2013. TTK is reported to be planning to buy **Antares Telecom**. Antares has deployed 5 LTE base stations for a trial network using 1900 – 1920 MHz (Band 39) spectrum in Moscow.

Megafon commercially launched LTE FDD service on May 14, 2013 in Moscow using its own network and 2 x 10 MHz of 2.6 GHz (band 7) spectrum. Currently **Megafon** has commercial LTE service in 53 regions

of Russia. It has not been possible to bring 800 MHz into use so far due to negotiations with the military.

Megafon obtained regulatory approval for its proposed takeover of **Skartel (Yota)** and formally announced on October 1, 2013 its acquisition of Maxiten, the holding company controlling Skartel/Yota. As a result MegaFon obtained 40 MHz of 2.6 GHz spectrum and 648,000 LTE subscribers. The Yota LTE network covered 27% of the population. On April 24, 2014 MegaFon announced completion of the key processes of the integration of Skartel (Yota), 100% of the shares of which were purchased by Megafon.

On February 25, 2014 **MegaFon** announced the commercial launch of the world's first 300 Mbps LTE Advanced network, supporting Cat 6 user devices, and using a combination of its own 2.6 GHz spectrum and 2.6 GHz allocated to Skartel. The service was initially launched within the Garden Ring in Moscow. The company plans to expand coverage to include Russia's largest cities. 300 MBps LTE-Advanced service was later launched in St Petersburg. A new brand name, 4G+, is used to promote mobile Internet from MegaFon. LTE-Advanced smartphones are now offered. Megafon has tested 450 Mbps LTE-Advanced for Category 9 user devices, combining 20 MHz 2.6 GHz + 20 MHz 2.6 GHz + 20 MHz 1800 MHz (band 3).

MegaFon commercially launched LTE1800 in Izhevsk in February 2015 (LTE1800 may be deployed in other regions also).

Megafon has begun LTE network deployment using 800 MHz band 20 spectrum, in St Petersburg.

Megafon is preparing to introduce VoLTE when regulatory conditions allow.

MTS commercially launched LTE FDD service in May 2013 in Moscow using its own network and 2 x 10 MHz of 2.6 GHz (band 7) spectrum. LTE1800 was introduced in Moscow in December 2014 and is being deployed in other areas. 800 MHz spectrum was brought into use in Moscow in early 2015. LTE1800 was activated in Ufa and St Petersburg in early 2015.

On September 10, 2014 **MTS** announced successful testing of LTE-Advanced carrier aggregation combining 30 MHz of bandwidth spanning the 1800 MHz and the 2600 MHz ranges to achieve 225 Mbps on its commercial network in Bashkirian (later extended to Moscow). http://www.mtsgsm.com/blog/

One June 18, 2015 **MTS** confirmed plans to deploy 2-band (150 Mbps) or 3-band (225 Mbps) LTE-Advanced systems to 15 Regions by end 2015, and LTE1800 in 19 Regions. Most base stations will have a dual-band network - 1800 + 2600 MHz or 2600 MHz LTE800 depending on spectrum availability. In the regions of North-West, including in St. Petersburg and Leningrad region, three types of aggregation of the two bands will be used. Moreover, in this region in 2015, MTS will start deploying triple-band sites 800 + 1800 + 2600 MHz.

MTS announced testing of LTE Broadcast technology in October 2015.

Rostelecom confirmed commercial launch of LTE FDD service in Sochi on June 3, 2013 using 2.6 GHz and 800 MHz spectrum. The company plans to build LTE networks in 8 Regions by the end of this year.

Rostelecom plans to deploy LTE using 450 MHz spectrum (currently used for CDMA) having completed trials in this band in the Kostroma region in December 2013.

Vimpelcom (Beeline) commercially launched LTE FDD in Moscow on May 27, 2013 using 2.6 GHz and plans to cover 80% of the city area by end 2013. Coverage was extended to the Moscow region in July 2014, again using 2.6 GHz. On August 27, 2014 the company announced launch of 110 Mbps using LTE-Advanced carrier aggregation (bands 7 and 20) within the Garden Ring. Beeline announced the sale of compatible smartphones (Samsung Galaxy Alpha) beginning on September 18, 2014. VoLTE was tested in Q1 2014 and VoLTE HD Video was also tested in October 2014 ahead of planned VoLTE launch. A VoLTE trial in Moscow and Moscow Region started in August 2015 for users with a specific phone.

New frequency auctions for 2.6 GHz LTE TDD band 38 spectrum are foreseen during 2014, for which a new decree was signed on May 24, 2014. On July 22, 2014 SCRF extended technology neutrality principle to allow use of 900 MHz (formerly GSM-only band) and 450 MHz for LTE deployments.

SkyLink (Rostelecom subsidiary) is trialling LTE450.

MTS and **Vimpelcom** announced in December 2014 a collaboration agreement to deploy joint LTE infrastructure in Russia and the CIS region.

Roskomnadzor confirmed that the number of operational LTE base stations in Russia increased to 42,047 by end 2014, from 12,364 at end 2013. 77.5% operate in 2.6 GHz spectrum band 7.

The Ministry of Telecom & Mass Communications (Minsvyaz) announced on June 30, 2015 that SCRF has cleared a wide range of frequencies for shared usage between mobile operators for LTE deployments. The spectrum ranges approved for LTE network sharing are 791-820MHz, 832-861MHz, 890-915MHz, 935-960MHz, 1710-1785MHz, 1805-1880MHz and 2500-2690MHz, with effect from October 1, 2015. The decision is designed to accelerate LTE market development in Russia.

Roskomnadzor auctioned technology-neutral 1800 MHz spectrum beginning on September 29, 2015. The spectrum was bought by Megafon, MTS, Tele2 and Vimpelcom.

SRFC is considering liberalising 2.1 GHz spectrum, presently used only for 3G services.

Serbia Republic

In February 2015 the regulator RATEL auctioned 1800 MHz band 3 spectrum suitable for LTE network deployments. The bidders were the 3 incumbent mobile operators: **Telenor, VIP Mobile** and **MTS**. RATEL announced that all were successful in obtaining 10 MHz paired of spectrum each, which are expected to be used for LTE network deployments.

Vip Mobile launched a 150 Mbps LTE network in the town of Pančevo on March 24, 2015. In its press release the company said that the network will soon cover Kopaonik and Zlatibor, and in following phases spread across the bigger Serbian towns.

Telenor commercially launched LTE1800 for post-paid customers on March 25, 2015. The network initially covers areas of Belgrade, Subotica city centre, Kopaonik and Zlatibor.

MTS commercially launched LTE1800 on April 3, 2015 with coverage in Belgrade, Novi Sad, Nis, Kragujevac, Arandjelovac, Sabac, Novi Pazar, Pancevo and Kopaonik.

RATEL has started an auction process for 800 MHz band 20 spectrum.

Slovak Republic

Regulator TU SR granted licences to **O2 Slovakia, Orange** and **T-Mobile Slovensko** for each to trial LTE FDD networks in 2.6 GHz in Banská Bystrica.

O2 Slovakia commercially launched LTE on a small scale on August 2, 2012 using LTE1800. A wider commercial launch followed in Bratislava and Kosice on December 9, 2014. O2 Slovakia is targeting 25% population coverage by end 2015 with the introduction of its 800 MHz spectrum.

Slovak Telecom commercially launched LTE1800 in Trnava, Nitra, Zilina, Banska Bystrica and Presov on November 15, 2013, with CSFB. Evolution to VoLTE is planned in future. Coverage reached 31% of the population by early June 2014. 2.6 GHz was brought into use in April 2014 to support Cat 4 service in Bratislava. 800 MHz is also to be introduced. The company achieved 300 MBps downlink in an LTE Advanced trial using 2 x 40 MHz of 2.6 GHz, which was announced in September 2014. 225 Mbps LTE-Advanced was launched in Nitra on June 25, 2015 combining 2x20 MHz band 7 & 2x10 MHz band 3.

TU SR conducted an auction of 800 MHz, 1800 MHz and 2.6 GHz spectrum for LTE in late 2013. **O2 Slovakia** subsequently announced that the company had won channels in the 800 MHz and 1800 MHz bands. O2, owned by investment group PPF, plans to use 800 MHz and 1800 MHz in its LTE network. Other winners were **Orange** and **Telefonica O2** plus new market entrant and domestic 3.5 GHz WiMAX™ operator **Swan Telecom**. Results:

- **Orange Slovensko:** 2 x 10 MHz 800 MHz, 2 x 4.8 MHz 1800 MHz, 2 x 20 MHz 2.6 GHz
- **Slovak Telecom**: 2 x 10 MHz 800 MHz, 2 x 40 MHz 2.6 GHz, 50 MHz 2.6 GHz TDD band 38
- **O2 Slovakia:** 2 x 10 MHz 800 MHz, 2 x 0.6 MHz 1800 MHz
- **Swan Telecom:** 2 x 15 MHz 1800 MHz

Orange Slovensko commercially launched Category 4 LTE on July 7, 2014 in the cities of Bratislava, Banska Bystrica and Kosice, using bands 7 and 20. 51.5% pop. coverage was achieved by July 2015.

Swan Telecom is deploying an LTE1800 network. Public test calls using LTE in Trnava commenced on October 16, 2014. Swan claimed its LTE network covered 40 cities (20% of population) by end 2014, thereby triggering a licence obligation on incumbents to enable national roaming. Full commercial launch is delayed until a national roaming agreement is concluded with an incumbent operator. **Swan** commercially launched an unlimited data-only LTE1800 service brand named 4G INTERNET v1.0 in 50 cities on March 13, 2015 together with several compatible devices: Huawei E5373 LTE portable router, ZTE MF831 LTE USB modem, ZTE MF910 LTE portable router, Huawei E8278 USB modem, Huawei E5180 router, ZTE MF283 + router, and BandRich Inc. R551P router. The company relaunched with a new brand (4ka) in October 2015, supporting voice and data calls and over a larger footprint. Swan is trialling VoLTE.

TU SR was replaced by a new regulator (RU) on January 1, 2014. RU awarded 3.6 GHz band 43 licences each of 40 MHz bandwidth to **Benestra, O2 Slovakia,** and **Swan Telecom.** Swan Telecom and O2 each additionally gained 3.4-3.6 GHz band 42 spectrum in another auction announced mid-2015.

Slovenia

Si.mobil announced commercial launch of LTE service on July 12, 2012 in Ljubljana, Brnik, and Bled using 1800 MHz (LTE1800). 800 MHz band 20 channels were brought into use in June 2014. The company provides LTE coverage to over 80% of the population (June 2015), targeting 95% by mid-2017. Si.mobil launched 300 Mbps LTE-Advanced launched in selected locations across 6 cities on November 25, 2014 using 800 MHz and 1800 MHz spectrum. VoLTE is being deployed.

Telekom Slovenije commercially launched LTE service on March 20, 2013 using refarmed 1800 MHz spectrum (LTE1800). By end February 2015 the LTE network covered 200 cities and towns, representing over 80% of the population, the network supporting a theoretical peak downlink speed of 150 Mbps using 20 MHz paired 1800 MHz spectrum. The company announced on June 1, 2014 that 800 MHz spectrum acquired in April 2014 (see below) had been brought into service for LTE. LTE service was also launched in 5 MHz bandwidth of 900 MHz spectrum on September 22, 2014 and coverage will be expanded to 300 sites by end 2016. 300 Mbps LTE-Advanced using carrier aggregation to combine 20 MHz of 1800 MHz and 20 MHz of 2.6 GHz spectrum was launched on December 14, 2014. LTE using 2.1 GHz (band 1) was introduced in March 2015. 225 Mbps LTE-Advanced combining 10 MHz 800 MHz and 20 MHz 1800 MHz was commercially launched in March 2015. The LTE network runs alongside UMTS, which has continuously been upgraded and which has supported 42 Mbps DC-HSPA+ since 2011. VoLTE is in deployment.

Regulator AKOS authorized test spectrum for LTE in the 700 MHz band (746-756MHz / 777-787 MHz) to a company called Neuron for tests between October 9, 2012 and January 9, 2013 in Ljubljana.

AKOS auctioned off frequencies in the 800 MHz, 900 MHz, 1800 MHz, and 2.6 GHz bands for 15 years, and unassigned 2100 MHz frequencies until September 2021. All of the offered bands, with the exception of two blocks (20 MHz) in the 1800 MHz band and one block (10 MHz) in the 2100 MHz FDD band, were sold. The total proceeds of the auction were EUR 148,740,934.00. The auction started on April 3, 2014. Results were announced after 55 bidding rounds on April 29, 2014. Three out of four incumbents took part: Simobil, Telekom Slovenije and Tušmobil. All licences included coverage obligations.

Si.mobil acquired FDD spectrum in 800 MHz, 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz and TDD spectrum in 2.6 GHz (band 38).

Telekom Slovenije won FDD spectrum in 800 MHz, 900 MHz, 1800 MHz, and 2.6 GHz

Tušmobil acquired FDD spectrum in 800 MHz, 900 MHz, and 1800 MHz and is targeting launch in 2015. **Tušmobil** has been rebranded Telemach Mobil by its new owner, cable TV and ISP **Telemach.**

On April 20, 2015 AKOS launched a consultation on allocation of spectrum in 700 MHz, 1400 MHz, 2.3

GHz, 3.5 GHz, and 3.7 GHz bands. An auction is planned in 2016.

Spain

An auction began on June 29, 2011 for 58 blocks of 800, 900 MHz and 2.6 GHz frequencies, with licences valid to 2030. The auction ended on July 29, 2011 raising €1.65 bn for 800 MHz and 2.6 GHz licences. Spectrum was won by **Vodafone**, **Telefónica** and **FT-Orange**. 800 MHz channels could be used after digital TV switchover, the first location being the city of Zamora from September 2014. However the spectrum was not released until April 2015. 2.6 GHz could be used immediately. **Vodafone** plans to use both bands for LTE, and re-farm 900 MHz for additional rural HSPA or LTE-based coverage.

It was subsequently confirmed that 800 MHz could be used by all 3 operators from July 20, 2015.

Vodafone commercially launched LTE Cat 4 on May 29, 2013 in Barcelona, Bilbao, Madrid, Malaga, Palma de Mallorca, Seville and Valencia. 1800 MHz (LTE1800) and 2.6 GHz is used. On October 15, 2014 announced launch of commercial 300 Mbps LTE-Advanced service using band 3 and band 7 spectrum in Barcelona, Madrid and Valencia. LTE-Advanced service was extended to Seville, Bilbao, Malaga, Zaragoza and La Coruña in December 2014. 800 MHz band 20 spectrum was introduced from January 2015. LTE coverage extends to more than 619 municipalities, including the 80 cities with over 70,000 inhabitants, all the provincial capitals, the autonomous cities of Ceuta and Melilla and Spain's tourist resorts. In December 2014, all cities with over 25,000 inhabitants had 4G coverage. 4G coverage is also available in high traffic density areas: 12 airports, 7 railway stations, 32 major event facilities, 20 football stadiums and ski slopes, among others (Vodafone press release, September 2, 2014). VoLTE was commercially launched across its whole LTE-Advanced network on July 7, 2015.

On May 17, 2015 **Vodafone** trialled LTE Broadcast technology showing 5 HD video channels in HD (High Definition) format during a soccer match at Estadio Mestalla where Valencia were playing against Celta. Triallists had real time access to 5 channels of multimedia content from the match.

Orange commercially launched LTE on July 8, 2013 in Barcelona, Madrid, Malaga, Murcia, Seville and Valencia using 1800 MHz (LTE1800) and 2.6 GHz. 800 MHz was introduced in Q2 2015. The company trialled LTE-Advanced in Valencia for which 20 MHz of 2.6 GHz and 10 MHz of 1800 MHz spectrum was combined using carrier aggregation and subsequently demonstrated 300 Mbps at the Mobile World Congress 2015 in Barcelona, This service, branded 4G+, is commercially available in Madrid, Bareclona and Valencia. In September 2015 Orange upgraded its LTE network to 336 Mbps for Barcelona and Madrid customers. The company intends to soon bring into service refarmed 2.1 GHz, 900 MHz and 1,800 MHz spectrum.

Yoigo commercially launched LTE service (LTE1800) on July 18, 2013.

Telefónica Movistar offered LTE service from September 13, 2013 as an MVNO on the Yoigo LTE1800 MHz network and commercially launched service on its own LTE1800 network in 28 cities from October 2013. 50% pop coverage is planned by end 2013. Movistar commercially launched 300 Mbps LTE-Advanced service on October 2, 2014 for customers in Barcelona and Madrid, then widely expanded in 2015 with the availability of the 800 MHz band 20 spectrum. Movistar is also trialling VoLTE.

ONO, JazzTel, Euskaltel, R, Telecable and **TelecomCLM** won regional 2.6 GHz licences.

Regional start-up **COTA** commercially launched LTE TDD fixed access service in band 38 spectrum (2.6 GHz) in Región de Murcia on March 1, 2013, branding their service as Murcia4G. The company informed GSA that coverage reached 35% of the population in the region of Murcia (end June 2013).

WiMAX™ operator **Neo-Sky** commercially launched LTE TDD service in 3.5 GHz (band 42) in June 2013. In December 2014 MVNO **Masmovil** acquired **Neo** including its 4G licence and has first refusal to the Neo-Sky WiMAX™ and LTE TDD systems.

Cable operator **R** (R Cable y Telecomunicaciones Galicia) is conducting LTE FDD and TDD trials in 2.6 GHz in 3 areas of Galicia and may launch only as an MVNO (by partnering with Vodafone).

Sweden

TeliaSonera launched the world's first LTE networks in Stockholm and Norway (Oslo) in December 2009. An 800/1800/2600 MHz multimode modem was introduced July 2011. By end 2012 almost 700 cities in Sweden are served. Coverage was set to double by end 2013. On October 1, 2012 TeliaSonera was the first LTE operator in Europe to offer an LTE Cat4 modem. TeliaSonera is deploying VoLTE.

Tele2 Sweden and **TeleNor Sweden** deployed an LTE network via a jointly-owned company (Net4Mobility), which includes spectrum sharing in 900 MHz and 2.6 GHz. Using this network, **Tele2 Sweden** and **TeleNor Sweden** commercially launched LTE services to their respective customers on November 15, 2010, initially in Stockholm, Gothenburg, Malmo and Karlskrona. The network now also uses 800 MHz and covers over 99% population. 1800 MHz and 2.6 GHz deliver capacity and speed. In May 2012 Tele2 Sweden and Telenor Sweden announced joint trials of LTE-Advanced. VoLTE was tested in the network in December 2012 and is planned to be launched by Tele2 and TeleNor.

Hutchison 3 is deploying an LTE FDD network and also using 50 MHz of TDD spectrum bought from Intel. Network technical readiness was announced by its infrastructure vendor on December 15, 2011. Commercial LTE service was launched April 23, 2012 according to information provided by the operator to GSA. LTE is currently offered in Stockholm, Gothenburg, Malmo and Lund. The LTE network uses TDD in 2.6 GHz and FDD in 2.6 GHz and 800 MHz. Customers may also use 3G/HSPA up to 42 Mbps (peak DL) in 2.1 GHz and 900 MHz bands.

An auction for 800 MHz opened on February 28, 2011 and ended after 5 days and 31 rounds. An auction for 2 x 35 MHz of 1800 MHz spectrum, for use from January 2013, began on October 11, 2011. The new licences are valid for 25 years from 2013.

TeliaSonera acquired more nationwide frequencies in the 1800 MHz band. The new frequencies are being used in their LTE network and for strengthening the mobile telephony network. In addition to its existing 10 MHz, TeliaSonera acquired 2 x 25 MHz of 1800 MHz spectrum. **Net4Mobility** also acquired more 1800 MHz spectrum for LTE1800. It means Net4Mobility and TeliaSonera each has 2 x 35 MHz in 1800 MHz. A consultation has started to determine interest/future use of 2.3 GHz (Band 40).

CDMA operator **Net1** has obtained regulatory approval to migrate to a nationwide LTE450 network.

700 MHz spectrum will be allocated for mobile services to align with the lower duplexer arrangement of the APT700 band.

Switzerland

Salt (formerly Orange) commercially launched LTE1800 on May 26, 2013. Some 2.6 GHz sites were activated in November 2013. The LTE network covered 90% population by end 2014. Theoretical peak download speeds are up to 150 Mbps (Cat 4). Some 800 MHz sites entered service in May 2014. On December 11, 2014 Salt announced commercial launch of 300 Mbps LTE-Advanced service in Berne combining 20 MHz each of bands 3 and 7. Rollout of LTE-Advanced in other major cities including Geneva, Lausanne, Basel and Zurich is ongoing. **Salt** was acquired by Xaviel Niel on 23 February 2015 and rebranded as Salt on February 27, 2015.

