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Develop a standard and get your 15 minutes of fame

EVERY ENGINEER HAS THE POTENTIAL TO DEVELOP A STANDARD. ALL IT TAKES IS INTEREST IN THE PROFESSION AND THE WILLINGNESS TO DEVOTE SOME OF YOUR OWN TIME TO THE TASK.

STANDARDS PLAY AN IMPORTANT ROLE in electrical and electronics engineering. Most engineers must adhere to standards while designing products and systems, but relatively few engineers are involved in developing them. Standards contribute to lowering product-development costs by letting you use off-the-shelf parts and reuse designs. The industry develops many standards to increase your ability to interface portions of systems with each other, such as, for example, a CPU accessing memory, a number of pc boards interfacing within a system, or two systems that can communicate independently of their manufacturing origin. In electronics, design standards cover physical-hardware characteristics and timing, the syntax and semantics of system-to-system communication (called protocols), and the types of tools you use in designing the system. The IEEE and the EIA are the best-known standards-making organizations in the electrical and electronics fields. One of the EIA-standardization bodies is the JEDEC (Joint Electron Device Engineering Council) Solid State Technology Association.

In their daily work, engineers deal with official, industry, and de facto standards. When an officially recognized standards-making organization successfully ballots a candidate document, it becomes an official standard. If an industry consortium develops a standard, the published document becomes an industry standard. When the industry widely accepts and uses a method, a tool, a hardware implementation, or a protocol, it becomes a de facto standard. For example, the IEEE 1014-1987 VME bus and the JEDEC JESD67 "I/O Drivers and Receivers with Configurable Communication Voltage, Impedance, and Receiver Threshold" are official standards; the ".lib" format by Synopsys is a de facto standard; and Verilog-A from Accellera is an industry standard. Sometimes, a company or an organization submits an industry or de facto standard to an official standards-making organization. The organization makes necessary modifications, and the standard then becomes an official standard. The Verilog modeling language is such an example. It was first a de facto standard and then became an industry standard from 1989 to 1995 when, with minor modifications, it became an official standard of the IEEE (1364-1995).

Official standards-making organizations are international organizations, national organizations, and industry consortia. International organizations, such as the IEC,

almost never develop their own standards. Commonly, their member countries offer their own standards as candidates for international balloting and acceptance. National organizations, such as the IEEE and the EIA in the United States, develop their own standards and frequently submit them for international adoption. Industry consortia, such as Accellera or the VSO (VMEbus International Trade Association Standards Organization) develop industry standards that they frequently pass to standards-making bodies for official balloting. Official standards-making bodies less frequently receive de facto standards. A commercial entity— frequently, the company that developed them—usually owns them. These owners have no incentive to release the property, and the industry has no need for it. The stability of a de facto standard rests solely on market pressures, and revisions commonly result from users' input. The development of de facto standards is similar to product development. In most cases, a language, protocol, or format becomes a de facto standard when customers and companies obtain the right to use it commercially.

AT A GLANCE

- Volunteers are most often the developers of standards.
- Three types of standards exist: de facto, national, and international.
- Organizations have the charter to develop national and international standards.
- Many national standards are used internationally without having achieved international-standard status.

THE NATIONAL STANDARDS-MAKING PROCESS

Although the process for developing industry and national standards varies with each standards-making body, many similarities exist among the various developing standards. In most cases, a prototype or straw-man proposal must exist before a committee or working group forms to work on a proposed standard. The working group holds meetings, and members work on the proposal until the group deems the document ready for ballot. Once the ballot passes, an overseeing organization officially approves the standard. From this point on, adoption of the standard is based on market forces. A standard with strong engineering characteristics won't necessarily be popular if its development has taken so long that the market requirements have changed. A good standard is both timely and correctly engineered.

A few standards-making organizations allow individual membership, but most allow only corporate membership. Membership in a standards-making organization is never free, but if the organization allows individual membership, and you can pay the membership fee or you have a sponsor that will pay it, you can participate in developing a standard. Most companies pay the membership fee for employees who belong to a professional organization, such as the IEEE. The IEEE is the largest professional-engineering society, with members in more than 150 countries, and the IEC or the ISO frequently adopt IEEE standards as international standards. Recognizing that standards development is an important function, the IEEE in 1998 formed the IEEE-SA (IEEE-Standards Association). Interested members of the IEEE pay a small additional yearly fee to be members of the IEEE-SA and obtain the right to participate in standards development. The IEEE-SA keeps the standards-development process current through the work of some of its standing committees, especially the procedures committee.

