# Analysis of the perspectives of multiscale simulation of devices and circuits

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Within the Mult.Eu.Sim project we have addressed the community working on device and circuit simulation in order to develop a document containing assessment of the current state of the art in the field of multiscale modeling and a vision of what will be important to pursue in the near future to match the needs of industrial and academic researchers working on the final downscaling of CMOS technology or on the application of emerging device concepts.

The initial core of the document has been written by the participants at a meeting held last spring in Bilbao, the resulting text has then been sent to a large number of researchers operating in the field worldwide. The feedback has been overwhelming, with messages of approval, suggestions for correction and improvement of the contents, submission of new sections covering aspects of multimode modeling that had not been initially included. In this way, the resulting document is backed by a large group of researchers, who are representative of mainly the device community and, in part, also of the circuit community.

The main conclusions are that multiscale modeling will have to provide tools with good predictive capabilities, but relatively straightforward to use also by nonspecialists. To become really attractive for the industry, simulation codes will have to provide insight into deviations of device behavior from what can be predicted by simple intuition.

There are several hints that traditional multiscale approaches, such as those based on the extraction of a compact model from a physics-based device simulation and inclusion of the compact model, defining the relationship among the electrical quantities at the terminals, into a SPICE-like circuit simulator, will not be directly suitable to the description of several types of architectures based on emerging devices. Therefore new hierarchies will have to be defined and validated.

Furthermore, it will be important that future multiscale tools will be able to run on computation facilities available to most interested parties. It is not the time any longer when the computational power of a supercomputer was found five or six years later in a desktop computer. One should in case aim at exploiting low-cost solutions to supercomputation, as in the case of GPU-based systems.

Overall, a close and continuous collaboration with experimental groups will be needed, in order to calibrate and validate the simulation tools all the way through their development.

The expertise currently available in Europe on specific issues very relevant to multiscale modeling, such as ab-initio approaches and integration of electrical and thermal simulation, should be leveraged upon and a critical mass should be reached for a coordinated effort to establish excellence in the development of multiscale TCAD tools for advanced devices.