

Understanding the Digital World

Wireless

 **LTE state-of the art**

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# Agenda

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- **Main LTE markets**
- **LTE spectrum**
- **Technology update: LTE-Advanced, TD-LTE and VoLTE**
- **Conclusions**

## Main LTE markets (Dec. 2013 figures)

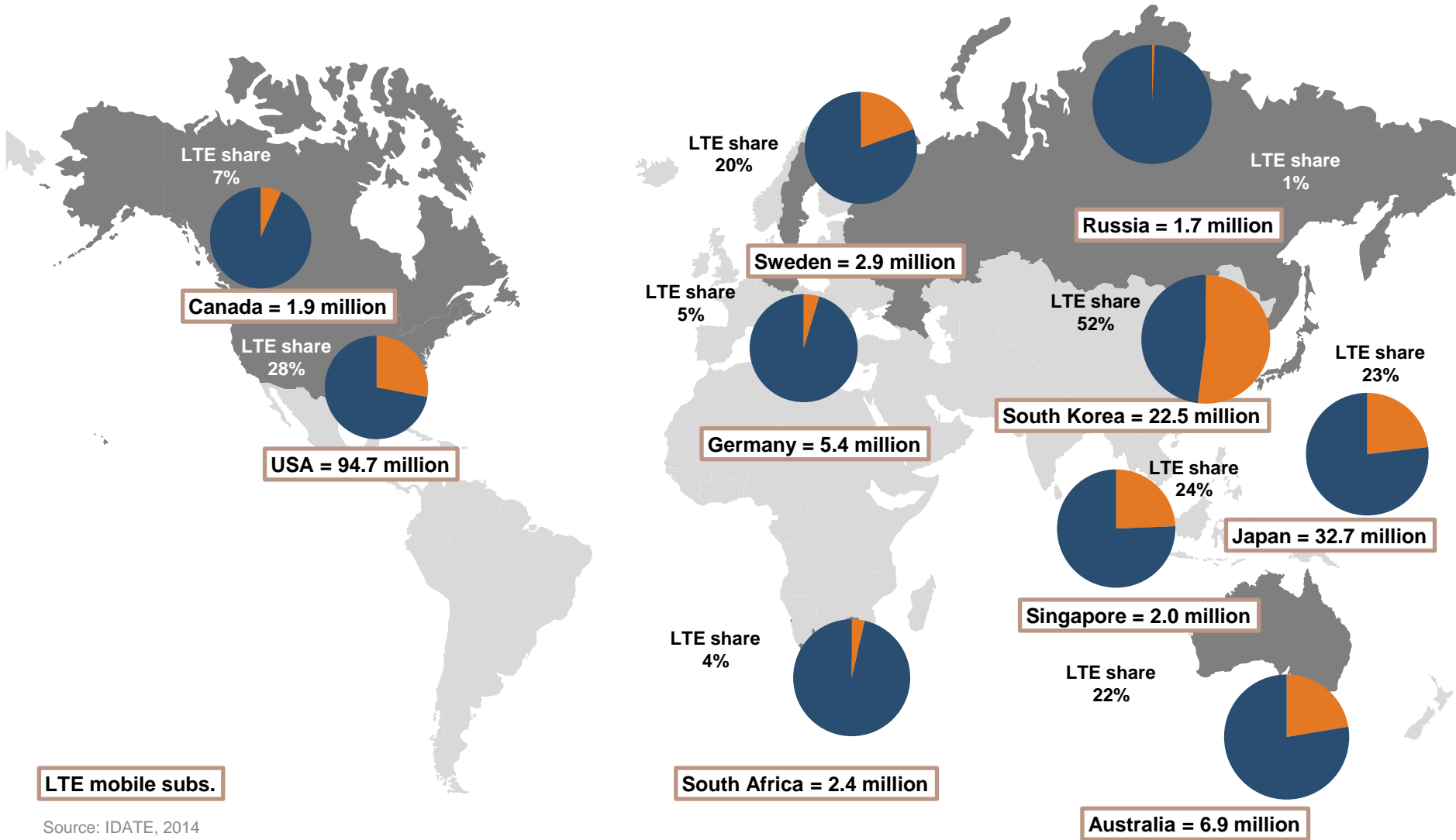
- **The United States** is again the top national user country base for LTE subscribers with 47% of total subscriptions worldwide (in our last report).
- **Japan** ranks in second place, with some 33 million LTE subscribers for the four competing operators.
- The adoption of LTE in **South Korea** since the launch of commercial offerings has been massive (52% of the mobile user base at end 2013, just two years after commercial launch) and much faster than for 3G technology (33% of the total mobile user base in 2005, some three years after its commercial launch). This ranks South Korea as the country with the highest penetration rate of LTE subscribers.
- **Sweden**, which had been the forerunner, appears in the seventh LTE share position in the world and third in Europe after **Germany** and **France**, at almost 3 million subscribers as at end 2013.