Swisscom commercially launched LTE on November 29, 2012 in 26 towns and cities. The network uses 800, 1800 (LTE1800), and 2600 MHz bands. Approx. 400,000 customers use the LTE service. An upgrade for 150 Mbps Cat 4 service was introduced with compatible devices offered for sale from June 2013. VoLTE was commercially launched on June 10, 2015. Swissom launched 300 Mbps LTE-Advanced on June 16, 2014 in Berne and Lausanne railway stations, with the cities of Berne and Biel following in early July 2014. 2.1 GHz spectrum (band 1) will be introduced for LTE shortly. Swisscom demonstrated LTE-Advanced three-carrier aggregation combining LTE in both FDD and TDD modes on August 18, 2015 using 3 carriers in two bands in a radio access network and used commercial-grade chipsets. Swisscom plans its rollout to subscribers in metropolitan areas by Summer 2016 to coincide with 3-carrier FDD/TDD smartphone availability. For the demonstration in their live commercial network, 2 LTE TDD carriers, each with 20 MHz bandwidth in the 2.6 GHz frequency band (band 41), and one LTE FDD carrier with 15 MHz in the 2.1 GHz band (band 1) were used. In this

specific set-up, a maximum 335 Mbps in the downlink was achieved.

On September 17th, 2015 Swisscom conducted a further demonstration in their commercial LTE-Advanced network. By introducing 256 QAM (quadrature amplitude modulation) in the combined three-carrier aggregation LTE FDD/TDD network, peak downlink speeds pver 426 Mbps were achieved, compared with 335 Mbps with the same set-up using current 64 QAM technology for the downlink.

Sunrise Communications commercially launched LTE on June 19, 2013 in Zurich, Bern, Lucerne, Geneva, Lausanne, Basel-Stadt, and several other locations using 1800 MHz (LTE1800) and 2.6 GHz. 800 MHz (band 20) is now in commercial use. Sunrise is targeting 97% population coverage (same as 3G/HSPA) by 2015. LTE-Advanced carrier aggregation has been trialled, and 300 Mbps (Cat 6) will be commercially launched when sufficient compatible terminals are in the market. VoLTE will be launched in 2015.

Tajikistan

Babilon-Mobile commercially launched LTE service in Dushanbe on October 6, 2012 using 1800 MHz (LTE1800) and 2100 MHz spectrum and initially the Huawei E398 USB dongle was offered.

Tcell commercially launched its 4G/LTE network using a 10 MHz carrier in 800 MHz (band 20) on April 15, 2014 covering Dushanbe, Khujand, Kayrakkum, Chkalov and Gafurov inside and outside buildings.

Turkey

Turkcell has trialled LTE. In stationary tests downlink speeds up to 170 Mbps were achieved. On April 6, 2012 Turkcell announced results of its mobile LTE trial in an area between Kartal and Maltepe (Istanbul). Turkcell demonstrated LTE-Advanced in July 2013, and achieved downlink speed of 891.6 Mbps. On April 20, 2015 Turkcell announced completion of testing of “Enriched VoLTE”.

Avea announced in September 15, 2011 completion of its successful LTE trial. On December 25, 2013 Avea held a press conference to report progress on their LTE trials including 300 Mbps and 450 Mbps LTE-Advanced trials, and VoLTE.

Vodafone has trialled LTE and has GSM/HSPA infrastructure which is LTE-capable. 3-carrier LTE-Advanced has been trialled using bands 3, 7 and 20 and achieved 450 Mbps.

In order to manage data growth **Turkcell** announced on December 25, 2014 a key milestone with its launch of two new HSPA+ technologies in its 3G network. Having successfully integrated 3C-HSDPA (3GPP Rel-10) and DC-HSUPA (3GPP Rel-9) technologies, Turkcell became the first mobile operator in the world to enable peak speeds of 63.3 Mbps downlink / 11.5 Mbps uplink in a 3G network.

Regulator BTK auctioned 390 MHz of 800, 900, 1800, 2100 & 2600 MHz LTE spectrum on August 26 2015. €3.36 billion was paid by the incumbent operators.

Avea: 900, 1800, 2.6 GHz FDD, 2.6 GHz TDD
Turkcell: 900, 1800, 2.1 GHz, 2.6 GHz FDD, 2.6 GHz TDD
Vodafone: 900, 1800, 2.6 GHz FDD, 2.6 GHz TDD

More at http://www.btk.gov.tr/tr-TR/Kurumdan-Haberler/45-G-Ihalesi-Ankarada-Yapildi

Turkcell announced plans to launch its LTE service in April 2016.

Turkmenistan

TMCELL commercially launched 2.6 GHz LTE in Ashgabat and Turkmenbashi on September 18, 2013.

Ukraine

MTS-Ukraine has trialled LTE.

Astelit called for for technology neutrality for 900 MHz and 1800 MHz spectrum.

ITC (CDMA Ukraine) is considering deploying LTE in 850 MHz spectrum.

Kyivstar announced in July 2014 around 300,000 LTE-capable devices on its network.

A President's decree on 23 July 2014 approved the principle of technology neutrality, allowing operators to deploy 3G or 4G technology in GSM spectrum bands subject to licence amendments.

Digital dividend spectrum will be released after digital TV transition is achieved in June 2018. Release of spectrum in both 800 MHz and 700 MHz digital dividend bands is foreseen.

United Kingdom

UK Broadband on February 29, 2012 announced switch-on of its first LTE TDD system in London. This was the world's first LTE TDD 3.5 GHz deployment and first commercial LTE deployment in the UK, and uses allocations within Bands 42 and 43 (3.5/3.6 GHz). UK Broadband operates a wholesale model and launched commercial service on June 28, 2012. LTE service is now available for consumers and businesses in Reading, Scunthorpe, Southwark (London), and Swindon. Indoor and outdoor CPEs, portable hotspots and a femtocell are available.

O2 tested LTE in 2.6 GHz spectrum and trialled LTE800 in Carlisle in 2010. In November 2011 the company started a large-scale LTE trial in central London, lasting until summer 2012, using 20 MHz of test spectrum in the 2.6 GHz band. The trial ran across 25 LTE cell sites and covered 40 sq. km.

Manx Telecom (Isle of Man) commercially launched LTE island-wide in 800 MHz & 1800 MHz (LTE1800) spectrum on July 29, 2014 for postpaid users.

SURE Telecom is deploying LTE on the Isle of Man and commercially launched KTE on March 2, 2015.

EE - owner of **Orange** and **T-Mobile UK** brands, commercially launched LTE1800 on October 30, 2012. EE announced 9.3 million LTE subscriptions had signed up to end March 2015. EE said that its LTE network covered over 75% of the population. EE announced doubling of the spectrum allocated for LTE this year from 10 to 20 MHz. On November 5, 2013 EE switched on its LTE-Advanced network in part of London (Tech City) delivering a theoretical peak downlink speed of 300 Mbps. The network uses carrier aggregation combining 20 MHz of 1800 MHz and 20 MHz of 2.6 GHz spectrum. Users working for Tech City area companies were selected to trial the service. 300 Mbps service was commercially launched in large parts of central London on October 30, 2014. EE has also successfully tested LTE Category 9 using 20 MHz 1800 MHz + 20 MHz 2.6 GHz and 15 MHz 2.6 GHz blocks, achieving 410 Mbps peak downlink speed. The same configuration was demonstrated by EE at London's Wembley Stadium in February 2015, achieving 400 Mbps. In December 2013 EE announced its first LTE roaming agreement, with AT&T for the US. Additional roaming destinations of France and Spain were announced in March 2014. EE plans to launch VoLTE in 2015 and *"only when a new voice service is on a par with, or better than, what customers are currently using".*

EE is investing in LTE Broadcast trials including in partnership with the BBC. eMBMS was demonstrated during the Commonwealth Games 2014, in Glasgow. A major trial at Wembley is planned in Summer 2015.

The 800 MHz and 2.6 GHz auction of 250 MHz of LTE spectrum by Ofcom was repeatedly delayed. Bidding by 7 companies opened on January 23, 2013. On February 20, 2013 Ofcom announced the winning bidders who collectively paid £2.34 billion:

- EE (800 MHz, 2.6 GHz FDD)
- Hutchison 3G UK Limited (800 MHz)
- Niche Spectrum Ventures (BT) (2.6 GHz FDD & TDD)
- Telefónica UK Limited (800 MHz)
- Vodafone (800 MHz, 2.6 GHz FDD & TDD)

HKT (UK) and MLL Telecom did not win spectrum.

EE is planning to introduce 800 MHZ spectrum into service by end 2015.

Vodafone and **O2** both commercially launched 4G/LTE services on August 29, 2013 using 800 MHz (band 20), initially in London, Bradford and Leeds. By March 2014 more cities and towns added by **O2** extended coverage to 33% of the population indoors and 41% outdoors. The company gained over 1 million LTE subscriptions by Q1 2014. The company said those customers used more data in the 4G network's first six months than the entire O2 network carried between the years 2000 and 2008. O2's LTE network covered 21 million people by mid-2014. VoLTE will be trialled in Q4 2015 ahead of planned commercial service introduction in 2016.

Vodafone launched LTE in London. 900,000 subscriptions were achieved by end June 2014. Vodafone is targeting LTE indoor coverage for 98% of the population by 2015. In October 2014 Vodafone announced it had begun deploying LTE-Advanced carrier aggregation combining band 7 and band 20, the first cities being Birmingham, London and Manchester. Vodafone plans to commercially launch VoLTE and WiFi calling in 2015. Vodafone is buying L-Band spectrum currently owned by Qualcomm.

3 UK bought 2 x 15 MHz of 1800 MHz spectrum from EE and commercially launched LTE1800. From December 2, 2013, 3 UK started upgrading customers with an LTE-compatible device, enabling access to LTE when in coverage. 3 UK aims to cover 98% of the population by end 2015. In early December 2014 the company announced it had 3.1 million LTE users. 3 UK is also currently deploying LTE in 800 MHz to boost indoor & outdoor coverage and support VoLTE service which was launched on September 15, 2015. 3 UK is buying L-Band spectrum currently owned by Qualcomm

Ofcom has authorized all five mobile operators to trade the rights to the radio spectrum they hold, covering 900 MHz, 1800 MHz and 2100 MHz.

Ofcom announced on July 9, 2013 that mobile operators are now allowed to refarm 2G (900, 1800 MHz) and 3G (2.1 GHz) spectrum for 4G (e.g. LTE) services. A 3dB increase in maximum transmit power using 900 MHz spectrum has also been approved. Requests from EE, 3 UK, O2 and Vodafone for a similar 3dB power increase for 3G and 4G services using 1800 MHz spectrum is under consideration and a consultation has been launched by Ofcom.

Ofcom conducted a consultation on use of 700 MHz for mobile broadband, following the Resolution passed at WRC 2012 that could lead to ITU Region 1 i.e. Europe, Africa, Middle East adopting 700 MHz for mobile broadband from 2015. A public consultation was launched on May 28, 2014 setting out proposals to make spectrum in the 700 MHz band available for mobile broadband from 2022 or possibly up to two years earlier. It includes an assessment of costs and benefits of such a change and invites comments by August 29, 2014. Ofcom recognises that European Member States including France, Sweden and Finland have already decided to use 700 MHz for mobile services and that others are considering plans to do so. Ofcom also acknowledges the benefits of compatibility with the APT700 band plan. On November 19, 204 Ofcom announced its decision to proceed with licensing this spectrum (which aligns with the lower duplexer arrangement of APT700).

The Ministry of Defence will release 190 MHz of spectrum to Ofcom to allocate available for commercial use. It includes 40 MHz in the 2.3 GHz band and 150 MHz above 3.4 GHz for TDD deployments. Both segments will be suitable for LTE deployments. Ofcom launched a consultation on October 16, 2013 after which it was decided that this spectrum will be auctioned in late 2015 - early 2016. Spectrum will be offered in 38 lots of 5 MHz; caps will be imposed. Consultations on details are progressing.

Ofcom announced a Notice of Proposal to permit LTE1800 mobile devices on board aircraft on a licence exempt basis. Comments were required by March 12, 2014. Use of mobile devices on aircraft has been permitted since 2008 but limited to GSM1800 (2G) only. This proposal extends licence exemption arrangements to cover use of 3G and 4G terminals. EU Member States were required to adopt this EU decision into national law by May 12, 2014.

CICRA (the Channel Islands Competition and Regulatory Authorities) consulted in July 2013 on the appropriate method of allocating spectrum, specifically 800 MHz (band 20) and 2.6 GHz (band 7), for enabling provision of LTE services in the Channel Islands (Guernsey and Jersey). CICRA later confirmed LTE-suitable spectrum had been awarded to **JT**, **Sure** and **Airtel** for Guernsey and Jersey.

Uzbekistan

MTS announced on July 28, 2010 commercial launch of LTE in Tashkent via its subsidiary ***Uzdunrobita***. The network was shut down in September 2012 and the company declared bankrupt in 2013. Assets were transferred to **Uzbektelecom**.

Ucell (TeliaSonera) commercially launched LTE using 2.6 GHz band 7 in Tashkent on August 9, 2010.

Beeline Uzbekistan announced its LTE network in Tashkent entered into a test phase in February 2012 and commercially launched LTE using 2.6 GHz band 7 in some areas of Tashkent on September 4, 2014.

2.3 GHz WiMAX™ operator **Super iMAX** branded **EVO** commercially launched LTE TDD in the same band on April 1, 2015 for customers in Tashkent, Samarkand, and Bukhara.

Middle East and Africa

Algeria

WiMAX™ operator **Algérie Télécom** commercially launched fixed LTE1800 service (peak 150 Mbps) for business users on May 1, 2014, and consumers on September 8, 2014. VoLTE is in deployment.

Angola

Movicel commercially launched LTE1800 in Cabinda on April 14, 2012; Luanda, Cacuaco are now covered.

Unitel launched commercial LTE1800 service on December 16, 2012 in Luanda. Unitel announced the successful demonstration of LTE-Advanced carrier aggregation by combining 900 MHz and 1800 MHz spectrum on its live network on December 18, 2013. 3-band LTE-Advanced carrier aggregation was demonstrated on December 5, 2014 combining 20 MHz paired carriers in each of bands 1, 3, and 7 and achieved 450 Mbps downlink data rate.
WiMAX™ operator **Multitel** (3.5 GHz) is migrating to LTE TDD and has selected its system supplier.

WiMAX™ operator **Net One** (2.5 GHz band 41) is migrating to LTE TDD, targeting launch in 2015.

Bahrain

Zain commercially launched LTE1800 on April 18, 2013 for fixed access. Support for smartphone and tablet users was added on April 30, 2014.

VIVA launched a small-scale commercial LTE1800 network on January 1, 2012. A wider commercial service was launched in January 2014.

Batelco commercially launched LTE1800 on February 27, 2013. Peak downlink speed was increased to 150 Mbps on September 26, 2013.

WiMAX™ operator **Menatelecom** commercially launched 3.5 GHz LTE TDD nationwide on November 19, 2013.

Regulator TRA cancelled an auction of new 900, 1800, 2100 MHz and 2.6 GHz spectrum. LTE permits in 900 MHz, 1800 MHz & 2.1 GHz were given to Batelco, Viva and Zain in September 2013.

Benin

Benin Telecoms is deploying an LTE1800 network.

Band 20 spectrum could be freed for use from 2016.

Botswana

Orange Botswana commercially launched LTE1800 on February 13, 2015 in Gabarone, to be followed by Francistown, Palapye & Maun within weeks.

Mascom Wireless announced on June 12, 2012 its launch of an LTE pilot trial network and according to media reports either commercially launched LTE service on February 14, 2015 or alternatively extended the pilot trial to become nationwide (GSA is seeking confirmation from the operator).

Burkina Faso

Airtel Burkin Faso has applied to regulator ARCEP for a licence to offer a 4G network.

Cameroon

WiMAX™ operator **YooMee** is deploying LTE TDD in band 41.

MTN is deploying a 3G/4G network with service launch by end 2015/early 2016.

Cape Verde

Regulator Agencia Nacional das Comunicacoes (ANAC) launched a public consultation on September 21, 2015 into the distribution of 4G LTE licences, including spectrum band choices. Comments are required by October 30, 2015.

http://www.anac.cv/images/consultapublicaintroducaorede4g.pdf

Chad

Tigo Chad commercially launched LTE in band 7 on September 10, 2014.
Airtel Chad received a 4G licence in April 2014.

Côte d'Ivoire

WiMAX™ operator **YooMee** commercially launched LTE TDD in band 40 in Abidjan on April 4, 2014.

WiMAX™ operator **VipNet** is deploying a band 42 LTE TDD network, targeting launch in 2015.

Orange launched a trial LTE network on June 13, 2014 in Abidjan and is extending rollout in anticipation of approval to offer nationwide commercial service.

Three mobile networks, **Comium, Cafe Mobile** and **Lap Green**, with a combined base of 1.5 million subscriptions, have been nationalised and are to be merged into a single operator.

Democratic Republic of Congo

Smile is deploying a commercial LTE network targeting launch in early 2016.

Equatorial Guinea

WiMAX™ operator **Guineanet** plans migration to LTE

Egypt

Vodafone, Mobinil, Etisalat Misr each trialled LTE.

Ethiopia

Ethio Telecom commercially launched 150 Mbps LTE1800 on March 21, 2015 in Addis Ababa for CPE and dongle users.

Gabon

Gabon Telecom commercially launched LTE on October 20, 2014.

Airtel Gabon received a 4G licence in March 2014 and in July 2015 announced the name of its infrastructure system supplier.

Gambia

WiMAX™ operator **Netpage** commercially launched fixed wireless access 2.3 GHz LTE TDD in March 2015 covering Greater Banjul and south to Brikama. MiFi, indoor and outdoor CPE devices are offered.
I-Link has an ISP licence with rights to build a wireless broadband network and plans to deploy LTE.

Gamtel is deploying 2.3 GHz LTE TDD targeting launch in 2015.

Ghana

Surfline has 2 x 15 MHz of 2.6 GHz band 7 and commercially launched LTE on August 19, 2014 in Accra and Tema. An expansion phase is underway.
Blu Telecoms (was **G-Kwiknet Limited)** has 30 MHz 2.6 GHz (band 38) and commercially launched LTE TDD on October 14, 2014 in Accra and Tema.

Goldkey Telecom has 2 x 15 MHz of 2.6 GHz and plans launch in 2015. **Glo Mobile** under parent Globacom planned to invest USD 600 million to deploy a 'unique, seamless and world class LTE network'. It is unclear if commercial service launch is yet achieved. **Expresso Telecoms** has 2 x 10 MHz of 850 MHz spectrum and operates a CDMA network.

As part of the e-Government Network Infrastructure being deployed by the National Information Technology Agency **(NITA)** all existing 30 WiMAX™ BTSs installed accross the nation were upgraded by February 2014 to LTE TDD for last mile connectivity, using 2.6 GHz (band 41).

MTN and **Vodafone** each has 33 MHz paired spectrum across 900/1800/2100 MHz bands. **Vodafone** commercially launched LTE on January 2, 2014 for users having compatible phones. **Airtel** and **Globacom** each have 2x 30 MHz spectrum across 900/1800/2100 MHz bands. **Tigo** has 2x28 MHz across these bands.

Iran

The Communications Regulatory Authority (CRA) plans to allocate LTE licences by March 2015.

MTN Irancell obtained a 3G and 4G license on August 4, 2014 and commercially launched 3G and

4G/LTE1800 service in Mashhad on November 24, 2014 for dongle and MiFi hotspot users. Population coverage rose to 50% by early December 2014. MTN Irancell also plans to offer fixed broadband wireless services. Irancell also offers WiMAX™ based services and obtained an LTE TDD license in August 2015.

WiMAX™ operator **Mobinnet Telecom Co. (MTC)** is migrating to LTE TDD and launched a pilot trial.

Iraq

MaxyTel is a member of the Global TD-LTE Initiative and committed to deploying an LTE TDD network.

Regional Telecom (Kurdistan) commercially launched LTE with 2.6 GHz spectrum (band 7) on June 10, 2013 under the Fastlink brand.

Newroz Telecom (Kurdistan) is deploying LTE.

WiMAX™ operator **Tishknet** is deploying a band 40 LTE TDD network in Kurdistan.

Israel

Partner (**Orange**) commercially launched LTE1800 service on July 15, 2014 in 2 x 5 MHz refarmed spectrum. **Partner** announced in November 2013 a proposed 4G network sharing agreement with **HOT Mobile** subject to regulatory approval.

Cellcom commercially launched LTE1800 on August 3, 2014 using refarmed 2 x 5 MHz spectrum.

Pelephone commercially launched LTE1800 on August 4, 2014 using refarmed 2 x 5 MHz spectrum.

In December 2013 **Cellcom**, **Golan Telecom** and **Pelephone** announced a 15-year agreement to deploy & operate a shared LTE network, subject to approval, and to co-operate to obtain spectrum.

