



QUALCOMM®



LTE TDD, The Global Solution for Unpaired Spectrum

September 2011



The Biggest Platform in the History of Mankind

APPROX. 2 BILLION NEW 3G SUBSCRIPTIONS TO BE ADDED BY 2015

>5.7 BILLION WIRELESS SUBSCRIPTIONS WORLDWIDE

~1.4B

3G SUBSCRIPTIONS
NOW

~3.2B

3G SUBSCRIPTIONS
BY 2015

LTE Has Strong Commitments

LTE MULTIMODE LAUNCHED

26

LAUNCHES

174

NETWORK COMMITMENTS

LTE TDD LAUNCHED

2

LAUNCHES (SEPT 2011)

>24

TRIALS/DEMOS

GROWING DEVICE ECOSYSTEM

>161

DEVICES

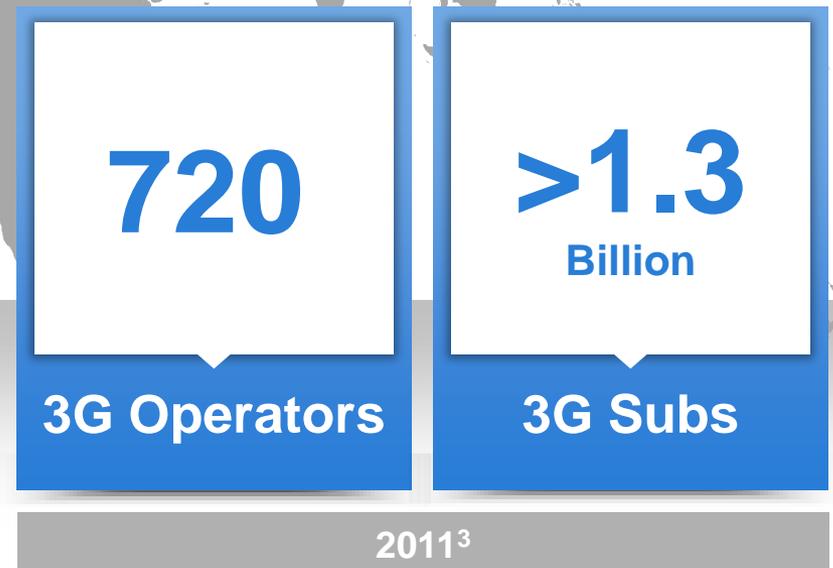
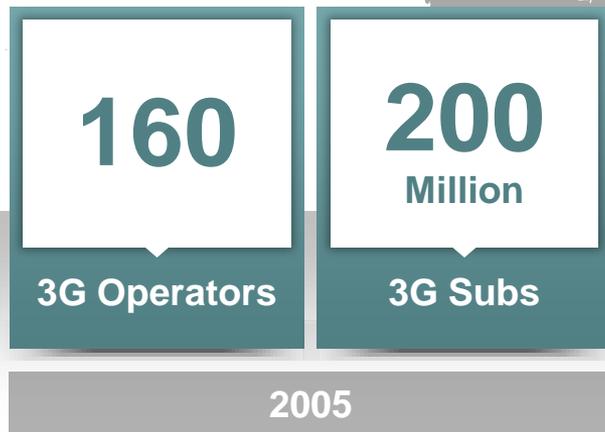
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VENDORS

Operators Committed to Combined 3G and LTE Strategy

3G adds ~17 million subscribers in < 3 weeks¹

WiMAX has approached 17 million subscribers globally since its existence²



LTE TDD: The Global Solution for Unpaired Spectrum

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Complements 3G to Boost Data Capacity

3G provides ubiquitous data, voice and global roaming

T
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Seamless 3G Interoperability from Day One