Ranking of countries by number of LTE mobile subscribers (million) and LTE share of the mobile user base (%), end 2013

Rank	Country	Dec. 2013	LTE share
1	United States	94.7	27.9%
2	Japan	32.7	23.1%
3	South Korea	28.4	52.0%
4	Australia	6.9	22.3%
5	Germany	5.4	4.7%
6	France	3.0	3.9%
7	Sweden	2.9	19.5%
8	UK	2.7	3.1%
9	South Africa	2.4	3.5%
10	Hong Kong	2.2	12.6%

Source: IDATE, April 2014

# Main LTE markets (Dec. 2013 figures)

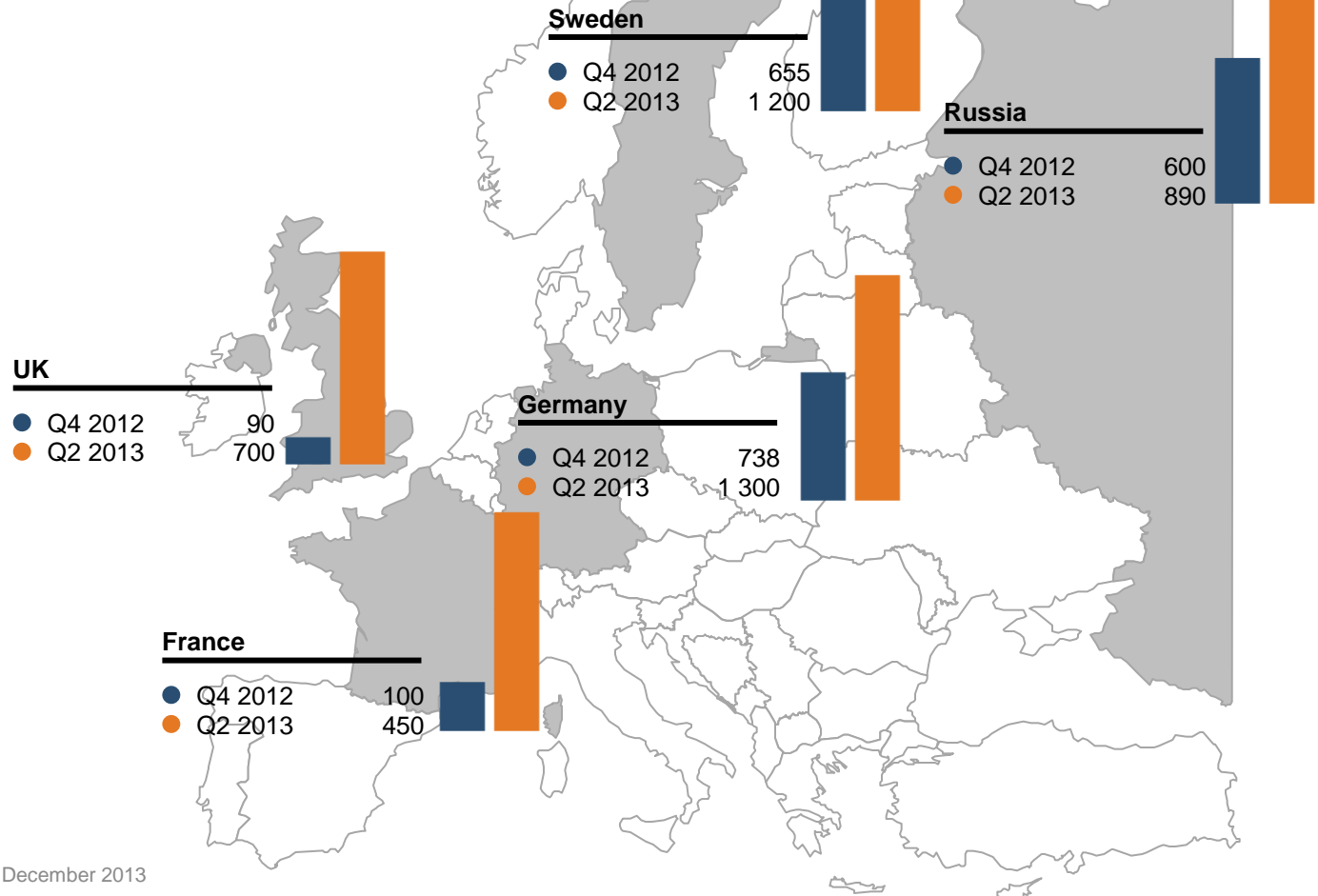


LTE mobile subs.

Source: IDATE, 2014

# LTE European market (in thousand)

Europe = 7.5 million LTE subscriptions (mid-2013)



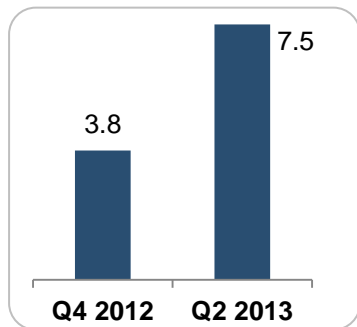
Source: IDATE, December 2013

# European Market – Main trends

## > Market trends

- Close to 7.5 million LTE subscriptions (Q2 2013)
- Germany and Sweden leads European market (Eastern + Western Europe) with around 1.2 million LTE subs each as of mid 2013
- Russia is the first Eastern European country with around 800 000 LTE subs but few progress made between Q4 2012 and mid 2013
- All three French operators launched LTE commercial services by May 2013
- UK and France follow with big progress between December 2012 and June 2013. Operators using the refarmed 1800 MHz spectrum lead the market (EE in the UK and Bouygues Telecom in France)

LTE subscriptions (million)