Regulator MoC conducted an auction of 1800 MHz spectrum for LTE and 6 bidders participated: Celcom, Golan Telecom, HOT Mobile, Partner, Pelephone, and 018 Xfone. The result was announced in January 2015 and raised around 63 million USD. Each of the bidders won 1800 MHz spectrum, in varying amounts.

Jordan

Regulator TRC launched an auction of 800 MHz, 2100 MHz, 2.3 GHz and 2.6 GHz in 2013. Two bids, from potential new market entrants, were rejected.

After a fresh call for interest in April 2014, **Zain** paid c. $270 million for 3G & 4G spectrum. **Zain** commercially launched a 150 Mbps LTE1800 network consisting of around 1,000 sites to all 12 Administrative Regions of the country, using 2x20 MHz spectrum, on February 14, 2015.

Orange acquired 2x10 MHz of 1800 MHz for LTE and commercially launched LTE1800 on May 26, 2015.

Umniah Telecommunications completed LTE trials in 2013 and is deploying a network in band 3 (LTE1800) targeting commercial launch in early 2016.

Kenya

Safaricom commercially launched LTE-Advanced on December 4, 2014 in areas of Nairobi plus Mombasa airport. Initially LTE1800 was used and band 20 using carrier aggregation was introduced in January 2015. Safaricom has applied for additional spectrum in the 800 MHz band.

Band 41 WiMAX™ operator **iWayAfrica** is migrating to an LTE TDD system.

Kuwait

Viva commercially launched LTE1800 on December 27, 2011 and is deploying LTE-Advanced carrier aggregation technology. VoLTE was launched on June 9, 2015.

Zain commercially launched nationwide LTE1800 on November 21, 2012 and is deploying LTE-Advanced carrier aggregation. Zain completed a VoLTE trial in June 2014 and plans commercial deployment.

Ooredoo commercially launched LTE1800 on July 9, 2013 and commercially launched 185 Mbps LTE-Advanced on March 26th, 2015 using carrier aggregation to combine spectrum in bands 3 and 20. VoLTE technology is being trialled.

Lebanon

Alfa commercially launched LTE1800 in Beirut on May 15, 2013 and is deploying VoLTE. In August 2015 the company announced that 300 Mbps LTE-Advanced has been demonstrated using 20 MHz of band 20 and 20 MHz of band 3 spectrum).

Touch commercially launched LTE on May 22, 2013 in Beirut using 800 MHz and LTE1800. A 225 Mbps LTE-Advanced carrier aggregation trial with 800 and 1800 MHz spectrum was completed in April 2013.

Lesotho

Vodacom commercially launched LTE on October 2, 2014 in Maseru using 800 MHz band 20 spectrum.

Libya

Al Madar plans to deploy an LTE network.

Madagascar

WiMAX™ operator **Blueline** commercially launched LTE TDD in band 41 in April 2014.

Telma commercially launched a 75 Mbps LTE network on June 19, 2015 in 50 cities.

Orange plans to deploy an LTE network in the major cities in 2015.

Airtel is deploying an LTE network to cover 85% of the population.

Malawi

CDMA operator **Access Communications** announced a trial launch of LTE using band 5 in the business districts of Blantyre on April 8, 2015 for selected users. By September 2015 the company plans complete coverage in Blantyre and Lilongwe.

Globe Internet is deploying LTE in Lilongwe.

Mauritius

Orange Mauritius commercially launched LTE1800 on June 21, 2012.

Emtel commercially launched LTE1800 in July 2012.

MTML commercially launched LTE on May 20, 2015.

Mayotte

Outremer Telecom is committed to deploy LTE.

Morocco

Regulator ANRT conducted an auction of LTE spectrum with bids required by March 12, 2015. The results were announced on March 18, 2015 confirming licence awards to the three incumbent mobile operators: Itissalat Al Maghrib (IAM, Maroc Telecom), Wana (Inwi) and Medi Telecom (Meditel) using spectrum in bands 3, 7 and 20. 65% of the population must be covered within 5 years.

Meditel (49% owned by the Orange group) commercially launched LTE on June 8, 2015 in Casablanca, and in Rabat on June 15, 2015.

Inwi (Wana) commercially launched 150 Mbps LTE1800 in 21 cities and some major highways on June 17, 2015.

IAM (Maroc Telecom) commercially launched 225 Mbps (Category 6) LTE service on July 13, 2015.

Namibia

On 30 March 2012 the Communications Regulatory Authority of Namibia (CRAN) converted MTC, AfricaOnline and WTN licences to technology and service neutrality. CRAN advised GSA that 800 MHz (band 20) would be available by end 2014 subject to broadcasters vacating the band.

MTC commercially launched LTE1800 on May 16, 2012 in Windhoek. VoLTE is planned.

Telecom Namibia acquired **Leo** and is deploying a unified 2G/3G/4G-LTE network. The company rebranded to **TN Mobile**, commercially launching LTE1800 on November 27, 2013 in Windhoek and surrounding areas, Walvis Bay, Swakopmund, Langstrand Henties Bay, Ondangwa, Ongwediva, Oshakati, Ohangwena and Oshikango.

Nigeria

Globacom provides LTE-connectivity to a 3rd party company providing backhaul services to corporates in Lagos etc. and plans LTE service for mobile users. Globacom has spectrum in the 700 MHz band. **Zoda Fones** is deploying LTE TDD in band 41. CDMA operator **Starcomms** is studying deployment of LTE. A proposal is in development to merge Starcomms, Multilinks and MTS First Wireless to form **CAPCOM.** This new company would seek to refarm 20 MHz of 1900 MHz spectrum to allow it to become the first national LTE broadband operator.

In December 2012 **Airtel** announced completion of an LTE trial in Lagos.

In April 2012 CDMA operator **Visafone Communications** outlined a 3-year development roadmap including LTE. **MTN Nigeria** is deploying LTE. **MTN** is currently acquiring **Visafone** that will lead to closure of the CDMA network and free up 800 MHz spectrum that MTN intends to use for LTE.

SWIFT Networks acquired the WiMAX™ operation of ISP ***Direct on PC*** to expand wireless broadband services in Abuja, Lagos and Port Harcourt. The combined entity is using the expanded capacity and spectrum (3.5 GHz and 2.3 GHz) to deploy LTE TDD alongside WiMAX™. Swift commercially launched band 40 LTE TDD in Lagos in November 2013. **SWIFT** subsequently got an additional 15 MHz of 3.5 GHz TDD spectrum from aquiring **Chromecom**. Over 100,000 WiMAX™ subscribers will be migrated to the to the new LTE network in Q3 2015.

WiMAX™ operator **Spectranet Limited** commercially launched 2.3 GHz LTE TDD in Lagos on August 20, 2013, and Abjua in November 2013. ISP **AG-Placid** plans to deploy an LTE service. WLL CDMA operator **Intercellular** obtained a National Unified Access License to deploy LTE. WiMAX™ operator **Mobitel** is deploying LTE TDD in existing 2.3 GHz. WiMAX™ operator **ADIV** is deploying LTE in existing band 42.

Smile Communications commercially launched LTE in Ibadan on June 6, 2013 then Lagos, Abuja and Port Harcourt. Smile has 10 MHz paired 800 MHz band 20. VoLTE has been trialled and in deployment.

MTN commercially launched its HyNet prepaid Internet service using LTE TDD technology in Lagos replacing 3.5 GHz WiMAX™ on July 22, 2015.

M-Tel plans to deploy an LTE network with rollout beginning in November 2015.

The Nigerian Communications Commission (NCC) auctioned 30 MHz of 2.3 GHz in February 2014 for a nationwide wholesale broadband service won by **Bitflux** who is deploying LTE-TDD for launch in 2015.

NCC planned to auction 2 x 70 MHz of 2.6 GHz spectrum from May 4, 2015 but it is delayed.

Oman

Omantel is a member of the Global TD-LTE Initiative (GTI) and launched commercial LTE TDD service on July 16, 2012 in band 40. Omantel commercially launched LTE1800 service on December 30, 2012. On April 27, 2015 Omantel announced commercial launch of its 4.5G LTE-Advanced service providing up to 200 Mbps theoretical peak downlink speed. Omantel recently acquired additional band 7 and band 20 spectrum which are to be used for LTE.

Ooredoo began deploying a 2.3 GHz LTE TDD network. Subsequently the regulator granted access to 1800 MHz spectrum. Ooredoo commercially launched LTE1800 in Muscat on February 17, 2013. On September 3, 2014 Ooredoo launched a Home Broadband package enabled by LTE TDD on the Batinah coast and Muscat, offering Cat 4 CPEs. On May 10, 2015 Ooredoo announced availability of its 4.5G LTE-Advanced service providing up to 200 Mbps theoretical peak downlink speed in hotspots around Muscat.

Qatar

Vodafone commercially launched 150 Mbps LTE (for Category 4 devices) using 800 MHz on June 3, 2014. Its 4G+ LTE-Advanced service was launched on May 12, 2015, combining band 3 and band 20 spectrum. 70% of its LTE sites were 4G+ enabled at that time. Enhancement to 225 Mbps followed. Vodafone launched the first tri-band carrier aggregation using 50 MHz bandwidth adding 2.6 GHz band 7 for a top speed of 375 Mbps on August 9, 2015.

Ooredoo commercially launched LTE on April 16, 2013 using 800 MHz and 2.6 GHz. National coverage was achieved January 2014. 225 Mbps 4G+ LTE-Advanced using bands 7 and 20 launched December 1, 2014. 150 Mbps is available outside of 4G+ areas. Ooredoo plans nationwide 4G+ service by end 2015. Ooredoo is deploying tri-band carrier aggregation to achieve 375 Mbps.

Ooredoo and **China Mobile** demonstrated 4.1Gbps using LTE-Advanced carrier aggregation of ten 20 MHz carriers of TDD and FDD spectrum. LTE international roaming is launched with Mobily.

Réunion

French regulator ARCEP announced on March 13, 2014 that LTE system test spectrum in the 1800 MHz and 2.6 GHz bands has been granted to **SRR**. **Outremer Telecom** is committed to deploy LTE.

Rwanda

Olleh Rwanda Networks deployed a national wholesale LTE network using 2 x 20 MHz band 20 available from November 11, 2014 offering 150 Mbps theoretical peak downlink and 95% coverage of Kigali.

Airtel commercially launched retail LTE service using Olleh on November 11, 2014.

MTN commercially launched retail LTE service using Olleh on November 11, 2014.

Tigo commercially launched retail LTE service using Olleh on January 8, 2015. The service is available in Kigali, Rubavu, Rusizi, Huye and Musanze.

Saudi Arabia

Etisalat (Mobily) commercially launched LTE TDD on September 14, 2011 via its Bayanat subsidiary in band 38 (2.6 GHz). Mobily commercially launched LTE1800 FDD in January 2013 and completed VoLTE trials in May 2013. LTE roaming was agreed with Etisalat (UAE) in early March 2014.

STC commercially launched band 40 LTE TDD on September 14, 2011. LTE1800 was introduced February 2013. On February 8, 2014 STC announced commercial launch of TDD LTE-Advanced 20+20 MHz band 40 (GSA assumption 150 Mbps) and in December 2014 completion of TDD-FDD carrier aggregation trials using band 3 and band 40.

Zain commercially launched LTE1800 on September 14, 2011. Refarmed 2.1 GHz and 1800 MHz spectrum is used in the 150 Mbps LTE-Advanced network commercially launched on June 24, 2015.

Data service provider **ITC** is deploying an LTE TDD network using 3.5 GHz spectrum, initially in Riyadh.

Senegal

Regulator ARTP authorised testing of LTE services until March 21, 2015. **Orange** and **Tigo** both launched pilot trials. The Orange trial end in March 2015. **Expresso** (**Sudatel)** has been granted a trial permit.

Seychelles

Airtel commercially launched an LTE800 network (band 20) on November 26, 2014.

Cable and Wireless is deploying an LTE network.

Somalia

Somtel is deploying an LTE network.

Nordic Group is licensed and plans to deploy LTE.

WiMAX™ operator **Sahal Telecoms** (Glocall Telecoms) is migrating to LTE TDD.

New entrant **SomCom** has national 900 MHz, 1800 MHz, 2.1 GHz & 2.6 GHz licences and seeks an investment partner to deploy GSM-3G-LTE networks.

South Africa

Vodacom commercially launched LTE1800 on October 10, 2012 in Johannesburg. 270 Mbps download speed using LTE-Advanced was demonstrated on Vodacom's network in September 2014, using temporary 2 x 20 MHz paired 2.6 GHz. VoLTE was commercially launched on April 10, 2015 initially for subscribers using the Samsung Galaxy S6 and S6 Edge. More devices will follow said Vodacom.

MTN commercially launched LTE1800 in Durban, Johannesburg, and Pretoria on December 1, 2012. Bloemfontein and Cape Town were added in 2013.

Telkom Mobile (8ta) has 70 MHz in band 40. LTE TDD was commercially launched on April 21, 2013 now available in Johannesburg, Pretoria, Cape Town, Durban and other areas. 150 Mbps band 40 LTE-Advanced was launched on November 15, 2014 in the Parkview and Parkhurst areas, later raised to 220 Mbps. Telkom Mobile will introduce LTE1800 later. The company also operates 3.5 GHz WiMAX™.

Cell C is deploying 2.1 GHz LTE. On December 19, 2012 a trial for selected heavy data users began in Cape Town, Durban, Johannesburg and Pretoria. Cell C commercially launched LTE to customers in Gauteng and KZN on September 23, 2015.

CDMA operator **Neotel** commercially launched LTE using 1800 MHz (LTE1800) in Gauteng on August 21, 2013. **Neotel** also owns 3.5 GHz and 800 MHz band 20 spectrum. **Vodacom** announced in May 2014 it will buy **Neotel** subject to approvals being obtained, with the deal expected to close in 1H 2015.

ISP **Afrihost** (owned by MTN) commercially launched an LTE fixed wireless broadband service on April 22, 2015 in conjunction with the Huawei B593 LTE CPE.

Wireless Business Solutions with interests in iBurst and Broadlink plans to deploy LTE. iBurst has 1800 MHz and 2.6 GHz and deployed a trial using 2.6 GHz.

Sudan

Zain is awaiting approval to deploy a commercial LTE network.

Swaziland

MTN is deploying an LTE1800 network.

Tanzania

Smile commercially launched 800 MHz (band 20) LTE on May 30, 2012 in Dar es Salaam for a limited set of users. By May 2013 coverage reached most of Dar es Salaam for all users. VoLTE has been trialled.

Tigo commercially launched LTE in band 20 on April 24, 2015 in Masaki and Mlimani City areas within Dar es Salaam. Tigo plans to fully cover the city by end July, and cover Arusha, Dodoma, Morogoro, Moshi, Mwanza and Tanga by end of August 2015.

Smart Telecom comemrcialy launched LTE TDD using band 40 on August 27, 2015.

Vodacom is deploying an LTE network using 800 MHz and 1800 MHz (LTE1800) spectrum. **TTCL** is deloying an LTE network for launch in 2015.

Telesis Tanzania, a mobile virtual network aggregator (MVNA) supporting a number of MVNOs, is deploying its own 800 MHz LTE network to cover Dar es Salaam and Mtwara, before national rollout.

Zantel is deploying an LTE network and exploring the potential of deploying License Assisted Access (LAA) technology. On 4th June 2015, Etisalat has agreed to sell its 85% stake in Zantel to Millicom International.

Tunisia

Tunisiana is upgrading its network to 3G and LTE.

Regulator INT launched a consultation on 4G introduction including preferred bands and bandwidths, network sharing, and increasing competition, with comments due by April 15, 2015. Licences are expected to be awarded in mid-2016.

UAE

Etisalat commercially launched LTE on September 25, 2011 using 2.6 GHz indoors & 1800 MHz (LTE1800) outdoors in urban & suburban areas. Cat 4 dongles were sold from June 2013. 300 Mbps (Cat 6) LTE-Advanced was commercially launched in September 2014 with carrier aggregation of 20 MHz band 3 and 20 MHz band 20. Coverage began in Aub Dhabi region and then covered UAE cities with 100 LTE-Advanced sites. Supported devices are Samsung Note 4, Alfa and Edge and Huawei Mate 7. On October 12, 2014 **Etisalat** announced that testing of 700 Mbps tri-band carrier aggregation on its network had been completed. VoLTE & SRVCC was tested successfully in the commercial network in July 2014. Implementation started in Abu Dhabi region and was completed successfully for all mobile access sites (all over UAE). The following handsets were tested successfully: Samsung (S5), Apple (iPhone 6)

and Nokia (830). Etisalat is also planning to introduce 450 Mbps LTE-Advanced in 2016.

Du commercially launched LTE1800 on June 12, 2012 targeting 90% population coverage by 2014. In August 2014 Du announced VoLTE had been successfully installed and tested over its commercial LTE network and demoed VoLTE calls at GITEX 2014; commercial launch is expected Q1/Q2 2015.

Du has successfully demonstrated LTE-Advanced with 900 Mbps over its LTE network in GITEX 2014 combining 3 carriers with MIMO 4x4. Du has successfully tested LTE-Advanced with carrier aggregation over its commercial network with 300 Mbps peak throughput by combining band 20 (800 MHz) and band 3 (1800 MHz) spectrum in July 2014 and commercially launched 225 Mbps LTE-Advanced service on March 1, 2015 combining 20 MHz band 3 and 15 MHz band 20 spectrum for Cat 6 terminals.

TRA plans to release 700 MHz and 800 MHz for mobile broadband by combining band 20 with the lower duplexer (2x30 MHz) of APT700.

Uganda

Smile commercially launched LTE for business users in Kampala in October 2012 in band 20. Service was extended to consumers on June 9, 2013. VoLTE has been trialled, and launch is planned in 2015.

MTN commercially launched band 41 LTE TDD network on April 25, 2013 in Greater Kampala and Entebbe. Service was extended to all major towns on July 9, 2015.

Orange commercially launched band 20 LTE on July 31, 2013. The parent company sold its majority stake to **Africell Holding**.

Vodafone commercially launched band 38 LTE TDD service on February 9, 2015 in Entebbe and Kampala. Rapid expansion is planned. In September 2015 the company announced 100,000 subscriptions had been achieved.

Zambia

MTN commercially launched LTE1800 on January 16, 2014 in Lusaka, Kitwe, Ndola and Livingstone. **Zamtel** commercially launched LTE in Kitwe on January 21, 2014. **Airtel** is deploying an LTE network. **Massnet** is deploying a 2.6 GHz LTE FDD network.

Zimbabwe

Econet Wireless commercially launched LTE1800 on August 22, 2013 in the Victoria Falls area to provide coverage at the UNWTOGA. Coverage is now available using over 20 sites in Bulawayo, Harare, and Victoria Falls.

NetOne is deploying LTE nationwide for commercial launch in 2015. WiMAX™ operator **Aqiva Wireless** is planning to deploy an LTE network.

Telecel plans to deploy an LTE network in 2016.

Sub-Sahara Africa

Afrimax says it has built up a large portfolio of LTE TDD spectrum in a number of countries and commenced operations in licensed markets.

LTE-Advanced global status

"LTE-Advanced" covers 3GPP technology from Release 10 (Rel. 10) onwards. Key features are carrier aggregation (to leverage more spectrum, increase data rates), advanced antenna technique/MiMO enhancements (more capacity), and relays. Enhancements include optimising HetNets (even more capacity and advanced interference management). Enhancements for both WCDMA-HSPA and LTE systems include architecture improvements for eNobeBs, local IP traffic offloading, optimizations for M2M, SRVCC and eMBMS. Rel. 10 was finalised in 2010. In addition to refining some Rel. 10 features, Rel. 11 includes basic functionality for coordinated multipoint (CoMP) transmission and reception, and enhanced support for heterogeneous deployments, eICIC. These features are now being introduced. The first LTE-Advanced feature to be commercialized was carrier aggregation, from mid-2013. A third of operators are investing in LTE-Advanced.