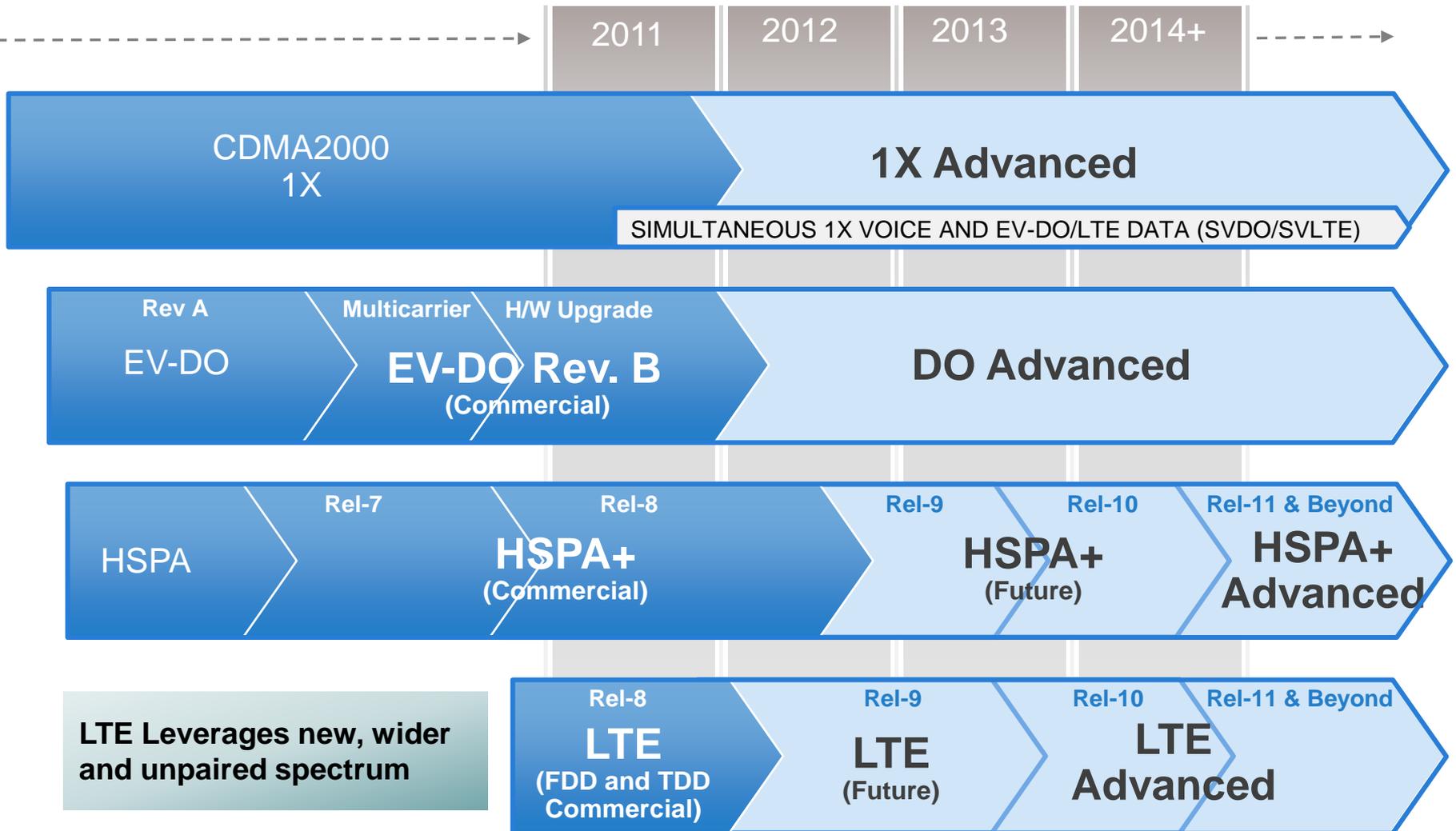
Leverages LTE FDD and Huge 3G Ecosystem

Common TDD/FDD standard and design ensures economy of scale

Qualcomm: Common FDD/TDD chipset platform

Multimode chipsets supports LTE FDD & TDD with 3G and its evolution

Qualcomm is a Leader in 3G and 4G



■ Commercial

Note: Estimated commercial dates.