Source: IDATE, December 2013

## > Auctions, new licenses

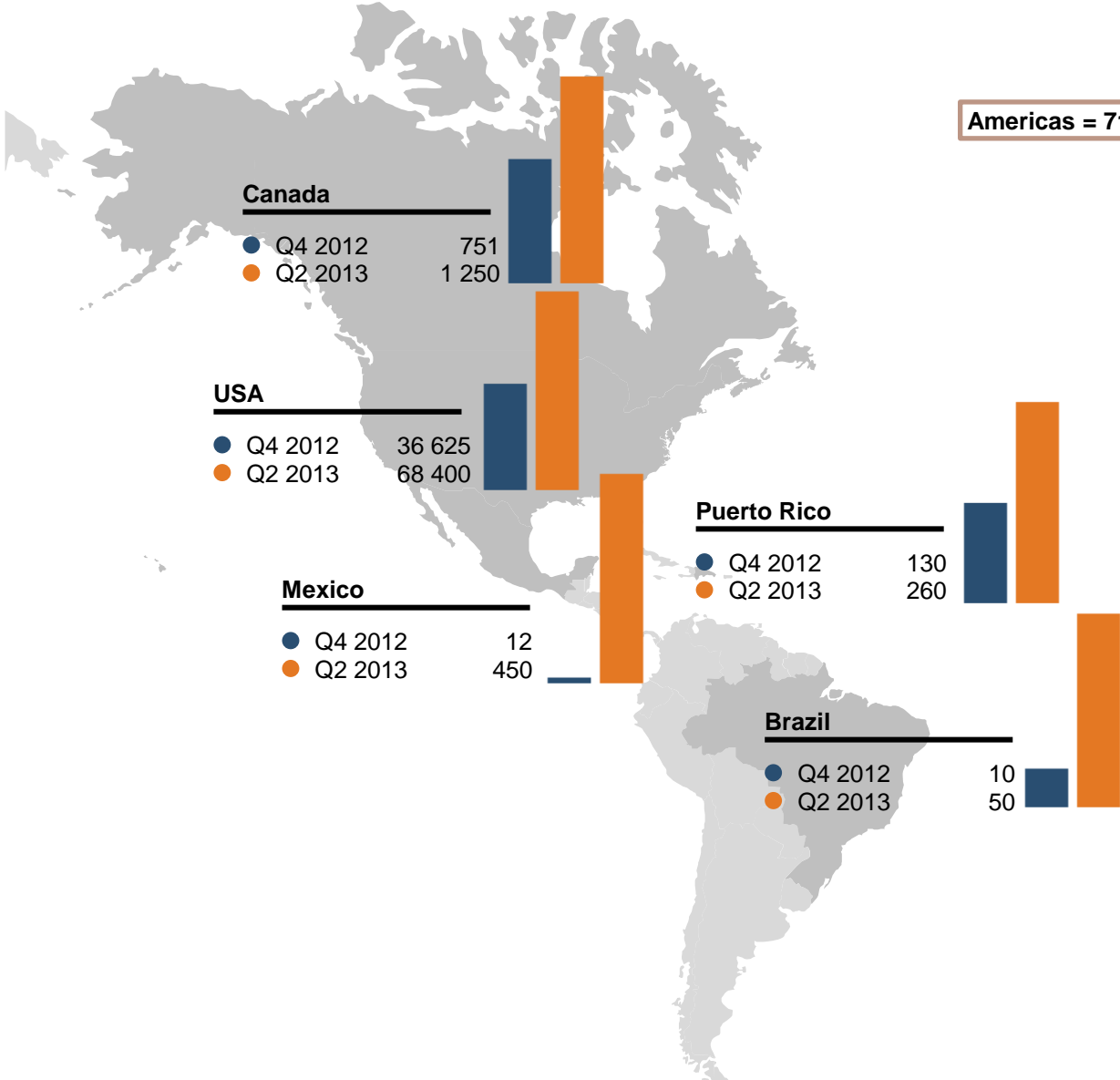
- In Austria, 800, 900 and 1800 MHz auction raised EUR 2.014 billion in October 2013
- In Finland, 800 MHz auctions raised EUR 108.01 million. 2x10 MHz were awarded to DNA, TeliaSonera and Elisa
- Digital Dividend auctions took place in November 2013. The 3x10 MHz paired blocks of 800 MHz were allocated to Base, Belgacom and Mobistar
- 'Big bang' auctions including the 700, 900 and 1800 MHz bands expected in Germany in 2014

## > Innovation

- The Swisscom 'Infinity' differentiated bandwidth plans achieved significant commercial success
- TeliaSonera moved to shared-data plans in March 2013
- In Sweden, TeliaSonera and Tele2 are expected to launch VoLTE by end-2013
- Swedish operators TeliaSonera and Tele2, and British telco Everything Everywhere, unveiled their plans to launch LTE-A services by end-2013.

# LTE American market (in thousand)

Americas = 71 million LTE subscriptions (mid-2013)

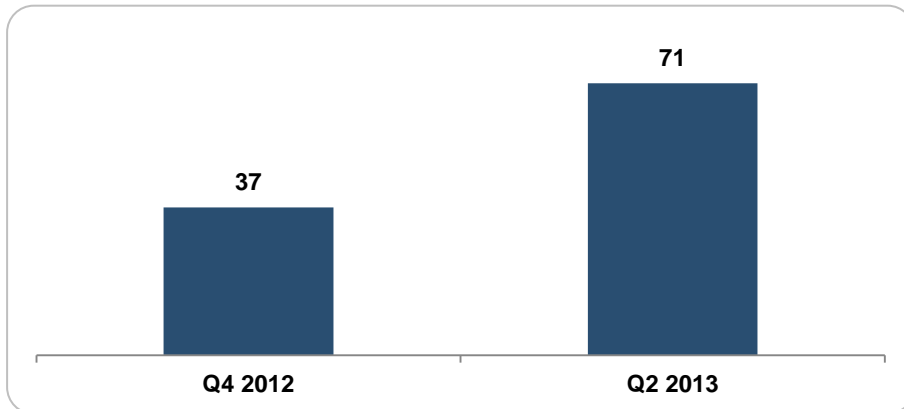


# American Market – Main trends

## > Market trends

- North America is still the LTE leader in terms of subscriptions, with close to 70 M in Q2 2013. With more than 30 M LTE subs, Verizon is the leading operator. It reached over 90% coverage with nationwide coverage expected by the end of the year
- Competition on the market is huge and drives operators investments in their network. AT&T will especially have invested USD 21 billion of capex in its network (wireless+wireline)
- Between Q4 2012 and mid 2013, Mexico grew up as the 3 biggest market with 450000M subs