95 LTE-Advanced systems launched in 48 countries

Country	Operator
Albania	Telekom Albania
Albania	Vodafone Albania
Australia	Optus
Australia	Telstra
Australia	Vodafone
Austria	A1 Telekom
Austria	3 (Drei)
Belgium	Mobistar
Belgium	Proximus
Canada	Bell Mobility
Canada	Rogers Wireless
Canada	Telus
China	China Telecom
Czech Republic	O2
Czech Republic	T-Mobile
Czech Republic	Vodafone
Denmark	3
Denmark	TDC
Estonia	EMT
Estonia	Tele2
Finland	Elisa
Finland	TeliaSonera
France	Bouygues Telecom
France	Orange
France	SFR
Germany	DT
Germany	O2
Germany	Vodafone
Greece	Cosmote
Greece	Vodafone
Hong Kong	CSL
Hong Kong	SmarTone
Indonesia	Smartfren
Ireland	Vodafone
Italy	TIM
Italy	Vodafone
Japan	KDDI
Japan	NTT DoCoMo
Japan	UQ Communications
Jersey	JT
Kenya	Safaricom
Kuwait	Ooredoo
Latvia	Bite
Latvia	LMT
Lithuania	Bite
Lithuania	Omnitel
Lithuania	Tele2
Luxembourg	Tango
Maldives	Dhiraagu
Monaco	Monaco Telecom
Morocco	IAM Maroc Telecom
Netherlands	KPN
Netherlands	Tele2
Netherlands	Vodafone
New Zealand	Spark
Norway	NetCom
Norway	TeleNor
Oman	Omantel
Oman	Ooredoo
Philippines	Smart
Portugal	Meo
Portugal	Vodafone
Qatar	Ooredoo
Qatar	Vodafone
Romania	Orange
Russia	Megafon
Russia	MTS
Russia	Vimpelcom
Saudi Arabia	STC
Saudi Arabia	Zain
Singapore	M1
Singapore	SingTel
Singapore	StarHub
Slovak Republic	Slovak Telecom
Slovenia	Si.mobil
Slovenia	Telekom Slovenije
South Africa	Telkom Mobile
South Korea	KT
South Korea	LG Uplus
South Korea	SK Telecom
Spain	Movistar
Spain	Orange
Spain	Vodafone
Switzerland	Salt
Switzerland	Swisscom
Taiwan	CHT
Taiwan	FarEasTone
Taiwan	Taiwan Mobile
UAE	Du
UAE	Etisalat
UK	EE

USA	AT&T
USA	Redzone Wireless
USA	Sprint
USA	T Mobile

142 operators investing in LTE-Advanced: 62 countries

Country	Operator	LTE-Advanced status	In service
Albania	**Telekom Albania**	**Commercial CA 225 Mbps**	**B3 + B7**
Albania	**Vodafone Albania**	**Commercial CA 225 Mbps**	**Bands to be advised**
Angola	Unitel	Trialled CA in B3 & B8 Trialled CA 450 Mbps using 2x20 MHz B1 + 2x20 MHz B3 + 2x20 MHz B7	
Australia	**Optus**	**Commercial CA TDD 220 Mbps** **Commercial CA FDD 185 Mbps** **Commercial CA FDD 225 Mbps** **Commercial CA TDD + FDD 220 Mbps** **Commercial CA 2 TDD + 1 FDD 330 Mbps** Demonstrated 480 Mbps using 4 CA (1 FDD, 3 TDD) Category 8 test drive 20 MHz B7 + 3x20 MHz B40	**2 x 20 MHz B40** **15 MHz B3 + 10 MHz B28** **20 MHz B7 + 10 MHz B28** **15 MHz B3 + 20 MHz B40** **15 MHz B3 + 20 MHz B40** **15 MHz B3 +20+20 MHz B40**
Australia	**Telstra**	**Commercial CA 300 Mbps** **Commercial CA 450 Mbps** **Commercial CA 600 Mbps with 256QAM**	**20 MHz B3 + 20 MHz B28** **20 MHz B3 + 20 MHz B7 + 20 MHz B28** **20 MHz B3 + 20 MHz B7 + 20 MHz B28**
Australia	**Vodafone**	**Commercial CA 225 Mbps**	**20 MHz B3 + 5 MHz B5 on many sites 20 MHz B3 + 10 MHz B3 some sites**
Austria	**A1 Telekom**	**Commercial CA 300 Mbps**	**20 MHz B7 + 20 MHz B20**
Austria	**3 (Drei)**	**Commercial CA 300 Mbps**	**B3 + B7**
Austria	T Mobile	Trialled CA B3 and B7	
Belarus	BeCloud - MTS	Trialled CA and achieved 250 Mbps	
Belgium	Base	Deploying 300 Mbps LTE-A	
Belgium	**Mobistar**	**Commercial CA 213 Mbps**	**20 MHz B3 + 10 MHz B20**
Belgium	**Proximus**	**Commercial CA 300 Mbps**	**Bands to be advised**
Canada	**Bell Mobility**	**Commercial CA 220 Mbps** **Commercial tri-band CA 290 Mbps**	**B2 + B4 + B7** **B4 + B7 + B17**
Canada	**Rogers**	**Commercial CA 225 Mbps**	**10MHz B4 + 20MHz B7**
Canada	**Telus**	**Commerical CA 110 Mbps** Deploying 150 Mbps	**Bands to be advised**
Chile	Entel PCS	Trialled CA 250 Mbps B7 & B28	
China	China Mobile	Trialled LTE TDD CA in 2014 achieved 220 Mbps Trialled intra-band LTE TDD CA in 2015, achieved 220 Mbps LTE-A CA in deployment using 40 MHz B41, 40 MHz B40, 40 MHz B41 + B39, and 30 MHz B39 LTE-A CA uplink trialled 3 carrier LTE TDD B41 in trial phase up to 330 Mbps Ooredoo Qatar with CMCC trialled FDD-TDD 10-carrier	
China	**China Telecom**	**Commercial 300 Mbps** "Tianyi 4G+" service	**B1 + B3 + B5**
China	China Unicom	Deploying 300 Mbps LTE-A by end 2015 330 Mbps LTE-A in 2016 with tri-band CA	
Croatia	T-Hrvatski Telekom	Trialled CA with 10 MHz B3 + 10 MHz B20 for 136 Mbps	
Czech Republic	**02 Czech Republic**	**Commercial CA 185 Mbps**	**20 MHz B3 + 10 MHz B20**
Czech Republic	**T-Mobile**	**Commercial CA 225 Mbps** 4x4 MIMO trialled using B20	**20 MHz B3 + 10 MHz B20**
Czech Republic	**Vodafone**	**Commercial CA 225 Mbps** Deploying 375 Mbps 3-CA with introduction of B7	**15 MHz B3 + 15 MHz B20**
Denmark	**3**	**Commercial CA 150 Mbps**	**B3 + B7**
Denmark	**TDC**	**Commercial CA 300 Mbps** 440 Mbps 3CC CA trial completed in 2015	**B7 + B20**
Denmark	Telenor	Deploying CA	

Denmark	Telia	Deploying 300 Mbps CA B3 + B7	
Estonia	Elisa	Deploying CA 300 Mbps 20 MHz B3 + 20 MHz B7	
Estonia	**EMT**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Estonia	**Tele2**	**Commercial CA 300 Mbps** Deploying 375 Mbps LTE-A	
Finland	DNA	Deploying 300 Mbps via Suomen Yhteisverkko JV	
Finland	**Elisa**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Finland	**TeliaSonera**	**Commercial CA 300 Mbps** via Suomen Yhteisverkko JV 3-band CA trial achieved 375 Mbps B3+B7+B20	**B3 + B7**
Finland	Ukko Mobile	TDD LTE-Advanced demo achieved 507 Mbps with 2 x 20 MHz B38	
France	**Bouygues Telecom**	**Commercial CA 225 Mbps** Testing 3-band: B3+B7+B20	**15 MHz B3 + 15 MHz B7**
France	Free Mobile	Trialling CA 220 Mbps B3 + B7	
France	**Orange**	**Commercial CA 225 Mbps** 300 Mbps CA trial used 3.5GHz and 2.6GHz in FDD Committed to deploy 450 Mbps 3CA by end 2017	**10 MHz B20 + 20 MHz B7**
France	**SFR**	**Commercial CA 187.5Mbps**	**B7 + B20**
Germany	**DT**	**Commercial CA 300 Mbps** 3-band CA 375 Mbps trialled B3 + B7 + B20 Tested IS-MIMO	**20 MHz B3 + 20 MHZ B7**
Germany	**O2**	**Commercial CA 225 Mbps**	**B7 + B20**
Germany	**Vodafone**	**Commercial CA 225 Mbps** Demoed Cat 8	**B7 + B20**
Greece	**Cosmote**	**Commercial CA 375 Mbps**	**B3+B7+B20**
Greece	**Vodafone**	**Commercial CA 300 Mbps** 375 Mbps trialled	**B3 + B7**
Guernsey	JT	Deploying B7 + B20	
Hong Kong	**CSL**	**Commercial CA 300 Mbps** 3-carrier 450 Mbps in deployment	**20 MHz B3 + 20 MHz B7**
Hong Kong	**SmarTone**	**Commercial CA 150 Mbps** Tri-band CA in deployment B3+B7+B8	**Two from B3, B7, B8**
Hong Kong	3	Deploying 10 MHz B3 + 20 MHz B7 for 225 Mbps Deploying FDD & TDD CA Deploying 3CC CA Committed to 5CC CA	
Hong Kong	CM HK	Trialling 15 MHz B7 + 20 MHz B40 + 10 MHz B40	
Hungary	Magyar Telekom	Trialled CA 250 Mbps 20 MHz B3 + 20 MHz B7	
Indonesia	**Smartfren**	**Commercial CA 225 Mbps** Future deployment: 20 MHz B40 + 10 MHz B40 + 10 MHz FDD	**20 MHz B3 + 10 MHz B40 AND B5 + B40**
Ireland	**Vodafone**	**Commercial 225 Mbps CA**	**Bands to be advised**
Israel	Cellcom	Deploying	
Italy	3 Italia	CA planned B3 + B7	
Italy	**TIM**	**Commercial CA 225 Mbps**	**Two from B3, B7, B20**
Italy	**Vodafone**	**Commercial CA 225 Mbps**	**Two from B3, B7, B20**
Japan	**NTT DoCoMo**	**Commercial CA 225 Mbps** 300 Mbps CA to be deployed by March 2016	**B3 + B19 and B1 +21**
Japan	Ymobile Corp	Trialling CA B9 + B42	
Japan	**KDDI**	**Commercial CA 150 Mbps**	**B1 + B18**
Japan	Softbank	5 carrier LTE TDD CA demoed. Trialling in B42 Trialled CoMP 3-band CA trial: B1 + B3 + B8 achieved 262.5 Mbps	
Japan	**UQ Comms**	**Commercial 220 Mbps 4x4 MIMO** CA in deployment	**20 MHz B41**
Jersey	**JT**	**Commercial CA 300 Mbps**	**B3 + B7 + B20**
Kenya	**Safaricom**	**Commercial CA 100 Mbps**	**B3 + B20**
Kuwait	Viva	Deploying	
Kuwait	**Ooredoo**	**Commercial CA 185 Mbps**	**B3 + B20**
Kuwait	Zain	Deploying CA	
Latvia	**Bite**	**Commercial CA 300 Mbps**	**B3 + B7**
Latvia	**LMT**	**Commercial CA 150 Mbps**	**B3 + B7**
Lebanon	Alfa	300 Mbps LTE-Advanced demonstrated with B3 + B20	
Lebanon	Touch	Trialled CA 250 Mbps B3 + B20	
Lithuania	**Bite**	**Commercial CA 300 Mbps** **Commercial CA 225 Mbps**	**B3 + B7** **B3 + B20**
Lithuania	**Omnitel**	**Commercial CA 200 Mbps**	
Lithuania	**Tele2**	**Commercial CA 210 Mbps**	**10 MHz B20 + 15 MHz B3**
Lithuania	Telecentras	Trialling	

Luxembourg	**Tango**	**Commercial CA 225 Mbps**	**B3 + B20**
Maldives	**Dhiraagu**	**Commercial CA 300 Mbps**	**B3 + B7**
Maldives	Ooredoo	Trialled	
Monaco	**MT**	**Commercial CA 223 Mbps**	**B7 + B20**
Morocco	**IAM: Maroc Telecom**	**Commercial CA 225 Mbps**	**Bands to be advised**
Montenegro	Crnogorski Telekom	Trialling CA 300 Mbps	
Nepal	NT	Planned	
Netherlands	**KPN**	**Commercial CA 225 Mbps**	**20 MHz B3 + 10 MHz B20**
Netherlands	**Vodafone**	**Commercial CA 225 Mbps**	**10 MHz B20 + 20 MHz B3**
Netherlands	**Tele 2**	**Commercial CA 225 Mbps**	**B7 + B20**
New Zealand	Vodafone	CA demoed	
New Zealand	**Spark**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Norway	**NetCom**	**Commercial CA 300 Mbps** Limited area, business users	**Bands to be advised**
Norway	**Telenor**	**Commercial CA 300 Mbps**	**B3 + B20 B3 + B7**
Oman	**Omantel**	**Commercial CA 200 Mbps**	**Bands to be advised**
Oman	**Ooredoo**	**Commercial CA 200 Mbps**	**Bands to be advised**
Philippines	Globe	Deploying 225 Mbps CA	
Philippines	**Smart**	**Commercial CA 225 Mbps**	**Bands to be advised**
Poland	Orange	Trialled 300 Mbps CA 10 MHz B20 + 10 MHz B3 + 20 MHz B7 10 MHz B20 + 10 MHz B7 + 20 MHz B7	
Poland	Polkomtel & Cyfrowy Polsat	Trialled 300 Mbps CA 20 MHz B3 + 20 MHz B7	
Portugal	**Meo**	**Commercial CA 300 Mbps** **Commercial CA 225 Mbps**	**20 MHz B7 + 20 MHz B3 20 MHz B7 + 10 MHz B20**
Portugal	Nos	Trialled 300 Mbps CA	
Portugal	**Vodafone**	**Commercial CA 300 Mbps** Trialled 450 Mbps B3 + B7 Trialled 600 Mbps tri-band CA with 256Qam	**B3 + B7**
Qatar	**Ooredoo**	**Commercial CA 225 Mbps** Ooredoo Qatar + CMCC trialled FDD-TDD 10-carrier 375 Mbps tri-band CA in deployment	**B7 + B20**
Qatar	**Vodafone**	**Commercial CA 375 Mbps**	**B3 + B7 + B20**
Romania	**Orange**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Romania	Vodafone	Deploying Cat 6 CA B3+B20	
Russia	**MegaFon**	**Commercial CA 300 Mbps**	**20 MHz B7 + 20 MHz B7**
		450 Mbps LTE-A CA trialled using 20 MHz B7 + 20 MHz B7 + 20 MHz B3	
Russia	**MTS**	**Commercial CA 225 Mbps** Deploying 150 Mbps and 225 Mbps in the Regions	**B3 + B7**
Russia	Osnova	Lab tested TDD LTE-A CA achiving 226.1 Mbps	
Russia	**Vimpelcom**	**Commercial CA 110 Mbps**	**B7 + B20**
Saudi Arabia	**STC**	**Commercial TDD LTE-A** FDD-TDD CA demonstrated: B3 + B40	**20 + 20 MHz B40**
Saudi Arabia	**Zain**	**Commercial CA 150 Mbps**	**B1 + B3**
Singapore	**M1**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHZ B7**
Singapore	**SingTel**	**Commercial CA 337 Mbps** FDD-TDD CA trialled (260 Mbps achieved) Deploying 450 Mbps CA	**20 MHz B3 + 20 MHz B7 + B8**
Singapore	**StarHub**	**Commercial CA 300 Mbps** 27.05.15 announcement that 600 Mbps demonstrated using 4x4 MIMO technology and carrier aggregation	**B3 + B7**
Slovak Rep	**Slovak Telekom**	**Commercial CA 225 Mbps** in Nitra, rollout continuing Trialled CA 300 Mbps 2x20 MHz + 2x20 MHz B7	**10 MHz B3 + 20 MHz B7**
Slovenia	**Telekom Slovenije**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Slovenia	**Si.mobil**	**Commercial 300 Mbps CA**	**20 MHz B3 + 20 MHz B20**
South Africa	**Telkom Mobile**	**Commercial CA 220 Mbps**	**B40**
South Africa	Vodacom	Demonstrated CA 270 Mbps using 2 x 20 MHz paired B7	
South Korea	**LG Uplus**	**Commercial CA 300 Mbps** Trialling B5 + B1 + B7	**20MHz B5 + 20MHz B1**
South Korea	**KT**	**Commercial CA 300 Mbps**	**10 MHz B1 + 20 MHz B3 + 10 MHz B8**
South Korea	**SK Telecom**	**Commercial CA 300 Mbps** Uplink CoMP trialled	**10 MHz B1 + 20MHz B3 + 10MHz B5 +**
Spain	**Movistar**	**Commercial CA 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Spain	**Orange**	**Commercial CA 300 Mbps**	**B3 + B7 + B20**
Spain	**Vodafone**	**Commercial 300 Mbps**	**20 MHz B3 + 20 MHz B7**
Sri Lanka	Dialog Axiata	Trialling 100+ Mbps CA	
Sweden	Tele2-Telenor	Trialling CA	
Switzerland	**Salt**	**Commercial 300 Mbps**	**20 MHz B3 + 20 MHZ B7**

Switzerland	Sunrise	Deploying CA 300 Mbps B3 + B7 + B20	
Switzerland	**Swisscom**	**Commercial CA 300 Mbps** Demonstrated 335 Mbps B1 + B41 426 Mbps achieved in tests using 256 QAM	**20 MHz B3 + 20 MHz B7**
Taiwan	**CHT**	**Commercial 180 Mbps**	**15 MHz B3 + 10 MHz B8**
Taiwan	**FarEasTone**	**Commercial CA**	**B3 + B28**
Taiwan	**Taiwan Mobile**	**Commercial CA 150 Mbps**	**5 MHz B3 + 15 MHz B28**
Turkey	Avea	Demonstrated 300 Mbps and 450 Mbps CA	
Turkey	Turkcell	Demonstrated 891.6 Mbps CA	
Turkey	Vodafone	Trialled 3-carrier 450 Mbps using B3 + B7 + B20	
UAE	**Du**	**Commercial CA 225 Mbps** 900 Mbps demonstrated using MIMO 4x4	**20 MHz B3 + 15 MHz B20**
UAE	**Etisalat**	**Commercial CA 300 Mbps** Trialling 700 Mbps CA 20 MHz B3 + 20 MHz B20 + 20 MHz B7 Planning 450 Mbps LTE-A launch in 2016	**20 MHz B3 + 20 MHz B20**
UK	**EE**	**Commercial CA 300 Mbps** Trialling CA 400 Mbps Cat 9 20 MHz B3 + 20+15 MHz B7	**20 MHz B3 + 20 MHz B7**
UK	Vodafone	Deploying B7 + B20	
USA	**AT&T**	**Commercial CA 110 Mbps**	**2x15 MHz of B4 + B17**
USA	DISH	Planned	
USA	**Redzone Wireless**	**Commercial CA 100 Mbps**	**B41**
USA	**T Mobile**	**Commercial CA 150 Mbps**	**20+20 MHz B4**
USA	**Sprint**	**Commercial CA 120 Mbps** Targets 180 Mbps end 2015	**B25/B26/B41**
USA	Verizon	CA in deployment for 2015 launch, using B13 + B4	

For a list of LTE-Advanced networks with peak downlink speeds see GSA paper:

LTE-Advanced Carrier Aggregation deployments: peak speeds

Sign in and follow the link on the home page www.gsacom.com

LTE-Advanced User Devices: According to GSA's Status of the LTE Ecosystem report (June 19, 2015) 1,132 devices support UE Category 4 (up to 150 Mbps downlink), i.e. 35% of all LTE devices, including 108 devices that also support UE Category 6 (downlink data rates above 150 Mbps up to 300 Mbps). Category 6 devices include small cells, routers, MiFis, smartphones and tablets.

Overview of 3GPP Release 12:
http://www.ericsson.com/res/docs/whitepapers/wp-lte-release-12.pdf

VoLTE global status

219 VoLTE devices (including carrier & frequency variants) including 198 smartphones are announced (GSA: Status of the LTE Ecosystem report, 29 June 2015).

