Qualcomm, Inc.

# Strategies to win in LTE and evolve to LTE Advanced

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## Table of Contents

# 1 Executive summary

With the critical milestones of 100 Million connections[1] reached and more than 200 networks deployed[2], LTE is on a strong growth path. Then consider that large regions such as China and India are just getting started on LTE; it is even more evident that the technology has much more potential.

From the technology and standards perspective, being a common global standard resulting in a common ecosystem, LTE has had a unifying effect and is lining up the whole industry behind one common goal.

While LTE is still proliferating rapidly, industry leaders have already gotten a head start in LTE's next step—LTE Advanced. The first step of LTE Advanced—carrier aggregation—was launched in June 2013, powered by third-generation Qualcomm Gobi™ modems integrated into Qualcomm Snapdragon™ 800 chipsets. LTE Advanced is shaping up to be a pervasive technology with solutions that not only meet the ever-increasing data demand of traditional mobile broadband services, but also open up opportunities to transform new industries. Direct device-to-device proximity based services, addressing unconventional spectrum, are some such examples. This paper analyzes the success factors of LTE and the many dimensions that LTE Advanced is poised to explore.

Qualcomm, being an industry leader, is at the forefront of LTE evolution, not only envisioning the impossible, but also inventing, developing and commercializing technologies that bring our vision to fruition. Our quest to develop solutions to increase the data capacity of today's networks by 1000-times (what we call the "1000x mobile data challenge"), and being first to commercialize LTE/3G multimode and now LTE Advanced (carrier aggregation) are vivid and recent proof-points of such thought leadership.

# *2 The success factors of LTE*

The global success of LTE is the result of a well thought-out, methodical approach to a complex challenge. Although, most of the initial LTE deployments were in developed regions using paired spectrum (LTE FDD), the success factors and the valuable lessons are universal and can be applied to emerging regions such as China and others, as well as to unpaired spectrum deployments (LTE TDD). In this section we will explore some of the important success factors.

## 2.1 Providing ubiquitous, un-interrupted data and voice experience

As with any new technology and a new network, the initial LTE deployment focus is going to be in high-traffic areas such as urban centers, with suburban and rural areas coming later. But, mobile device users like to use their phones everywhere, and they expect the same and consistent experience all the time. To offer such seamless experiences, LTE/3G multimode devices that enable tighter interworking with 3G for data/voice and with 2G for voice are of paramount importance. Voice is gradually evolving to packet-switched VoLTE (Voice over LTE), but during the transition, LTE will still rely on 3G/2G voice through a feature called Circuit-Switched Fall Back (or through an option that requires dual-radios, one exclusively used for 3G/2G voice). With LTE brand fragmentation, 3G will also remain as the means for global roaming for LTE devices.

Qualcomm was the first in the world to introduce LTE/3G multimode modems back in 2010, and the first to implement CSFB and to test VoLTE with SRVCC (Single Radio Voice Call Continuity, required for handoff from VoLTE to 3G/2G).

### 2.2 Ability to address LTE band fragmentation and all smartphone tiers

As evident, global LTE deployments are spread across many bands, including paired and unpaired spectrum, in additional to many bands that 3G/2G technologies are deployed. All of this amounts to a situation where there may be a requirement to support 40 more bands. This indeed is a formidable hurdle for device makers hoping to leverage their devices across global LTE networks.

Envisioning this challenge early on, Qualcomm has been diligently working on the solution. In April 2013, we introduced a unique solution that we call Qualcomm RF360™, which realizes the dream of a single SKU LTE world phone. Qualcomm RF360 will enable vendors to bring their devices to the global market quickly and cost-effectively.

Undoubtedly, smartphones define the present and the foreseeable future of mobile broadband networks. It would not be an overstatement to say that having an extensive smartphone deployment plan is as important as the LTE deployment itself. The faster the operators and vendors can bring their smartphones, tablets and other mobile computing devices to more users, the closer they are to success. This, in turn, means the ability to offer a range of devices in all the product segments—extremely high-end, to high-volume tiers—while still providing an excellent user experience across the board is key. Qualcomm's Snapdragon family of chipsets with integrated Qualcomm's Gobi LTE/3G modems is designed to do exactly that—from Qualcomm Snapdragon 800 in the premium-tier to Qualcomm Snapdragon 400 in the high-volume tier.

### 2.3 Tight interworking between FDD and TDD

LTE is a common global standard with a common global ecosystem. It has two modes—FDD and TDD—addressing paired and unpaired spectrum bands respectively. The initial decision between the two is purely based on spectrum availability. However, in the future we believe that most of the operators will have both the networks to leverage all the spectrum resources they have.

A common LTE standard also means there is inherent FDD/TDD interworking support. Since there are already operators with both FDD and TDD networks, interworking is more of a requirement than an option. LTE FDD/TDD interworking is going to expand and become even tighter as carrier aggregation evolves.

Another important aspect is the ability to utilize the same devices for both FDD and TDD networks. Qualcomm's Gobi modems support both FDD and TDD on the same chip and fully support seamless interworking from the first generation itself.

## 3 *LTE Advanced is here!*

LTE Advanced is the next milestone in the evolution of LTE, starting from 3GPP Rel. 10, as shown in Fig. 3.1

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