The IEEE is organized into societies that focus on specific professional areas of interest of the IEEE membership. The IEEE now contains 41 professionally oriented societies that could sponsor standards work. To be eligible as a sponsor, a society must provide the IEEE-SA with a document that describes the process the society follows in selecting a candidate proposal for submission to the IEEE-SA and the method used to oversee a working group. Currently, 18 of the societies are actively developing standards. Sponsoring organizations the Nanotechnology Council and the Corporate Society, associated with the IEEE, have a charter that differentiates them from the professional societies. The Corporate Society allows corporations, government organizations, consortia, and academia to use the support structure of the IEEE to develop standards. The goal is to allow the members of the Corporate Society to develop an IEEE standard in two years or less. The industry now recognizes the Corporate Society, which recently developed its own standards-sponsoring procedure, as a sponsoring organization for standards work, and it is sponsoring its first standards development, dealing with batteries in portable-computing devices. Organizations interested in fostering the work of the IEEE-SA can join the Corporate Society by paying a yearly membership fee from $1000 to $5000, depending on the corporation's yearly revenues. The fee for government organizations is $5000, and the fee for other standards-making organizations is $1000. The Corporate Society has 41 members, the same number, coincidentally, as the number of professional societies in the IEEE.

The IEEE-SA standards-development process may at first seem complex and cumbersome, but it is necessary (**Figure 1**). The IEEE-SA follows five imperative principles: due process, openness, consensus, balance, and the right of appeal. The primary condition is that standards are quasilegal documents. Courts of law often use standards as evidence. Also, various government and regulatory agencies often adopt standards and make them legal requirements. The process must ensure that the chance of someone's inadvertently breaking the law is null or minimal.

If you have an idea for a standard and you want to use the resources of the IEEE-SA to develop it, you must first find a sponsoring society. Each society may have a slightly different organizational approach to standards sponsorship. The Computer Society, for example, sponsors standards development in EDA through the DASC (Design Automation Standards Committee). Often, when an interested party presents a new proposal for a standard to a society, a study group explores the standard's desirability and feasibility. If the study group deems the project feasible, it appoints an individual to chair the eventual working group. This person, together with a sponsor, develops a PAR (project-authorization request). The PAR provides a description of the scope and purpose of the intended work as well as other administrative information that ensures compliance with the IEEE-SA process. The sponsor submits the PAR to NESCOM (New Standards Committee) of IEEE-SA. NESCOM reviews the material and, if necessary,

works with the sponsor and the working-group chairman to modify its contents to meet the guidelines. One of the most common errors that PAR submitters make is to use language that is so specific to the field of interest that it is ambiguous to engineers who do not specialize in that field. Because standards can be legal documents, interested parties must be able to read the PAR and obtain a good understanding of the scope and purpose of the proposed work. Therefore, the working group must use language that avoids jargon and conventions.

Once NESCOM approves the PAR, the working group has five years to develop and ballot a standard. Developing a standard is demanding, and volunteers, with the support of the IEEE staff, do the work. Although most corporations interested in developing a standard support employees who attend working-group meetings, few and only large corporations can afford to have employees that work on standards full time. Most working-group members dedicate their own time to standards work, which is the main reason that making a standard is such a long process. Once the proposed standard is ready for balloting, the IEEE-SA helps the working group form a balloting group. The IEEE-SA, like other organizations, uses a consensus process in validating a standard. At least 75% of the balloting group must vote, and 75% of the votes cast must be in favor of the standard. A working group may follow three types of standards-balloting procedures. The first is a traditional balloting process by individuals only. The second allows a mixed balloting group made up of corporations or organizations and individuals. The third allows a ballot group made up only of corporations or organizations. In all cases, each entity has one vote. If the voting is successful, the working-group chairman submits the proposed standard to the REVCOM (Review Committee) of the IEEE-SA, which scrutinizes both the balloting process and the format and language of the standards to make sure that it meets all of the necessary guidelines. Once REVCOM approves the document, it becomes an official IEEE standard, and the IEEE publishes it.

