

CAPTURING MORE VALUE FROM SEMICONDUCTOR IP CONCEPTS IN SECURITY, SOURCING, LICENSING AND ROYALTIES

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In the first installment of this series on enterprise-level collaboration in semiconductor IP management, we explored the early-phase activities of cataloging, governance, and tracking. This phase provides a foundation for use of IP in design activities. As teams begin scaling up and sharing IP design data, unlocking the potential value of both acquired and designed IP takes on new dimensions.

Next, we look at the mid-phase of semiconductor IP management and tasks, including security, sourcing, licensing and royalties, where critical information needs to be managed and available across an organization.

MID-PHASE COLLABORATION AROUND IP

IP is both a product and a process, with three distinct phases (see Figure 1). Capturing more value from semiconductor IP means collaboration around the mid-phase tasks of security, sourcing, licensing and royalties.



Figure 1: Three phases of managing semiconductor IP collaboratively.

Where functional and verification metadata dominated in the early-phase, usage metadata becomes more important in the mid-phase as IP is reused by designers not directly involved in its creation. Some of this metadata may be unfamiliar territory for designers concentrating on functional requirements, requiring more collaborative IP management with help from additional roles in the organization.

What are some of the challenges in the mid-phase? Let's explore concepts in IP security, sourcing, and licensing and royalties in more detail.

IP Security

Securing intellectual property—controlling its distribution and access—is one of the biggest challenges faced by any company or organization. In the semiconductor space, hard and soft IP security tags have been used throughout the supply chain, albeit with mixed success.

Tagging is a mechanism that defines the ownership and origin of IP. The Accellera™ standard organization website says: “This standard provides a way to track both hard IP and non-hardened or soft IP information throughout the design and development process. The design process can include editing, synthesis, timing, placement, wiring and other steps leading to GDSII generation.... At each level, tracking information is obtained from the previous level and is transported to the next level using the appropriate output format.”

The hard IP tagging standard has found wide use. It consists of a text string included in the text layer of a graphic database system (GDS). It is offered in a GDSII format and optimized for a specific foundry process. Any tool that can read GDS can read the tag to determine the origin and owner of the IP. This is an important way to ensure the quality and, to a lesser degree, the security of the IP block.

Soft IP tagging remains problematic. It is typically synthesizable in a high-level language, such as RTL, C++, Verilog®, or VHDL®. The goal is that these soft-IP security mechanisms will work throughout the EDA-tool design flow and propagate downward into the GDSII. In other words, the high-level, soft-IP tags can be detected at the GDS level. However, as noted by Accellera, “Control of third-party IP source is lost once IP is licensed, unlocked or otherwise made available in clear code.”

Hard IP is easier to tag as it moves through the design flow; for example, a logical tagging indicates RTL code was synthesized on a particular date by a particular company’s tool. Soft IP presents other challenges for tagging, in part because soft macros are meant to be customized and modified by the end user before they are finally laid out. If one tool in the development chain didn’t generate or include an IP tag—which is often the case with soft IP—then the benefits of tagging are lost.

Concerns over security will grow as more companies find and productize their own IP. To protect their IP investment, many companies start by using non-disclosure agreements (or NDAs) as a simple security measure. Encryption of IP thwarts some unauthorized usage. However, the best measure of protection is to track IP usage.

Often, companies simply lose track of where the IP is used. This often leads to IP showing up in places that it shouldn’t. One reason for this is poor internal governance within corporate databases. There should be a managed pedigree, or record, of IP heritage.

Semiconductor IP guru Warren Savage has noted that many companies often don’t know where IP is going in their own chips. Tagging capabilities for both hard and soft IP are available, but work with varying degrees of success. One frequently encountered problem is that IP is accidentally used where a valid license doesn’t exist.

IP Sourcing

It may seem that IP sourcing should be part of the IP cataloging or governance operations. However, sourcing merits its own dedicated management effort. The increasing complexity of system-on-chip (SoC) designs has encouraged the sourcing of IP from multiple vendors across multiple geographic boundaries. Indeed, Asia is emerging as a key source of all types of IP, including semiconductor-related IP (see Figure 2).