Created 09/19/2011

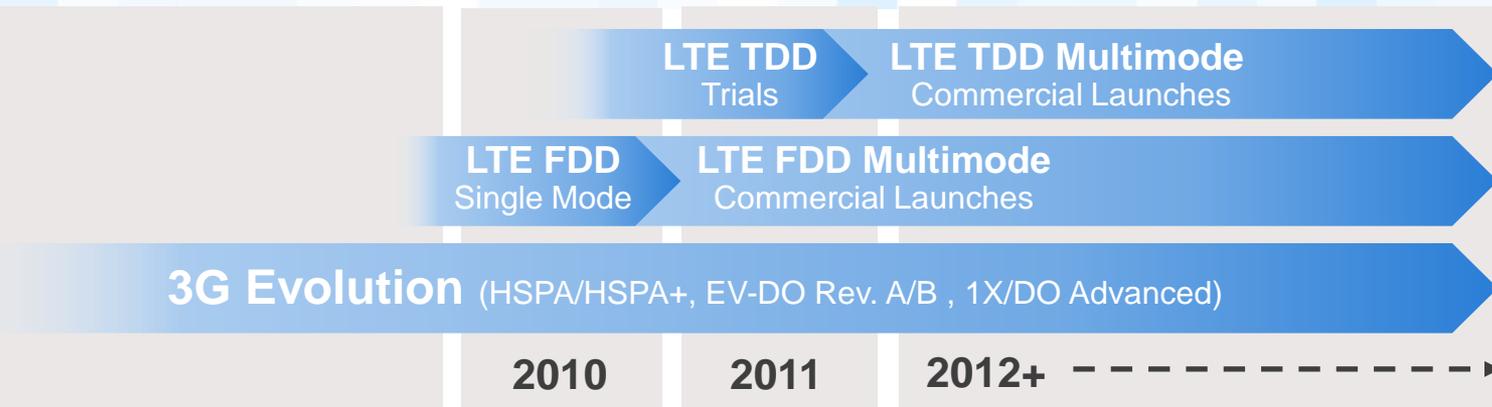
LTE TDD: The Global Solution for Unpaired Spectrum

- Eco-System Committed
- China and India Committed
- WiMAX to LTE TDD Migration¹
- Leverages LTE FDD
 - Shares most of FDD design and standard
 - Common core network

GLOBAL TDD SPECTRUM	Potential Spectrum
2.5/2.6 GHz (IMT Extension gap) B38 ³ : 2570 MHz to 2620 MHz	50 MHz
2.3 GHz B40 ⁴ : 2300 MHz to 2400 MHz	100 MHz

³IMT extension band provides 50 MHz TDD in addition to 70 MHz + 70 MHz FDD in most countries. ²B40 will e.g. be used for India and China, can provide up to 100 MHz, but less spectrum may be available in some markets.

LTE TDD launched in 3Q 2011¹



¹Examples: Mobily and STC in Saudi Arabia launched in September 2011. Also examples of the continued WiMAX to LTE TDD migration

LTE TDD Commitments Worldwide

Worldwide Commitments

- **Mobily and STC in Saudi Arabia launched in Sept 2011**
- Major efforts in India 2.3GHz BWA Spectrum:
 - RIL committed to LTE TDD and is expected to commercially launch in 2011.
 - Bharti Airtel is committed to LTE TDD.
 - Qualcomm and Ericsson demonstrated LTE TDD mobility in India November 30th 2010.
- China Mobile launched large-scale LTE TDD trials of more than 1,000 base stations, commercial service expected 2012.
- Japan Softbank Mobile is considering LTE TDD in 2.5 GHz.
- Clearwire USA requested 3GPP to standardize LTE TDD for the 2496 – 2690 MHz band and has released results of trials the company carried out on LTE TDD and FDD systems.
- Russian WiMAX™ operator Yota is shifting to LTE.
- Orange France deployed a trial LTE TDD/FDD network in Paris. Testing FDD-TDD co-existence.
- Sweden /Denmark Hutchison 3 has acquired 2.6 GHz spectrum and plans to deploy a combined LTE FDD/TDD network.
- Australia WiMAX operator Vivid Wireless trialed LTE TDD in 2010, Commercial network launch is expected by 2012.
- Malaysian WiMax operators planning to deploy LTE TDD.

Source: GSA, May 2011, LTE TDD launches per press releases

Eco-System Committed

- All major Infrastructure vendors support LTE TDD:
 - Examples are Alcatel-Lucent, Alvarion, Ericsson, Huawei, Motorola, Nokia Siemens Networks and ZTE.
 - Common LTE FDD and TDD Infrastructure products.
- Chipset vendors committed to LTE TDD chipsets in 2.3/2.5 GHz
 - Qualcomm, Altair, Sequans, Innofidei, Wavesat, Beceem, Runcom LG, Huawei, Samsung, ST-Ericsson.
(Source: GSA, Signals Research Group)

