May–June 1999
Volume 104, Number 3

ISSN 1044-677X

Journal of Research of the

National Institute of Standards and Technology

United States Department of Commerce
Technology Administration
National Institute of Standards and Technology

Journal of Research of the National Institute of Standards and Technology

Volume 104 Number 3 May–June 1999

Available online
http://www.nist.gov/jres

The *Journal of Research of the National Institute of Standards and Technology,* the flagship periodic publication of the national metrology institute of the United States, features advances in metrology and related fields of physical science, engineering, applied mathematics, statistics, and information technology that reflect the scientific and technical programs of the Institute. The *Journal* publishes papers on instrumentation for making accurate measurements, mathematical models of physical phenomena, including computational models, critical data, calibration techniques, well-characterized reference materials, and quality assurance programs that report the results of current NIST work in these areas. Occasionally, a Special Issue of the *Journal* is devoted to papers on a single topic. Also appearing on occasion are review articles and reports on conferences and workshops sponsored in whole or in part by NIST.

ISSN 1044-677X **Coden: JRITEF** **Library of Congress Catalog Card No.: 89-656121**

United States Government Printing Office, Washington: 1999

Volume 104, Number 3, May–June 1999
Journal of Research of the National Institute of Standards and Technology

Contents

Available online
http://www.nist.gov/jres

Articles

Conference Reports

News Briefs

Volume 104 Number 3, May–June 1999
Journal of Research of the National Institute of Standards and Technology

Volume 104, Number 3, May–June 1999
Journal of Research of the National Institute of Standards and Technology

Volume 104, Number 3, May–June 1999
Journal of Research of the National Institute of Standards and Technology

[J. Res. Natl. Inst. Stand. Technol. 104, 291 (1999)]

Conference Report

ELECTRONIC COMMERCE OF COMPONENT INFORMATION WORKSHOP Gaithersburg, MD July 15-17, 1998

Report prepared by

James A. St. Pierre and Curtis H. Parks

Electricity Division,
Electronics and Electrical Engineering Laboratory,
National Institute of Standards and Technology,
Gaithersburg, MD 20899-8114

and

Ronald Waxman

EDA Standards Consulting,
2369 Paddock Lane,
Reston, Virginia 20291

Available online: http://www.nist.gov/jres

1. Introduction

Integral to the electronics industry are product data-exchange standards and specifications that enable the design, manufacture, documentation, procurement, and support of modern electronics. The traditional formats for capturing designs and manufacturing information, engineering drawings and paper specifications, are rapidly being replaced by digital (computer sensible) formats. To be effective and efficient this information must be correct, complete, and unambiguous. Among the ongoing technical challenges in this arena are the development of adequate information models and standards that describe the essential characteristics of electrical and electronic products.

Currently, there are at least five established standards that can be used to transfer data among automated tools for fabricating electronic products. The industry's complaint is that these standards are not fully capable of expressing designs unambiguously and that "harmonization" of these standards is needed to avoid costly waste in design and manufacturing. Harmonization of these product data standards is intended to enable the translation of design information from one format to another with no loss, corruption, or modification of the design intent.

One factor that will affect the future health of the U.S. electronics industry will be its ability to perform current business functions, electronically, over the Internet. The automation of business practices, such as the search for and brokering of component information, will enable the U.S. electronics industry to compete globally in a timely manner. A key element of internet commerce will be to make component information available via the Internet in formats that can readily be incorporated into computer aided engineering, design, and manufacturing (CAE, CAD, and CAM) tools. The Electronic Commerce of Component Information (ECCI) workshop held at NIST Wednesday – Friday, July 15–17, 1998, provided a forum for discussion of issues related to the exchange of technical information for electronic components in support of the global electronic component e-commerce (electronic commerce) marketplace. The goals and objectives of the workshop were to identify technologies that could be developed to remove barriers and to create opportu-

nities for businesses and consumers in the electronics industry by accelerating the development of means to access, exchange, and reuse electronic component information. The workshop brought together industry technology experts, including representatives of technical consortia, and trade associations who were interested in participating in defining the scope of activity required to establish an international ECCI environment. Individuals from academic institutions, non-profit research organizations, and government laboratories also participated. This report provides an overview of the workshop as well as some of the planned follow-on activity. A full report, which includes all of the presentations given during the workshop, can be accessed via the www [1]. The on-line report, based on the contributions of the attendees, makes recommendations for follow-on activity consisting of collaborative efforts to further develop the mechanisms for access to component data and the standards necessary to bring about the desired ECCI environment.

