Thank you for downloading this e-Book, one of a series Radisys has produced in association with The Mobile Network.

LTE TDD is a technology that is rapidly gaining awareness globally, as operators seek to meet increasing user demands whilst extracting full benefits from their spectrum assets.

Perhaps the most important question this eBook seeks to answer is, why now for TDD? Why is this asymmetric mode rising up as a priority, when it was so little deployed within 3G networks?

The answer, as the following article and infographic make clear, is that LTE TDD brings with it highly advantageous capabilities that meet operators’ current demands.

From high capacity downlink media streaming to broadcast services, from in-building small cells to backhaul, LTE TDD is a mode that enables operators to develop and support dynamic new use cases in a fashion that is interoperable with other 3GPP network standards and requires little additional infrastructure investment.

That is why we are now seeing increased market momentum and activity in the industry bodies to develop and deploy the technology. The growing ecosystem of chip, system, test and platform vendors is also testament to that.

Finally, Radisys is one well positioned to support those systems vendors and operators as they seek to develop LTE TDD network technology. Please do contact us for further information on this exciting market.

Hi!

Todd Mersch, Senior Director of Software & Services, Radisys

THE EVOLUTION OF LTE TDD

As a result, wireless operators globally are facing increasing demand for high speed mobile broadband services.

More and more users are going after bandwidth-consuming applications like YouTube and Netflix, leaving operators searching for technology to stay ahead of this ever-growing demand. Many operators are looking to LTE as the de facto global standard for mobile broadband technology due to its cost savings, high spectral efficiency, mobility and interoperability. Even with LTE, however, operators see a need to offload their data traffic in order to provide users with wireline-like speed and capabilities. According to a recent report by Qualcomm®, while LTE allows operators to use new, wider spectrum and complements existing 3G networks to handle even more mobile traffic, radio link improvement is fast approaching the theoretical limit and the spectrum available to operators is often limited and expensive.

In a race for providing a wireline-like experience to wireless users, operators are not leaving any stone unturned. Operators are already offloading data traffic via small cells and Wi-Fi, but have found that these solutions lack mobility. Wi-Fi is effective in improving user experience when a significant portion of users are located in the vicinity of hotspots – such as residential homes, airports and coffee shops – and the resulting data traffic can be offloaded to Wi-Fi applications, however it’s not mobile. A mix of macro cells and small cells, also referred to as a Heterogeneous Network (HetNet), as well as small cell value added services like Local IP Access (LIPA) can ease pressure, but these solutions are also constrained to a specific location and number of users.

Just when operators are at a point where they have exhausted all possible data offload approaches, Time Division Duplex (TDD) in the form of LTE shines through. TDD has the potential to be positioned as a complementary solution to Frequency Division Duplex (FDD) networks, bringing additional capacity to congested areas, opening up a new way of data offload and backhaul for small cell deployments.
WHAT IS TDD?

There are two modes of operation for LTE technology: FDD and TDD, which are technically very similar and part of the same radio access specification.

LTE FDD and TDD were both defined and introduced as part of the 3GPP in 2009 to make efficient use of paired and unpaired spectrum allocations over a common, core network architecture. The main differences are around the duplex method used. In both LTE FDD and LTE TDD, the transmitted signal is organised into subframes of one millisecond (ms) duration and 10 subframes constitute a radio frame. Each subframe normally consists of 14 orthogonal frequency division multiplexing (OFDM) symbols (12 OFDM symbols in an extended cyclic prefix). Although the frame structure is in most respects the same for LTE FDD and LTE TDD, there are some differences between the two - most notably the use of special subframes in TDD. The subframes in TDD are allocated either for uplink (UL) or downlink (DL) transmission. In the case of FDD operation, there are two carrier frequencies, one for UL transmission and one for DL transmission. During each frame, there are consequently 10 UL subframes and 10 DL subframes, and UL and DL transmission can occur simultaneously within a cell.

In TDD operation, there is only a single carrier frequency, and UL and DL transmissions in the cell are always separated in time. As the same carrier frequency is used for UL and DL transmission, both the base station and the mobile terminals must switch from transmission to reception and vice versa. Thus, as a subframe is either a UL subframe or DL subframe, the number of subframes per radio frame in each direction is less than 10.