LTE Complements 3G to Boost Data Capacity



Common TDD/FDD platform

- LTE TDD is optimal technology to leverage unpaired spectrum
- Seamless 3G service continuity with multimode devices
- 3G provides ubiquitous data coverage and voice services
- 3G provides roaming in global FDD bands

LTE (*FDD or TDD*)

3G Coverage

Ensures ubiquitous data coverage, enables voice services and global roaming

LTE TDD Excellent for Hot-Spot Expansions

- Existing networks can leverage LTE TDD for targeted capacity expansions
 - TDD spectrum typical available at higher frequency bands optimal for capacity expansion¹
 - Excellent indoor complement for small nodes—does not interfere with FDD network
- New LTE TDD networks—plan for small nodes from day one
 - Mix of LTE TDD hot spots (picocells, femtocells) with LTE TDD macro coverage

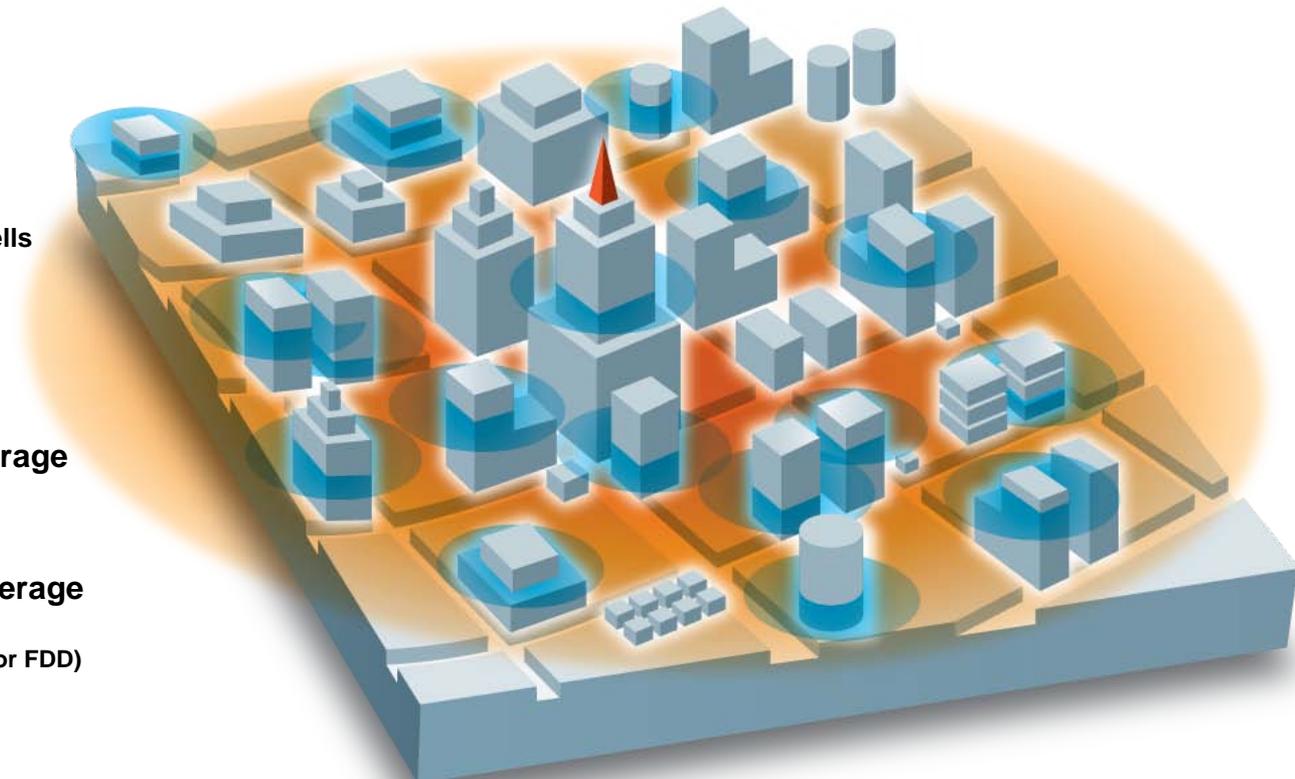
Capacity boost

LTE TDD Hot-spots
E.g. Micro, Pico and Femtocells
(2.3 GHz and 2.5/2.6 GHz)