In addition to NIST, the co-sponsors of the workshop included the Institute of Institute of Electrical and Electronics Engineers (IEEE), Computer Society (CS), Design Automation Technical Committee (DATC), and Design Automation Standards Committee (DASC), the Silicon Integration Initiative (Si2), the Virtual Socket Interface Alliance (VSIA), and the University of Maryland's Computer-Aided Life-Cycle Engineering (CALCE) project.

One standard that received a lot of attention during the workshop was the Electronic Component Information Exchange (ECIX) standard being developed by the Si2. The NIST Electricity Division's Electronic Information Technologies (EIT) group has provided support for the ECIX project from its inception. ECIX also has ongoing support from a wide variety of industry participants. The ECIX project [2] is dedicated to designing standards for the creation, exchange, and use of electronic component information, including application specific integrated circuit (ASIC) cores or virtual components. The ECIX architecture and standards are intended to be extensible, unambiguous, well documented and are maintained under the direction of Si2. Si2 has requested NIST help to move the ECIX standards into the International Electrotechnical Commission (IEC) arena. ECIX currently consists of three draft standards: Pinnacles Component Information Standard (PCIS), Component Information Dictionary Standard (CIDS), and the Timing Diagram Markup Language (TDML). These ECIX standards are intended to enable engineers and design support personnel to view component datasheet information (PCIS), including viewing and analyzing timing diagram information (TDML) contained in ECIX datasheets, and directly support electronic design automation (EDA) tools and automatic generation of EDA library information such as logic symbols. In addition to traditional datasheet information, PCIS can enable controlled access and transfer of supplier provided design files (e.g., simulation models, test benches, and physical data) to the end-customer. A key component of the PCIS datasheet is the identification of the links to on-line dictionaries of terminology and component classifications provided by the CIDS.

The workshop was structured as a series of panel sessions. Panel members presented information regarding their current activities. A question and answer segment was included as part of each panel to ensure adequate time for feedback from workshop participants. The attendee interaction provided the data for the workshop results. In addition to the panel sessions, time was allocated to allow participants to demonstrate their ECCI oriented products and/or capabilities. Some of the demonstrations focused on existing or pending products, while others focused on standards development activities.

Following Panel 3, a discussion session was held in which all participants had the opportunity to help determine "Where do we go from here?" That session took place on the second afternoon, while most of the attendees were still present.

The problems discussed at the workshop include:

- Lack of interoperability between tools.
  Hardware manufacturing tools require integration via software frameworks.
  Software design tools require better integration and testing.
- Information loss, corruption, or distortion during transfer from system to system.
  Differences may exist in underlying information models.
  Multiple standards require translations.
- Traditional distribution of component and design information creates bottlenecks in the design process.
  Manual information entry is prone to errors.
  Authoritative on-line Data Dictionaries are lacking.
  Printed data books quickly become out of date.
  Adding a component to a library can take weeks.

2. Workshop Summary

The workshop was intended for those interested in creating, accessing, locating, integrating, manipulating, or maintaining information and/or engineering data (e.g., data sheets, simulation models, timing informa-

tion, thermal data, geometry, etc.) or electronic components, either physical or virtual, such as:

- Electronics designers, manufacturers, and assemblers of e.g., PCA/PCB, semiconductors (Including virtual components)
- Tool users and product users
- Semiconductor companies (product developers, tool users)
- EDA tool developers and users
- Government:

  DARPA (Defense Advanced Research Programs Agency),

  NASA (National Aeronautics and Space Agency),

  NIST (National Institute of Standards and Technology),

  AFWAL (Air Force Wright Aeronautical Laboratories),

  ARL (Army Research Laboratory),

  NRL (Naval Research Laboratory).
- Standards organizations and consortia:

  IEEE CS DATC and DASC, IEC/TC93, Si2, VSIA, EIA, SRC, EDA IC.

