

WWA (IMS/RFIC) Wednesday 08:00 – 17:00 BCEC Room 153AB
Integration Trends towards 4G
Full-day workshop reviewed by MTT-2, MTT-20, MTT-23

Organizer(s):

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4G will not facilitate the design of cell phones. Compared to today's 3G, future 4G multi-standard, multi-band cellular phones have to cover an increasing number of wireless standards. These standards include GSM, CDMA, WCDMA, 3GPP LTE/4G, WIMAX and even MIMO WIMAX AND MIMO LTE/4G at up to 25 frequency bands, and includes connectivity systems like WLAN and Bluetooth, and support navigation systems like GPS and Galileo. Pressure on integration clearly increases. This workshop will highlight all relevant topics in the transceiver value-chain of cell phones. The presentations cover the full range starting with the discussion of architecture issues and transceiver concepts. Reporting on the progress made with CMOS integration follows. Then, in the direction of the chain towards the antenna, flexibility issues are discussed. Finally, novel power amplifier concepts, RF front-end integration, and multi-band antennas are addressed.

Speakers:

1. Aarno Pärssinen, Nokia NRC, Helsinki, Finland

“RF System and Architecture Design Challenges in Multi-mode Mobile Devices in 4G Era”

The mobile communication industry has been able to produce some of the most complex radio devices ever. The multi-standard radio access can provide mobile internet services with the best available technology for the consumers. Recently, the rapidly increasing amount of data traffic including video transfers both in uplink and downlink is strongly paving the way towards 4G. The variety of existing protocols and the number of frequency bands combined with emerging standards and the overwhelming complexity in frequency band allocations is inevitably posing challenges to exploit transceiver architectures more efficiently in the device level. Hence, the major opportunities are not only in the increased integration level towards lower cost but also in the scalability of radio platforms for different markets and various demands of consumers. The presentation will address some of the key architectural tradeoffs in the 4G era.

2. Kyutae Lim and J. Laskar, Georgia Tech, Atlanta, USA

“All Digital Out-Phasing Transmitter (ADOPT) for Multi-band/Multi-standard Applications”

The most of current and future wireless communication systems are likely to adopt the modulation schemes that have high spectral efficiency. Since these modulation scheme, such as OFDM, has a high peak to average power ratio (PAPR), substantial back-off is generally needed to ensure adequate amplifier linearity at the transmitter. The out-phasing power amplification, also called linear amplification using nonlinear components (LINC), is considered as one solution which may offer high efficiency and good linearity. However, in spite of the efficiency enhancement, the out-phasing topology has not been widely used in

commercial amplifiers due to its strict matching requirements both in phase and amplitude of each path, and non-isolation distortion and efficiency degradation caused by the RF power combiner.

3. A. Hanke, Infineon Technologies, Neubiberg, Germany
“Evolution of Cellular Transceivers in nm CMOS Technologies towards 4G”

This Presentation should give an overview on challenges to build a Transceiver in nm CMOS for 4G applications. First a definition of the required ingredients is shown, followed by a general introduction to challenges in nm CMOS to come to an adequate RF performance. Special topics for 4G integration (focus on LTE) are rated, showing the critical design issues. Potential implementations for the Key blocks are presented, and issues are discussed. Last part is on other challenges, as all 4G phones will incorporate additionally different other standards, that must not interfere with the Cell system. Last part will show some info on upcoming digital interfaces for next generation wireless.

4. Bogdan Staszewski, TU Delft, The Netherlands
“Trends for Highly Integrated Multi-mode Transceiver Architectures in Nanoscale CMOS”

One of the recent most significant trends in RF wireless transceivers is the transition to deep-submicron and nanometer-scale CMOS technologies for the benefit of integration with the digital baseband part of the modem. This leads to obvious significant benefits such as reducing the cost and increasing reconfigurability of the overall solution. The freely available, low-cost, yet powerful digital logic and memory could be used to assist the analog/RF circuitry. The less obvious, but potentially much more significant, benefits arise when one realizes that the digital logic freely available in the modem could be used to simplify the lineup of external components. This is especially important in 4G wireless systems that need to support extensive network of discrete components for multi-mode and multiband operation.

5. Faraz Ali and R. Gloeckler, Ericsson/University of Erlangen-Nuremberg, Germany
“Trends in Multiband PA”

There has been considerable interest and efforts to minimize the number of additional components required for multiband power amplifier. Reducing number of components is vital to decrease complexity, size cost and power dissipation in the transmit chain in the context of an upcoming standard for 4G, notably Ericsson's LTE. Noticeable PA module strategies with multifrequency band coverage are: Unit selection Broadband Distributed Band reconfigurable Multiband matching BST varactors are important for their application in frequency agile/tunable multiband matching circuits. BST varactors models are utilized to investigate performance of PA with tunable matching network. System level investigations were performed to have an insight on gain, power, spectral emissions and linearity of a tunable PA. A demo Board is developed with tunable L match network along with a novel tunable 2nd harmonic short using BST Varactor.

6. Chafik Meliani and G. Boeck, University of Technology Berlin, Germany
“High Efficiency Broadband/Multiband PAs for Next Generation Transmitters”

The classical PA design approach of achieving high output power and high efficiency at the same time leads traditionally to switched mode PAs with frequency-selective reactive matching concepts. This is in line with several system demands where small fractions of bandwidth are required. However, in modern transmitter architectures, broad- or multiband operation under maintenance of high efficiency is required. By this way module complexity, component count and cost are reduced. Focusing on the frequency range between 1 and 10 GHz, we propose first approaches for GaN-HEMT based broad- and multiband switched mode PAs achieving high bandwidth and efficiency at the same time. The adaptive maintenance of the efficiency under back-off operation will be discussed, too.

7. Pasi Tikka, EPCOS, Munich, Germany
“Future RF Frontend towards 4G”

In this presentation concepts of multimode and -band frontend arrangements are discussed. Presentation consists of latest duplexer, filter and switch arrangements to offer multiband and -mode support. Support of OFDM based system (e.g. LTE) impact to design of duplexers and filters will be described including design examples from 2G to 3G and towards LTE. Status of adaptive antenna tuning to assist antenna design to cope with multiple bands will be discussed and practical results will be shared. Benefits of adaptive antenna tuner in multiband RF will be shared.

8. Dirk Manteuffel and I. Wolff, IMST GmbH, Kamp-Lintfort, Germany
”Design Challenges for the Integration of Antennas into 4G Mobile Handsets”

The 4th generation of mobile communications aims on combining multiple standards and applications seamlessly into a single mobile terminal. This shall be done based on a fully integrated IP-based system indicating that the mayor system aspects are treated on the software basis, e.g. SDR (Software Defined Radio). However, the approach also requires reconfigurable hardware which is challenging especially with respect to the antennas because of their fundamental relation to the wavelength. This paper will discuss new approaches to address the challenges involved in the integration of the antenna features into a mobile terminal. It aims on providing directions to the designers of 4G mobile terminals as well as formulating challenges yet to be solved for researchers in the field.