Wide Area Coverage

3G FDD Wide Area Coverage
HSPA+ and EV-DO Rev. B
(e.g. 800/900 MHz and 2.1 GHz)

LTE FDD Wide Area Coverage
(Or LTE TDD)
(e.g. digital dividend spectrum for FDD)



¹Note: LTE TDD can provide sufficient coverage, especially for capacity driven macro networks, but provides reduced coverage compared to FDD

Standardized, Seamless 3G Interoperability Supported from Day One



- LTE FDD/TDD Standardized in 2009¹
- Optimized 3G Interoperability
 - Both with WCDMA/HSPA+ and CDMA2000 1X/EV-DO
- Seamless voice support—3G fallback
 - Circuit Switched FallBack (CSFB) to WCDMA, 1X or GSM to support voice and emergency services

- Leverages same core network as LTE FDD
 - Shares most of FDD design and standard
 - Inherent seamless interoperability with LTE FDD
 - UMTS core network components may be upgradeable to support EPC functionality
- LTE continues on 3G's strong track record of mobility, interoperability and high spectral efficiency

Common LTE
Core Network
(EPC)

Combined
FDD/TDD LTE
(and 3G)

LTE FDD

LTE TDD

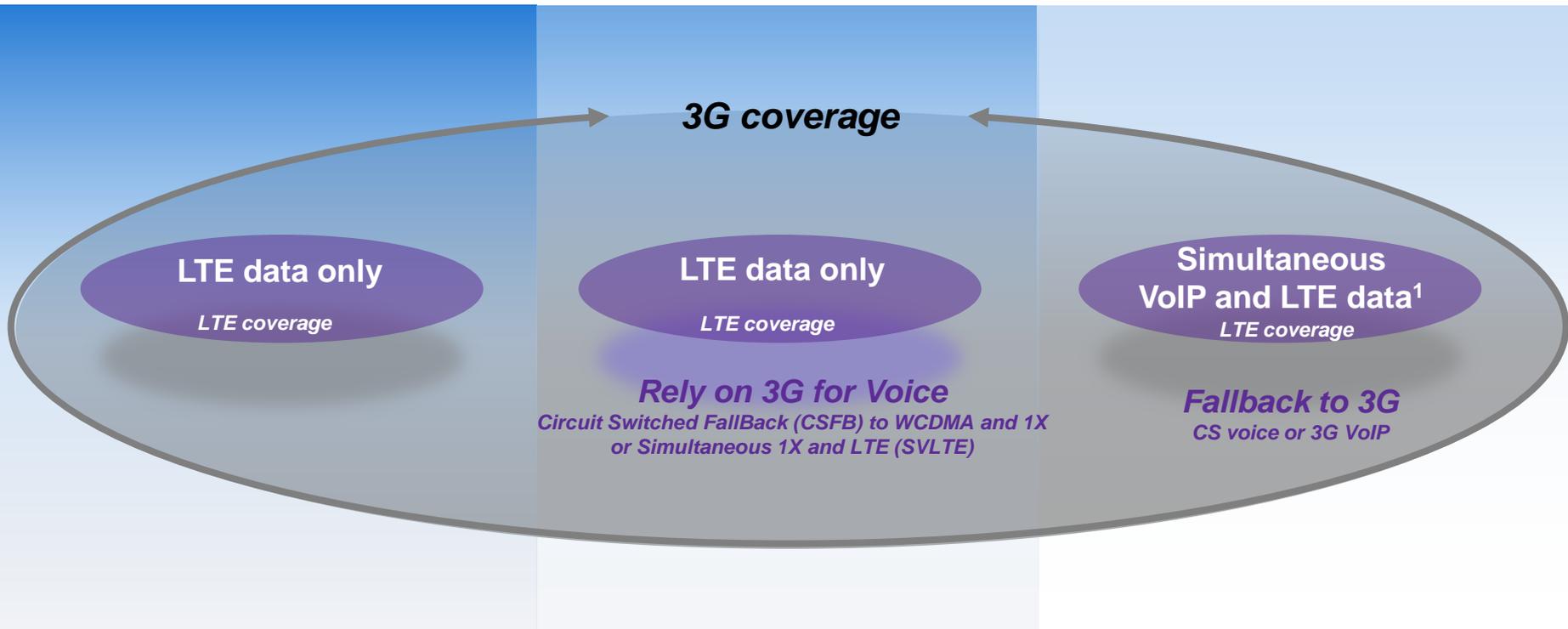
¹The LTE air interface 3GPP publication was 12/2007, but the core network (EPC) was published mid 2008. LTE R8 ASN.1 was frozen in March 2009 (A stable ASN.1 code is required for commercial implementation of the standard).