The following is a partial list of data and functionality required to support an ECCI environment. This workshop was primarily focused on the first element in the list "Data content."

- Data content

  (e.g., datasheets, CAE/CAD/CAM files, models: simulation; geometric; thermal; etc..., and linkage/reflection between these views),

  Part identification,

  Part equivalence,

  Intellectual property considerations,

  Part qualification,

  Data access methods,

  Data access permission,

  Supplier/User business agreements,

  Other.

3. Panel 1. End-User Scenarios and Requirements

Panelists:

Jim St. Pierre—NIST (Chair),
Bill Russell—Air Force Research Laboratory, WPAFB,
Jeff Barton—Texas Instruments,
Kim Singer—OrCAD,
Jeff Williams—Information Handling Services (IHS),
Tony Hilvers—Institute for Interconnecting and Packaging Electronic Circuits (IPC),
Patrick McCluskey—University of Maryland.

A lively discussion followed the presentations by the panel members. It was generally agreed that there is a need for a set of standards that bridges all aspects of a design. Furthermore, most attendees (especially users of component information) agreed that if all of the component suppliers provided component information in the ECIX format, significant cost savings within their organizations could be achieved. A significant portion of these cost savings would come from the elimination of re-entry of design information. Using the ECIX standards, users would be able to directly load their databases, catalogs, or electronic design automation tools, without human intervention. It is nontrivial for the component suppliers to provide a fully documented ECIX datasheet. Some suggested that a phased approach would help the suppliers to migrate to the ECIX standard. There was a lengthy discussion centered on the ECIX utilization and deployment plans. There is a need for functional or behavioral information to be included in (or referenced from) an ECIX datasheet. ECIX is working on adding the ability to encode multiple views of a component. Although ECIX is an important component in solving the problem, it relies on the existence of a wide variety of component information standards that can be referenced or "wrapped" by an ECIX datasheet.

A convergence of harmonized standards was also noted as an important goal. One aspiration is to use existing standards wherever possible. The participants agreed that there is a significant need for education of the potential suppliers and users of these standards if we are to achieve consensus. The community that will benefit from ECCI must be a part of the solution by contributing to requirement definition, surveys, education, and development.

A question was raised as to: "How much information are the component suppliers willing to provide?" One

of the component suppliers indicated that they are considering implementing multiple levels of access to their on-line component information. Following this model, only certain customers would have access to the "latest-and-greatest" component information. Customer access to a component supplier's information would be determined on a case-by-case basis.

Another issue concerns the mechanisms available to transport the component information? In other words, should the information be human-readable, computer readable, or both? Because ECIX is migrating to the XML format, it will ultimately support readability by both humans and computers.

Another area that needs to be addressed in more detail relates to system design and analysis. There is a need for methodologies and tools to support system analysis (performance, timing, and fault analysis) for a large system based on the components being proposed for the system. Evaluation of a proposed component's effect on a system, and the system's effect on the proposed component, is an important aspect of the design process. An effective ECCI methodology must provide users with this system-oriented data as well as the component and sub-system oriented data.

3.1 Panel 1: Forward Plans

This panel highlighted the urgency of getting the component suppliers to commit to providing data in a standard format, such as ECIX. The attendees recognized that the workshop lacked a critical mass of component suppliers necessary to build consensus. The Si2 representatives indicated that they were already beginning a project to develop this consensus by organizing the user community regarding their requirements for a minimal set of parameters that they require from the suppliers. The next step would be to organize a series of meetings at which the users could present their needs to the suppliers in an effort to build the necessary consensus. NIST committed itself to supporting this effort, as did several of the industry participants.

4. Panel 2: Standards Efforts

Panelists:

Curtis Parks—NIST (Chair),
Mealnie Yunk—Si2,
Jean Lebrun—Thomson CSF (CIREP),
Steve Waterbury—NASA,
Takeshi Fuse—Fujitsu (VSIA),
Mitsuru Takahashi—Hitachi (E-CALS).

