Book excerpt: Power Integrity Analysis and Management for Integrated Circuits

Raj Nair, Donald Bennett - April 12, 2012

From the Preface:
This book is our earnest and first effort at demystifying power integrity, its detailed analysis, and its management for integrated circuits in the nanometer scale era.

The focus of the book is squarely on integrated circuits and power integrity as it pertains to such components. It is intended both for the student engineer gaining an introduction to the field of integrated circuit design, and for those skilled in the art, developing systems based on integrated components. Hence, every attempt has been made to emphasize basic concepts, principles, and intuitive understanding, while also discussing state-of-the-art and advanced concepts and technologies. This book differs from prior, related efforts at least in that it emphasizes comprehensive, true-physical modeling of integrated circuits and systems behavior. Beginning with an intuitive understanding of power integrity in a fundamental, physical sense, through analogies with mechanical systems and their underlying laws, we explore root causes for a rise to predominance of power integrity as a performance differentiator for integrated circuits.

A simple example is helpful in establishing the importance of power integrity to integrated circuits and systems. Today, as integrated systems become increasingly powerful and portable, system and device power and energy consumption is a critical design constraint. But less noticed is power integrity, despite its principal role in determining power consumption. Most of us notice that if we dim the lights in our entertainment rooms too much, sharp changes in brightness of our television screens hurt our eyes. Our attempt to reduce lighting energy consumption therefore depends directly on the level of light noise we encounter. The very same is true for integrated circuits: minimization of power and energy consumption through supply voltage reduction, a fundamental approach, depends directly on knowing the level of power supply noise, or, in other words, power integrity.
Chapter listing:
Chapter 1: Power, Delivering Power, and Power Integrity
Chapter 2: Ultra-Large-Scale Integration and Power Challenges
Chapter 3: IC Power Integrity and Optimal Power Delivery
Chapter 4: Early Power Integrity Analysis and Abstraction
Chapter 5: Power Integrity Analysis and EMI/EMC
Chapter 6: Power Distribution Modeling and Integrity Analysis
Chapter 7: Effective Current Density and Continuum Models
Chapter 8: Power Integrity-Aware Chip Floorplanning and Design - Being featured
Chapter 9: Power Integrity Management in Integrated Circuits and Systems

The book can be purchased here

Chapter 8: Power Integrity-Aware Chip Floorplanning and Design
Shane Stelmach and Snehamay Sinha

The modern chip designer is required to make many complex and mutually dependent trade-offs. Power integrity (PI) is among these. Generally, one must find the most economical way to meet certain functionality and performance requirements: The design’s PI must be adequate to meet these goals. The responsibility for this is shared between various designers, including the chip architect, the logic designer, the physical layout designer, and the package designer, as well as the system team for the greater product. The integrated circuit (IC) design team focuses on areas impacting PI such as average and peak power management as well as chip floorplanning considerations. These include robust power distribution architectures, the arrangement of active power-consuming circuits, and the interspersing of passive components such as power supply decoupling capacitors.

In this segment
8.1 Design for Power Integrity: Nanometer Era Considerations
8.2 Design for Power Integrity: Techniques

Coming next

8.3 Power Management and Power Integrity
References

The book can be purchased here

Raj Nair holds more than forty patents in VLSI Design and general electronics. He has investigated power management and power integrity at system, circuit, and device levels. At Intel, he developed integrated CMOS voltage regulation techniques for managing power integrity in nanoscale microprocessors. At ComLSI, Inc. and Anasim Corp., startups he founded, he developed advanced power integrity techniques and tools.

Dr. Donald Bennett, cofounder of Anasim, invented the patent-pending Effective Current Density (ECD) method for high-level abstraction and physics-based power integrity simulation. He previously founded QuantumDA, Inc.
This posting is part of the EDA Designline power series and is archived and updated. The root is accessible [here](#). Please send me any updates, additions, references, white papers or other materials that should be associated with this posting. Thank you for making this a success - Brian Bailey.