LTE Voice Through Fallback to 3G

Initial Launches
Data Cards

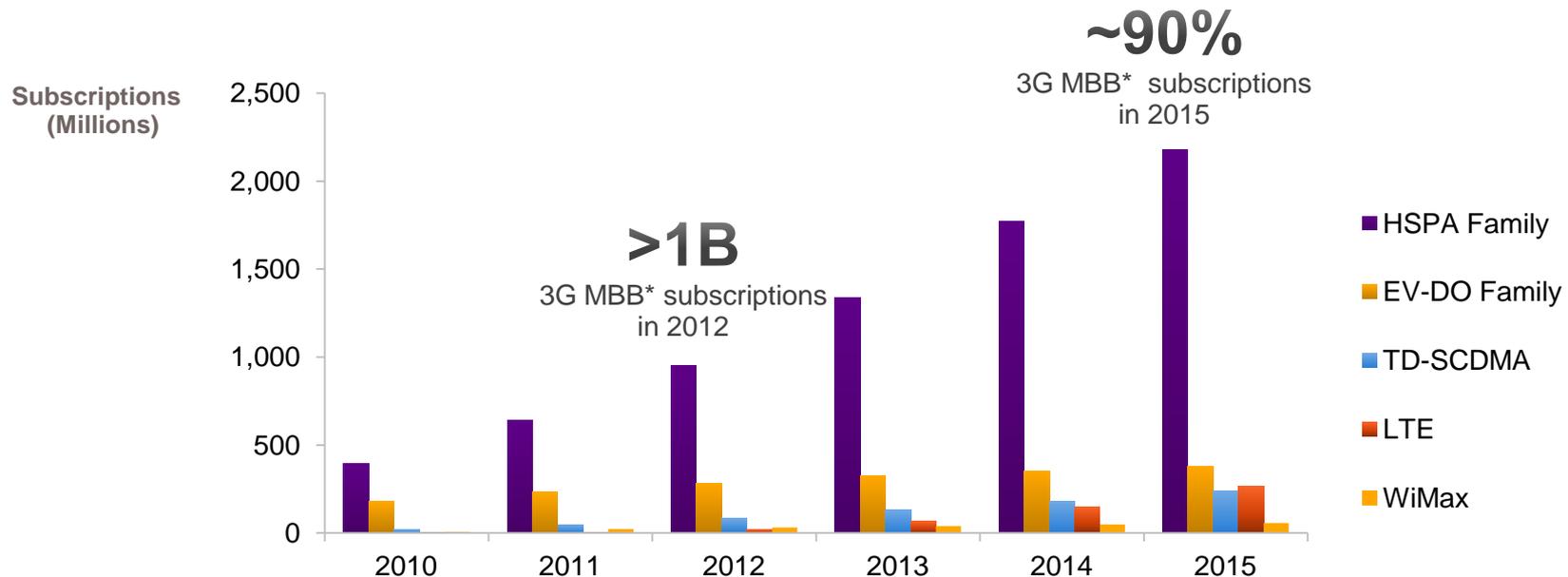
Initial Voice Solution
LTE Data Handsets

Long Term Voice Solution
LTE VoIP Handsets



LTE Leverages Huge 3G Ecosystem

- The 3G ecosystem is committed to LTE and multimode devices
- LTE leverages 3G's scale to provide similar access to devices
 - More than 3000 HSPA devices by ~250 vendors (Source: GSA as of April 2011)