The focus of this panel was to explore current efforts in the standards domain that have a relation to ECCI, including the represented projects and others. Interoperable standards are critical to the success of component information exchange. In addition standardization promotes stability, interoperability, known interfaces, and the ability to more easily address higher-level system complexity.

While there was no specific general discussion period for this panel, several important discussion points were made throughout the panel presentations. These points are listed here:

- Several users of the JEDEC dictionary expressed an interest in seeing the dictionary in ECIX Component Information Dictionary Standard (CIDS) format. This would be useful since it would allow linkage between datasheets in ECIX-PCIS format and terminology from the Joint Electronic Device Engineering Council (JEDEC) dictionary, via the ECIX CIDS format. NIST has previously developed a dictionary translator to convert IEC and company dictionaries into the ECIX CIDS format.
- Component Information Representation European Project (CIREP) is reaching the conclusion of its first phase, and they are interested in interoperability testing at an international level. There was significant interest among the workshop participants from the United States and Asia in such testing.
- The IEC 61360 dictionary is only available from CODUS Ltd. for a fee. Several workshop participants indicated that they felt it was very important that dictionaries be made freely available, since they are such a basic piece of the infrastructure necessary to make ECCI successful.
- The issue of parallel standardization efforts arose, specifically "Why do we develop standards that overlap others?" One participant suggested that standards are typically created by users to fulfill a perceived need, and not for the sake of the standards bodies. Also, different industry constituencies have different needs for handling similar information regarding components, which inevitably leads to some overlap between standards. There was agreement that because of the voluntary nature of standards development in this country, it is impossible to force standards developers to drop their activity and work on a standard which overlaps another related standard.
- One participant suggested that standards development can be viewed from two perspectives. One is

from the perspective of systems developers—looking at the total system needs (e.g., ISO/TC184/SC4's Application Protocol (AP) 210). The other is from the perspective of a point solution (e.g., the way the Electronic Design Interchange Format (EDIF) came about). These two directions led to the overlap of AP 210 and EDIF as the standards evolved within their respective communities. However, this does not necessarily imply that one or the other provides the industry with a complete solution.

- Any global solution to ECCI will require a set of complementary standards; one standard will not be sufficient.
- The best interest of the industry will be served if the VSIA considered using ECIX standards to exchange information about "virtual components."

4.1 Panel 2: Forward Plans

Based on the input from the workshop, the NIST Electronic Information Technologies Group (EITG) will work with Si2 to determine if the current dictionary translator software can be extended to handle JEDEC's dictionaries. NIST, Si2, CIREP and ECALS representatives agreed to plan on a follow-up meeting in November or December of 1998 to begin defining the details of an international interoperability testing project.

4.2 Demonstrations

Most of the participants elected to present information and/or demonstrations of their activities in the area of electronic commerce of component information. On Wednesday evening, July 15, time was provided for these presentations/demonstrations, which included presentations by the following organizations: IBM, ECIX, Viewlogic, NIST, Si2, ORCAD, InfoQuick, and Digital Market, Inc.. The following companies offered to provide demonstrations upon demand: IHS, Questlink, ASC.

5. Panel 3: Interoperability and Lessons Learned

Panelists:

Jim St.Pierre—NIST (Chair),
Steve Weitzner—EE Times,
Preet Virk—ViewLogic/Synopsys,
Steve Thompson—NIST,
Betsy Dunphy—IBM,
Allen Hefner—NIST,
Ron Mayer—Digital Markets.