LTE subscriptions (million)



Source: IDATE, December 2013

## > Auctions, new licenses

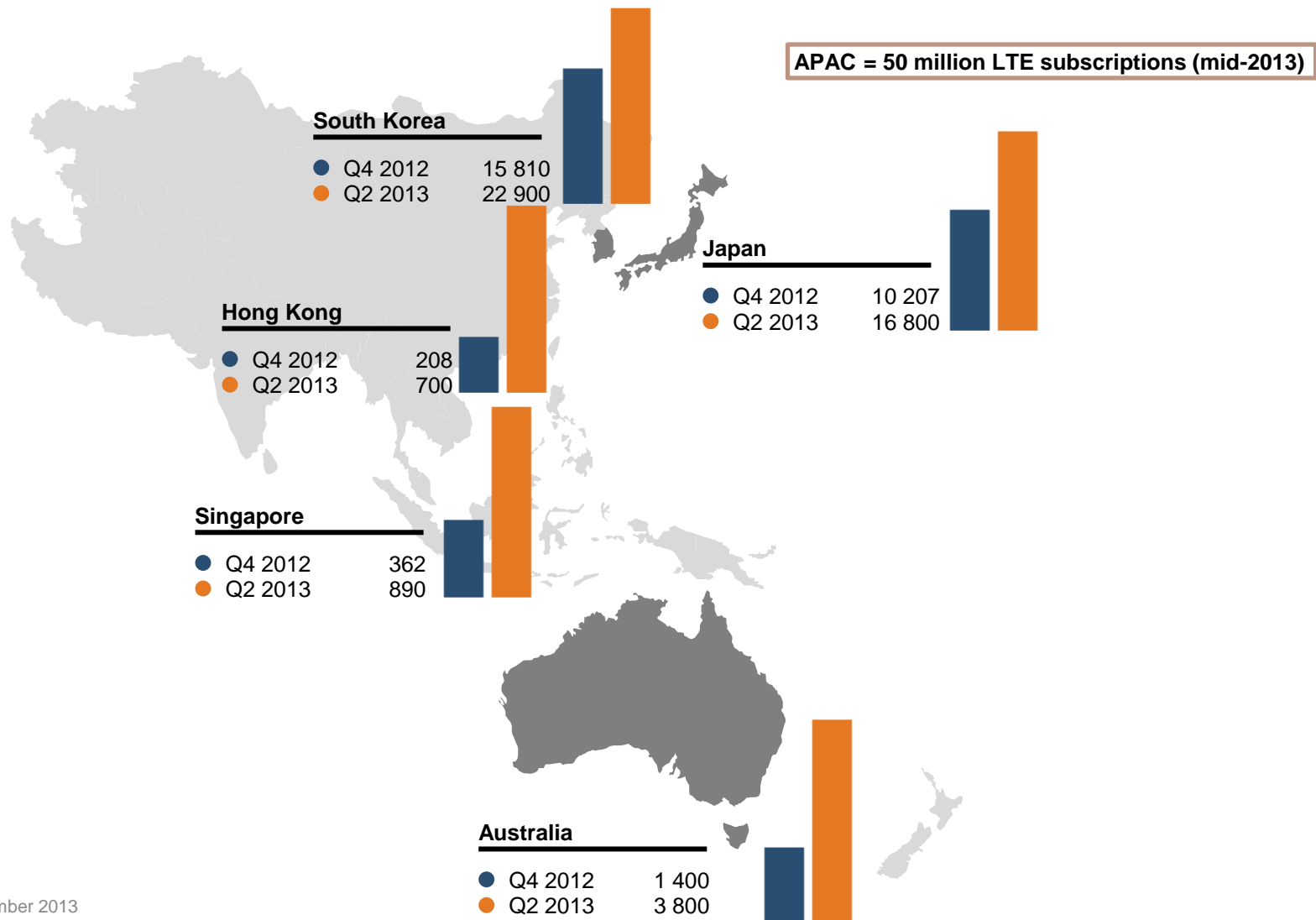
- Mexico's reached a deal with concession-holders, including MVS Multivision, to recover 68 percent of available space in the 2.5 GHz spectrum in October 2013
- In Brazil, the 700 MHz band will be auctioned in 2014 (with the APT plan) after a public enquiry
- In Argentina and Chili, the AWS band (#4, 1.7/2.1 GHz) will be auctioned for LTE use
- FCC introduced an innovative LTE auction scheme for the 600 MHz band with 3 steps involving broadcasters for the release of spectrum, repackaging from the FCC and bids from operators

## > Innovation

- Sprint demoed its Spark program in October 2013 that will see devices working on FDD 800 MHz and 1.9 GHz spectrum as well as on its TDD 2.5 GHz spectrum with carrier aggregation. 8x8 MiMo will be supported in the 2.5 GHz band.
- Spark vendors selected by Sprint were Alcatel Lucent, Samsung and Nokia. Ericsson was not selected
- Following Sprint, T-Mobile, Clearwire and AT&T will launch VoLTE in 2013