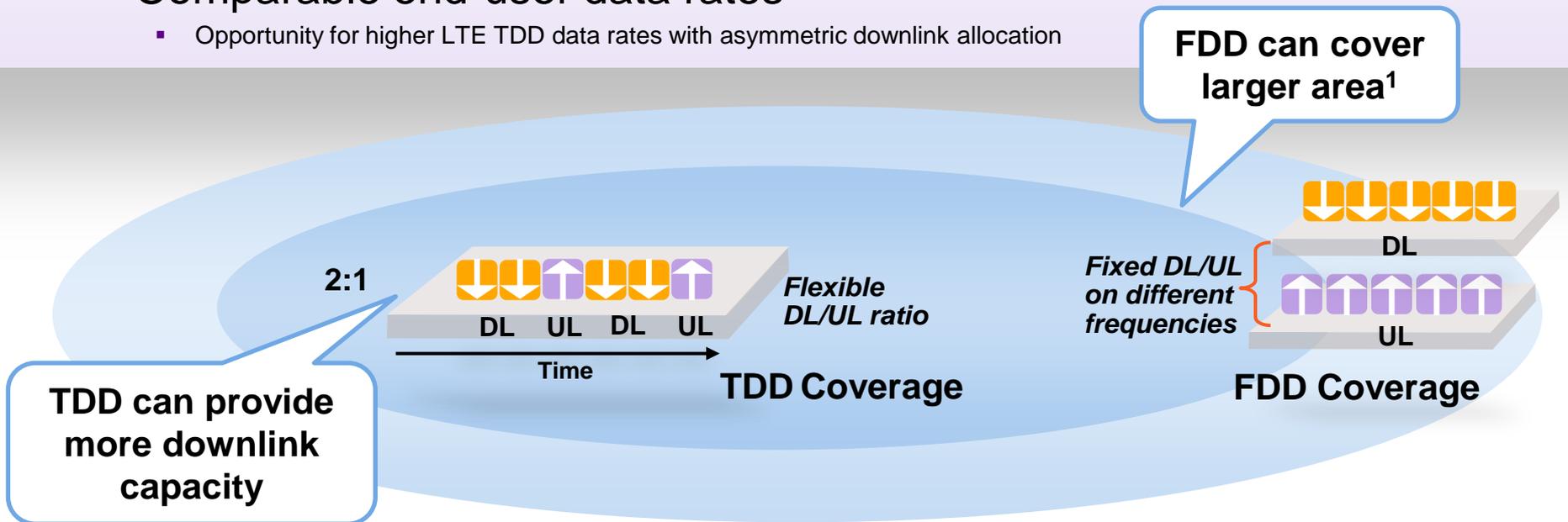


Note:* 3G MBB includes EV-DO family, HSPA family and TD-SCDMA,

Source: HSPA, EV-DO, TD-SCDMA and LTE subs – Wireless Intelligence (Jul11) and WiMax - ABI (May11)

TDD/FDD Tradeoff

- TDD can provide more downlink capacity
 - Flexibility to assign more downlink resources to meet actual asymmetric data usage
- FDD can provide better coverage
 - Only applicable to coverage driven deployments, capacity driven deployments in e.g. urban areas would not be coverage limited
- Comparable end-user data rates
 - Opportunity for higher LTE TDD data rates with asymmetric downlink allocation