A key point brought out during this panel discussion was that consistency among the information provided by different manufacturers is very important. Since contract manufacturers can deal with hundreds or even thousands of manufacturers and suppliers, the more consistently the standard is used, the more they will benefit. Some participants also noted that it would be very bad if every supplier used a different dictionary. On the other hand, there are good reasons not to force the use of a single dictionary. In fact, it is a necessity in the case of new technology development, because the developer of a new technology will often define new terms to describe the technology. There seemed to be some consensus during the workshop that JEDEC is most qualified to create a good dictionary for memories. Recommended dictionaries for certain types of components, while not required, might be helpful. Another sugggestion made was that, if many different organizations use many different dictionaries, perhaps the information services companies such as IHS and Aspect could play a role in translating dictionaries, or providing a mapping between dictionaries. This would allow users to compare two components from different manufacturers, that reference different dictionaries to define their terminology (e.g., IEC and JEDEC). Widespread acceptance or recognition of a dictionary would be important before industry would adopt it. A lot of people expressed interest in a freely available dictionary.

Component manufacturers currently provide different levels of information to different customers. In general, they are not yet making comprehensive information (e.g., simulation models, thermal data, geometry information) for the majority of their components generally and freely available via the Internet. It is hard to tell who in the industry—component manufactures, distributors, information-service-companies, or component customers—will be the driving-force for the acceptance of these standards. These groups will need to create the electronic component information before other people can use it. However, OEMs will play a critical role by showing a preference for suppliers who utilize these emerging standards.

Currently different organizations, and even groups within an organization, communicate component information inconsistently. One opinion: it would be helpful to have some "key" that could be used to refer to related information in other systems (e.g., EDA, PDM, ERP, MRP). This discussion about a "key" deteriorated into a part-number focused debate; but a few interesting points about part-numbers were revealed. Not all organizations use or communicate part numbers in a consistent way. Even a single part in a single bill-of-materials can have many different useful part numbers. For example, during design engineers refer to a part number that may

map only to a component's electrical and physical properties. However, the purchasing department refers to the same component by it's "orderable part number," which also specifies how it's shipped (in a bag or a box, etc). In the debate that followed, many different concepts were discussed (manufacturer's part number, orderable part number, internal part number, end-customer part number, mythical-universal-registry-of-part-numbers, and a few others). The number of different approaches to this problem only adds to the confusion. Many organizations do indeed use part numbers to communicate component and bill-of-material information even though that may not be the best way to do so. Resolution of the part number naming and equivalence problem is very difficult. One suggestion that had some merit was for providing a "mapping" between the various types of part numbers for a particular part. This approach would not require a single unique "key," but a key could be assigned to each set of part numbers that are "linked."

While electrical and mechanical properties really are properties of a component itself, "business properties," (such as "price," "lead time," and "availability") may be more a property of the relationship between the organizations involved than the part itself. Possibly, these properties may be out of scope for the ECIX standard; attempts to standardize them now could be a long process and may not meet everyone's requirements.

3.1 Panel 3: Forward Plans

The main suggestion for a follow-on activity for this panel was to pursue mechanisms for improving the ability of end-users to process a bill-of-material. It was generally noted that this a very difficult problem, however it would provide cost savings to the industry if it could be solved. NIST and the IPC agreed to have follow-up discussions regarding this problem. In addition, there were discussions between a NIST Manufacturing Extension Program (MEP) representative and some of the workshop participants regarding ways that small and medium sized enterprises could get improved access to component information, and in particular, part substitution information. One proposal for solving this problem was a pay-per-use system for looking up component information. Such a system would minimize the cost issue for small and medium sized enterprises which can not afford to purchase an expensive component database system.

6. Workshop Forward Plan Development

Two discussion sessions were held regarding forward plans. The first, when most of the participants were present, took place on Thursday afternoon. The second, when only a small cadre of participants remained, took place on Friday morning.

The first discussion session was organized around major conclusions by the attendees that the workshop give direction for future work. The second discussion session specifically addressed proposed work that can and should be done by Si2 (ECIX pilot study methodology), by IEC, and by IEEE. The following key points were raised during the Thursday meeting:

- ECIX related activity

  Virtual components:

  Recommendation: Si2 should work closely with the VSIA on defining standards for exchange of virtual component information. Following the workshop, Si2 members have joined the appropriate working groups of VSIA, and NIST researchers have had discussions with VSIA on how they could best support their standards efforts.

