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Quality of Electronic and Software Intellectual Property Used in System and System on Chip (SoC) Designs

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A list of organizations represented on this committee can be obtained on request to its secretary.

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QUALITY OF ELECTRONIC AND SOFTWARE INTELLECTUAL PROPERTY USED IN SYSTEM AND SYSTEM ON CHIP (SOC) DESIGNS

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IEEE Standard for Quality of Electronic and Software Intellectual Property Used in System and System on Chip (SoC) Designs

Sponsor

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Approved 16 June 2011

IEEE-SA Standards Board

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This standard contains material originally published by the VSI Alliance and currently available in the public domain (http://vsi.org/). Acknowledgment is made to the VSI Alliance, who developed the VSIA-QIP v4.0 spreadsheet and macros, and the QIP Metric Users Guide Version 4.0 document from which some material in this standard was derived.

Abstract: A standard XML format for representing electronic design intellectual property (IP) quality information, based on an information model for IP quality measurement, is defined. It includes a schema and the terms that are relevant for measuring IP quality, including the software that executes on the system. The schema and information model can be focused to represent particular categories of interest to IP users. In the context of this document, the term *IP* shall be used to mean *electronic design intellectual property.* Electronic design intellectual property is a term used in the electronic design community to refer to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media.
Keywords: AMS, analog and mixed signal, design environment, EDA, electronic design automation, electronic system level, ESL, IEEE 1734, implementation constraints, MEMS, microelectromechanical systems, QIP, Quality IP metrics, register transfer logic, RTL, SCRs, semantic consistency rules, use models, verification IP, VIP, XML design meta data, XML schema

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IEEE Introduction

This introduction is not part of IEEE Std 1734-2011, IEEE Standard for Quality of Electronic and Software Intellectual Property Used in System and System on Chip (SoC) Designs.

The purpose of this standard is to provide a unified view of quality measures for *electronic design intellectual property* (IP) to facilitate the use and integration of IP used in electronic system design. These quality measures can be evaluated in the context of the end application to help determine suitability and plan mitigation measures for potential integration gaps. This can enable the continuous improvement of IP used for system design and verification by providing a mechanism for qualitative comparison between such IP. The standard IP quality measures and characteristic exchange format defined can be incorporated into a variety of electronic design automation (EDA) tools. The goal of this specification is to specify a quality standard metric that will account for the variances in designing, verifying and testing the IP, which will result in fair quality assessment, reducing the risk of schedule slip or mask spins due to faulty IP.

The working group consisted of electronic system, IP provider, semiconductor, and EDA companies, and used the VSI Alliance Quality IP (QIP) metric as a baseline for the metrics. The data specified by the standard is extensible in locations specified in the schema. This structure can be used as the basis of both manual and automatic methodologies.

This standardization project provides electronic design and SoC engineers with a well-defined standard that meets their requirements in evaluating and validating IP and enables a step function increase in their productivity. This project also provides the EDA industry with a standard to which they can adhere and that they can support in order to deliver their solutions in this area.

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Quality of Electronic and Software Intellectual Property Used in System and System on Chip (SoC) Designs

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1. Overview

1.1 Scope

This specification defines a standard XML format for representing electronic design intellectual property (IP) quality information, based on an information model for IP quality measurement. It includes a schema and the terms that are relevant for measuring IP quality, including the software that executes on the system. The schema and information model can be focused to represent particular categories of interest to IP users. In the context of this document, the term *IP* shall be used to mean *electronic design intellectual property*. Electronic design intellectual property is a term used in the electronic design community to refer to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media.

1.2 Purpose

The purpose of this standard is to provide a unified view of quality measures for IP to facilitate the use and integration of this IP used in electronic system design. This will enable the continuous improvement of IP used for system design and verification by providing a mechanism for qualitative comparison between such

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IP. The standard IP quality measures and characteristic exchange format defined can be incorporated into a variety of electronic design automation (EDA) tools.

