

## **FSA Mixed-Signal/RF Subcommittee: Setting the Foundation**

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*Since 1994 the FSA has continued to remain cognizant of current and arising industry challenges and needs, and the Association's subcommittees are monumental in identifying and tackling these obstacles. Over the past decade, each FSA subcommittee has been tasked with different objectives; however, each one is dedicated to achieving one common goal—reducing the barriers to conducting business effectively and aiding our members in their success.*

*For the 10-year anniversary issue, the Fabless Forum editorial staff invited each subcommittee chairman to contribute an article highlighting their respective group's work and accomplishments. The content within the following articles also emphasize the commitment, and dedication these volunteers contribute toward the fabless business model.*

Mission: The purpose of this Subcommittee is to accelerate the formation of an advanced mixedsignal/ RF foundry supply chain and ecosystem for fabless and hybrid companies.

Mixed-signal and radio frequency (RF) technology is experiencing explosive growth in communications, computer and consumer applications. As new wireless capability is built into what were previously “dumb” or “non-communicative” devices, virtually every consumer electronics product today can either transmit or receive information, or has a roadmap to do so in the future. Mobile phones, televisions, computers, set-top boxes and video game consoles are a few examples of everyday products that require mixed-signal or RF devices to communicate by sending and receiving the signals between these consumer products. In parallel with the more visible trend in the overall growth and convergence of the communications, computer and consumer markets, the performance requirements of the semiconductors in these markets are increasing as well. Specifically, the analog functions are increasingly challenging in terms of the circuit design and the manufacturing process technology used for the design. Pre-amplifiers for hard-disk drives, power management for laptops, color LCD controllers and laser drivers for DVD players are examples of devices in consumer market segments that are forecasting significant growth amidst complex design challenges, thus drawing the attention of the fabless community.

### **A Changing Industry Landscape**

As with most emerging market segments, there are challenges to overcome to be successful in capturing the opportunities in a timely and value-added manner. The fabless community faces limited access to the appropriate technology required to meet new performance requirements in a novel market segment, whereas IDMs may have leveraged some advantage by anticipating the next-generation product requirements.

When a reasonable technology match is found, the next barrier to overcome is whether the process design kit (PDK) meets the needs of the design team, first in terms of appropriate models, and second, in terms of the device attributes necessary for a complete design.

With the growth of fabless participation in mixed-signal and RF product development comes the anticipation of circuit IP availability that mirrors the current state of IP in the digital world, where enabling building blocks are generally available “off the shelf,” or can be readily adapted (synthesized) to meet slightly different specifications. On-going success in providing mixed-signal and RF products depends on the ability to migrate a product design to the next-generation technology at the right time, by anticipating the needs of the marketplace, and participating in the definition of application-specific technology requirements, unlike the process geometry driven digital roadmaps for logic products.

This growth in mixed-signal and RF content has provided the motivation for the fabless semiconductor industry to coordinate its efforts, with the objective to improve the underlying foundation for the design, manufacturing and delivery of competitive products.

The importance of a mature ecosystem, from IP to final package test of ICs, is clear to all participants due to time-to-market and upfront cost limitations. Maturity of the digital CMOS ecosystem, with dependable foundry sources, a broadly accepted roadmap, comprehensive design tool solutions, a network of IP suppliers at all levels and trusted backend providers has set benchmarks for a newly forming mixed-signal and RF ecosystem. Because everyone has been left on their own to establish product development capabilities in mixed-signal and RF, the current expectations of such an ecosystem are quite low. The potential payback, as demonstrated by the growing efficiencies in digital product development, could be in the form of an ecosystem that accelerates the development of innovative, new products once the mixed-signal design team has been freed from reinventing common blocks and has a clear path for productization.

To address the need to develop that mixed-signal and RF ecosystem, the FSA Mixed-Signal and RF (MS/RF) Subcommittee was formed in an effort to provide a forum for fabless, EDA, foundry, assembly and test companies to participate in the creation of the network needed to support the design, manufacturing and time-to-market needs of a rapidly growing segment of the foundry market.

### **Establishing the Right Focus**

There are many aspects of mixed-signal and RF design and manufacturing that should be addressed, but tackling all issues simultaneously would be a daunting task. The intent of the MS/RF Subcommittee is to establish working groups, led by industry leaders from the Subcommittee member companies, to address specific requirements in a focused manner, and make it easier to establish this ecosystem one step at a time. To date, the MS/RF

Subcommittee has on-going PDK and Modeling Working Groups, and has started to establish an IP Working Group and MS/RF Roadmap Working Group.