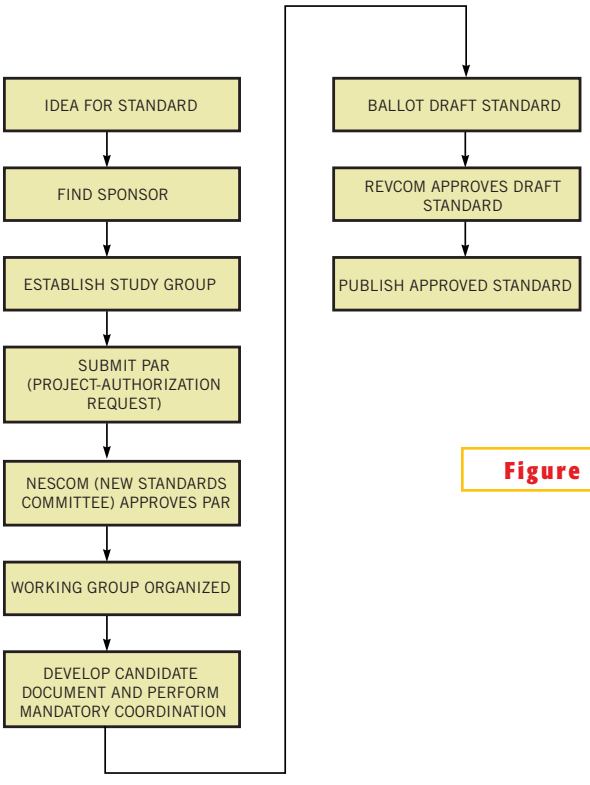

Figure 1

The IEEE follows a precise and well-documented process to develop a standard.

The EIA is another important developer of engineering standards. It organizes its standards activities into its original constituents: the CEA (Consumer Electronics Association), ECA (Electronic Components, Assemblies, and Materials Association), GEIA (Government Electronics and Information Technology Association), JEDEC, and TIA (Telecommunications Industry Association). EIA members are companies, not individuals. Engineers can contribute to standards-development activities only if they are employees of a member company. Within the EIA, a standard begins as a technical contribution that generates enough interest among the members that they provide manpower for its development. A working group completes a PIN (project-initiation notice) and forwards it for approval to either the EIA or the TIA board. Once the working committee feels that the document is ready for ballot, it circulates the document on a Committee Letter Ballot. The circulation aims to generate consensus and resolve comments. Once the committee resolves the comments, it forwards the document to the EIA Strategy and Standards Department or, in the case of the TIA, the Telecommunications Standards Subcommittee. If the document is intended to become an American National Standard, the EIA also forwards the document and all pertinent information to the ANSI (American National Standards Institute) Board of Standards Review with a request for approval. After review and approval, the EIA officially publishes the standard. ANSI and IEEE keep standards up to date by requiring their sponsors to review them at least every five years.

INDUSTRY STANDARDS

The process of creating national and international standards is long, but the electronics industry often needs to respond quickly to the need for a standard. In some cases, the open-consensus process is also an obstacle. Therefore, companies sometimes form a consortium to establish a legal entity that owns the standard and shelters companies from the appearance of collusion. Accellera is the most successful standards-making consortium in the EDA industry.

In 2000, VI (VHDL International) and OVI (Open Verilog International), two organizations that had significant experience in the standards-making process, merged to form Accellera. Accellera distinguishes itself from most other consortia by being a feeder organization to the IEEE. Accellera and its founding organizations are so far responsible for providing the initial document for 10 IEEE standards . This number works out to almost one standard per year. In addition, its ALF (Advanced Library Format) document is the basis for P1603, which is now in the balloting process with the IEEE. Wolfgang Roethig, senior engineering manager for EDA R&D at NEC in Santa Clara, CA, chaired the development of ALF and now chairs P1603. He thinks that one of Accellera's most im-

portant roles is to serve as an incubator for IEEE standards. While the Accellera standard makes its way through the IEEE process, engineers can base implementations on the standard and acquire feedback from users. The experiences and feedback strengthen the IEEE candidate standard before the committee finalizes and votes on the document.

Accellera members are corporations, divided into corporate and associate members, depending on the level of involvement they wish to have in running the affairs of the consortium. The annual membership fee is $15,000 for corporate members and $5000 for associate members. The chairman of the Technical Committee submits an idea for a new standard to the board of directors, which decides on the merits of the proposal. If the committee approves the proposal, it forms a technical subcommittee to ensure that work proceeds in a regular and orderly manner. The chair of Accellera's technical committee reports quarterly to the board on the progress each subcommittee makes. When the technical subcommittee finishes its work, it presents the document to the board, and each member of Accellera gets an opportunity to review and comment on the document. Once the subcommittee has addressed these comments, the board votes on whether to approve the document. If it approves the document, the document becomes an Accellera standard and a candidate for submission to the IEEE as the basis for a PAR.

SI2 (Silicon Initiative) is a consortium of companies involved in EDA, semiconductors, and systems. Its annual membership fee is $47,500. Most of its work aims to improve design methodologies and tool integration. One of its major activities is to serve as the host organization for the OpenAccess coalition, a group of companies interested in developing an API (application-programming interface) to a design database. The OpenAccess coalition is not organized as a traditional consortium and has no legal status. Thus, it needed a hosting organization. The OpenAccess coalition offers various levels of membership, from no-fee, click-through licenses to full memberships of $47,500 per year, depending on the level of involvement a company desires. The OpenAccess coalition is using the Cadence database as the target for the API, but the coalition work aims to be independent of the database, describing only the syntax of the interface and the semantics of the data model.

