IEEE STANDARDS ASSOCIATION IEEE

IEEE-SA and How Standardization Can Enhance Your Business and Career

Case Study in Electronic Design Automation

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Contents

IEEE Technical Societies/Councils

Top-class technical expert base

- Aerospace & Electronic Systems
- Antennas & Propagation
- Broadcast Technology
- Circuits & Systems
- Communications
- Components, Packaging, & Manufacturing Technology
- Computer
- Computational Intelligence
- Consumer Electronics
- Control Systems
- Council on Electronic Design Automation
- Council on Superconductivity
- Dielectrics & Electrical Insulation
- Education
- Electromagnetic Compatibility
- Electron Devices
- Engineering in Medicine & Biology
- Geosciences & Remote Sensing
- Industrial Electronics
- Industry Applications
- Information Theory
- Intelligent Transportation Systems
- Instrumentation & Measurement
- Lasers & Electro-Optics
- Magnetics
- Microwave Theory & Techniques
- Nanotechnology Council
- Nuclear & Plasma Sciences
- Oceanic Engineering
- Power Electronics
- Power & Energy
- Product Safety Engineering
- Professional Communication
- Reliability
- Robotics & Automation
- Sensors Council
- Signal Processing
- Social Implications of Technology
- Solid-State Circuits
- Systems Council
- Systems, Man, & Cybernetics
- Technology Management Council
- Ultrasonics, Ferroelectrics, & Frequency Control
- Vehicular Technology

IEEE Standards

Span a broad spectrum of technologies




Examples:

- Aerospace Electronics
- Broadband Over Power Lines
- Broadcast Technology
- Clean Technology
- Cognitive Radio
- Design Automation
- Electromagnetic Compatibility
- Green Technology
- Ethernet/Wi-Fi
- Medical Device Communications
- Nanotechnology
- National Electrical Safety Code
- Organic Components
- Portable Battery Technology
- Power Electronics
- Power & Energy
- Radiation/Nuclear
- Reliability
- Transportation Technology
- Test Technology

Technology is Opening the World

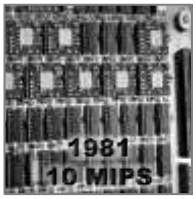
And Now….

1961 – 2011
A 100,000,000X Improvement…

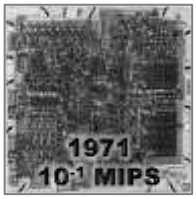
Apollo Guidance Computer, ~100 Microns, MIT

1961 – 1981
A 10,000X Improvement…

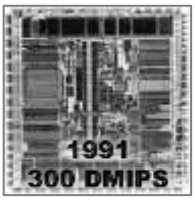
S-1 Supercomputer, ~3 Microns, LLNL



4004, 10 Microns, Intel



EDA Back Then…



Alpha 21064, 0.75 Microns

Itanium, 180 Nanometers, Intel

Ivy Bridge, 22 Nanometers, Intel

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Sources: MIT, 1961; D.E. Weisberg, The Engineering Design Revolution, 2008; 4004, Intel, 1971; Lawrence Livermore National Lab., 1983; Wikimedia Commons; Courtesy of A. Domic; Intel 2001; M. Bohr, Intel, IDF 2011; S. Siers, Intel, ISSCC 2012; Sandra 2011

Helping Design the Chips Inside

Mobile • Smart Everything • Data Center & Networking • Digital Home • Cloud Infrastructure

Computing & Peripherals • Medical • Automotive • Industrial • Military / Aerospace • Other

A 100,000,000X Improvement…

The Role of EDA & IP

Electronic	Smart Everything
Design	Increasingly Complex
Automation	More Sophisticated

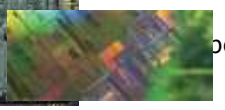
EDA: Where Electronics Begins

- Software "tools" for chip design
  - Architecture design
  - Functional design and verification
  - Physical design and verification
  - Various logic, physical and electrical analyses
- Standards improve productivity
  - Tool interoperability
  - Data exchange, sharing, and consistency

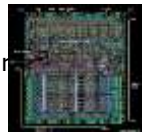
As Technologies Evolve …

- Semiconductor Process: Microns➔SubMicrons➔Nanometer
- Transistor/Gate Count: Thousands➔Millions➔Billions