111 operators are investing in VoLTE in 52 countries (deployments, trials, studies)

30 operators commercially launched VoLTE-HD voice in 21 countries

Country	Operator	VoLTE status
Australia	**Telstra**	**Launched**
Canada	**Rogers Wireless**	**Launched**
China	**China Mobile**	**Launched**
Czech Republic	**T Mobile**	**Launched**
Germany	**Vodafone**	**Launched**
Hong Kong	**CSL**	**Launched**
Hong Kong	**3 HK**	**Launched**
Indonesia	**XL Axiata**	**Launched**
Italy	**Vodafone**	**Launched**
Japan	**KDDI**	**Launched**
Japan	**NTT DoCoMo**	**Launched**
Japan	**Softbank**	**Launched**
Kuwait	**Viva**	**Launched**
Liechtenstein	**Swisscom**	**Launched**
Portugal	**Vodafone**	**Launched**
Romania	**Orange**	**Launched**
Singapore	**M1**	**Launched**
Singapore	**SingTel**	**Launched**
Singapore	**StarHub**	**Launched**
South Africa	**Vodacom**	**Launched**
South Korea	**KT**	**Launched**
South Korea	**LG Uplus**	**Launched**
South Korea	**SK Telecom**	**Launched**
Spain	**Vodafone**	**Launched**
Switzerland	**Swisscom**	**Launched**
Taiwan	**Ambit Microsystems**	**Launched**
UK	**3 UK**	**Launched**
USA	**AT&T Mobility**	**Launched**
USA	**T-Mobile US**	**Launched**
USA	**Verizon Wireless**	**Launched**
Algeria	Algérie Telecom	In deployment
Australia	Optus	Trialling
Australia	Vodafone	In deployment
Austria	T Mobile	Trialling
Brazil	TIM	Trialled
Bulgaria	Mtel	Planned
Bulgaria	Max	In deployment
Cambodia	Chuan Wei Ltd	In deployment
Canada	Sasktel	In deployment
Canada	Telus	In deployment
China	China Telecom	Trialling
China	China Unicom	In deployment
Colombia	Avantel	In deployment
Czech Republic	O2 Czech	In deployment
Czech Republic	Swan Telecom	Trialling
Denmark	TDC	Trialling
Denmark	Telenor	In deployment
Ecuador	CNT	In deployment
France	Bouygues Telecom	In deployment
France	Orange	Planned
France	SFR	In deployment
Germany	DT	In deployment
Germany	O2	In deployment
Greece	Vodafone	Trialled
Hong Kong	China Mobile HK	In deployment
India	Bharti Airtel	Trialling
India	RIL	Trialling
India	Videocon	Planned
Indonesia	Smartfren	In deployment
Indonesia	Telkomsel	Trialled
Italy	Vodafone	Trialling
Kazakhstan	Altel	In deployment
Kuwait	Ooredoo	Trialled
Kuwait	Zain	Trialled
Lebanon	Alfa	In deployment
Namibia	MTC	Planned
Netherlands	KPN	Trialling
Netherlands	T-Mobile	In deployment
Netherlands	Tele2	In deployment
Netherlands	Vodafone	In deployment
New Zealand	Spark	Trialling
New Zealand	Vodafone	Trialled
Nigeria	Smile	In deployment
Norway	Ice.net	Trials planned
Norway	Telenor	In deployment
Poland	Polkomtel	Trialled
Poland	Sferia	Planned
Romania	Vodafone	Trialling
Russia	MTS	In deployment
Russia	Megafon	In deployment
Russia	Vimpelcom	In deployment
Saudi Arabia	Mobily	In deployment
Serbia	Vip Mobile	Trialled
Singapore	M1	In deployment
Slovakia	Slovak Telecom	Planned
Slovenia	Si.mobil	In deployment
Slovenia	Telekom Slovenije	In deployment
Spain	Telefonica Movistar	Trialling
Sweden	Tele2	In deployment
Sweden	Telenor	In deployment
Sweden	TeliaSonera	In deployment
Switzerland	Sunrise	In deployment
Taiwan	Asia Pacific Telecom	In deployment
Taiwan	FarEasTone	In deployment
Taiwan	Taiwan Mobile	In deployment
Tanzania	Smile	Trialled
Thailand	DTAC	Trialling
Turkey	Avea	Trialling
Turkey	Turkcell	Trialled
UAE	Du	In deployment
UAE	Etisalat	In deployment
Uganda	Smile	In deployment
UK	EE	In deployment
UK	O2	In deployment
UK	Vodafone	In deployment
USA	C Spire	Planned
USA	KPU	In deployment
USA	US Cellular	In deployment
USA	Sprint	In deployment
USA	VTel	In deployment
Venezuela	Digitel	Testing

LTE TDD: Global status

62 LTE TDD (TD-LTE) systems are commercially launched in 37 countries. 18 operators deployed converged FDD & TDD networks.

Country	Operator	TDD band
Australia	NBN Co.	Band 40
Australia	Optus FDD & TDD	Band 40
Bahrain	Menatelecom	Band 42
Belgium	b•lite	Band 42
Brazil	On Telecomunicacoes	Band 38
Brazil	Sky Brazil Services	Band 38
Canada	ABC Communications	Band 42
Canada	Bell Mobility FDD & TDD	Band 42
Canada	CCI Wireless	Band 42
Canada	Sasktel FDD & TDD	Band 41
Canada	Telus FDD & TDD	40, 42
Canada	Xplornet	Band 42
China	China Mobile	39/40/41
China	China Telecom	Band 40, 41
China	China Unicom	Band 40, 41
Colombia	DirecTV	Band 38
Côte d'Ivoire	YooMee	Band 40
Dominican R.	WIND Telecom	Band 38
Finland	Ukko Mobile FDD & TDD	Band 38
Gambia	Netpage	Band 40
Ghana	BLU	Band 38
Ghana	NITA	Band 41
Hong Kong	CMHK FDD & TDD	Band 40
India	Aircel	Band 40
India	Bharti Airtel	Band 40
Indonesia	PT Internux	Band 40
Indonesia	Smartfren FDD & TDD	Band 40
Italy	Linkem	Band 42
Japan	Softbank FDD & TDD	Band 41
Japan	UQ Communications	Band 41
Madagascar	Blueline	Band 41
Nigeria	MTN HyNet	Band 42
Nigeria	Spectranet	Band 40
Nigeria	Swift Networks	Band 40
Oman	Omantel FDD & TDD	Band 40
Oman	Ooredoo FDD & TDD	Band 40
Peru	Americatel (Entel)	Band 40
Philippines	PLDT	Band 42
Poland	Aero2 FDD & TDD	Band 38
Romania	Idilis/2K Telecom	Band 38
Russia	Megafon FDD & TDD	Band 38
Russia	MTS FDD & TDD	Band 38
Russia	Vainakh Telecom	Band 40
S. Arabia	Mobily FDD & TDD	Band 38
S. Arabia	STC FDD & TDD	Band 40
S. Africa	Telkom Mobile (8ta)	Band 40
Spain	COTA Murcia4G	Band 38
Spain	Neo-Sky	Band 42
Sri Lanka	Dialog Axiata FDD & TDD	Band 40
Sri Lanka	Lanka Bell	Band 40
Sri Lanka	SLT	Band 38
Sweden	3 Sweden FDD & TDD	Band 38
Tanzania	Smart Telecom	Band 40
Trinidad&Tobago	TSTT	Band 41
Uganda	MTN	Band 41
Uganda	Vodafone	Band 38
USA	Redzone Wireless	Band 41
USA	Speedconnect	Band 41
USA	Sprint FDD & TDD	Band 41
UK	UK Broadband	Band 42, 43
Uzbekistan	EVO	Band 40
Vanuatu	WanTok	Band 40

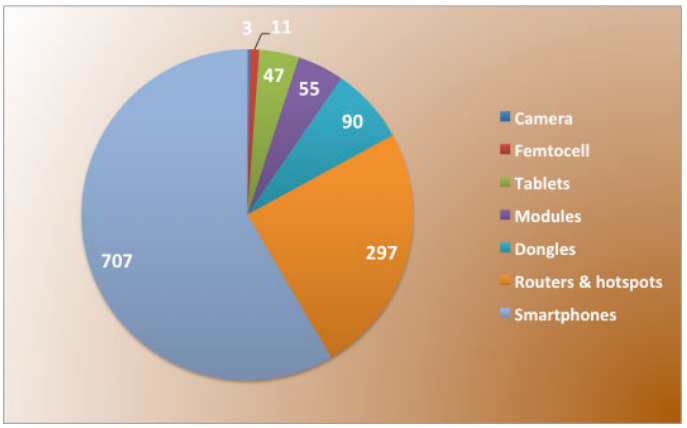
Band 40 is used most often for TDD deployments. 54 additional operators are deploying LTE TDD networks plus 18 more that are engaged in trials or studies.

LTE TDD User Devices Ecosystem

GSA maintains a database of LTE FDD and TDD user devices. Key metrics are published in the Status of the LTE Ecosystem report. The June 19, 2015 report confirmed 3,253 LTE devices (including operator & frequency variants) by 305 manufacturers. **1,210 devices i.e. 37.2% of LTE devices** (28% in July 2014) **support LTE TDD (TD-LTE).** Smartphone is the largest category; there are 707 LTE TDD smartphones. Bands 40 and 38 have the largest device ecosystems. Bands 39 and 41 are also well supported. There is a good choice of multiband, dual-mode FDD-TDD devices.

LTE TDD	
2300 MHz band 40	869 devices
2600 MHz band 38	752 devices
1900 MHz band 39	630 devices
2600 MHz band 41	625 devices
3500 MHz band 42/43	32 devices

1/ Several devices are multi-band and multi-mode
2/ Certain devices are carrier or country specific



LTE1800: LTE deployments in 1800 MHz band

LTE network deployment in 1800 MHz is mainstream. The motivations are clear:

- Coverage area approx. 2 times compared to deploying in 2.6 GHz band
- Possibility to re-use assets including antenna cables of GSM1800 or WCDMA-HSPA2100
- Possibility to deploy multi-RAN with simultaneous LTE and GSM capabilities
- 1800 MHz band widely available throughout Europe, APAC, MEA, regions of South America – thus having the potential to be a core - and global - band for LTE deployments
- Operators often have sufficient bandwidth in 1800 MHz to secure the full benefits of LTE
- Often easier to re-farm than 900 MHz
- User device eco-system is building; a good choice of user devices available by end 2011
- Can be a transition strategy between HSPA and availability of new (e.g. 2.6 GHz, digital dividend) spectrum

The LTE1800 Zone on www.gsacom.com provides a vast amount of information about deployment of LTE in 1800 MHz spectrum, including white papers by leading vendors plus updates/presentations from mobile operators, and other resources. Visit the LTE1800 Zone via the banner on www.gsacom.com

GSA REPORT: "Embracing the 1800MHz opportunity: Driving mobile forward with LTE in the 1800MHz band" www.gsacom.com/lte1800

The report shows from practical, economic and business perspectives why 1800 MHz emerged as a prime band for LTE deployments in virtually all regions of the world, and its importance for international roaming.

Key Findings:
http://www.gsacom.com/news/gsa_342.php4

192 commercially launched LTE1800 systems

192 operators have commercially launched LTE1800 (band 3) systems in 92 countries/territories either as a single band or as part of a multi-band deployment. 1800 MHz is the most widely used and prime band for LTE globally, deployed in 43.4% of LTE networks, greatly assisting international roaming for mobile broadband services. More LTE1800 deployments are in progress. 1800 MHz mobile licences have been awarded to 350+ operators in nearly 150 countries.

Country	Operator
Åland Islands	Ålcom
Albania	Eagle Mobile
Albania	Telekom Albania
Algeria	Algérie Télécom
Angola	Movicel
Angola	Unitel
Aruba	Setar NV
Australia	Optus
Australia	Telstra
Australia	Vodafone
Austria	3
Azerbaijan	Azercell
Azerbaijan	Bakcell
Bahrain	Batelco
Bahrain	Viva
Bahrain	Zain
Belgium	BASE
Belgium	Mobistar
Belgium	Proximus
Bhutan	Bhutan Telecom
Bonaire	UTS
Botswana	Orange
Brazil	Nextel
Brunei	DST
Bulgaria	Max
Cambodia	Smart Axiata
Cayman Islands	Digicel
Costa Rica	Claro
Costa Rica	Movistar
Croatia	T-Hrvatski
Croatia	VIPNet
Curaçao	UTS
Cyprus	MTN
Cyprus	PrimeTel
Czech Republic	O2 Czech Republic
Czech Republic	T Mobile
Czech Republic	Vodafone
Denmark	3
Denmark	Telenor

Denmark	Telia
Dominican Republic	Orange Dominicana
Estonia	Elisa
Estonia	EMT
Estonia	Tele2
Ethiopia	Ethio Telecom
Fiji	Vodafone Fiji
Finland	DNA
Finland	Elisa
Finland	TeliaSonera
France	Bouygues Telecom
Georgia	Geocell
Georgia	Magticom
Germany	DT
Germany	O2
Greece	Cosmote
Greece	Vodafone
Greece	Wind Hellas
Hong Kong	3HK
Hong Kong	China Mobile HK
Hong Kong	CSL
Hong Kong	Smartone
Hungary	Magyar Telekom (MT)
Hungary	Telenor
Iceland	Nova
Iceland	Siminn
Indonesia	3 Indonesia
Indonesia	Indosat
Indonesia	Smartfren
Indonesia	Telkomsel
Indonesia	XL Axiata
Iran	MTN Irancell
Ireland	3 Ireland
Ireland	Meteor
Isle of Man	Manx Telecom
Israel	Cellcom
Israel	Partner – Orange
Israel	Pelephone
Italy	3 Italia
Italy	TIM
Italy	Vodafone
Japan	Ymobile Corp (band 9)
Japan	NTT DoCoMo
Jersey	JT
Jordan	Orange
Jordan	Zain
Kazakhstan	Altel
Kenya	Safaricom
Kosovo	IPKO
Kosovo	Vala
Kuwait	Viva
Kuwait	Ooredoo
Kuwait	Zain
Latvia	Bite
Latvia	LMT
Latvia	Tele2
Lebanon	Alfa
Lebanon	Touch
Liechtenstein	Orange
Liechtenstein	Swisscom
Lithuania	Bite
Lithuania	Omnitel
Lithuania	Tele2
Luxembourg	Orange
Luxembourg	POST
Luxembourg	Tango
Macedonia	ONE
Macedonia	T Mobile
Macedonia	Vip
Malaysia	Celcom
Malaysia	Maxis
Maldives	Dhiraagu
Malta	Vodafone
Mauritius	Emtel
Mauritius	Orange
Montenegro	Crnogorski Telekom
Morocco	Inwi
Namibia	MTC
Namibia	TN Mobile
Netherlands	KPN
Netherlands	T Mobile
Netherlands	Vodafone
New Caledonia	OPT
New Zealand	2degrees
New Zealand	Spark
New Zealand	Vodafone
Norway	Telenor
Norway	NetCom / TeliaSonera
Oman	Ooredoo
Oman	Omantel
Pakistan	Warid Telecom
Pakistan	Zong
Philippines	Globe
Philippines	Smart
Poland	Mobyland/CenterNet
Poland	Orange Polska
Poland	Play
Poland	Polkomtel
Poland	T-Mobile Polska S.A
Portugal	Meo
Portugal	Nos
Portugal	Vodafone
Qatar	Vodafone
Romania	Cosmote

Romania	Orange
Romania	Vodafone
Russia	Megafon
Russia	MOTIV
Russia	MTS
Russia	Tattelecom
Russia	Tele2 Russia
Saudi Arabia	Mobily
Saudi Arabia	STC
Saudi Arabia	Zain
Serbia	MTS
Serbia	Telenor
Serbia	VIP Mobile
Singapore	M1
Singapore	SingTel
Singapore	StarHub
Slovak Republic	O2 Slovakia
Slovak Republic	Slovak Telecom
Slovak Republic	Swan Telecom
Slovenia	Telekom Slovenije
Slovenia	Si.mobil
South Africa	Vodacom
South Africa	MTN
South Africa	Neotel
South Korea	KT
South Korea	SK Telecom
Spain	Movistar
Spain	Orange
Spain	Vodafone
Spain	Yoigo
Sri Lanka	Dialog Axiata
Sri Lanka	Mobitel
Sweden	Tele2
Sweden	Telenor
Sweden	TeliaSonera
Switzerland	Salt
Switzerland	Sunrise
Switzerland	Swisscom
Taiwan	Chunghwa Telecom
Taiwan	FarEasTone
Taiwan	Taiwan Mobile
Tajikistan	Babilon-Mobile
UAE	Du
UAE	Etisalat
UK	3 UK
UK	EE
Venezuela	Digitel
Zambia	MTN
Zimbabwe	Econet Wireless

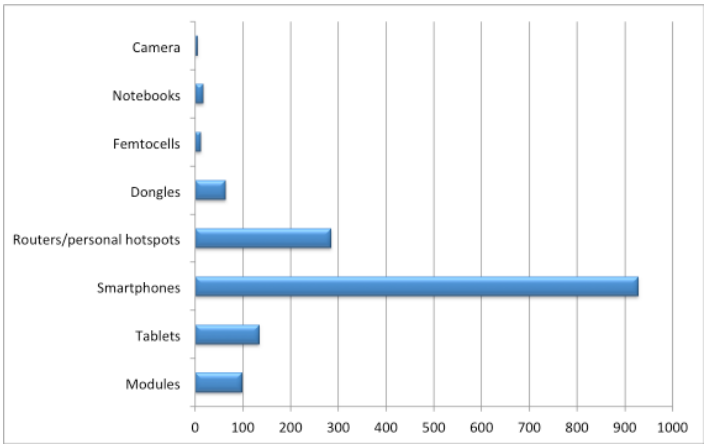
LTE1800 User Devices Ecosystem

GSA confirmed in its Status of the LTE Ecosystem report published on June 19, 2015 that 1800 MHz (3GPP band 3) continues to benefit from having the largest devices ecosystem with 1,543 user devices.

Over 47% of LTE devices can operate in this band.

928 LTE1800 smartphones represents 60% of total LTE1800 devices, of which 64 support UE Category 6 (up to 300 Mbps peak downlink).

134 tablets represents 8.7% of the LTE1800 device ecosystem and is a fast developing segment.



Form factors of LTE1800 devices

Detailed analysis of all LTE1800 devices is available using GSA's **GAMBoD** tool (access restrictions apply – see www.gsacom.com/gambod).

LTE1800 LinkedIN Group:
http://www.linkedin.com/groups?=&gid=3129390

LTE1800 zone
http://www.gsacom.com/lte1800

LTE Roaming

Many operators offer international roaming service for their LTE customers – this is an indicative list:

Unitel	Angola	with	Proximus	Belgium
A1 Telekom	Austria	with	Swisscom	Switzerland
Mobistar	Belgium	with	Orange	France, Luxembourg, Spain, UK
Elisa	Estonia	with	Elisa Telenor Vodafone	Finland Norway Romania
Vodafone	Germany, Greece, Italy, Portugal, Spain, Romania	with	Vodafone	Croatia, Czech Republic, Greece, Italy, Portugal, Romania, Spain, Thailand, Others
KDDI	Japan	with	SK Telecom, CSL, M1, Bouygues Telecom, Swisscom, Orange Espana, AT&T, Rogers, VIVO, Claro	Brazil Canada France Hong Kong Singapore South Korea Spain Switzerland USA
NTT DoCoMo	Japan	with	AT&T, Rogers, Hutchison, Bouygues Telecom	US, USVI, Puerto Rico, Canada, France, HK
KPN	Netherlands	with	Various	10+ countries
Telenor	Norway	with	Various	Swisscom, KPN, MTS
MegaFon	Russia	with	AT&T, Rogers	USA, Canada
MTS	Russia	with	Orange, Telenor, Vodafone CZ, others	22 countries (Nov 2014)
Mobily	Saudi Arabia	with	Batelco Ooredoo	Bahrain Qatar
Mobily	Saudi Arabia	with	Etisalat	UAE
Orange	Moldova	with	Orange	France, Romania, Spain
Play	Poland	with	IPX platform	Various
SingTel	Singapore	with	Optus	Australia
SingTel	Singapore	with	CSL Ltd	Hong Kong
SingTel	Singapore	with	Softbank	Japan
SingTel	Singapore	with	Maxis	Malaysia
SingTel	Singapore	with	Globe	Philippines
SingTel	Singapore	with	SK Telecom	South Korea
SingTel	Singapore	with	China Mobile	China
SingTel	Singapore	with	Swisscom	Switzerland
KT	South Korea	with	China Mobile	China
SK Telecom	Sth Korea	with	Globe	Philippines
Tele2	Sweden and Baltic region	with	FarEasTone and various	Taiwan and various
TeliaSonera	Sweden	with	TeliaSonera companies	Norway, Denmark, Estonia, Finland, Spain
TeliaSonera	Norway	with	TeliaSonera companies	Sweden, Denmark, Estonia, Finland, Spain
TeliaSonera	Denmark	with	TeliaSonera companies	Norway, Sweden, Finland, Estonia, Spain
TeliaSonera	Estonia	with	TeliaSonera companies	Norway, Sweden, Finland, Denmark
TeliaSonera	Sweden	with	Orange	France
TeliaSonera	Sweden	with	Omnitel	Lithuania
Swisscom	Switzerland	with	Mobily	Saudi Arabia
Swisscom	Switzerland	with	A1	Austria
Swisscom	Switzerland	with	Rogers	Canada
Swisscom	Switzerland	with	KT, SK Telecom	South Korea
Swisscom	Switzerland	with	Bouygues Telecom	France
Swisscom	Switzerland	with	CSL, Smartone, CMHK	Hong Kong
Swisscom	Switzerland	with	Softbank	Japan
Swisscom	Switzerland	with	Globe	Philippines
Swisscom	Switzerland	with	M1	Singapore
EE	UK	with	AT&T (for US)	France, Spain, US
Antel	Uruguay	with	Others	Various
AT&T	USA	with	Various	15 countries

The number of LTE roaming agreements is rapidly growing. Recent agreements include for example:

Vodafone Romania confirmed agreements in 50 countries

Sprint has roaming agreements with 27 rural operators

Swisscom: multiple LTE roaming agreements
https://www.swisscom.ch/content/dam/swisscom/en/res/mobile/subscription-tariffs/tariffs-roaming-abroad/LTE-Roaming-EN.pdf

Dialog Sri Lanka: multiple LTE roaming agreements
https://www.dialog.lk/international-4g-lte-roaming

China Mobile: LTE roaming with 71 countries and regions

Category 4 global status

LTE networks capable of supporting 150 Mbps peak downlink (for UE Cat 4 devices) having up to 20 MHz of bandwidth allocated for LTE (as permitted in pre-Release 10 systems) are commercially launched in 52 countries: Algeria, Australia, Austria, Bahrain, Canada, China, Croatia, Czech Republic, Denmark, Estonia, Ethiopia, Finland, France, Germany, Hong Kong, Hungary, Italy, Japan, Jersey, Jordan, Latvia, Liechtenstein, Lithuania, Luxembourg, Japan, Kenya, Kyrgyzstan, Moldova, Montenegro, Netherlands, New Zealand, Norway, Oman, Poland, Qatar, Romania, Russia, Rwanda, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, UAE, UK, and USA.