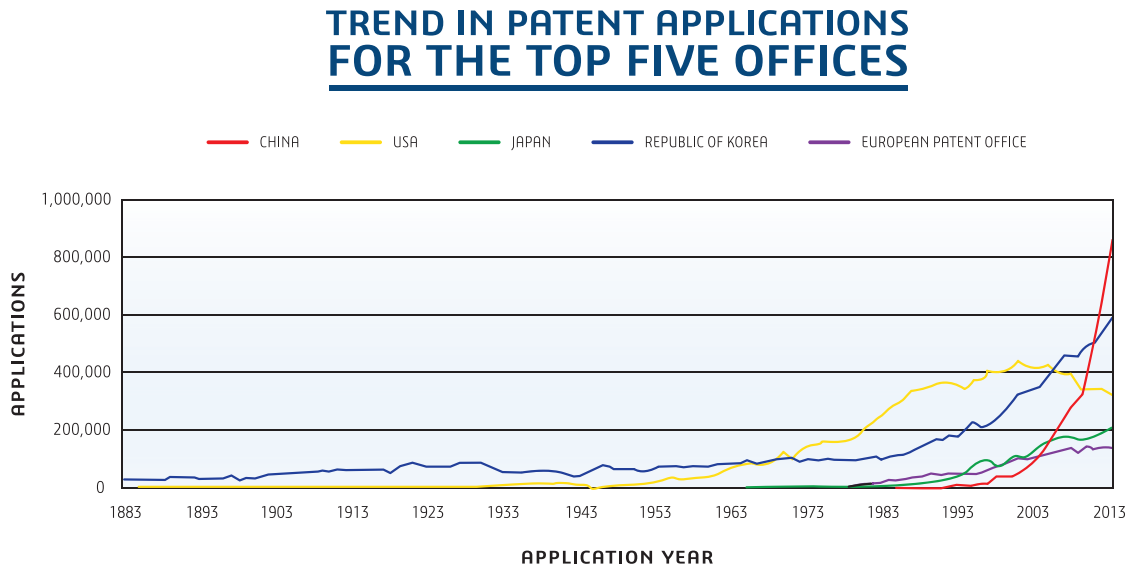


Figure 2: Trend in patent applications (courtesy Intellectual Property Watch).

While SoC design IP typically represents more than half of all IP sourced externally by a company, other forms of IP are growing in importance, including manufacturing, verification and especially software. Selecting an IP vendor can be a challenging task as it can be difficult to compare IP attributes, such as quality, performance, functionality, verification, cost and other criteria. In some cases, just obtaining the metadata for proper comparison may be a problem.

When sourcing IP, the main decision criteria after performance, involve cost and risk—two factors especially difficult to predict. The total cost of IP ownership depends upon integration cost, amount of silicon area, royalty payments and non-refundable engineering (NRE) fees. Similarly, delivery issues, integration challenges, market adoption and legal challenges determine the risk of using IP. Further, each project may be affected by these risks in different ways, depending upon the end product.

IP sourcing risks may not be fully appreciated or believed to be something that could be contracted away. Risk can be underestimated by assuming a “make” rather than “buy” decision to be less risky. Compounding the cost and risk challenges are many common misconceptions. For example, cost calculations often miss or undervalue various components, such as the time value or labor spent in sourcing.

While consolidation of the IP market may help alleviate some of these issues, trends suggest that some suppliers are diversifying away from either traditional design service models or the chip design business altogether. These are just some of the reasons why IP sourcing is a business process that must be managed.

IP Licensing and Royalties

The only way to fully extract the value of IP is to license it. A company often has more licensable IP than it knows. Items include source code and configurations, EDA scripts and constraints, verification test benches and scripts, documentation, and drivers, debuggers and software.

From a business perspective, licensing and royalty collection is a good way to gauge the true competitive value of IP. There is a huge untapped store of value in unlicensed IP. Many companies seem reluctant to license their IP—some fear it might negatively impact their business and privacy may also be a concern. Others are uncertain as to a market for their IP.

Perhaps the biggest reason for hesitation is the transactional costs associated with the licensing of IP. Typically, licensing activities require the attention of high-level management. IP is often not very portable and formats vary. In the past, many companies have lacked an infrastructure that supports the licensing and general management of IP.