FDD makes it relatively easy to dynamically change the capacity ratio between UL and DL to reallocate time slots, which makes it well suited for today’s DL-heavy traffic pattern.

In most instances, network operators will desire more DL capacity than UL since users are more frequently download content like video and web pages than upload content they’ve created. Beyond the regional deployments of TD-SCDMA, TDD wasn’t deployed widely in 3G networks, but it has great potential in LTE. The operator community was originally hesitant to adopt this new technology due to its similarity to WiMAX, but has since discovered that TDD and FDD technologies can co-exist nicely and support the growth of a new market with LTE TDD. Because they have common core network architecture, there is no additional CAPEX and the two technologies coexist seamlessly. The main difference is the need for a specific radio frequency (RF) unit. Another significant difference is in the physical layer definition: the higher layers and the rest of the network architecture remain applicable for the FDD. TDD is still leading the game, however. Most commercial LTE networks are based on FDD because the FDD ecosystem is more mature and is still where most of the spectrum allocation is done. All major operators around the world are already acquiring wide bands of FDD spectrum for their 4G LTE networks, which is well suited for voice because it is inherently symmetric in the UL and DL. In addition, FDD can provide better coverage of a larger area due to the fixed DL/UL on different frequencies.

However, some operators are able to exploit the TDD advantage by deploying the two technologies in tandem to offload traffic for very asymmetrical applications such as video or even newer areas like machine-to-machine (M2M) applications. For example, one operator has developed an innovative use case of LTE TDD being used as a backhaul for small cell deployments. As multimedia broadcast and multicast services (MBMS) pick up traction, it makes even more sense to effectively deliver this broadcast information in the DL using the unpaired TDD without impacting the user services delivered on FDD in parallel.

Existing FDD networks can leverage LTE TDD for targeted capacity expansions, ensuring a larger economy of scale by utilising common EPC network architecture wherever possible. TDD is excellent for hot-spot expansions (picocells and femtocells) and new LTE TDD networks plan for small nodes from day one.
of smart-antenna technologies such as beamforming. A mix of LTE TDD hot-spots with LTE FDD macrocells will boost capacity and expand coverage. Most vendors in network infrastructure equipment and device chipsets support both TDD and FDD in their commercial products, indicating that they see a strong market potential for both flavors.

THE CURRENT STATE OF TDD TECHNOLOGY ADOPTION

LTE TDD is expected to be widely adopted in 2015, reaching 89 million connections and representing roughly 25% of the total forecasted LTE connections for that year.

TDD spectrum is already allocated in numerous countries. Several UMTS mobile operators in Europe and Asia received small chunks of TDD spectrum in the 2.1GHz band. The spectrum was allocated at the same time as larger channels of UMTS FDD spectrum and in most cases the TDD spectrum went unused. However, most operators are opting to roll out TDD on 2.3 GHz and 2.6 GHz. These bands offer the largest contiguous blocks of spectrum enabling the best possible performance. While TDD is selling quickly, unpaired bands are still available in the handset chipset market in the US. It is likely to launch a multi-mode LTE FDD/LTE TDD chipset along with backward compatibility in 3G services. ZTE and many other companies are also working to ensure that devices will be available with FDD and TDD support at no extra cost.

This simplifies implementation and minimizes the additional OPEX/CAPEX costs to deploy LTE TDD. TDD is comparable to FDD in data throughput as well as latency measures, and handover (Ho) procedures can be enabled from FDD to TDD and vice versa. This is the new beginning of the hybrid LTE TDD/FDD deployment model.

TDD technology is pre-commercialisation and therefore requires all-IP OFDM-based. These similarities to WiMAX development is also a valuable asset when it comes to developing LTE TDD solutions because both technologies are all-IP OFDM-based. These similarities provide an easy path for WiMAX operators to transition to LTE.