  To help the adoption of ECIX, a toolkit is needed. For example, software tools (e.g., an instance loader (extractor/parser)) which can provide some of the basic infrastructure that everyone will need to adopt the three ECIX standards: PCIS, TDML, CIDS. NIST plans to have ongoing discussions with Si2 regarding what software tools NIST might develop to help support this.

  A formal method for defining different "views of component information" based on use models is needed, and NIST Electronics and Electrical Engineering Laboratory researchers will contact NIST Information Technology Laboratory researchers to determine the status and applicability of the ITL work on "role-based-access" to information.

  ECIX transition plan:

  The current ECIX project is scheduled to end during the summer of 1999, and it is not clear what the status of the project will be at that point. A suggest-

ion was for Si2, industry, and Government to work together to define a life-cycle maintenance plan for the ECIX standards development, adoption, and deployment.

- Dictionaries, tools and accessibility

  Most of the participants saw a need for industry to have free access to standard dictionaries.

  A suggestion was made for this issue to be raised with ANSI.

  In addition, workshop participants interested in free or low cost dictionaries were urged to vote for this at the international level, e.g., IEC and ISO.

- Market needs survey

  This discussion centered on the need to gather end-user's requirements. The Si2 indicated that they were just beginning a project to gather requirements for component information from OEMs. The workshop helped to emphasize the importance of this activity. NIST was asked to participate in this effort to provide support on technical and standards issues.

- Bills of Material

  Recommendation: contact should be made with ISO to review and consider utilizing the appropriate standards in this domain. In addition it was recommended that interoperability with the Object Management Group (OMG) business model should be explored.

  The problem of part number schemas and the need to map equivalent part numbers is still a significant issue. The workshop participants all agreed that it is a large and expensive problem but felt that it is too difficult to solve due to entrenched business practices and a lack of industry interest in cooperating on a solution. NIST was asked to continue investigating ways of minimizing this problem, which would be acceptable to industry.

- Standards coordination and data content

  There was general agreement that the standards process must keep pace with commercial implementations in order to be viable.

  Further investigation is necessary to determine how the product standardization bodies can contribute to specification of data content for component definition (e.g., IEC, IEEE, and JEDEC).

  Recommendation: use of knowledge based information technology together with intelligent agents should be investigated in relationship to locating and using component information.

- Component data quality

  Provide a methodology to support acceptance of new terminology and component classifications.

  Consider CIREP architecture to support value constraints definition.

  Test and confirm compliance to the reference standard.

- Proposed pilots

  A dictionary and thesaurus infrastructure pilot was suggested in order to:

  Verify the ability to capture terms and propagate them at the company, national, and international levels;

  Implement the JEDEC dictionary as a CIDS instance. This idea generated a lot of interest at the workshop. Since the workshop, NIST has been working with both Si2 and EIA (i.e., JEDEC), regarding the development of a software tool to convert the JEDEC dictionary into CIDS format to be used in this pilot;

  Evaluate the CIREP tools and CIREP component modeling paradigm as part of the dictionary pilot;

  Exercise world-wide interaction between ECIX, CIREP, E-CALS; Evaluate the feasibility of manufacturing a printed circuit assembly using ECIX data.

7. Follow on Activities

As a result of this workshop, a follow-on meeting was held in Tokyo Japan, at the EIAJ headquarters, on December 8, 1998, to discuss interoperability testing between the ECIX, CIREP, and ECALS projects. A U.S. proposal for testing was presented at that meeting. The ECALS and CIREP representatives indicated that they needed more time to evaluate the proposal. A schedule was established for submitting comments on the proposal, modifying the proposal, and reaching consensus. A mini-workshop has been tentatively scheduled for March 1999, in Europe, to achieve these goals.

8. References

[1] B. Goldstein, C. Parks, J. St.Pierre, and R.Waxman, Web reference: Report of the Workshop on Electronic Commerce of Component Information: http://megavolt.eeel.nist.gov/~jimstp/ecci/workshopreport/sld001.htm, valid January 28, 1999.

[2] Web Reference: Electronic Component Information Exchange project: http://www.si2.org, valid January 28, 1999.