2A) Challenges for future system architectures (power, variability)

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Due to the requirements of modern multi-media and communication applications (merging of communication, computing and consumer electronics) and the widening gap between platform/processor requirements and the available process technology characteristics, many important challenges have appeared. Several of these are directly associated with the way system and platform architecture will have to be modified in the next decade in order to deal with power and variability aspects. This involves also an effective timing and power closure approach to meet real-time and energy constraints.

Issues that are of the most direct concern include bandwidth to memories and the related power consumption, the effective parallelisation of the processor cores, and dealing with increased programmability/flexibility while retaining an acceptable energy budget for the task at hand.
For the off-the-shelf memories the shift has been to larger band-widths and data density at a reasonable cost. For embedded memories, the emphasis has been especially on access speed at a reasonable area and especially power cost while remaining functional under high process variability.
This is however not sufficient, so in the future we will see a much more distributed and partitioned memory organisation inducing a much tighter cooperation between system architecture, circuit and technology solutions to address the challenges.
For the processor parallelisation the traditional way has been to provide quite homogeneous array or matrix of cores. But this leads to ineffective programming paradigms which are very difficult to address. Options to get out of these dilemmas will be explored, with their impact on design and technology.
Finally, the move towards more flexible architectures induces a strong requirement on more effective energy-performance tradeoffs in future programmable platforms. Due to the strong impact of deep-submicron technology, variability (including the time-dependent aspects) and an effective balancing of power dissipation sources have a direct effect on the design paradigms.

In this tutorial overview, an attempt will be made to provide a holistic picture of the main trends in this exciting area and of why these are happening now. No details of circuits or specific systems alternatives will be given though.