The VSIA (Virtual Socket Interface Alliance) is a consortium with more than 100 member companies that pay a $1000 to $20,000 annual membership fee, depending on their previous-year revenues. An individual membership costs $1000 per year. The developers of consortium formed it in 1996 with the goal of establishing a unifying vision for the SOC (system-on-chip) industry and the technical standards to enable the most critical component of the vision: the mix and match of virtual components, or intellectual property (IP), from multiple sources. To develop the necessary standards, the VSIA has formed a number of DWGs (development working groups). Each DWG develops, then votes on a document. The technical committee then reviews the document. the committee approves the document and then releases it to the membership for review, which takes a maximum of 60 days. The DWG then addresses any comments and makes the necessary changes. The technical committee reviews the latest version, and upon approval, forwards it to the board of directors. Once the board approves the document, it becomes a public document.

The OCP-IP (Open Core Protocol International Partnership) consortium's mission is similar to that of VSIA. The consortium has about 70 members, which divide in two categories paying $10,000 to $25,000 per year, depending on the level of involvement they wish to have. It also has university program members. In addition, board members self-assess their companies on a sliding scale, according to revenues for funds required to meet any shortfall in the yearly operating budget. The mission of OCP-IP is to create a common standard for IP-core interfaces, or sockets, that facilitate "plug-and-play" SOC design. It has developed a standard, Open Core Protocol, that is available for license.

A few EDA vendors formed OSCI (Open SystemC Initiative) three years ago to provide a forum for promoters and users of SystemC and to provide the administrative mechanism for the open-source licensing model that the SystemC

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EDA sector uses. OSCI uses a modified open-source license arrangement. Although the community is free to contribute source code, a steering group controls the release of the code to the official SystemC database. The membership, which now also includes users' companies, divides into: individual members who pay an annual fee of $2000, associate corporate members whose fee is $10,000, and corporate members with a fee of $25,000. The board of directors deals with financial and organizational matters, and a steering group has full technical authority. This group comprises all working-group chairmen, plus one technical representative from each corporate member not already represented. The steering group oversees all additions and modifications to the source code of contributed programs. Approximately 45 active members exist among all of the working groups. Engineers need not be members of OSCI or one of its working groups to contribute. Any engineer can submit code that he or she believes will improve the SystemC environment to OSCI's Web site. If an OSCI member proposes technical modifications to the SystemC environment, an investigative group forms to judge the technical merits of the proposal. The investigative group reports to the steering group, which may decide to establish a working group to develop the proposal into actual code. The steering group reviews the work of each working group on a quarterly basis. Once a working group finishes its work, the steering group reviews the work to make sure that it is sound, that the test plan has been followed, and that the documentation is in place. It then releases the approved source code into the database, and the code becomes available to those corporations or engineers that sign the appropriate license.

INTERNATIONAL STANDARDS

The global nature of the electronics industry requires that many national standards achieve worldwide acceptance and application. As early as the beginning of the last century, engineers and scientists working in the electrical field saw the need for international standardization. In 1906, they established the IEC. The International Federation of the National Standardizing Associations began in 1926 to carry out standardization work in other fields with emphasis on mechanical issues. Its work terminated in 1942. In 1946, delegates from 25 countries met in London to create an organization aimed at facilitating the international coordination and unification of industrial standards. The new organization, the ISO, headquartered in Geneva, began work during February 1947. Design and manufacturing engineers are familiar with the ISO through its ISO 9000 family of standards.

The IEC also has headquarters in Geneva. It prepares and publishes international standards for all electrical, electronic, and related technologies. The IEC has 62 nations as members, and the list includes all technologically advanced countries. A number of technical committees carry out the technical work, with representatives in all the member nations that are interested in the particular area. A technical-committee working group that believes a national standard is a worthy candidate for internationalization will prepare a candidate CDV (committee draft for vote) document. All member countries review the document, using either the English or the French version. They then have five months to review and vote on it. If two-thirds of the votes cast are in favor, and negative votes do not exceed one-quarter of all votes cast, the document is approved. If the document does not receive a 100% majority, the technical committee makes modifications to address member concerns. This process can take as long as four months. The revised version, FDIS (Final Draft International Standard), then recirculates for approval. The same rules apply to both CDV and FDIS approval.

An agreement is in place between the IEEE and the IEC through the TC-93 Design Automation Technical Committee that allows IEEE documents concerning EDA to be considered CDVs, thus saving most of the five months required for preliminary voting within the IEC. A mix of dedicated technologists and professionals with the political skills to generate consensus is responsible for the standards that make the electronics industry so efficient at both the national and international levels. □

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