Operators may refer to their networks as *LTE-Advanced*. This is correct only for Release 10 and beyond deployments. For a list of LTE-Advanced networks and peak downlink speeds see GSA paper "LTE-Advanced Carrier Aggregation deployments: peak speeds" (July 21, 2015).

According to GSA's Status of the LTE Ecosystem report (June 19, 2015) 1,132 UE Category 4 devices (35% of all LTE terminals) have been announced, including 108 devices that also support Category 6.

APT700 band plan

Industry support for the APT700 band plan is strong. Whereas APT700 provides both FDD and TDD arrangements, it is the FDD plan that has gained global support from industry and regulators in markets addressing approaching 4 billion people. The FDD configuration is standardised by 3GPP (band 28) for a 2 x 45 MHz arrangement, with 10 MHz guardband between downlink and uplink.

APT700 FDD band plan (3GPP Band 28)

703-748 MHz for the uplink
10 MHz guard band
758-803 MHz for the downlink

Telstra, GSA and the GSMA jointly promote APT700 spectrum allocations for LTE to explain the benefits and opportunities from its use. The main infrastructure systems providers including Alcatel-Lucent, Ericsson, Huawei and Nokia support APT700. 700 MHz is excellent for wide area coverage in regional and rural environments, and for in-building coverage, and is an important digital dividend arising from the shift by TV broadcasters to digital transmissions. Adoption of the APT700 FDD band plan by many countries has created a major opportunity for near global spectrum harmonization for LTE, ensuring the greatest economies of scale for user devices, capacity for mobile broadband, and roaming. 42 countries allocated, committed to or recommend APT700 FDD (band 28) for LTE systems:

LAC region: Argentina, Brazil, Chile, Colombia, Costa Rica, Curaçao, Dominican Republic, Ecuador, Honduras, Mexico, Panama, Peru, Venezuela

APAC/Oceania: Afghanistan, Australia, Bangladesh, Bhutan, Brunei, Cambodia, Fiji, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, New Zealand, Pakistan, Papua New Guinea, Singapore, South Korea, Taiwan, Thailand, Tonga, Vanuatu, Vietnam

Middle East: UAE confirmed adoption of the APT700 lower 2 x 30 MHz duplexer. This is also the preferred frequency arrangement for 700 MHz allocations in Europe and throughout ITU Region 1

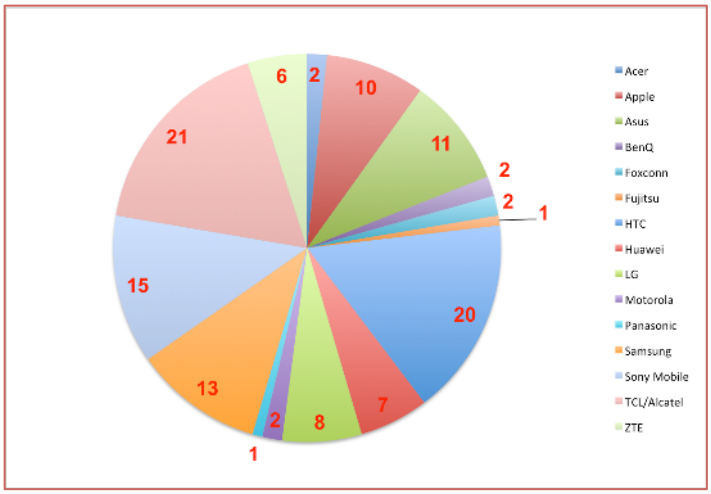
Europe: Finland, France, Germany, Sweden, and UK

APT700 band 28 is licensed to mobile operators in 13 countries: Argentina, Australia, Brazil, Chile, Ecuador, Fiji, Japan, Mexico, New Zealand, Panama, Papua New Guinea, South Korea, and Taiwan

12 commercially launched APT700 b28 operators

APT700 Network	Country	Launched
Digicel	Papua New Guinea	26.03.14
FarEasTone	Taiwan	03.06.14
Taiwan Mobile	Taiwan	04.06.14
Vodafone	New Zealand	18.07.14
Optus	Australia	23.07.14
Telstra	Australia	25.07.14
Spark	New Zealand	28.08.14
Asia Pacific Telecom	Taiwan	24.12.14
C and W	Panama	11.03.15
Movistar	Panama	27.03.15
Ambit Microsystems	Taiwan	15.05.15
Claro	Panama	06.08.15

139 APT700 (band 28) user devices are launched by key suppliers including Acer, Apple, Asus, Foxconn/InFocus, Fujitsu, HTC, Huawei, LG, Motorola, Samsung, Sierra Wireless, Sony, TCL/Alcatel, and ZTE. (*Status of the LTE Ecosystem report, 19.06.15*). 121 devices are smartphones:



121 APT700 band 28 smartphones per vendor

Further APT700 device analysis is available using GSA's GAMBoD tool (access restrictions apply www.gsacom.com/gambod).

APT700 zone
White papers, presentations, links

Visit http://www.gsacom.com/apt700

***APT700 band** LINKEDIN group:*
http://www.linkedin.com/groups?gid=4759091

LTE Broadcast

Mobile Broadband users demand spontaneous access to video content, a higher-quality experience and more convergent mobile services than before. Owing to the popularity and adoption of smartphones and tablets, mobile subscriptions for high data consumption devices are expected to reach 8 billion by 2019. Mobile data traffic is expected to grow 10 fold between 2013 and 2019, driven mainly by video.

LTE Broadcast (also called LTE Multicast) enabled by eMBMS technology substantially reduces the bandwidth needed to deliver multimedia content one-to-many thus allowing operators to efficiently launch media services over LTE to meet this demand. It offers mobile-network operators a profitable business proposition through service differentiation, new revenue opportunities, and more efficient distribution of live and other digital media. LTE Broadcast enables multiple users to receive the same content simultaneously. LTE broadcast can deliver the same content to multiple users with the capability to support a virtually unlimited number of users simultaneously, thereby maintaining efficient use of spectrum and network investments. LTE Broadcast will open new business models for mobile network operators.

Recent months have witnessed a high level of activity in eMBMS/LTE Broadcast activities globally and traction is building across all regions. Several use cases are being developed and trialled, and more are emerging. The first LTE Broadcast service was commercially launched in January 2014 and the eMBMS-capable devices ecosystem is building, however more devices are needed. Several operators announced planned service launches in 2015.

Several TV broadcasters/content owners are participating in LTE Broadcast trials including the BBC (UK), IRT (Institut für Rundfunktechnik, research institute of broadcasting companies in Austria, Germany and Switzerland, Bavarian broadcast company, Bayerischer Rundfunk, and further research partners), TDF (France) and RAI (Italy)

UPDATES FROM GSA
Log in to www.gsacom.com and follow the link to

Country	Network	Status
Australia	Telstra	Deploying
China	China Mobile	Trialled
China	China Telecom	Largescale user trial
France	Orange	Trialled
France	TDF	Trialling
Germany	Vodafone	Trialled
Germany	IRT	Trialling
India	RJIL	Trialled
Italy	RAI	Trialling
Italy	TIM	Trialling
Netherlands	KPN	Trialled
Philippines	Globe	Deploying
Philippines	Smart	Trialled
Poland	Polkomtel Plus	Trialled
Portugal	Meo	Trialling
Russia	MTS	Trialled
Singapore	SingTel	Trialling
South Korea	KT	COMMERCIAL
Spain	Vodafone	Trialled
UAE	Etisalat	Trialling
UK	EE & BBC	Trialling
UK	Three UK	Trialling
USA	AT&T	Deploying
USA	Verizon Wireless	Deploying

LTE Broadcast global activities - summary
(© GSA – Global mobile Suppliers Association)

LTE-Broadcast
http://www.linkedin.com/groups?gid=7435919

Visit http://www.gsacom.com/lte-broadcast for information papers, reports, global activities map, presentations, etc. from leading developers of eMBMS/LTE Broadcast & content providers including 3UK, BBC, DT, EE, Ericsson, Expway, Facebook, Globe Telecom, Huawei, Indycar Series, Nokia, Orange, Polkomtel, Portugal Telecom, Qualcomm, Smart, Telstra, Verizon Wireless & Vodafone.

COMING SOON FROM GSA: **LTE BROADCAST REPORT** - Sponsors/contributors include the BBC, EE, Ericsson, Nokia, PCCW-CSL, Polkomtel, Qualcomm, Smartfren, Telstra - and others.

657 LTE operator commitments in 177 countries / territories

Country	Operator	Launch
Norway	NetCom / TeliaSonera	Launched 14.12.09
Sweden	TeliaSonera	Launched 14.12.09
Uzbekistan	UCell	Launched 09.08.10
Poland	Aero2 FDD and TDD later	Launched 07.09.10
USA	T Mobile US	Launched 21.09.10
Austria	A1 Telekom	Launched 05.11.10
Sweden	TeleNor Sweden	Launched 15.11.10
Sweden	Tele2 Sweden	Launched 15.11.10
Hong Kong	CSL Limited	Launched 25.11.10
Finland	TeliaSonera	Launched 30.11.10
Germany	Vodafone	Launched 01.12.10
USA	Verizon Wireless	Launched 05.12.10
Finland	Elisa	Launched 08.12.10
Denmark	TeliaSonera	Launched 09.12.10
Estonia	EMT	Launched 17.12.10
Japan	NTT DoCoMo	Launched 24.12.10
Germany	Deutsche Telekom	Launched 05.04.11
Philippines	Smart Communications	Launched 16.04.11
Lithuania	Omnitel	Launched 28.04.11
Latvia	LMT	Launched 31.05.11
Singapore	M1	Launched 21.06.11
South Korea	SK Telecom	Launched 01.07.11
South Korea	LG Uplus	Launched 01.07.11
Germany	O2 (Telefonica)	Launched 01.07.11
Canada	Rogers Wireless	Launched 07.07.11
Austria	T Mobile	Launched 28.07.11
USA	Mosaic Telecom	Launched Jul 2011
Canada	Bell Mobility FDD, LTE TDD later	Launched 14.09.11
Saudi Arabia	Mobily LTE TDD and later FDD	Launched 14.09.11
Saudi Arabia	STC LTE TDD and later FDD	Launched 14.09.11
Saudi Arabia	Zain	Launched 14.09.11
USA	AT&T Mobility	Launched 18.09.11
UAE	Etisalat	Launched 25.09.11
Australia	Telstra	Launched 27.09.11
Denmark	TDC	Launched 10.10.11
Austria	3	Launched 18.11.11
Puerto Rico	AT&T Mobility	Launched 20.11.11
Puerto Rico	Claro	Launched 24.11.11
Kyrgyzstan	Saima Telecom	Launched 09.12.11
Brazil	Sky Brazil (LTE TDD)	Launched 13.12.11
Finland	DNA	Launched 13.12.11
Uruguay	Antel	Launched 13.12.11
USA	Leap Wireless/Cricket	Launched 21.12.11
Singapore	SingTel	Launched 22.12.11
Kuwait	Viva	Launched 27.12.11
Armenia	Vivacell-MTS	Launched 28.12.11
Bahrain	Viva	Launched 01.01.12
Hungary	Magyar Telekom	Launched 01.01.12
South Korea	KT	Launched 03.01.12
Russia	Megafon/Yota FDD and TDD	Launched 15.01.12
Canada	Telus FDD later TDD	Launched 10.02.12
USA	Peoples Telephone Co-op	Launched 14.02.12
Japan	Softbank (XGP/LTE TDD)	Launched 24.02.12
Portugal	Meo	Launched 12.03.12
Portugal	Vodafone Portugal	Launched 12.03.12
Portugal	Nos	Launched 15.03.12
Japan	Ymobile Corp	Launched 15.03.12
USA	US Cellular	Launched 22.03.12
Croatia	T-Hrvatski Telekom	Launched 23.03.12
Croatia	VIPNet	Launched 23.03.12
USA	Panhandle Telephone Co-op	Launched 03.2012
Australia	NBN No (LTE TDD)	Launched 02.04.12
India	Bharti Airtel (LTE TDD)	Launched 10.04.12
Angola	Movicel	Launched 14.04.12
Puerto Rico	Open Mobile	Launched 19.04.12
Moldova	IDC	Launched 21.04.12
Sweden	3 Sweden LTE FDD and TDD	Launched 23.04.12
Hong Kong	CM HK LTE FDD later TDD	Launched 25.04.12
USA	Cellcom	Launched 30.04.12
USA	Pioneer Cellular	Launched 30.04.12
Netherlands	Vodafone	Launched 01.05.12
Hong Kong	3 HK	Launched 02.05.12
Netherlands	Ziggo	Launched 03.05.12
Netherlands	Tele2	Launched 08.05.12
Netherlands	KPN	Launched 11.05.12
Netherlands	T-Mobile	Launched 11.05.12
Namibia	MTC	Launched 16.05.12
Tanzania	Smile	Launched 30.05.12
UAE	Du	Launched 12.06.12
Colombia	Une-EPM	Launched 14.06.12
Azerbaijan	Azercell	Launched 19.06.12
Czech Rep	O2 Czech Republic	Launched 19.06.12
Mauritius	Orange	Launched 21.06.12
Guam	IT&E	Launched 28.06.12
UK	UK Broadband (LTE TDD)	Launched 28.06.12
Hungary	Telenor	Launched 05.07.12
Dominican R	Orange Dominicana	Launched 09.07.12
Slovenia	Si.mobil	Launched 12.07.12
USA	Sprint LTE FDD later TDD	Launched 15.07.12
Oman	Omantel LTE TDD later FDD	Launched 16.07.12
USA	Infrastructure Networks	Launched 25.07.12
Australia	Optus FDD and LTE TDD later	Launched 31.07.12
Mauritius	Emtel	Launched Jul 2012
Slovak Republic	O2 Slovakia	Launched 02.08.12
USA	Big River Broadband	Launched 07.08.12
Hong Kong	Smartone	Launched 28.08.12
Poland	Polkomtel Plus	Launched 09.12
USA	Chariton Valley Comms	Launched 09.12
USA	Nortex Communications	Launched 09.12
Russia	MTS LTE TDD later FDD	Launched 01.09.12
USA	C Spire Wireless	Launched 10.09.12
Singapore	StarHub	Launched 19.09.12
Japan	KDDI	Launched 21.09.12
Japan	Softbank Mobile FDD and TDD	Launched 21.09.12
Canada	MTS Allstream	Launched 25.09.12
Denmark	3 Denmark	Launched 28.09.12
Philippines	Globe	Launched 28.09.12
Luxembourg	Tango	Launched 01.10.12
Guam	DoCoMo Pacific	Launched 04.10.12
Tajikistan	Babilon Mobile	Launched 06.10.12
Norway	Telenor	Launched 10.10.12
South Africa	Vodacom	Launched 10.10.12
USA	Alaska Communications	Launched 12.10.12
Mexico	Telefonica Movistar	Launched 15.10.12
Luxembourg	Orange	Launched 29.10.12
UK	EE	Launched 30.10.12
Uganda	Smile	Launched Oct 2012
Belgium	Belgacom / Proximus	Launched 05.11.12
USA	Bluegrass Cellular	Launched 05.11.12
Antigua-Barb	Digicel	Launched 06.11.12
Italy	Vodafone	Launched 06.11.12
Mexico	Telcel	Launched 06.11.12
Italy	TIM	Launched 07.11.12
Montenegro	Telenor	Launched 08.11.12
USA	Sprocket Wireless	Launched 09.11.12
Greece	Cosmote	Launched 16.11.12
Moldova	Moldcell	Launched 16.11.12
USA	Strata Networks	Launched 19.11.12
Moldova	Orange	Launched 20.11.12
Romania	Vodafone	Launched 20.11.12
Kuwait	Zain	Launched 21.11.12
France	Orange	Launched 22.11.12
USA	Shentel	Launched 23.11.12
Estonia	Tele2	Launched 27.11.12
France	SFR	Launched 28.11.12
Switzerland	Swisscom	Launched 29.11.12
South Africa	MTN	Launched 01.12.12

Romania	Orange	Launched 12.12.12
Brazil	Claro	Launched 13.12.12
Angola	Unitel	Launched 16.12.12
Bolivia	Entel Movil	Launched 16.12.12
Greece	Vodafone	Launched 17.12.12
Puerto Rico	Sprint	Launched 18.12.12
Kazakhstan	Altel	Launched 25.12.12
Sri Lanka	Dialog LTE TDD later FDD	Launched 30.12.12
Sri Lanka	Mobitel	Launched 31.12.12
Malaysia	Maxis	Launched 01.01.13
USA	Thumb Cellular	Launched 13.01.13
Canada	Sasktel LTE FDD later TDD	Launched 31.01.13
USA	GCI	Launched 2013
USA	Evolve Broadband	Launched 02.13
Italy	3 Italia	Launched 01.02.13
Estonia	Elisa	Launched 14.02.13
Canada	Eastlink	Launched 15.02.13
Paraguay	Personal	Launched 08.02.13
Oman	Ooredoo LTE FDD later TDD	Launched 17.02.13
Paraguay	Vox	Launched 18.02.13
Bahrain	Batelco	Launched 27.02.13
New Zealand	Vodafone	Launched 28.02.13
Brazil	On Telecomunicacoes LTE TDD	Launched 03.13
Lithuania	Tele2	Launched 03.13
Spain	COTA Murcia4G (LTE TDD)	Launched 01.03.13
USA	MiSpot	Launched 14.03.13
Dominican R	Tricom	Launched 18.03.13
Denmark	Telenor	Launched 20.03.13
Guam	iConnect	Launched 20.03.13
Slovenia	Telekom Slovenije	Launched 20.03.13
Iceland	Nova	Launched 04.04.13
USA	United Wireless	Launched 09.04.13
Qatar	Ooredoo	Launched 16.04.13
US Virgin Isles	Sprint	Launched 17.04.13
Bahrain	Zain	Launched 18.04.13
South Africa	Telkom Mobile / 8ta (LTE TDD)	Launched 21.04.13
Malaysia	Celcom Axiata	Launched 22.04.13
Uganda	MTN Uganda (LTE TDD)	Launched 25.04.13
Brazil	Oi	Launched 25.04.13
Maldives	Ooredoo	Launched 28.04.13
Romania	Cosmote	Launched 29.04.13
Brazil	TIM Brasil	Launched 30.04.13
Brazil	Vivo	Launched 30.04.13
USA	Adams NetWorks	Launched 05.2013
France	Bouygues Telecom	Launched 06.05.13
Thailand	True Move	Launched 08.05.13
USA	NorthwestCell	Launched 13.05.13
Lebanon	Alfa	Launched 15.05.13
USA	PVT/Fuego Wireless	Launched 17.05.13
Lebanon	Touch	Launched 22.05.13
USA	Chat Mobility	Launched 23.05.13
Switzerland	Salt (formerly Orange)	Launched 26.05.13
Russia	Vimpelcom	Launched 27.05.13
Spain	Vodafone	Launched 29.05.13
Spain	Neo-Sky LTD TDD	Launched Jun 2013
Russia	Rostelecom	Launched 03.06.13
Nigeria	Smile Communications	Launched 06.06.13
Iraq	Fastlink (Regional Telecom)	Launched 10.06.13
USA	Appalachian Wireless	Launched 10.06.13
Australia	Vodafone	Launched 12.06.13
Switzerland	Sunrise Communications	Launched 19.06.13
Chile	Claro	Launched 27.06.13
USA	MTA	Launched mid-2013
US Virgin Isles	AT&T Mobility	Launched 02.07.13
Iceland	Fjarskipti (Vodafone Iceland)	Launched 04.07.13
Malaysia	DiGi	Launched 05.07.13
Spain	Orange	Launched 08.07.13
Kuwait	Ooredoo	Launched 09.07.13
Puerto Rico	T Mobile	Launched 11.07.13
Spain	Yoigo	Launched 18.07.13
USA	Custer Telephone	Launched 26.07.13
Uganda	Orange	Launched 31.07.13