TDD’s INTRODUCTION INTO DIFFERENT MARKETS AND REGIONS

TDD is already seeing momentum in Asia and Europe as many launches in these regions are including TDD in their network roll-out plans. UK Broadband has launched LTE services in London, Reading and Swindon, using Huawei’s LTE TDD solution. This is the first LTE TDD 3.5GHz deployment in the world and the first commercial LTE TDD deployment in the UK. Trading under the name now Broadband, UK Broadband also operates a wholesale model, working with partners to offer commercial services to businesses, consumers and the public sector.

In larger cities like Beijing, many people live in high-rise apartment buildings made of concrete, which creates both coverage and quality challenges for mobile operators, including LTE. To make TDD technology more reliable, and many have announced plans to deploy LTE TDD. For example, an option for WiMAX operators or greenfield operators with 2.3GHz or 2.5GHz spectrum, so there has been a trend for WiMAX operators to switch to LTE. The technical expertise gained from WiMAX development is also a valuable asset when it comes to developing LTE TDD solutions because both technologies are all-IP OFDM-based. These similarities provide an easy path for WiMAX operators to transition to LTE.

Due to its affordable spectrum it will become a respite in congested areas, adding capacity for the offload of asymmetric data like video and M2M applications.

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A Twin EBOK: The Evolution of LTE TDD

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REFERENCES


With plenty of data offload techniques, the introduction of the HetNet concept, the improvements in spectral efficiency and the innovative data plans now being proposed and dreamed of around the world is making a wireless-like experience to wireless users is becoming a reality.

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1. AN INTRODUCTION

LTE TDD:

asymmetric applications such as streaming and Unpaired spectrum's flexible uplink/downlink APAC, the Middle East, and Latin America. These are the main bands for LTE TDD There are many LTE TDD bands, but the largest The two modes deliver similar performance and with downlink and uplink transmissions with a single carrier frequency used The TDD mode uses unpaired spectrum, unpaired spectrum (Time Division Duplex – FDD mode) or operate in paired spectrum (Frequency The 3GPP LTE standard is designed to

TD LTE COMMERCIAL DEVELOPMENT TIMELINE

76Mbps network from Qualcomm, and Innofidei at Sequans, ST-E

Data cards of single mode

World Expo

Technology announced that the entire 190 MHz of spectrum in the 2.5/2.6 GHz band will be allocated for LTE TDD deployments in China, which harmonises its TDD spectrum with Japan and the US, two major LTE markets.

NOW AND IN THE FUTURE: LAUNCHES & TRIALS

i. Operator interest 50 operators in Global LTE TDD Initiative (GTI)

ii. Device and vendor ecosystem 166 LTE devices from a total 821 LTE devices %20 LTE device have support for LTE TDD mode. Major manufacturers support: LG Optimus LTE TDD mode launched in Saudi Arabia 2013. Most establishment report for Bands 38 and 40. Nine companies bid for China Mobile's LTE TDD tender, showing widespread support for the mode amongst base station and platform vendors.

iii. Increased support for spectrum harmonisation amongst operators and regulators. In October 2012, China's Ministry of Industry and Information Technology

DID YOU KNOW?

BUT IT'S NOT JUST CHINA...

i. By July 2013, there were 18 commercially launched LTE TDD networks. 54 operators have made LTE TDD commitments, 6 operators have launched combined FDD-LTE TDD networks. ii. ARCChart predicts "massive" launches in India, Brazil, Russia, Japan and USA, generating revenues of $91 billion by 2017.

3. MARKET MOMENTUM

LTD TDD INVESTMENTS WORLDWIDE

2008

16 commercial LTDD Systems and a further 38 LTDD Commercial networks in deployment or planned

2011

3.8 billion by 2017. USA, generating revenues of $91

2012

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MAXIMISE SPECTRUM UTILISATION with Radisys small cell solutions

With the deployment of small cells, the emergence of HetNet and improvements in spectral efficiency, the mobile broadband dream of providing a wireline-like experience to wireless users is becoming a reality.

Implementing LTE TDD can lead to a new way of capacity addition and optimised bandwidth allocation – increasing quality of experience and coverage and enabling operators to monetise mobile broadband.

Radisys is first to the market with LTE-TDD solutions, provides an accelerated TDD Roadmap and is actively supporting customers for TDD trials and deployments.

LTE TDD READY SMALL CELL SOLUTION