# REQUIREMENTS OF TDD/FDD SINGLE CHIPSET FOR LTE DEVICE

## A WHITE PAPER BY NGMN ALLIANCE

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**Abstract:**

**This document is produced by the Next Generation Mobile Network Task Force TD-LTE.**

**This document provides general technical analysis on LTE TDD/FDD single chipset and summarizes the vendor survey which aims to give requirements and reference to chipset vendors for TDD/FDD single chipset design and implementation.**

DOCUMENT HISTORY

| DATE | VERSION | AUTHOR | CHANGES |
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| 14/08/2009 | V 0.1 | XIAO SHANPENG, CHINA MOBILE | INITIAL DRAFT |
| 22/09/2009 | V 0.2 | SHAO CHUNJU, CHINA MOBILE | UPDATES ON BB ARCHITECTURE DETAILS |
| 22/01/2010 | V 0.3 | SHAO CHUNJU, CHINA MOBILE | UPDATES WITH THE SURVEY RESULTS FROM 9 CHIPSET VENDORS |
| 26/03/2010 | V 0.4 | LOU FEIFEI, CHINA MOBILE | ADAPT TO NGMN TEMPLATE |
| 11/05/2010 | V 0.5 | SHAO CHUNJU, CHINA MOBILE | ABBREVIATION ADDED AND CLARIFICATIONS ON SINGLE CHIP WITH OTHER RATS |
| 24/05/2010 | V 0.6 | SHAO CHUNJU, CHINA MOBILE | MINOR MODIFICATIONS BASED ON VENDORS' FEEDBACK |
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## ABBREVIATIONS

| | |
|---|---|
| ABB | Analog Baseband |
| ADC | Analog-to-Digital Converter |
| CPU | Central Processing Unit |
| DAC | Digital-to-Analog Converter |
| DBB | Digital Baseband |
| DSP | Digital Signal Processor |
| FDD | Frequency Division Duplexing |
| FEM | Front End Module |
| GCF | Global Certification Forum |
| ITDD | Initial Terminal Device Definition |
| LNA | Low Noise Amplifier |
| LTE | Long Term Evolution |
| MAC | Media Access Control |
| PA | Power Amplifier |
| PLL | Phase Locked Loop |
| PMIC | Power Management Integrated Circuit |
| RAT | Radio Acess Technology |
| RF | Radio Frequency |
| RFIC | Radio Frequency Integrated Circuit |
| TDD | Time Division Duplexing |

# 1 INTRODUCTION

ITDD D1 delivered requirements for Global Roaming Target Device as, “To satisfy the end user expectation of a global LTE experience, the FDD/TDD dual mode device is highly preferred in D1. Further more, a single baseband chipset that supports both FDD and TDD should be mandated, and a universal RF chipset that supports all global LTE bands should be required.”

Based on this, LTE FDD/TDD single Baseband chip and RF chip will be taken as a baseline requirement. Besides, the legacy modes and bands should also be supported for roaming purpose according to the requirements from different operators. In this document, we will only focus on the analysis for LTE FDD and TDD in one baseband and RF chip. Single baseband and RF chip with other RATs is out of the scope of this document.

Since baseband and RFIC are the core modules in terminal device, general technical and cost analysis will be given in the following sections to drive the vendors developing single chip baseband and RFIC.

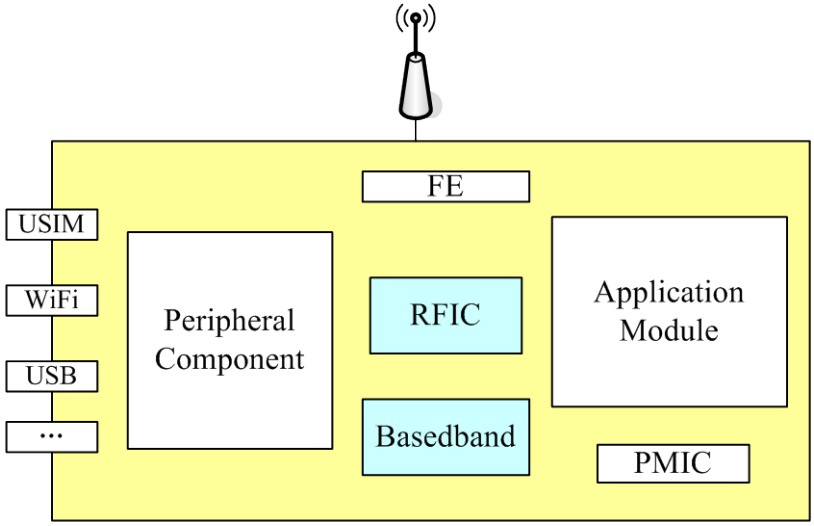


Figure 1 General architecture for device platform

# 2 SINGLE CHIPSET BASED BAND

Baseband is the core for communication protocols of the device platform. Generally, the main functionalities include digital baseband (DBB) processing and analog basedband (ABB) processing. For better understanding of the functionalility split for baseband chipset, we will take Figure 2 as an example for further descriptions.