# LTE APAC market (in thousand)



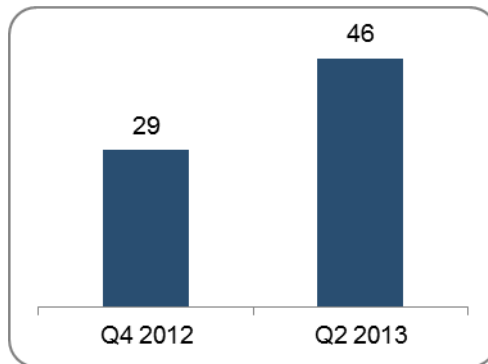
Source: IDATE, December 2013

# Asian-Pacific Market – Main trends

## > Market trends

- Globally, Asia-Pacific market is second, behind the American, with close to 50 M subscriptions in Q2 2013.
- South Korea alone almost hit 23 M subscriptions in June 2013 and has reached nationwide coverage.
- Massive TD-LTE network deployments in region with China leading this market.? India expected to follow later on.
- In Sept 2013 China Mobile selected Huawei and ZTE for the provision of 50% of the 200 000 TD-LTE BTS. Ericsson, NSN and Alcatel Lucent will provide 10% each of that number

LTE subscriptions (million)



Source: IDATE, December 2013

## > Auctions, new licenses

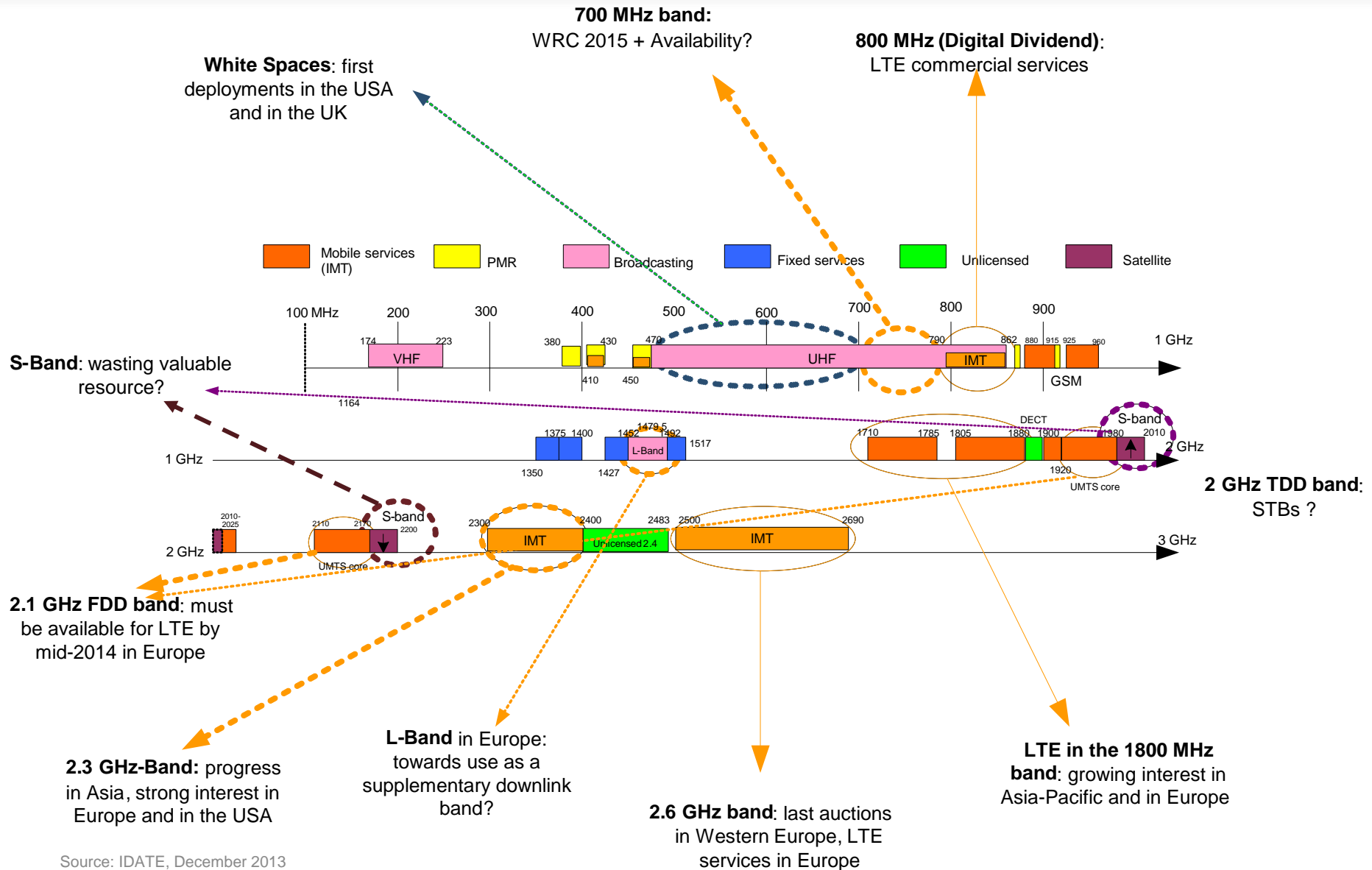
- In China, FDD spectrum was awarded to China Unicom and China Telecom in the 1800 and 2100 MHz in October 2013. TD-LTE licenses should be awarded at the end of 2013
- In October 2013, Telecom NZ and Vodafone paid \$66 million for 2x15 MHz (three lots) in the 700 MHz auction. A 3<sup>rd</sup> operator 2degree secured 2x10 MHz in the same band. This adoption of FDD version of 700 MHz APT plan adds up to the support of this scheme by Japan, India, Australia, Taiwan
- In Taiwan, auction for spectrum in the 700, 900 and 1800 MHz started in September 2013. Bids totaled NT\$93.92 billion (US\$3.2 billion)
- South Korean 1,800 MHz and 2.6 GHz bands to be auctioned by end-2013. Meanwhile, 40 MHz out of 108 MHz will be allocated in the 700 MHz