Venezuela	Digitel	Launched 31.07.13
USA	ETC	Launched 08.2013
Nigeria	Spectranet (LTE TDD)	Launched 20.08.13
South Africa	Neotel	Launched 21.08.13
Zimbabwe	Econet Wireless	Launched 22.08.13
UK	O2	Launched 29.08.13
UK	Vodafone	Launched 29.08.13
Kiribati	TSKL	Launched 02.09.13
Liechtenstein	Orange	Launched 02.09.13
Russia	Vainakh Telecom (LTE TDD)	Launched 02.09.13
Poland	Orange Polska (ex Centertel)	Launched 10.09.13
Turkmenistan	TMCELL	Launched 18.09.13
Ireland	Meteor	Launched 26.09.13
USA	Copper Valley Telecom	Launched 30.09.13
Belgium	BASE	Launched 01.10.13
Czech Rep	T Mobile	Launched 01.10.13
Monaco	Monaco Telecom	Launched 01.10.13
Luxembourg	POST	Launched 10.2013
Spain	Movistar	Launched 10.2013
USA	Syringa Wireless	Launched 10.2013
Guam	GTA	Launched 11.10.13
Ireland	Vodafone	Launched 14.10.13
Bhutan	Bhutan Telecom	Launched 24.10.13
Japan	UQ Communications (LTE TDD)	Launched 31.10.13
Nigeria	Swift Networks (LTE TDD)	Launched 11.13
USA	Flat Wireless d.b.a Clear Talk	Launched 11.13
Malta	Vodafone	Launched 01.11.13
Aruba	Setar NV	Launched 06.11.13
New Zealand	Spark	Launched 12.11.13
Poland	Play	Launched 13.11.13
Chile	Movistar	Launched 14.11.13
Indonesia	PT Internux (LTE TDD)	Launched 14.11.13
Brunei	DST	Launched 15.11.13
Slovak Republic	Slovak Telecom	Launched 15.11.13
USA	S and R Communications	Launched 17.11.13
Bahrain	Menatelecom (LTE TDD)	Launched 19.11.13
Costa Rica	Kölbi (ICE)	Launched 25.11.13
Namibia	TN Mobile	Launched 27.11.13
USA	Nex-Tech Wireless	Launched 27.11.13
Montenegro	Crnogorski Telekom	Launched 28.11.13
Cayman Islands	Digicel	Launched 28.11.13
Cayman Islands	LIME	Launched 29.11.13
France	Free	Launched 01.12.13
Greenland	Tele-Post	Launched 01.12.13
Colombia	Movistar	Launched 02.12.13
Macedonia	T Mobile	Launched 02.12.13
UK	3 UK	Launched 02.12.13
Fiji	Vodafone Fiji	Launched 05.12.13
USA	Mid-Rivers Communications	Launched 09.12.13
Czech Rep	Vodafone	Launched 10.12.13
Malaysia	U Mobile	Launched 17.12.13
China	China Mobile (LTE TDD)	Launched 18.12.13
Ecuador	CNT EP	Launched 12.13
Latvia	Tele2	Launched 12.13
USA	Colorado Valley	Launched 12.13
USA	nTelos Wireless	Launched 12.13
Ghana	Vodafone	Launched 02.01.14
Peru	Telefonica Movistar	Launched 02.01.14
Italy	Wind	Launched 12.01.14
Iceland	Siminn	Launched 15.01.14
Zambia	MTN	Launched 16.01.14
Sri Lanka	SLT (LTE TDD)	Launched 19.01.14
Zambia	Zamtel	Launched 21.01.14
Cambodia	Smart Axiata	Launched 22.01.14
Ireland	3 Ireland	Launched 27.01.14
Ghana	NITA (LTE TDD)	Launched 02.14
Sri Lanka	Lanka Bell (LTE TDD)	Launched 04.02.14
Bahamas	BTC	Launched 13.02.14
Colombia	Claro	Launched 13.02.14
Uruguay	Claro	Launched 13.02.14
China	China Telecom (LTE TDD)	Launched 14.02.14
China	China Unicom (LTE TDD)	Launched 18.03.14

Papua N Guinea	Digicel PNG	Launched 26.03.14
Chile	Entel PCS	Launched 28.03.14
Belgium	Mobistar	Launched 31.03.14
Madagascar	Blueline (LTE TDD)	Launched 04.14
Costa Rica	Claro	Launched 01.04.14
Vanuatu	WanTok (LTE TDD)	Launched 01.04.14
Côte d'Ivoire	YooMee (LTE TDD)	Launched 04.04.14
Tajikistan	Tcell	Launched 15.04.14
Belgium	b•lite (LTE TDD)	Launched 22.04.14
Canada	ABC Communications (LTE TDD)	Launched 23.04.14
Philippines	PLDT (LTE TDD)	Launched 29.04.14
Algeria	Algérie Télécom	Launched 01.05.14
USA	KPU (Alaska)	Launched 05.05.14
Kyrgyzstan	O!	Launched 08.05.14
Thailand	DTAC – TriNet	Launched 10.05.14
Bulgaria	Max	Launched 20.05.14
Peru	Claro	Launched 21.05.14
Taiwan	Chunghwa Telecom	Launched 29.05.14
Qatar	Vodafone	Launched 03.06.14
Taiwan	FarEasTone	Launched 03.06.14
Taiwan	Taiwan Mobile	Launched 04.06.14
Abkhazia	A-Mobile	Launched 04.06.14
Poland	T-Mobile Polska S.A	Launched 05.06.14
Brazil	Nextel	Launched 16.06.14
Russia	Tattelecom	Launched 27.06.14
New Zealand	2degrees	Launched 30.06.14
USA	VTel	Launched 01.07.14
Macedonia	Vip	Launched 02.07.14
Costa Rica	Movistar	Launched 04.07.14
Slovak Republic	Oramge Slovensko	Launched 07.07.14
NMI	IT&E	Launched 14.07.14
Israel	Partner – Orange	Launched 15.07.14
India	Aircel (LTE TDD)	Launched 16.07.14
Bolivia	Tigo	Launched 17.07.14
Dominican R	Claro	Launched 17.07.14
Colombia	DirecTV (LTE TDD)	Launched 25.07.14
Isle of Man	Manx Telecom	Launched 29.07.14
Israel	Cellcom	Launched 03.08.14
Israel	Pelephone	Launched 04.08.14
Abkhazia	Aquafon	Launched 06.08.14
Malaysia	Telekom Malaysia	Launched 08.08.14
Fiji	Digicel	Launched 14.08.14
Colombia	Avantel	Launched 19.08.14
Ghana	Surfline Communications	Launched 19.08.14
Taiwan	Taiwan Star Mobile	Launched 25.08.14
Macedonia	ONE	Launched 29.08.14
USA	SI Wireless / Mobile Nation	Launched 09.14
Uzbekistan	Beeline	Launched 04.09.14
Uruguay	Movistar	Launched 05.09.14
USA	BIT Communications	Launched 09.09.14
Canada	Videotron	Launched 10.09.14
Chad	Tigo	Launched 10.09.14
Pakistan	Zong	Launched 27.09.14
Lesotho	Vodacom	Launched 02.10.14
Colombia	ETB	Launched 07.10.14
Mexico	AT&T (Nextel de Mexico)	Launched 13.10.14
Peru	Americatel / Entel (LTE TDD)	Launched 13.10.14
Ghana	BLU (LTE TDD)	Launched 14.10.14
Dominica	LIME	Launched 16.10.14
Gabon	Gabon Telecom	Launched 20.10.14
Andorra	Andora Telecom	Launched 21.10.14
USA	Rock Wireless	Launched 23.10.14
Maldives	Dhiraagu	Launched 28.10.14
Guatemala	Movistar	Launched 29.10.14
USA	Carolina West Wireless	Launched 03.11.14
Russia	MOTIV	Launched 06.11.14
Rwanda	Airtel	Launched 11.11.14
Rwanda	MTN	Launched 11.11.14
Finland	Ukko Mobile FDD: TDD later	Launched 17.11.14
Antigua-Barb	LIME	Launched 20.11.14
Iran	MTN Irancell	Launched 24.11.14
USA	Silver Star Communications	Launched 24.11.14

Seychelles	Airtel	Launched 26.11.14
Canada	Xplornet (LTE TDD)	Launched 03.12.14
Italy	Linkem (LTE TDD)	Launched 03.12.14
Kenya	Safaricom	Launched 04.12.14
Indonesia	Telkomsel	Launched 08.12.14
Honduras	Tigo	Launched 10.12.14
Kosovo	IPKO	Launched 11.12.14
Russia	Tele2 Russia	Launched 17.12.14
Trinidad&Tobago	TSTT (LTE TDD)	Launched 18.12.14
Argentina	Personal	Launched 19.12.14
Argentina	Movistar	Launched 22.12.14
Indonesia	Indosat	Launched 22.12.14
Indonesia	XL Axiata	Launched 22.12.14
Taiwan	Asia Pacific Telecom	Launched 24.12.14
Pakistan	Warid Telecom	Launched 26.12.14
Canada	CCI Wireless (LTE TDD)	Launched 12.2014
Liechtenstein	FL1	Launched 01.02.15
Rwanda	Tigo	Launched 08.01.15
Georgia	Magticom	Launched 01.02.15
Georgia	Mobitel	Launched 01.02.15
Uganda	Vodafone (LTE TDD)	Launched 09.02.15
Botswana	Orange	Launched 13.02.15
Jersey	JT	Launched 13.02.15
Jordan	Zain	Launched 15.02.15
New Caledonia	OPT	Launched 16.02.15
Dominican R	WIND Telecom (LTE TDD)	Launched 19.02.15
Venezuela	Movistar	Launched 19.02.15
Gambia	Netpage (LTE TDD)	Launched 03.15
Romania	RCS/Idilis/2K Tel (LTE TDD)	Launched 03.15
Isle of Man	SURE Telecom	Launched 02.03.15
Åland Islands	Ålcom	Launched 03.03.15
Greece	Wind Hellas	Launched 03.03.15
Liechtenstein	Swisscom	Launched 05.03.15
Cyprus	MTN	Launched 10.03.15
Cyprus	PrimeTel	Launched 10.03.15
Panama	C and W	Launched 11.03.15
Slovak Republic	Swan Telecom	Launched 13.03.15
Georgia	Geocell	Launched 15.03.15
Ethiopia	Ethio Tel	Launched 21.03.15
Canada	Tbaytel	Launched 23.03.15
Serbia	VIP Mobile	Launched 24.03.15
Serbia	Telenor	Launched 25.03.15
Turks & Caicos	Digicel	Launched 25.03.15
Panama	Movistar	Launched 27.03.15
Uzbekistan	EVO (LTE TDD)	Launched 01.04.15
Serbia	MTS	Launched 03.04.15
Malawi	Access Communications	Launched 08.04.15
Laos	Lao Telecom	Launched 09.04.15
Lithuania	Bite	Launched 15.04.15
South Africa	Afrihost	Launched 22.04.15
Tanzania	Tigo	Launched 24.04.15
Kosovo	Vala	Launched 28.04.15
Guatemala	Tigo	Launched 04.05.15
Azerbaijan	Bakcell	Launched 05.05.15
Latvia	Bite	Launched 05.05.15
Taiwan	Ambit Microsystems	Launched 15.05.15
USA	Speedconnect (LTE TDD)	Launched 19.05.15
Mauritius	Movistar	Launched 20.05.15
Ecuador	Movistar	Launched 22.05.15
Jordan	Orange	Launched 26.05.15
Guernsey	Sure	Launched 31.05.15
Jersey	Sure	Launched 31.05.15
USA	Redzone Wireless (LTE TDD)	Launched 03.06.15
Morocco	Meditel	Launched 08.06.15
Morocco	Inwi (Wana)	Launched 17.06.15
Bonaire	UTS	Launched 17.06.15
Curaçao	UTS	Launched 17.06.15
Bonaire	TELBO	Launched 19.06.15
Madagascar	Telma	Launched 19.06.15
Laos	Unitel	Launched 23.06.15
Argentina	Claro	Launched 06.15
Guernsey	JT	Launched 06.15

Indonesia	3 Indonesia	Launched 06.07.15
Indonesia	Smartfren (LTE FDD & TDD)	Launched 07.07.15
Morocco	IAM Marco Telecom	Launched 13.07.15
Albania	Telekom Albania	Launched 22.07.15
Nigeria	MTN HyNet (LTE TDD)	Launched 22.07.15
Bolivia	Viva	Launched 24.07.15
Cambodia	SEATEL	Launched 26.07.15
Ecuador	Claro	Launched 28.07.15
Turks & Caicos	LIME	Launched 31.07.15
Albania	Vodafone Albania	Launched 07.15
Guernsey	Airtel-Vodafone	Launched 07.15
Jersey	Airtel-Vodafone	Launched 07.15
Panama	Claro	Launched 06.08.15
Tanzania	Smart Telecom (LTE TDD)	Launched 27.08.15
Albania	Eagle Mobile	Launched 01.09.15
South Africa	Cell C	Launched 23.09.15
Nicaragua	Claro	Launched 01.10.15
Åland Islands	TeliaSonera	2015
Angola	Net One (LTE TDD)	2015
Australia	BigAir	2015
Azerbaijan	Azerfon / Nar Mobile	2015
Azerbaijan	Sazz (LTE TDD)	2015
Bahamas	CBL	2015
Bangladesh	Banglalion (LTE TDD)	2015
Belarus	beCloud	2015
Botswana	Mascom	2015
Cambodia	EMAXX (LTE TDD)	2015
Cambodia	Metfone	2015
Côte d'Ivoire	VipNet (LTE TDD)	2015
Gambia	Gamtel (LTE TDD)	2015
Ghana	Goldkey Telecom	2015
Gibraltar	Gibtelecom	2015
Honduras	Hondutel	2015
India	Reliance (LTE TDD and FDD)	2015
India	Videocon	2015
India	Vodafone	2015
Indonesia	First Media (LTE TDD)	2015
Indonesia	Berca Hardayaperkasa	2015
Iraq	Newroz Telecom	2015
Iraq	Tishknet (LTE TDD)	2015
Ireland	Imagine Group (LTE TDD)	2015
Laos	Beeline	2015
Macau	3Macau	2015
Macau	CTM	2015
Macau	China Telecom Macau	2015
Macau	SmarTone	2015
Madagascar	Orange	2015
Malaysia	Asiaspace (LTE TDD)	2015
Malaysia	P1 Networks (LTE TDD)	2015
Malaysia	REDtone	2015
Malaysia	YTL Communications (LTE TDD)	2015
Malta	GO	2015
Mongolia	Mongolia Telecom	2015
Nicaragua	Movistar	2015
Nigeria	Bitflux (LTE TDD)	2015
Norway	Ice.net	2015
Peru	DirecTV (LTE TDD)	2015
Poland	Milmex (LTE TDD)	2015
Puerto Rico	Aeronet (LTE TDD)	2015
Senegal	Orange	2015
Senegal	Tigo	2015
Slovenia	Telemach Mobil (ex-Tušmobil)	2015
Somalia	Nordic Group	2015
Somalia	Sahal Telecoms (LTE TDD)	2015
Sri Lanka	Etisalat	2015
Swaziland	MTN	2015
Tanzania	Telesis	2015
Tanzania	TTCL	2015
USA	BayRICS	2015
USA	CenturyLink	2015
USA	Illinois Valley Cellular	2015
USA	West Central Wireless	2015
Venezuela	DirecTV	2015
Venezuela	Movilnet	2015
Zambia	Massnet	2015
Zimbabwe	NetOne	2015
Azerbaijan	Delta Telecom (LTE TDD)	2016
Chile	WOM (formerly Nextel)	2016
D R Congo	Smile	2016
French Guiana	Orange	2016
India	BSNL (LTE TDD)	2016
India	Tikona (LTE TDD)	2016
Jordan	Umniah	2016
Turkey	Turkcell	2016
Zimbabwe	Telecel	2016
Angola	Multitel (LTE TDD)	To be confirmed
Argentina	Airlink	To be confirmed
Armenia	Armentel	To be confirmed
Armenia	UCOM	To be confirmed
Australia	EnergyAustralia Ausgrid	To be confirmed
Australia	TPG Internet	To be confirmed
Azerbaijan	Naxtel	To be confirmed
Bangladesh	Ollo/BIEL (LTE TDD)	To be confirmed
Bangladesh	BTCL (LTE TDD)	To be confirmed
Bangladesh	Mango	To be confirmed
Bangladesh	Qubee (LTE TDD)	To be confirmed
Belarus	BeST (Life)	To be confirmed
Belize	BTL	To be confirmed
Belgium	BUCD (LTE TDD)	To be confirmed
Benin	Benin Telecoms	To be confirmed
Brazil	Algar Telecom	To be confirmed
Brit Virgin Isles	CCT	To be confirmed
Brit Virgin Isles	Digicel	To be confirmed
Brit Virgin Isles	LIME	To be confirmed
Bulgaria	Bulsatcom	To be confirmed
Bulgaria	Mtel	To be confirmed
Bulgaria	Telenor	To be confirmed
Bulgaria	4G Com	To be confirmed
Bulgaria	Vivacom	To be confirmed
Cambodia	Chuan Wei Ltd	To be confirmed
Cameroon	MTN	To be confirmed
Cameroon	YooMee (LTE TDD)	To be confirmed
Canada	Core Broadband	To be confirmed
Chad	Airtel	To be confirmed
China	Velatel-Aerostrong (LTE TDD)	To be confirmed
Costa Rica	IBW International (LTE TDD)	To be confirmed
Côte d'Ivoire	Orange	To be confirmed
Croatia	Velatel (LTE TDD)	To be confirmed
Denmark	Net1	To be confirmed
Egypt	Etisalat Misr	To be confirmed
Egypt	Vodafone	To be confirmed
Equat Guinea	Guineanet	To be confirmed
El Salvador	IBW International (LTE TDD)	To be confirmed
Fiji	TFL	To be confirmed
France	Bollore Telecom (LTE TDD)	To be confirmed
French Guiana	Only (Outremer Telecom)	To be confirmed
Gabon	Airtel	To be confirmed
Gambia	I-Link	To be confirmed
Germany	DBD (LTE TDD)	To be confirmed
Ghana	Glo Mobile	To be confirmed
Guadeloupe	Outremer Telecom	To be confirmed
Guatemala	IBW International (LTE TDD)	To be confirmed
Honduras	Claro	To be confirmed
Hong Kong	21 Vianet Group (LTE TDD)	To be confirmed
Hungary	MVM Net	To be confirmed
Hungary	Vodafone Hungary	To be confirmed
Iceland	365 Media	To be confirmed
India	Idea Cellular	To be confirmed
Indonesia	IM2 (LTE TDD)	To be confirmed
Iran	MTC (LTE TDD)	To be confirmed
Iraq	MaxyTel (LTE TDD)	To be confirmed
Italy	Go Internet (LTE TDD)	To be confirmed