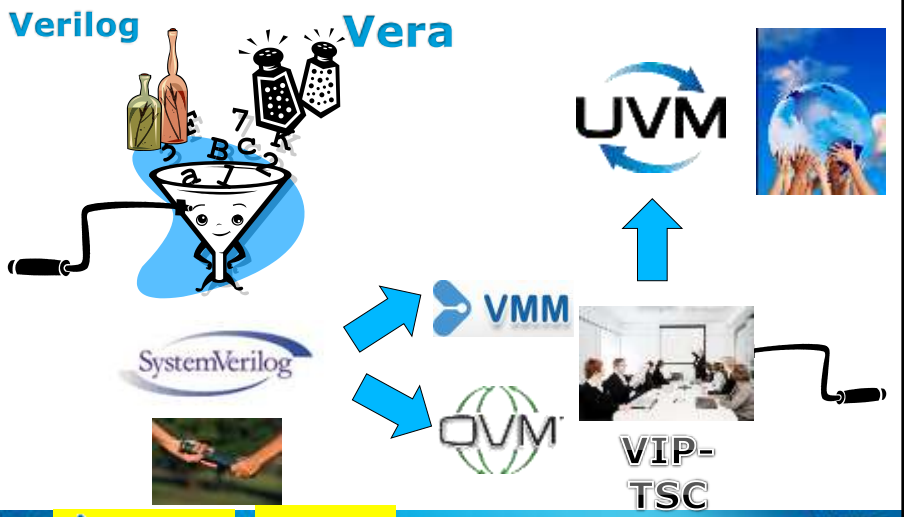
- Desig[illegible]logies: Flat➔Block ➔IP



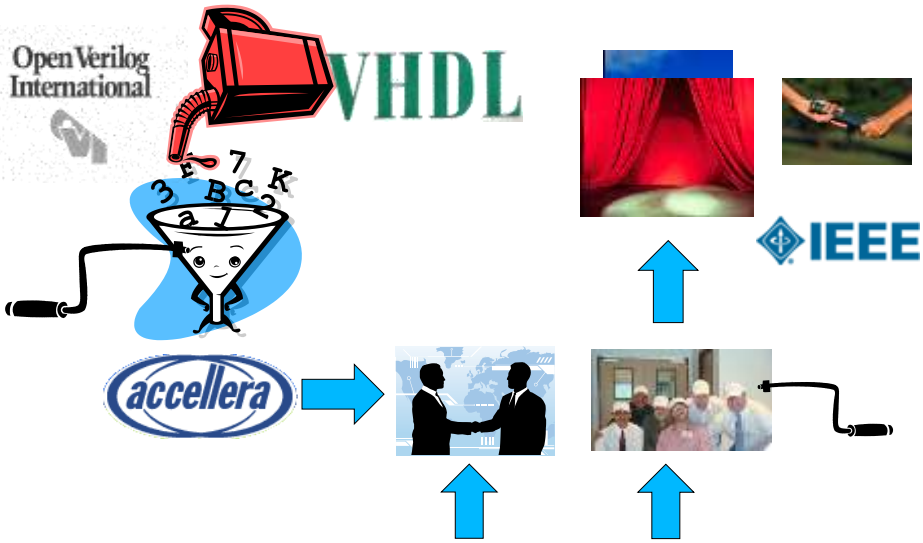
- Verif[illegible]penches➔Envir



… So Do Standards



… and Standards Organizations



EDA Standards Under IEEE

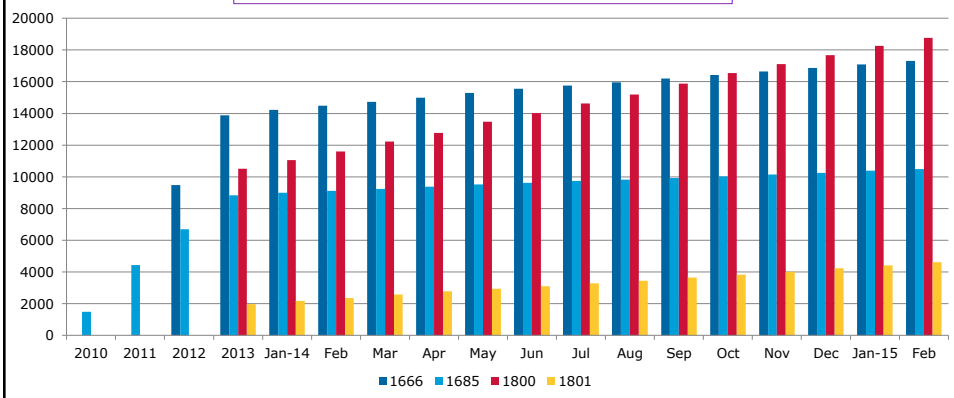
IEEE Std #	Description
1076	VHDL
1149	JTAG (Test)
1364	Verilog HDL
1450	Standard Test Interface Language (STIL)
1481	Delay & Power Calculation System (DPCS)
1647	Functional Verification Language 'e'
1666	**System C LRM**
1685	**IP-XACT**
1734	Standard for Electronic Design Intellectual Property (IP) Quality
1735	IP Encryption and Rights Management
1800	**System Verilog**
1801	**Unified Power Format (UPF)**
1850	Property Specification Language (PSL)