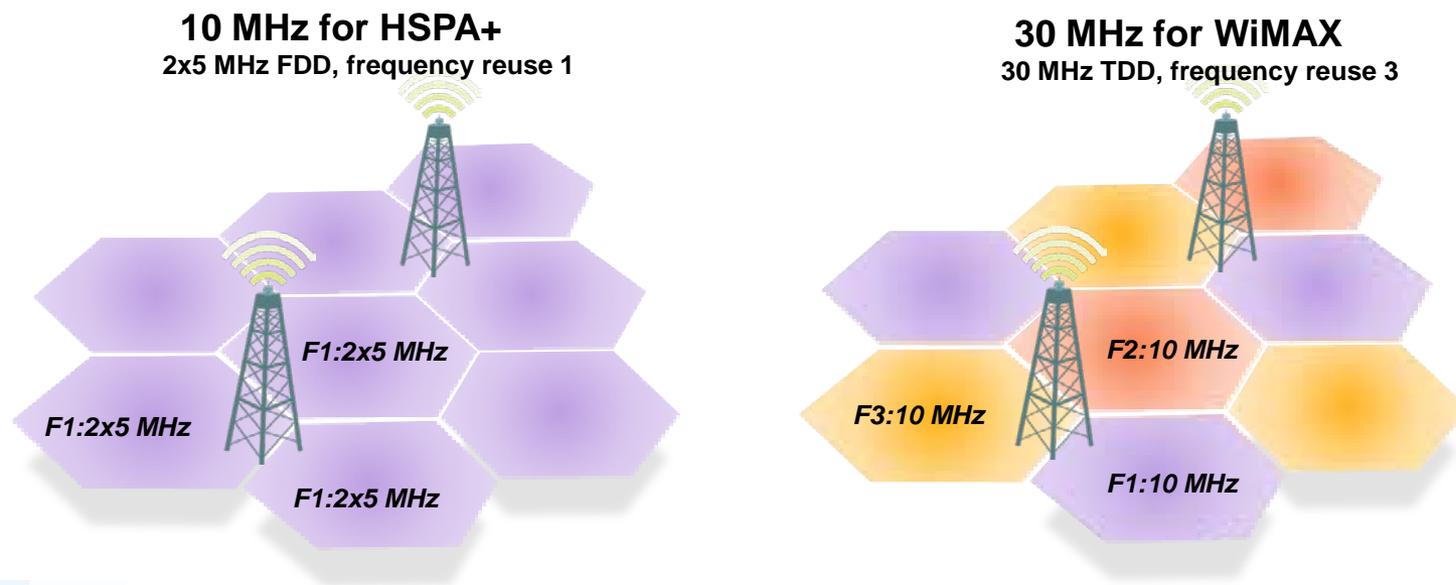
¹Assuming same transmit power . The main reason for reduced coverage is that the uplink device power is used part of the time for TDD but continuously for FDD . As an example, an 1:1 UL/DL allocation means a duty cycle of ~40% in the uplink which contributes to a ~3dB reduced link budget (note that the DL duty cycle can vary between 40 % to 60% depending how much of special field sub frames are used– not shown in graphics).

LTE TDD is Designed for Spectrally Efficient Frequency Reuse 1

Example: HSPA+ delivers comparable Performance to WiMAX in significantly less spectrum—WiMAX is using frequency reuse 3

Based on independent drive testing in well-established network over a multi-day period, Signals Research Group, LLC (SRG) found that¹:

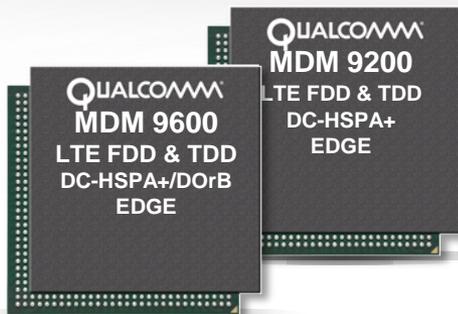
- HSPA+ (without MIMO) delivers higher than 5 Mbps data rates more than 50% of the time with bursts in excess of 17 Mbps.
- These results are comparable with separate testing done in a Mobile WiMAX network utilizing 30-60MHz of spectrum—3 to 6 times more spectrum



¹Source: See report "The Real-World User Experience in a Commercial HSPA+ Network" prepared by Signals Research Group, LLC, available at the GSMA website: <http://www.gsmamobilebroadband.com/upload/news/files/28062010140021.pdf>

Common LTE FDD & TDD Chipset Platform

Modems & Data Cards



- 50+ designs by 25+ OEMs
- Commercial 4Q 2010
- 100 Mbps DL/50 Mbps UL



Smartphones & Tablets



- Dual-Core CPU (28nm)
- Superior graphics & multimedia
- Integrated connectivity (WLAN, GPS, Bluetooth, FM)
- MSM8960 launches in 2012
- Handset & tablet launches in 2011 based on MDM9x00+MSM



Industry's First LTE/3G Multimode Chipsets

Summary: LTE TDD is The Global Solution for Unpaired Spectrum

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Complements 3G to Boost Data Capacity

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➤ Thank You

Achievable & Supported Peak Data Rates

LTE TDD Peak Data Rates (Mbps)

Accounts for overhead at different bandwidths

Bandwidth /Partition	DL (2x2 MIMO)		UL (1x2)	
	1:1	2:1	1:1	2:1
10 MHz	41	50	15	11
20 MHz	82	102	30	23

- Peak data rates scale with the bandwidth (and antenna configuration)

- Similar peak data rates for FDD & TDD

UE Supported Peak Data Rates (Mbps)

Based on UE categories defined in 3GPP standard

LTE UE Category	1	2	3	4	5
DL	10	50	100	150	300
UL	5	25	50	50	75

- Higher TDD downlink peak data rates with asymmetric allocation