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Preface

Despite the fact that a range of limitations are beginning to appear as CMOS technology is being raised to ever higher levels of perfection, it is anticipated that silicon will be the dominant material of the semiconductor industry for at least the first half of the 21st century. The forecast for microelectronics development updated in 2008 by SIA (Semiconductor Industry Association) reaches ahead to the years 2016–2022. Unfortunately, a comparison with former SIA forecasts indicates that in certain aspects they become less aggressive (that is less optimistic) with time.

While the development of silicon microelectronics in the past could be attributed mostly to the reduction of the feature size (progress in lithography), today it relies more on new material (SOI, SON, SiGe or SiC) and architecture (ultra-thin body, double-gate, multiple-gate) solutions. The combination of this trend with continuous miniaturization provides the opportunity of improving IC functionality and speed of operation.

Telecommunications and information technology are arguably the most powerful drivers behind microelectronics product development nowadays. Plenty of new applications are being for fast analog and RF circuits, as well as for information processing ones. It is clear that with the anticipated peak $f_{\max} = 425$ GHz and $f_T = 395$ GHz to be reached by RF SiGe-base bipolar transistors in 2014, according to the 2008 update of ITRS, a lot of effort must be put into the development of appropriate material, processing, characterization and modeling. While progress in the bipolar technology is impressive, the increase of MOSFET speed is even more so. The same issue of ITRS predicts on-chip clock of ~ 14 GHz for 2022.

High-speed isn't, however, everything. Portable wireless products push, for obvious reasons, for low-power solutions. This trend requires new architectural solutions (e.g., channel thinning), and in consequence, new material, such as SOI (or its possible successor SON – silicon-on-nothing), where current driveability is considerably higher than in conventional MOSFETs.

In this issue the Reader will find papers devoted to RF operation of SOI technology, device concepts, numerical analysis of device and circuit parameter variation, fabrication, process simulation, sensors and characterization.

The ongoing increase of operating frequencies applies to satellite communication systems, too, where millimeter band use is expected soon. This raises the issue of adverse propagation phenomena, in particular weather-dependent atmospheric attenuation. As this attenuation rises with frequency, it must be mitigated with proper satellite and antenna design.

Effective use of limited pool of radio frequencies requires proper spectrum management; relevant activities are largely carried out within ITU. The existing spectrum management arrangements are criticized as inefficient in many respects, and several proposals for improvements are presented, taking into account recent advances in technology.

Broadband wireless systems like WiMAX face the problem of limited radio spectrum in a particularly acute way. Spectrum efficiency and system capacity can be improved by dynamic resource management in so called flexible radios, allowing optimized use of limited channel capacities and computing resources. Flexible radio architecture must also deal with interactive use of spectrum by multiple applications, while meeting stringent quality of service (QoS) requirements. The key solution is a software defined radio with embedded intelligence, able to sense the current environment defined as spectrum occupancy, interference, etc., and adapt to it, to ensure the best performance possible with variable spectrum constraints. A cognitive radio with human-like intelligence is required, working in environment whose parameters are not known a priori and can rapidly change. The mathematical foundations for such devices include Bayesian probability theory, maximum entropy principle, etc., to optimize signal sensing and use of multiple antennae.

Advanced as it is, current RF technology fails to deliver coherent, high power CW terahertz radiation, however. As the need to utilize THz frequencies in communications, medicine, security, inspection, etc., grows, the intersubband-based quantum cascade laser may become the source of choice. Before such devices become practical, they must be engineered to work without cryogenic cooling required today.

The quality of multimedia service as perceived by the user of a next generation network (NGN) can be greatly affected by the performance of signaling system during connection setup phase, in particular by delays incurred when heterogenous multi-domain network provides the service. The impact of signaling system performance on user quality of experience (QoE) has been analyzed, with focus on the signaling system and procedures defined within the EuQoS project.

The next paper in this issue deals with the recommendations and regulations regarding the pan-European eCall programme. This is a road safety improvement effort aimed to reduce the current number of road fatalities of over 40,000 a year, providing a standardized in-vehicle emergency call service, with automated feed of accident location and other information to relevant public safety answering point (PSAP). Besides right technology, effective solution needs a harmonized pan-European regulatory framework.

Secure identification of user is of critical importance to many services, as ID theft and other security treats increase. Digital signatures are often user ID-based: user's e-mail, phone number, etc., serves as a public key. Unfortunately, the analysis presented shows such architectures can provide only medium level of security, albeit some improvements are possible.

We hope the Readers will find this issue of the *Journal of Telecommunications and Information Technology* useful and interesting.

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