1.3 Design environment

The IP quality specification is a mechanism to express and exchange information about design IP, its development, data management, documentation, verification and validation processes, as well as evaluating the quality and stability of the owning or development organization. While the XML description formats are the core of this standard, describing the quality specification in the context of its basic use model, the design environment (DE), more readily depicts the extent and limitations of the semantic intent of the data. The DE coordinates a set of tools and IP, or expressions of that IP (e.g., models), through the evaluation and manipulation of metadata descriptions of the IP such that the IP can be efficiently integrated into and SoC and reused.

1.3.1 Design intellectual property

Quality IP (QIP) is structured around the concept of IP reuse. *Electronic design intellectual property,* or IP, is a term used in the electronic design community to refer to a reusable collection of design specifications that represent the behavior, properties, and/or representation of the design in various media. The name IP is partially derived from the common practice of considering a collection of this type to be the intellectual property of one party. Both hardware and software collections are encompassed by this term.

Examples of these collections may include the following:

a) Design objects—This can include the following:
   1) Fixed HDL descriptions: Verilog®, VHDL[1]
   2) Verification IP descriptions: Verilog (see IEEE Std 1364™ [B2], IEC/IEEE 61691-1-1 [B1])[2]
   3) Hardened IP descriptions: GDSII, LEF, LIB, LVS, Characterization Reports
   4) Software descriptions: C, C++, etc.
   5) HDL-specified verification IP (e.g., basic stimulus generators and checkers)

b) IP views—This is a list of different views (levels of description and/or languages) to describe the IP object. These views include the following:
   1) Design view: RTL Verilog or VHDL, flat or hierarchical components
   2) Simulation view: model views, targets, simulation directives, etc.
   3) Documentation view: standard, user guide, etc.
   4) Supporting scripts: synthesis, makefile, manufacturing test, etc.

1.4 QIP-compliant enabled implementations

Complying with the rules outlined in this subclause allows the provider of tools or IP to class their products as *QIP compliant.* Conversely, any violation of these rules removes that naming right. This subclause first

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introduces the set of metrics for measuring the valid use of the specifications. It then specifies when those validity checks are performed by the various classes of products and providers: DEs, point tools, and IPs.

a) Parse validity

   1) Parsing correctness: Ability to read all QIP descriptions.

   2) Parsing completeness: Cannot require information that could be expressed in a QIP format to be specified in a non-QIP format. Processing of all information present in a QIP document is not required.

b) Description validity

   1) Schema correctness: Metrics are described using XML files that conform to the QIP schema.

   2) Usage completeness: Extensions to the QIP schema shall only be used to express information that is not currently described in QIP. This information shall be forwarded to the IEEE 1734 committee for potential inclusion in a later release.

c) Semantic validity

   1) Semantic correctness: Adheres to the semantic interpretations of QIP data described in this standard.

   2) Semantic completeness: Obeys all the semantic consistency rules described in Annex B.

These validity rules can be combined with the product class specific rules to cover the full QIP-enabled space. The following subclauses describe the rules a provider has to check to claim a tool or DE is QIP compliant.

A QIP-compliant DE or point tool may read descriptions based on multiple versions of the QIP schema. If the DE or point tool does provide this capability, the effect shall be as if all of the descriptions had been translated by an XSL Transform (XSLT), which converts descriptions from one version to the next.

1.4.1 Design environments

A QIP-enabled DE:

a) Shall follow the parse validity requirements shown in 1.4.

b) Shall do so without losing any preexisting information when modifying any existing QIP descriptions. In particular, it shall preserve any vendor extension data included in the existing QIP description.

1.5 Conventions used

The conventions used throughout the document are included here.

QIP schema is case-sensitive.

1.5.1 Visual cues (meta-syntax)

Bold shows required keywords and/or special characters, e.g., addressSpace. For the initial definitional use (per element), keywords are shown in **boldface-red** text, e.g., **bitsInLau** (see also 1.6).

Bold italics shows group names or data types, e.g., ***nameGroup*** or ***boolean***.

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