Jamaica	Digicel	To be confirmed
Jamaica	LIME	To be confirmed
Kazakhstan	Kcell	To be confirmed
Kenya	iWayAfrica (LTE TDD)	To be confirmed
Kyrgyzstan	Sky Mobile (Beeline)	To be confirmed
Kyrgyzstan	Megacom	To be confirmed
Libya	Al Madar	To be confirmed
Lithuania	LRTC (Telecentras) (LTE TDD)	To be confirmed
Madagascar	Airtel	To be confirmed
Malawi	Globe Internet	To be confirmed
Malaysia	Altel	To be confirmed
Martinique	Outremer Telecom	To be confirmed
Mayotte	Outremer Telecom	To be confirmed
Mongolia	Ulusnet (LTE TDD)	To be confirmed
Montenegro	Velatel (LTE TDD)	To be confirmed
Myanmar	Ooredoo	To be confirmed
Myanmar	Myanmar P & T	To be confirmed
Myanmar	Telenor	To be confirmed
Nepal	Ncell	To be confirmed
Nepal	Nepal Telecom	To be confirmed
Nicaragua	IBW International (LTE TDD)	To be confirmed
Nigeria	ADIV (LTE TDD)	To be confirmed
Nigeria	AG-Placid	To be confirmed
Nigeria	Globacom	To be confirmed
Nigeria	Intercellular	To be confirmed
Nigeria	M-Tel	To be confirmed
Nigeria	Mobitel (LTE TDD)	To be confirmed
Nigeria	Visafone Communications	To be confirmed
Nigeria	Zoda Fones (LTE TDD)	To be confirmed
Norway	MCP	To be confirmed
Paraguay	Tigo	To be confirmed
Peru	Bitel	To be confirmed
Peru	Olo (LTE TDD)	To be confirmed
Philippines	Bayan Telecommunications	To be confirmed
Réunion	Outremer Telecom	To be confirmed
Russia	Antares Group	To be confirmed
Russia	Osnova Telecom (LTE TDD)	To be confirmed
Russia	SMARTS	To be confirmed
Russia	Smoltelecom (LTE TDD)	To be confirmed
Russia	TTK	To be confirmed
Saudi Arabia	ITC (LTE TDD)	To be confirmed
Seychelles	Cable and Wireless	To be confirmed
Somalia	SomCom	To be confirmed
Somalia	Somtel	To be confirmed
South Africa	WBS (iBurst)	To be confirmed
St Helena/Asc/TdC	Sure South Atlantic	To be confirmed
Sudan	Zain	To be confirmed
Sweden	Net1	To be confirmed
Taiwan	Global Mobile (LTE TDD)	To be confirmed
Tanzania	Vodacom	To be confirmed
Tanzania	Zantel	To be confirmed
Thailand	AIS	To be confirmed
Trinidad&Tobago	Digicel T&T	To be confirmed
Tunisia	Tunisiana	To be confirmed
Turkey	Avea	To be confirmed
Turkey	Vodafone	To be confirmed
Uruguay	Dedicado (LTE TDD)	To be confirmed
UK	NSV (BT) (FDD and TDD)	To be confirmed
US Virgin Isles	Choice Wireless	To be confirmed
USA	All West Wireless	To be confirmed
USA	Blue Wireless	To be confirmed
USA	Breakaway Wireless	To be confirmed
USA	Etex Telephone Co-op	To be confirmed
USA	Convergence Technologies	To be confirmed
USA	DISH	To be confirmed
USA	Inland Cellular	To be confirmed
USA	Immix Wireless	To be confirmed
USA	iWireless	To be confirmed
USA	James Valley Telecoms	To be confirmed
USA	Lightsquared	To be confirmed
USA	MTPCS	To be confirmed
USA	NNTC	To be confirmed
USA	Phoenix Wireless	To be confirmed
USA	Pine Belt Wireless	To be confirmed
USA	Sagebrush Cellular (Nemont)	To be confirmed
USA	Snake River PCS	To be confirmed
USA	South Central Communications	To be confirmed
USA	SouthernLINC	To be confirmed
USA	SRT Communications	To be confirmed
USA	O2 Secure Wireless	To be confirmed
USA	S&T Telephone Cooperative	To be confirmed
USA	SGRITA	To be confirmed
USA	Texas Energy Network	To be confirmed
USA	Union Wireless	To be confirmed
USA	Public Service Wireless	To be confirmed
USA	City of Charlotte Council	To be confirmed
Vietnam	RusViet Telecom	To be confirmed
Venezuela	Movilmax (LTE TDD)	To be confirmed
Zambia	Airtel	To be confirmed
Zimbabwe	Aqiva Wireless	To be confirmed

PRE-COMMITMENT TRIALS, STUDIES

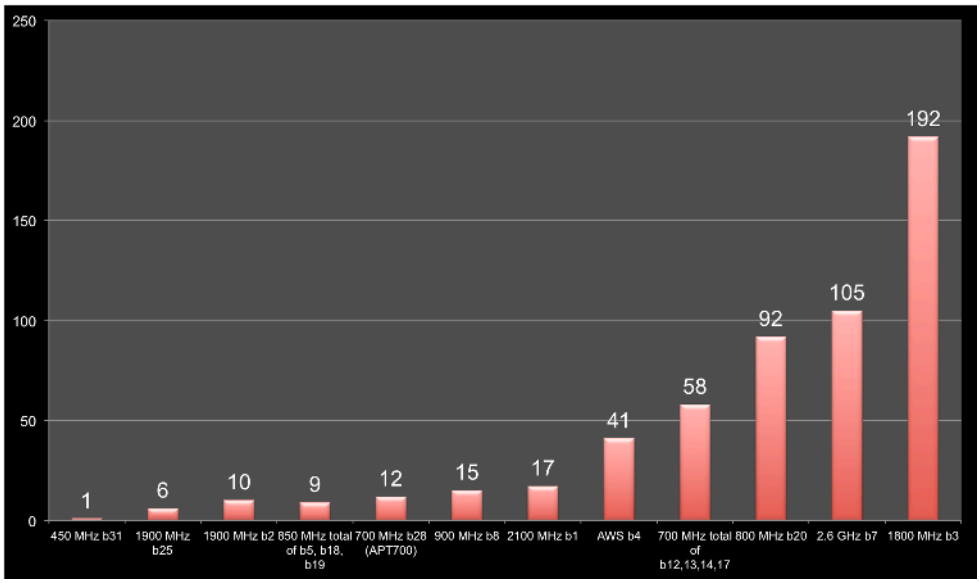
35 pre-commitment LTE trials, studies

Country	*Operator*
Afghanistan	Etisalat
Albania	Plus Communication – trialling LTE
Armenia	Orange – public demonstration held
Belarus	MTS
Belgium	Telenet
Bolivia	NuevaTel
Bosnia – H	Telekom Srpske trial completed
Bosnia – H	BH Telecom is planning a trial
Canada	Wind Mobile
Egypt	Mobinil
Finland	Anvia – trialling in 700 MHz spectrum
Guadeloupe	Dauphin Telecom
India	MTNL – study phase LTE TDD
India	SSTL studying LTE800 (band 5)
Latvia	Triatel
Latvia	Lattelecom
Kazakhstan	Beeline
Kazakhstan	Tele2
New Zealand	Kordia – study phase
New Zealand	Woosh – study phase
Nigeria	Airtel Nigeria – Lagos trials completed
Nigeria	Starcomms – study phase
Réunion	SRR trial in 1800 MHz & 2.6 GHz
Saint Martin	Dauphin Telecom
Senegal	Expresso/Sudatel – authorized to trial
Singapore	MyRepublic is trialling LTE
South Korea	KMI applied for LTE TDD licence
Spain	"R" conducting LTE TDD trials
Taiwan	Fitel (LTE TDD)
Ukraine	MTS-Ukraine
USA	ISICSB
Vietnam	FPT Telecom
Vietnam	Indochina Telecom LTE TDD
Vietnam	VDC (VNPT)
Vietnam	Viettel

Operators listed in the above table are investing in LTE trials, studies etc. or plan to do so but have not formally committed to deploy a commercial LTE network. Over time many complete their studies and progress to formally deciding on commercial network deployment commitment.

Spectrum used in commercially launched LTE networks

LTE FDD networks



90% of LTE operators have deployed the FDD mode of the standard The chart (left) shows the main frequency bands currently in use in 398 commercially launched FDD networks, according to the information detailed in this Evolution to LTE report.

The most widely used band in network deployments in commercial service today continues to be 1800 MHz which is used in over 43% of commercially launched LTE networks. 192 operators worldwide have launched LTE1800 (band 3) systems, either as a single band system, or as part of a multi-band deployment. As 1800 MHz is the prime band for LTE deployments worldwide, it greatly assists international roaming for mobile broadband services.

The next most popular **contiguous** bands are 2.6 GHz (band 7) as used in 105 networks (23.7%) in commercial service, followed by 800 MHz (band 20) used in 92 networks (21%) and AWS (band 4) used in 41 networks (9%).

Download the spectrum chart at http://www.gsacom.com

LTE TDD networks

Almost 1 in 7 LTE operators have commercially launched service using the TDD mode.

62 operators have deployed the TDD mode in their LTE networks:

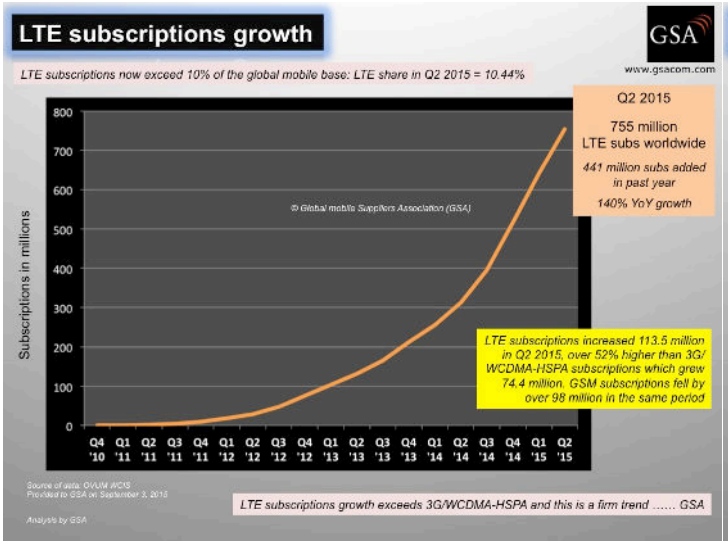
3GPP band	Frequency	Number of networks
40	2.3 GHz	26
38	2.6 GHz	15
41	2.6 GHz	13
42	3.5 GHz	12
39	1.9 GHz	1

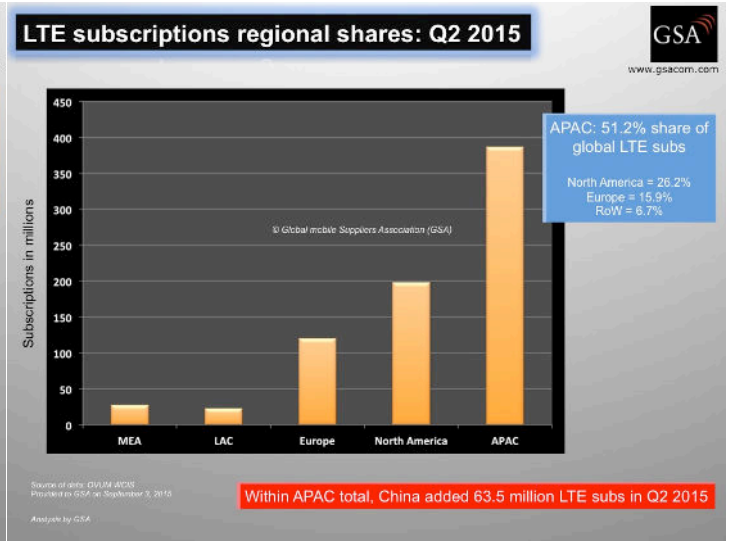
- 44 operators used the TDD mode only
- 18 operators used both FDD and TDD modes

The frequency bands that are currently in commercial use in 62 commercially launched TDD networks are shown in the table.

Note: some LTE TDD networks use more than one spectrum band

Worldwide LTE subscriptions: 755 million – Q2 2015





Download the above LTE subscriptions growth and regional shares charts (available in PDF and jpeg file formats) from the GSA website at http://www.gsacom.com/news/statistics

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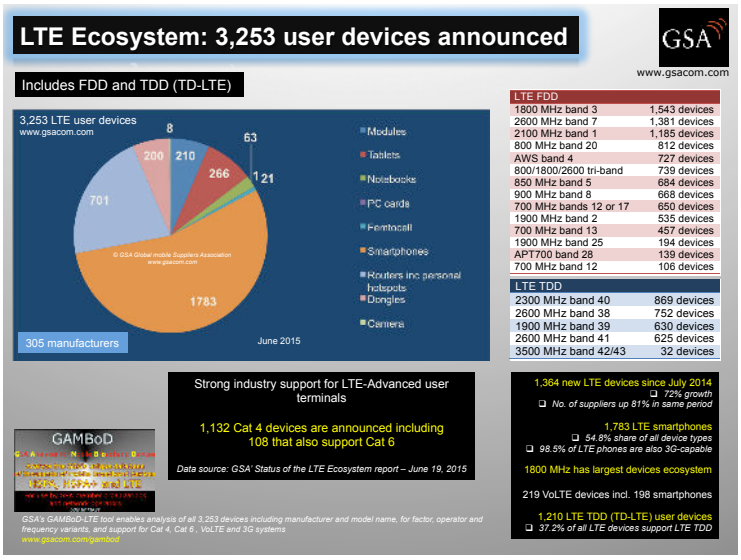
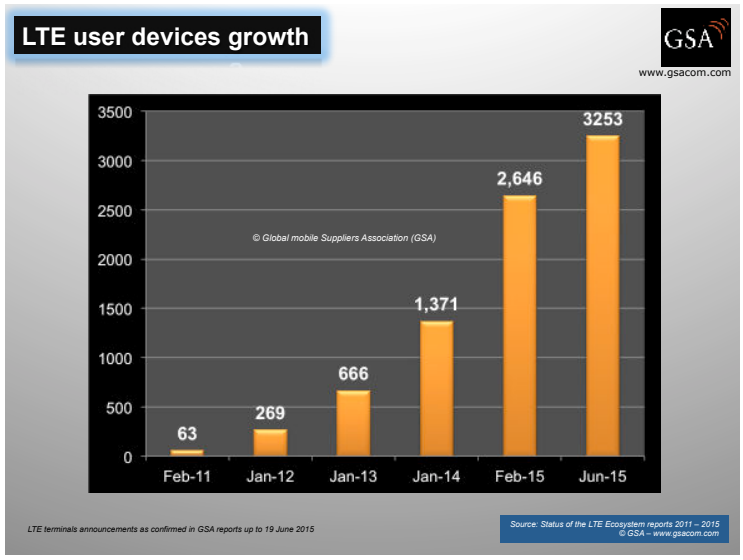
3,253 LTE User Devices launched – June 19, 2015 (GSA report)





See GSA's Status of the LTE Ecosystem report: Free download for GSA registered site users via the link on http://www.gsacom.com

Download the above charts and more charts, maps etc. from http://www.gsacom.com/news/statistics

NEXT UPDATE OF LTE DEVICES DATABASE IS PLANNED FOR END OCTOBER 2015

PRESS RELEASE

GSA confirms 3,253 LTE devices, LTE-Advanced takes hold

June 21, 2015: The latest update to the Status of the LTE Ecosystem report by GSA (Global mobile Suppliers Association) confirms fast expansion of the LTE ecosystem and the increasing focus on LTE-Advanced capable devices. A total of 1,364 new LTE user device product launches since July 2014 has pushed the current total of LTE user devices up to 3,253. The number of LTE device manufacturers grew 81% in the same period to 305 companies.

Many more companies are expected to participate in the market in the near future as the rapid market development continues.

Alan Hadden, VP of Research, GSA, said: "Dozens of new LTE terminals are being launched every week with a growing share incorporating LTE-Advanced technology. The number of Category 4 devices rose 63% in the past 4 months, however the range of Category 6 devices quadrupled in the same period."

The report covers LTE FDD and TDD (TD-LTE) devices.

The smartphone is the largest LTE device category. 1,783 smartphones including operator and frequency variants are announced, giving an improved 54.8% share of all LTE device types. 98.5% of LTE smartphones are multimode, capable of operating on at least one 3G technology in addition to LTE and almost 44% of LTE phones can operate on 42 Mbps DC-HSPA+ networks. LTE tablets and personal hotspots are other fast-growing categories.

Spectrum bands

1800 MHz (3GPP band 3) is the most widely used band for LTE network deployments and benefits from having the support of the largest devices ecosystem of 1,543 devices. The next most used band is 2.6 GHz (band 7: 1,381 products) then 2.1 GHz (band 1: 1,185 products).

LTE-Advanced

The rapidly expanding choice of LTE-Advanced devices is evident as more operators invest in carrier aggregation. 1,132 devices support UE Category 4, (150 Mbps downlink) i.e. 35% of all LTE devices, including 108 terminals that also support UE category 6. Most current LTE-Advanced systems support Category 6 devices, defined by 3GPP as covering the range 151 Mbps up to 300 Mbps theoretical peak downlink data throughput, and 50 Mbps on the uplink.

APT700

The report notes increasing traction for APT700. Adoption of the APT700 FDD band plan (698-806 MHz) by most countries across APAC and Latin America is a major opportunity for global spectrum harmonization for LTE systems, paving the way for ensuring the greatest economies of scale for devices addressing a market of approaching 4 billion people, for more capacity, and roaming. 139 APT700 band 28 devices: smartphones, tablets, CPEs and MiFis, are launched.

LTE TDD (TD-LTE)

Support for LTE TDD (TD-LTE) is growing. 1,210 devices i.e. 37% of all LTE devices compared to 28% in July 2014, support TDD. Bands 40 (2.3 GHz) and 38 (2.6 GHz) have the largest ecosystems and bands 39 and 41 are also mature. Convergence is a strong theme and a growing trend with several devices supporting both TDD and FDD modes.

VoLTE

VoLTE technology is being widely deployed. Initially operators are deploying VoLTE enabling HD voice for their LTE users. 219 VoLTE-capable devices (including carrier and frequency variants) including 198 smartphones have been announced by all the leading vendors including Apple, Asus, Fujitsu, HTC, Huawei, LG, Motorola, Pantech, Samsung, Sharp, and Sony Mobile.

The Status of the LTE Ecosystem report published by GSA on 19 June 2015 is available as a free download to registered site users via the link at http://www.gsacom.com

Registration page for new site users
http://www.gsacom.com/php/register_form

Related charts and maps are available at
http://www.gsacom.com/news/statistics

MORE RESOURCES ON www.gsacom.com

- ☐ ***Snapshot*** *market status series published by GSA – see www.gsacom.com*
- ☐ ***Maps, charts*** *on the home page and http://www.gsacom.com/news/statistics*
- ☐ *Top 10 GSA Members papers topics, download stats: LTE-A, M2M, 5G, IoT, App coverage, LAA*
- ☐ *LTE2100 market status report (LTE deployments, devices in 2.1 GHz band 1)*
- ☐ *Status of the LTE Ecosystem report: GSA confirms 3,253 LTE devices announced by 305 suppliers*
- ☐ *LTE in 900 MHz spectrum (3GPP band 8) – market status*
- ☐ *The Journey to 5G (GSA white paper)*

Links to recent papers / presentations by GSA Members, operators, partners *on http://www.gsacom.com*

- *Microwave Towards 2020 (Ericsson white paper)*
- *Multi-antenna Optimization in LTE (Nokia Networks WP)*
- *LTE-M: Optimizing LTE for the Internet of Things (Nokia Networks WP)*
- *Improving Indoor App Coverage (Ericsson presentation)*
- *App Coverage - Effectively relating network performance to user experience (Ericsson WP))*
- *5G: New Air Interface and Radio Access Virtualization (Huawei white paper)*
- *Accelerating IoT (Ericsson presentation)*
- *idDAS: Bringing intelligence to coverage provision (Cobham Wireless WP*
- *LTE-Advanced Network Evolution (3 UK presentation at LTE World Summit 2015)*
- *Build a LTE-Centric World (Huawei Keynote at LTE World Summit)*
- *LTE Release 13 and road to 5G (3GPP presentation)*
- *E911/E112 Location Accuracy improvement (Sunsight Instruments WP)*
- *Ericsson Mobility Report: June 2015*

5G papers/presentations from leading organisations, operators, vendors, universities, others

LinkedIN discussion groups managed by GSA

Global mobile Suppliers Association (GSA) http://www.linkedin.com/groups?gid=2313721

APT700 band http://www.linkedin.com/groups?gid=4759091
HD Voice (W-AMR) http://www.linkedin.com/groups?=&gid=3032759
LTE1800 http://www.linkedin.com/groups?=&gid=3129390
LTE-Broadcast http://www.linkedin.com/groups?gid=7435919
LTE Public Safety and Critical Communications http://www.linkedin.com
LTE TDD http://www.linkedin.com/groups?gid=3978061
LTE User Devices http://www.linkedin.com/groups?gid=4146472
NVP - New Ventures Program http://www.linkedin.com/groups?gid=4176808
UMTS900 http://www.linkedin.com/groups?gid=3031942
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LTE-U http://www.linkedin.com/groups?gid=8307556
5G http://www.linkedin.com/groups?gid=5089259

GSA (Global mobile Suppliers Association) represents GSM/EDGE/WCDMA-HSPA/HSPA+, LTE/LTE-Advanced and future 5G suppliers. GSA brings together a global industry community of telecoms professionals through its website, reports, information papers and practical activities to inform, influence, educate, explain and promote the opportunities enabled by mobile broadband systems. The GSA website www.gsacom.com has over 70,000 registered users for knowledge gathering and information sharing of key facts, trends and analysis, and over 25,000 connections using our social network platforms LinkedIn, Twitter and Facebook. Over 1 million GSA reports, presentations, information papers, maps, charts and other resources were downloaded from www.gsacom.com in under five years.

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Information for producing this report is obtained in several ways, including information exchanges between GSA and network operators and with regulatory authorities, suppliers and other stakeholders. This is in addition to review of company statements, press releases and briefings in order to confirm facts to ensure that this report reports the true situation.

Your comments about this report and updates are welcome by email please to info@gsacom.com

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ETSI has registered "LTE" as a trademark for the benefit of the 3GPP Partners. GSA is a Market Representation Partner in 3GPP