DRAGON

Newsletter
August 2011

Project number: **248277** Project web-site: **www.dragon-project.eu** Project start: **February 2010** Project duration: **02/2010 – 01/2013**

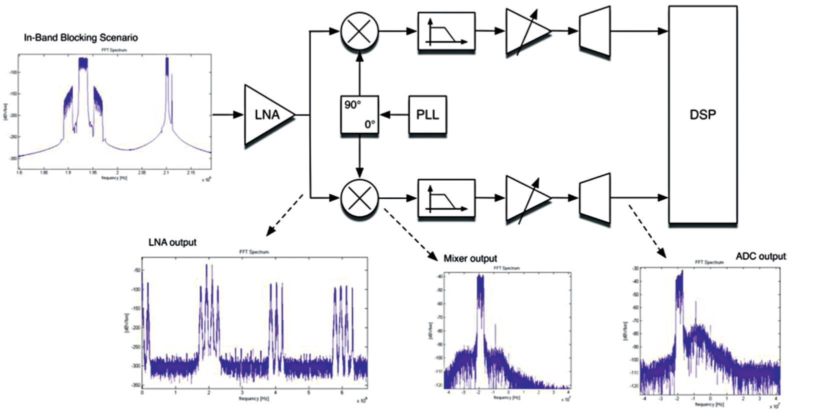


PHOTO: Ericsson AB

Figure 1: Parameters for each block

Design of a transceiver chain using the TBS Matlab framework

The main task of work package 1 in the DRAGON project is to provide the specifications of a transceiver designed for the newer mobile communication standards. The new services provided by smartphones lead to growing demands for faster information access, which implies a considerable increase in the bit-rate and the downlink/uplink bandwidths.

Parameter	Duplexer	LNA	Mixer	BB-Filter	VGA	ADC
TX gain (dB)	-50	-	-	-	-	-
RX gain (dB)	-2	**30**	2/π	0	**48**	
IIP2 (dBm)	-	15	50	70	85	
IIP3 (dBm)	-	-5	**40**	50	22	
NF (dB)	**4**	3,5	10	5	10	
RF to LO port isolation (dB)	-	-	75	-	-	-
BB-Filter order	-	-	-	3	-	-
BB-Filter type	-	-	-	Chebyshev	-	-
BB-Filter bw (MFz)				20		
ADC type	-	-	-	-	-	Nyquist
N bit ADC	-	-	-	-	-	8

Table 1: Receiver chain and signal spectrum referred to an in-band blocking test case

For instance, the latest standards, like LTE, provide a peak download rate greater than 300Mbit/s by using complex modulation techniques and a high reconfigurability of the network, which also facilitates the handling of a large number of users. The objective of the DRAGON project is to ensure the fulfillment of the performance required by the standard while containing the power consumption and the complexity of the system by exploiting all the advantages of new digital CMOS technologies. In fact, the low power supply and the high threshold voltage of such technologies do not allow sophisticated analog functions and the trend is to move the complexity of the system into the digital domain exploiting its property of reconfigurability and technology independence realizing a more software defined radio.

However, the analog chain of the transceiver remains one of the most critical parts of the system. The output SNR depends on the performance of the analog blocks, in particular in terms of noise, linearity, gain and filtering. For this reason, Ericsson (work package 1 leader) has developed a flexible framework for Matlab, named TBS (Test Bench Simulator), which enables a simulation of the entire transceiver chain easier and faster than any other regular CAD software. Using the tools provided by the framework it is possible to realize all the input scenarios defined by the standard, to set the parameters of all analog blocks of the chain and to verify the result of the test to provide a comparison of the simulated output SNR to the required one. Moreover it is possible to show the spectrum of the signal at the output of each block, studying the analog signal processing before the ADC. This flexibility allows us to study the best control algorithms that increase the SNR while minimizing the power consumption. Also, when working iteratively in a team with circuit designers, it is very simple to verify the constraints and find the best compromises.

The starting point is the release 8 of the 3GPP standard. By using input scenarios according to the ETSI document, Ericsson is able to provide, for each test, sets of parameters of every block of the transceiver which satisfy the needed SNR, necessary to obtain the required throughput. For instance, Figure 1 shows the receiver chain and the signal spectrum referred to an in-band blocking test case, while Table 1 reports the set of parameters for each block. The test is passed with a margin of 1.5 dB.

Article Source: Fredrik Tillman, Ericsson AB

Tanja Scheliessnig, editor

Editorial

PHOTO: Technikon

Dear reader,

The DRAGON project finds itself in the middle of its second project year and it's time to reflect on the first valuable results of the project.
Our newsletter is intended to offer information on the interesting activities of the project, as well as to present new technologies created during the project.
In this first issue, the design of a transceiver chain using Matlab as well as the concept of multi-level burst-mode transmitters will be presented.
We hope the content of this issue is of interest to you. Any feedback is warmly welcome.

About DRAGON

DRAGON – Design Methods for Radio Architectures GOing Nanoscale- is a specific targeted research project, co-financed by the European Commission under the EU Seventh Framework Programme. The project is running for 36 months from February 2010 to January 2013.

DRAGON aims at developing a design platform comprising multi-standard transceiver specifications and novel flexible architectures in order to break the barriers imposed by the lack of scaling properties of analog components.