## > Innovation

- HK CSL was first to launch LTE-A services in May 2013, operator SK Telecom followed in June. SKT had 1 million LTE –A subscribers in October 2013
- South Korean operators first to launch VoLTE in summer 2012. Carrier aggregation was launched in June and October 2013
- The SoftBank TD-LTE network uses the largest operating small-cell network counting 160,000 microcells offering LTE services in band 41 (2.5 GHz) with speeds up to 110 Mbps.

# LTE spectrum

# Main radio spectrum 'trends' - 2014-2015



Source: IDATE, December 2013

# LTE spectrum

## > Fragmentation is here to stay

- At mid-2013, the main LTE frequency bands were 1800 MHz (#3), 2.6 GHz (#7) and 700 MHz (North American bands #12, 13, 14 and 17).
- The 1800 MHz band (#3) is used by 40% of LTE operators
- Regional harmonisation likely to be the first step:
  - Americas: DD (700 MHz), AWS, 2.6 GHz
  - Europe: DD (800 MHz), 1800 MHz, 2.6 GHz
  - Asia-Pacific: 2.3 GHz, 2.6 GHz
- A major hurdle for chipset and devices vendors
- Roaming is not a priority today

## > Band plans are important, as seen in the USA

- Two different band plans in the 700 MHz bands respectively for AT&T and Verizon Wireless.

### Main LTE frequency bands

Countries	Existing frequency bands	New frequency bands
Europe	900 MHz 1800 MHz 2.1 GHz	800 MHz (DD) 2.6 GHz 3.5 GHz (very limited deployment)
USA	850 MHz 1.7/2.1 GHz (AWS) 1900 MHz (PCS) 2.5 GHz	700 MHz (698-806 MHz) S-band (Dish)
South America	1.7/2.1 GHz (AWS) 1800 MHz 1900 MHz (PCS)	450 MHz 700 MHz (698-806 MHz) 2.6 GHz
China	Band 39 (1880-1920 MHz)	2.3 GHz 2.6 GHz
India		700 MHz 2.3 GHz
Japan	850 MHz 1.7/1.9 GHz 2.1 GHz	700 MHz 900 MHz 1.5 GHz, 2.6 GHz
South Korea	1800 MHz 2.1 GHz	800 MHz
Rest of Asia-Pacific	900 MHz 1800 MHz	700 MHz (698-806 MHz planned) 2.3 GHz 2.6 GHz

Legend: Currently used by LTE Likely use by LTE Other mobile frequency bands

Source: IDATE, December 2013

# The 700 MHz band: a new harmonised frequency band for LTE?

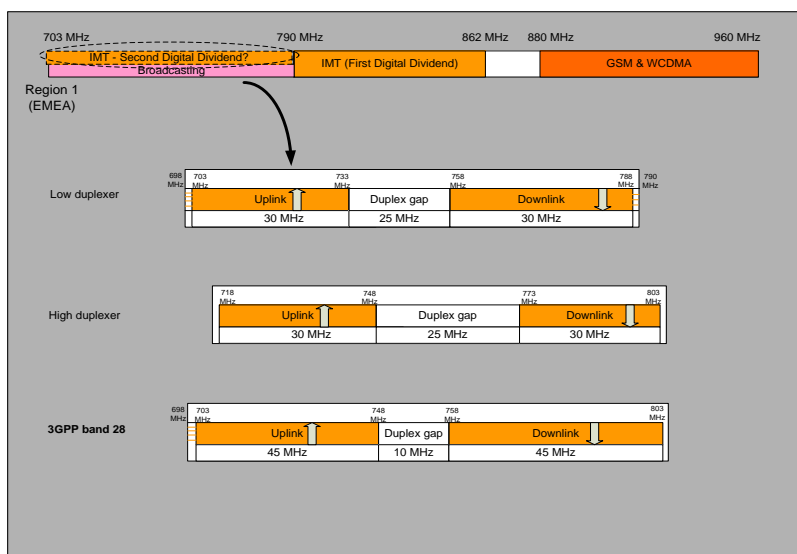
- The 700 MHz band corresponds to the first Digital Dividend in the USA and in Asia-Pacific, whereas it could become the second Digital Dividend in the EMEA region.
- The Asia-Pacific Telecommunity (APT) finalised a harmonised band plan for 698-806 MHz for Region 3 which was approved by ITU. As is the case with the APT band plan, 2 x 45 MHz of spectrum will be available.
- The entire band, according to the APT plan, enables the use of 2 x 45 MHz for FDD operation. A TDD plan has also been defined.
- The APT band plans include two duplexers associated with two separate 30 MHz duplex plans. The first is compatible with Europe (lower duplex plan: 703-733 and 758-788 MHz) and the second (718-748 and 773-803 MHz) has already been selected by some Asian countries such as Japan.