Still, the reluctance to license IP is more than offset by the many reasons to license it. In the semiconductor market, products have so much IP in them that no single bit of IP makes or breaks a product. Creative IP use enables customers to pursue specialty products—especially in the trend to platform-based designs. Licensing and royalty collection can also produce a lucrative revenue source when well-managed.

Another big motivator to both catalog and license company-specific IP comes from the legal community. “IP-related lawsuits are increasingly being used for competitive advantage,” notes Mark Davis, principal at Deloitte Consulting, based in New York City. “Growing patent ‘troll’ activities are requiring firms to manage IP tightly and be able to defend against claims.”

The business and legal issues of using product IP is just as daunting in scope as the technical ones. “Managing catalogs of licensed and proprietary IP across numerous product lines is becoming a challenge in the semiconductor industry,” said Eric Nguyen, director of business intelligence at Jama Software, a computer software company headquartered in Portland, Oregon. Due diligence requires that firms conduct patent and technology checks to ensure they are not violating IP agreements. Additionally, firms must handle the payments of licensees.

Knowing what IP is legally safe to use will also affect the engineer’s design choices. Generally, the hardware IP blocks—such as microprocessor cores from ARM® and Intel®—are well-established with IP protection. However, the software side can be more difficult to manage.

The optimal product design choice depends upon achieving the right mix of a company’s internal IP and third-party offerings, said Richard Wawrzyniak, senior market analyst for ASICs and SoCs at Semico Research. “Firms may be required to license specific IP to accomplish a product feature desired by customers,” Wawrzyniak said. “On the flip side, they may choose to invest more time in R&D/engineering to invent something that goes beyond existing IP to ensure they are free and clear from patent claims.”

ENTERPRISE-LEVEL SOLUTION FOR IP MANAGEMENT

Dassault Systèmes offers a comprehensive approach created to help with mid-phase tasks of security, sourcing, and licensing and royalties as part of its **3DEXPERIENCE®** platform.

The Dassault Systèmes' "**Silicon Thinking**" **Industry Solution Experience** is a portfolio of integrated circuit design and engineering performance enhancement solutions with IP management as one of the key capabilities. Applications supporting industry roles in semiconductor IP management include:

- **Semiconductor IP Classifier** enables users to organize a company's globally dispersed IP in a catalog, facilitating search and compare, and enabling efficient design reuse. The IP catalog can be tailored to a company's product and business environment, presenting different classified views depending on the user's access rights.
- **Software & SoC Designer** enables collaboration on software and semiconductor designs to effectively manage changes coming from multiple contributors from within the enterprise. Data can be managed at both the detailed file/directory level, and at a "modular" level of abstraction. Design data contributed by individual teams can be seamlessly integrated into higher level designs.
- **IP Security Manager** enables organizations to classify data properly with defined security rules (based on organization, citizenship, physical location and their combination) and exceptions in an evaluated expression. This classification framework implements the description of category-specific rules that must be met by any user trying to access a data item.

These are examples of an extensive set of industry-based process experiences intended to bring engineering and business teams together to produce complex products more quickly and use resources most effectively. These applications don't get in the way of engineering design, they facilitate it.

With a focus on collaborative innovation, the experience built into the **3DEXPERIENCE** platform and the Silicon Thinking semiconductor IP management solution is aimed at putting the right information in the right hands securely.

DESIGN FRAMEWORK SETS UP ENDGAME

IP management tasks cut across hardware, software, engineering and business domains. Collaboration on tasks of security, sourcing, and licensing and royalties streamline design choices, prevent unforeseen costs and legal exposure, and potentially open new sources of revenue for Semiconductor firms.

For more information on how collaboration tools can help with SoC design and innovation, visit:

<http://www.3ds.com/industries/high-tech/silicon-thinking>

With the early- and mid-phase tasks of semiconductor IP management handled, value is unlocked and a framework for execution of chip designs exists. In the third installment in this series, we will explore the use of IP management strategies in the endgame final phase of platform-based design of systems matching customer demands in near real-time.