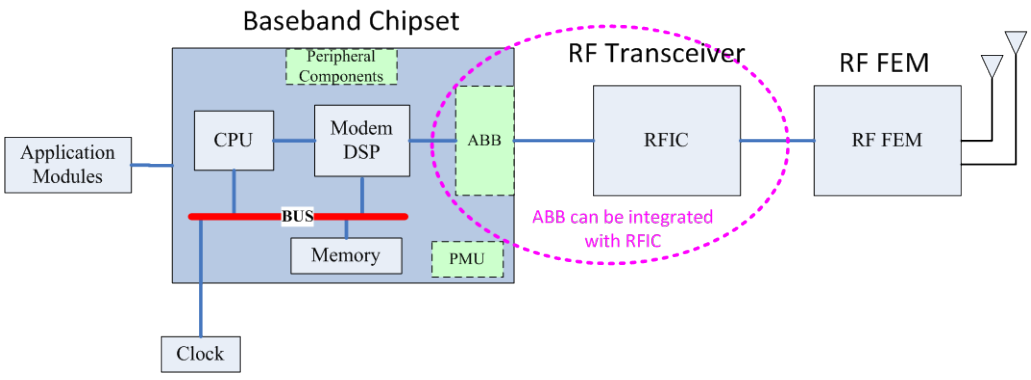

Figure 2 Functionality split inside the device platform (Example only)

The basic functionality for DBB is protocol stack handling, including MODEM and upper layer signaling processing. It usually consists of several modules: CPU, Modem, Memory and Peripheral interface.

Among those DBB components, Modem-DSP mainly deals with L1 functionalities, including Hardware accelerator(s) for Turbo coding, MIMO algorithms, FFT/IFFT; DSP software for channel estimation, synchronization and some configurations. CPU mainly deals with L2/L3 protocol stacks, including MAC/RLC/PDCP/RRC/NAS and peripheral components management. Memory is usually used for HARQ related processing.

ABB is sometimes integrated with RFIC. It is mainly used for DAC/ADC. If ABB is integrated with RFIC, digital interface between Baseband and RFIC is adopted.

According to the technical analysis in TD-LTE Task Force general document, the main difference between FDD and TDD lies on three aspects: TDD native features, TD-LTE specific functionalities and lower MAC.

Since the difference in core specs is mainly related with TDD specific frame structure, rather than key functionalities, the hardware and almost all of the design and implementation can be shared by FDD and TDD. For specific technical points, the differences can be covered by updating software.

Besides, the cost increment compared with single mode mainly comes from the early R&D expenditure. Benefiting from the global scale of single LTE chipset, the total cost increment for dual mode LTE chipset is quite restricted.

# 3 UNIVERSAL RFIC

The main functionality for RFIC is radio transceiver. Traditionally, the radio transceiver is composed of several RF components, including ADC/DAC (can be ABB sometimes), Mixer, PLL, PA, LNA, Filter, etc.

Usually, the challenges for RFIC design come from the wide bandwidth, high integrity, and mixed digital and analog design.

Based on ITDD D1 output, as a minimum requirement, the global roaming device shall cover LTE bands from Europe, USA, Japan and Korea.

Further more, GSM/GPRS/EDGE and UMTS bands shall also be considered in multi-mode devices.

Using up-to-date crafts, RFIC vendors are capable of manufacturing the integrated wide bandwidth RFIC covering most of the RATs and bands.

The price of the chipset is quite sensitive to the shipment volumes. The universal RFIC satisfying most of the mobile technology and bands could benefit a lot from the large scale global mobile market.

# 4 PRODUCT ROADMAP

From the survey we have done in December, 2009, most LTE device vendors have recognized and followed this “single chipset” product trend.

9 vendors, 6 from NGMN and 3 from outside, have returned feedbacks for the TDD/FDD single chipset questionnaire. All of them will provide TDD/FDD single chipset products (mostly between 2010Q2 and 2011Q2). 8 out of 9 have provided detailed bands and frequency information.

Besides, most vendors have also considered including other RAT into the same chipset, such as EDGE, WCDMA, TD-SCDMA. Several vendors have clear roadmap for that. More details of vendor survey results are in [1].

# 5 TEST AND CERTIFICATION OPTIMIZATION

For multi-mode and multi-band device, the testing and certification will be a time-consuming work. The mechanism to optimize the test and certification process is critical for the industrialization of this kind of devices, esp. for LTE FDD/TDD devices.

Since the main difference lies on the physical layer and lower MAC, there is much room to reduce the test cases for LTE FDD/TDD dual mode devices, especially for the NAS related test cases.

GCF and 3GPP RAN5 shall give more investigations on how to optimize the test and certification process for multi-mode and multi-band devices.

# 6 REFERENCES

[1] NGMN TF TD-LTE Survey results for WP3 - TDD-FDD terminal chipset, http://member.ngmn.org/Application/documentapp/downloadLatestRevision/default.aspx?docID=1039