## Status of the 700 MHz band (December 2013)

Geographical area	700 MHz band	Band plan	Allocation	Commercial services
Europe	703-788 MHz	APT likely	>= 2015	Probably in 2017-2020
Middle East & Africa	703-788 MHz	APT likely	>= 2013	>= 2015
North America	699-798 MHz	US	2008	Yes: LTE in the USA
South America	698-806 MHz	Mainly APT	>= 2014	>= 2015
Asia-Pacific	698-806 MHz	APT	Japan, Australia, (New Zealand in Q3 2013)	>= 2014

Source: IDATE, December 2013

## Possible implementation of 2 x 30 MHz FDD band in 700 MHz (lower duplex)



Source: IDATE, December 2013

# Technology update: LTE-Advanced, TD-LTE and VoLTE

# LTE-Advanced update

## LTE-advanced implementations roadmap

Date	USA	Asia-Pacific	Europe	Other countries
H2 2012				Yota (network only)
2013		SK Telecom	Telia	Telstra
		LG U+	Telenor (trials)	
		KT	EE (Nov 2013)	
		DOCOMO (trials)		
2014	AT&T (March 2014, Chicago)	CSL plans to launch cat 6	Vodafone Italy	MegaFon: cat 6 services in Moscow in Feb 2014
	Sprint (March 2014)	KDDI (planned)	T-Mobile	STC (TD-LTE-A)
	Verizon Wireless	M1 (Malaysia) will launch cat 6	Bouygues, France(June 2014)	
		Taiwan Mobile (by end 2014)	Vodafone Spain	
		SK Telecom: Cat 6	Tele2 Sweden & Telenor	
2015		SK Telecom: 3x20MHz aggregation for 450 Mbps in the downlink		
		Docomo (commercial launch)		
2016	Dish			

Source: IDATE, March 2014

LTE-Advanced brings many new features improving interference management, performance at the cell-edge, complementarity between macro and small cells, spectrum efficiency. It is standardized under Rel 10 and onwards. The latest release under standardization is Rel 12 (features frozen by the end of 2014).

Most popular future is carrier aggregation, which brings both capacity and throughputs to operators.

- First services based on Carrier Aggregation were launched in June 2013 in South Korea by SK Telecom, offering throughputs of 150 Mbps (Cat 4) in the downlink with an aggregation of 2x10 MHz in the band 1800 MHz (band #3) and 800 MHz (band #20).
- Next step in carrier aggregation include:
  - Cat 6 services (300 Mbps in the downlink) with aggregation of 2x20MHz: launch throughout 2014 (SK Telecom, MegaFon, CSL, EE with first smartphones in H2 2014)
  - Aggregation of 3x20 MHz to reach throughputs of 450 Mbps (SK Telecom in 2015)
  - TDD-FDD band aggregation (Rel 12) used by carriers such as Sprint and its Spark network in March 2014, then TDD interband carrier aggregation later (not yet standardized in Rel 12) with China Mobile

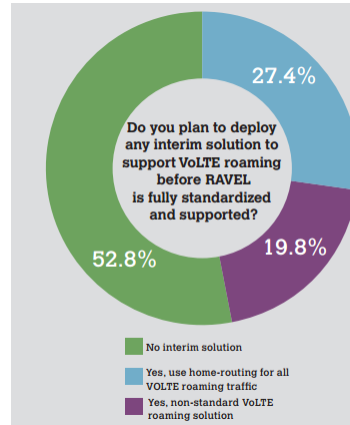


# VoLTE status

## > VoLTE status and launch date

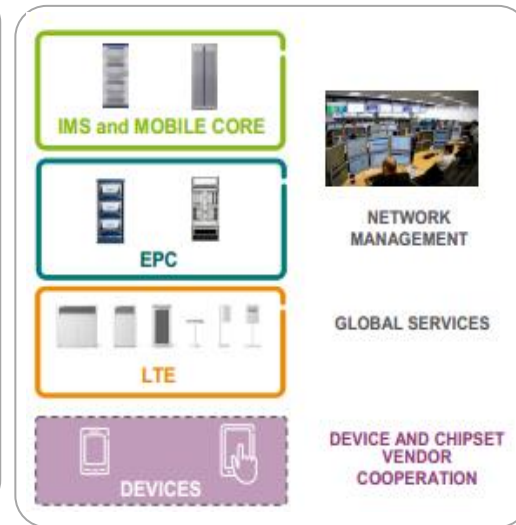
- South Korea is currently the only country with large scale commercial VoLTE services launched in H2 2012
- In the US, both AT&T and Verizon have delayed their launch stating that further tests and improved implementation in the network had to be performed
- Elsewhere however, deployments are numerous and 2014 should see several new commercial launches, of which China Mobile, with the first VoTDLTE service
- As of today VoLTE support in the device is still limited (some Samsung, LG, Pantech and Sony devices)
- While first data roaming agreements have been setup between some operators, the question of LTE voice Roaming is still to be addressed. This is the goal of Roaming Architecture for Voice over LTE with Local Breakout that is developed by the 3GPP
- The solution is not yet standardized and most operator will wait for this standardization before implementing any solution

“Do you plan to deploy any interim solution to support VoLTE roaming before RAVEL is fully standardized and supported?”