UPCOMING EVENTS

ESSCIRC - 37th Solid-State Circuits Conference
September 12-16, 2011,
Helsinki, Finland
www.esscirc2011.org

EuMW 2011 - European Microwave Week
October 9-14, 2011,
Manchester, UK
www.eumweek.com

Forget Smart Apps! Use Smart Hardware!

The DRAGON project addresses disruptive design methodologies to significantly advance today's transceiver architectures for mobile phones in terms of size, energy, and costs. In order to make a major progress in the achievable transceiver efficiency, meaning a reduction of dissipated power, the DRAGON project pursues a holistic design approach employing entirely new architectures, such as multi-level burst-mode transmitters, but on top of that also tries to include application and user dependent characteristics to optimize the hardware design.

In the work package "Low Power Concept & Architecture" a major objective is the efficiency optimization of transmitters in mobile phones. In the optimization process, the radio frequency power amplifier is targeted first, as it is responsible for most power losses; something you may have experienced by getting hot ears when you had longer calls. In the Dragon project we investigate the new concept of multi-level burst-mode transmitters, which outperform conventional power amplifiers in terms of efficiency. Based on user behavior, Graz University of Technology and the Telecommunications Research Center Austria have developed together with Infineon Technologies an optimization procedure that can be used to further increase the efficiency of multi-level burst-mode power amplifiers [1]. To this end, the transmitted power over time for each call of all users within a network is statistically evaluated, which results in a so-called power profile of the network. With methods from statistics and signal processing, this power profile can be exploited in order to tailor the hardware design of the power amplifiers to the user behavior. As a result, the power consumption in the network and therefore the average power consumption for each phone can be significantly decreased. Your phone stays cool even after long calls and the battery lasts longer. In Figure 1 an example of a power profile is shown in green. In the same figure you can also see the efficiency curve for a single-level burst-mode transmitter (dashed orange line) compared to the curve for the multi-level burst-mode transmitter (solid orange line) after optimization with the developed framework. The average efficiency of the single-level burst-mode transmitter is already at 40% outperforming many state-of-the art designs, but by using the multi-level approach and the optimization procedure we can boost the achievable average efficiency to more than 70%. For mobile cellular users, the improvement in the efficiency will increase the battery usage time for talking, using apps, and surfing the net.

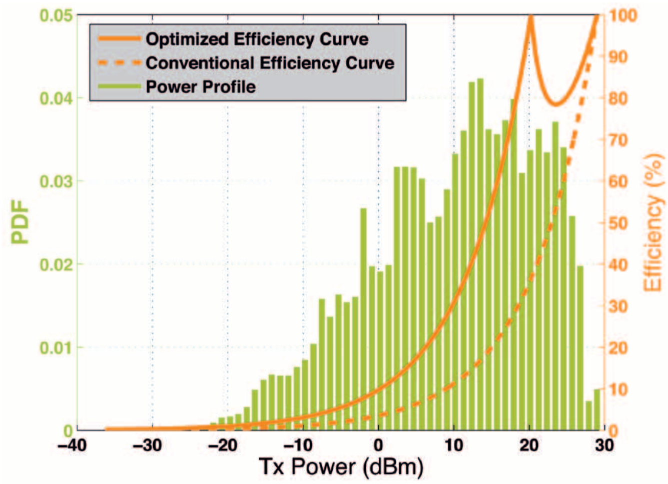
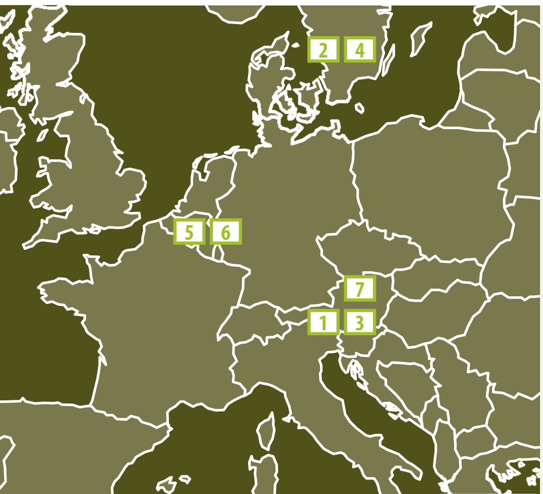


PHOTO: FTW

Figure 2: UE transmit power distribution (light-green line) and the efficiency curves for a single-level burst-mode transmitter (dashed orange line) and the optimized multi-level burst-mode transmitter (solid orange line).

[1] Shuli Chi, Peter Singerl, Christian Vogel, "Coding Efficiency Optimization for Multilevel PWM Based Switched-Mode RF Transmitters," Proceedings of the 54th Midwest Symposium on Circuits and Systems (MWSCAS 2011), Seoul (Korea), 7-10 August 2011

Article Source: Christian Vogel, Telecommunications Research Center Vienna (FTW)



Consortium:

1. **Technikon Forschungs- und Planungsgesellschaft mbH (Austria)**
2. **Ericsson AB (Sweden)**
3. **Infineon Technologies Austria AG (Austria)**
4. **Lund University (Sweden)**
5. **Katholieke Universiteit Leuven (Belgium)**
6. **imec (Belgium)**
7. **Graz University of Technology (Austria)**

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