Preface

There is a lot of buzz in the industry about More-than-Moore technology directions, and especially the 2.5D and 3D System in Package (SiP) integration options. In principle, More-than-Moore integration, and 2.5D and 3D SiP implementation, is an opportunity that can be leveraged to extend system level miniaturization without More-Moore type of scaling, and to bring incremental cost-power-performance value. At a superficial level, it would appear that the SiP concept of integrating multiple die in a package—either by putting them side by side (2.5D integration) or on top of each other (3D integration)—is pretty straightforward, and not all that novel. This would seem especially so now that the key enabling foundational technology modules, such as the Through Si Vias and the uBumps, have been proven out, and are in volume manufacturing. After all, there are several announced SiP products that leverage the 2.5D and 3D integration technologies, and more are rumored to be coming. So, what is the big deal?

However, in practice, implementation of competitive 2.5D and 3D SiPs for mainstream products—especially for cost conscious consumer market—is challenging. The entire IC product design and sourcing ecosystem, and the standard industry practices and methodologies, have all been optimized over the last few decades for sourcing 2D SoC type of products, and are therefore challenged by some of the requirements for, and uniqueness of, 2.5D and 3D SiPs. Thus, adoption of 2.5D and 3D technologies is disruptive to the standard industry paradigms.

The intent of this book is to explore the tradeoffs that need to be considered in order to make 2.5D and/or 3D integration technologies attractive for use in high volume IC components targeting consumer products, competing in, for example, the mobile market. The new degrees of freedom offered, as well as the new constraints imposed by these integration technologies are in fact quite insidious. The tradeoffs required to optimize a 2.5D or 3D SiP products and make them competitive versus traditional 2D SoC IC are complex, mutually interdependent, involve architecture, design, Si and package technologies, have consequences in multiple physical domains, and impact both the technical and business considerations. It IS complicated!
This book therefore reviews the various popular technology options for both 2.5D and 3D integration, with focus on the candidates that are productizable within a 3- to 5-year implementation horizon. Basic manufacturing process flows, and the associated supply chain, required to realize a competitive SiP product are summarized. 2.5D SiP integration options based on Si, Organic Substrate, or Glass Interposers, or on Fan Out Wafer Level Package technology, are all reviewed. 3D SiP integration based on Through Si Via chip stacking, including the various technology and stacking options are presented. The value propositions of 2.5D and/or 3D integration are outlined, with a focus on monetization opportunities in high volume consumer marketspace. The potential system-level benefits of tighter memory integration—either via an HBM stack in a 2.5D package or WideIO in a 3D package—are presented. The opportunity of improving component-level cost structure through splitting a mono-die SoC into a Split Die SiP are explored. The 2.5D and 3D SiP architecture, physical design, Si and Package process technology, and product sourcing tradeoffs and considerations are explored, and the effects of the differences between 2.5D/3D integration versus 2D SoC are amplified. The upgrades to the design methodologies and EDA tools required to optimize 2.5D and 3D SiPs are identified, and some practical short cut solutions are proposed. The impact of 2.5D and 3D integration on electrical performance as well as on the thermal and mechanical stress characteristics, are described, and methodologies for addressing the potential interactions are outlined. Typical standard practices used in making new IC product development decisions, as well as the structure of the typical corporate entities involved in sourcing IC products, are also reviewed, and the business implications of adopting a disruptive More-than-Moore type of technology are assessed.

Thus, this book provides a holistic perspective that spans the broad process and the design technologies and methodologies, and addresses both, the technical and business considerations. It is not quite an ‘everything-you-always-wanted-to-know-about-2.5D/3D-technology-but-were-afraid-to-ask’ type of work, but it does elaborate on why adoption of More-than-Moore type of 2.5D and 3D integration technologies is complicated. It can be done, but it is complicated…

San Diego, USA

Riko Radojcic
More-than-Moore 2.5D and 3D SiP Integration
Radojcic, R.
2017, XV, 182 p. 68 illus., 66 illus. in color., Hardcover
ISBN: 978-3-319-52547-1