Source: Telecoms Intelligence (February 2013)

## VoLTE end-to-end solution



Source: Ericsson

## VoLTE deployments

Country	Operator	Status	Date
France	Bouygues	In deployment	2014
Germany	Telefonica	In deployment	Q1 2014
Sweden	Tele2	In deployment	2014
	Telia Sonera	In deployment	2014
China	China Mobile	large scale trials	launch by the end of 2014
Japan	NTT DOCOMO	In deployment	Late 2013/early 2014
	KDDI	In deployment	Late 2013
South Korea	SK Telecom	Launched	August 2012
	LG U+	Launched	August 2012
	KT	Launched	October 2012
Hong Kong	CSL Soft	Launched	Dec 2013
USA	AT&T	In deployment (Delayed)	2014
	Clearwire	In deployment	2H 2013
	MetroPCS	Launched	August 2012
	Sprint	In deployment	Late 2013/early 2014
	Verizon Wireless	In deployment (Delayed)	2014

Source: IDATE, March 2014

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# LTE video services

## Streaming and live HDTV services on LTE networks

- **Verizon Wireless: Viewdini**

- Viewdini is a mobile video aggregator that lets smartphone and tablet users discover and access videos from Comcast, Hulu, Netflix and mSpot,... The product was launched on June 1<sup>st</sup>, 2012. It's the first video metasearch service available for 4G LTE android and iOS devices in the US.

- **LG U+: U+ HDTV**

- This HD streaming service is based on LTE, and provides both live HDTV and VOD (Video On Demand). 36 HD channels and more than 5000 VOD are available for ₩5,000/month.
- KT offers a similar service with 60 channels and 22000 VOD for the same subscription rate.

- **KT: Video upload**

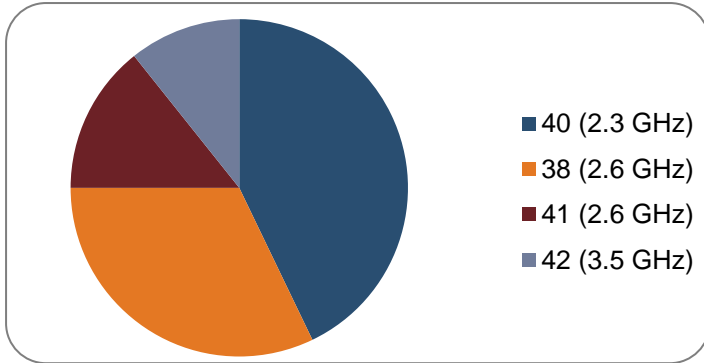
- The "Olleh Navi Black Box" is a free driving recorder, which comes with Olleh Navi App. The recorded: data can be exported to uCloud storage. This app can use a smartphone's camera or a dedicated video camera to record automatically what happens in front of the car. The video is stored on uCloud and 50GB of storage is provided for free for KT subscribers.



# Status of TD-LTE deployment

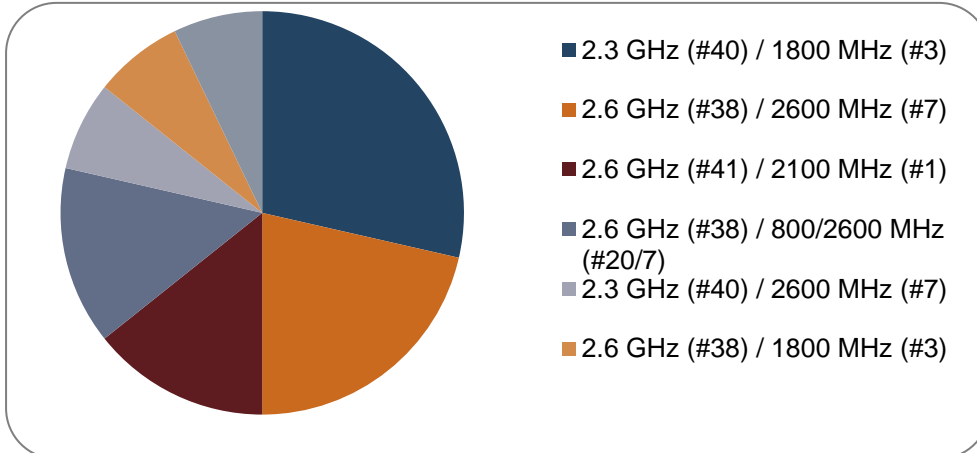
- As of January 15, 2014, 28 TD-LTE networks were commercially launched worldwide.
- The 2.3 GHz band (#40) was the first frequency band used by TD-LTE networks, followed by the 2.6 GHz band (#38)
- Most popular TDD and FDD bands are combined together in these FDD/TDD deployments. For FDD networks, band 3 (1800 MHz) is the most used, followed by band 7. As for TDD bands, band 40 and 38 are the most used.

**Figure 1: Number of TD-LTE network launched by frequency bands (January 2014)**



Source: IDATE and GSA, January 2014

**Figure 2: Combination of FDD and TDD frequency in commercially-launched FDD-TDD networks**



Source: IDATE, Adoption and challenges around TD-LTE, March 2014

# Conclusions

# Conclusions

## LTE already successfully adopted...

- **200 million LTE subscriptions at end-2013 worldwide**
  - Top three countries for LTE subscriptions: USA, South Korea, Japan. USA represented 50% of the total

## ...and growing

- **Rapid growth of LTE population coverage in South Korea (100%), USA**
- **250 commercial LTE networks (end-2013), 450 MNOs committed to launching LTE**
- **Close to 1 000 LTE devices at mid-2013**
- **Already 19 LTE frequency bands in use by Q2 2013 and more to come**

## LTE-Advanced, the « real 4G » earlier than expected

- **LTE-Advanced has been launched during H2 2013 in South Korea**
- **TD-LTE is still a nascent ecosystem: 3 million subscriptions at the end of 2013**
- **Video represents close to 60% of LTE traffic**

## 5G in 2020

# Who we are

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