### **PDK Working Group**

The purpose of the PDK Working Group, led by EDA tool veteran and Silvaco's VP of marketing, Ken Brock, is to establish the basic requirements of MS/RF design kits and create some standardization around the representation of the contents of design kits. The PDK Working Group member companies, which include representatives from foundry, fabless and EDA vendors, together determined that having a comprehensive guide to the contents, identifying the available components and device types, the supported models and tool compatibility, as well as other features contained within the design kit was a valuable first step for the PDK Working Group. This PDK Checklist was created and launched in early 2004, and has since been widely adopted and is quickly becoming a standard document to accompany the release of new versions of mixedsignal/ RF foundry design kits. Even though the Checklist does not specify what should be in the PDK, it is clear that the availability of a standard format for representation of the contents goes a long way to providing a first order benchmark for the foundry customer. The condensed format also provides a first look at process capabilities when trying to determine the most suitable technology for development of a mixedsignal/ RF product, saving the customer from the task of reviewing a number of different documents to identify all of the available device types and components. This Checklist is an incremental, but influential, first step in standardizing around a common set of requirements to enable mixed-signal and RF designs to get to market more quickly and efficiently.

### **Modeling Working Group**

The Modeling Working Group has taken a similar approach in addressing the rapidly changing and increasingly intricate requirements of mixed-signal and RF modeling. The group has taken on the task of establishing a modeling checklist that includes the standard models supported by the foundries, and the extensions of those models with features such as statistical, mismatch and noise simulation capabilities. It is necessary for designers to know what type of models are supported by the foundry they are choosing, as well as the quality and method of validation of those models. The charter of the Modeling Working Group is to define the short-term and longterm infrastructure and support needed for mixed-signal and RF modeling environments. This goes one level deeper than the PDK Checklist, providing a basis for model comparison that should assist in the evaluation of suitability and capabilities for mixed-signal/RF design.

### **IP Working Group**

As one of two new working groups in the formation stage, the IP Working Group led by Fereydoun Babaei, director of business development, 1st Silicon, is intended to address a recognized need for some focus on the key mixed-signal and RF IP requirements of fabless companies. In contrast to the maturing digital IP market, the mixed-signal/RF IP ecology is still in its infancy. There are many reasons that addressing mixed-signal/RF IP

requirements has been considered complex in the past, including the lack of process standardization across foundries, incompatibilities in PDKs and models and detailed specifications that can be different for each application.

The purpose of the IP Working Group within the MS/RF Subcommittee is to outline and communicate the IP requirements for the mixed-signal and RF design space, including the basic blocks and silicon validation requirements for each. It is anticipated that the groundwork of other FSA working groups in the area of IP can be reused as a template for the determination of IP requirements while adding the unique nature and attributes of MS/RF. Defining the scope and set of near-term outcomes for this activity will provide a foundation for efforts to provide a broader set of standardized IP building blocks that can be used to accelerate design cycles and lead to higher level MS/RF integration, a parallel that can be drawn from the impact of digital-IP availability on the development of system-on-chip (SOC) designs for digital products.

### **Roadmap Working Group**

The new Roadmap Working Group is intended to provide a forward-looking view of MS/RF requirements, ultimately spanning both the process technology and the design tools. The voice of the fabless community in the areas of technology and EDA development goals could provide significant guidance to foundries and EDA tool developers that, in turn, would lead to development of the right process features, driven by future product requirements, and the desired productivity tools that make it possible to achieve first-pass success of complex MS/RF designs. The International Technology Roadmap for Semiconductors (ITRS) plays a large role in defining the manufacturing requirements for future generations of technology; the complementary role of an FSA roadmap for MS/RF technology would be to focus on the applications roadmaps of interest to the fabless community in these market segments, which are more broadly served by the addition of specialized capability to standard processes rather than by the most advanced line-width technologies. Similarly, there is significant momentum behind development of the design tools required for integration of large digital systems in SOC products, but the needs of the analog/RF designer have not been addressed with similar focus on tool functionality and integration. An industry view of priorities for MS/RF EDA tool enhancements would benefit both the developers in terms of efficient use of R&D spending, more tool sales and users who get the tools they need to speed products to market. As the remainder of the mixedsignal and RF ecosystem is defined and standardized by the other working groups, there is also an inherent change in the EDA tools required to model or support these requirements. The Roadmap Working Group can continue to provide an avenue for incorporating and adapting to those changes.

### **Opportunity Created by the FSA**

The FSA's establishment of a Technology Committee shows that the Association is not focused solely on business issues, but also on the often divergent technology camps represented by its members. The ability to establish or participate in a subcommittee with a unique and well-defined charter to make the fabless industry stronger is a significant

opportunity afforded to FSA members. The participation in such a subcommittee allows members to hear their customers,' vendors' and competitors' opinions and concerns on a wide variety of topics that will determine the health of the industry.

Technology changes constantly, and requirements to support the technology are changing too. Wireless networking is being supported in millions of devices, and the compatibility of analog and digital, or mixed signal, is a necessity. The world of digital applications is driven by companies that are part of a maturing ecosystem on a relatively well-defined path for the process technology and design environment. A focused effort to create the same infrastructure for mixedsignal and RF is the charter of the FSA MS/RF Subcommittee. It is the belief of the Subcommittee that the establishments of the basic requirements and standards will not only make things simpler and more readily available for fabless companies, but will drive the growth and success of the various participants in the MS/RF supply chain.