IEEE Standards Access at No Charge

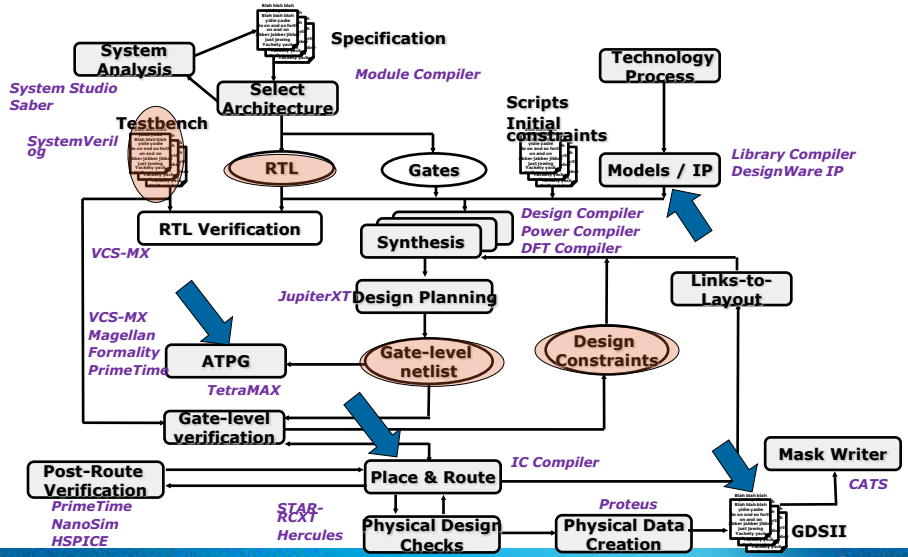
- Accellera Relationship with IEEE-SA: "IEEE Get" program
  - http://standards.ieee.org/about/get/

50,000 downloads!

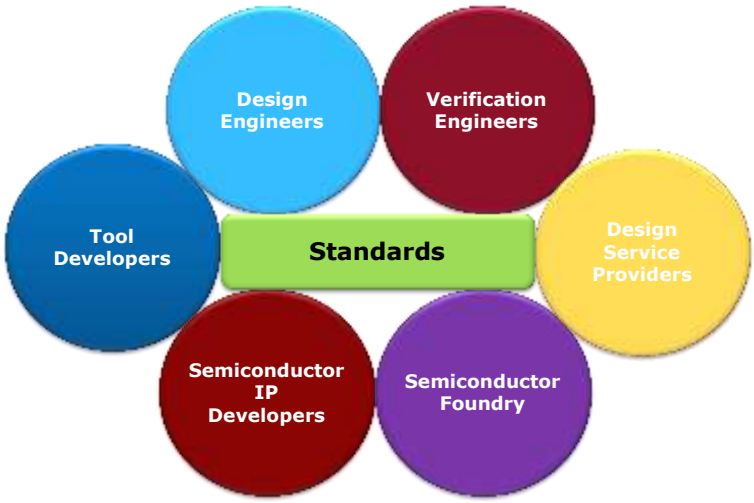
Cummulative Downloads 2010-2015



Example Design Flow: Synopsys Tools



EDA Community and Standards



SystemVerilog Journey

- Ratified as IEEE Std. 1800-2005
  - Started with SystemVerilog 3.1a from Accellera
  - Less than one year from transfer to ratification
  - More than 200 products support the standard
  - Rapid adoption across design and verification community
- Ratified as IEEE Std. 1800-2009
  - Verilog IEEE 1364 completely integrated
  - Large user community looking for design and verification productivity improvement
- Ratified as IEEE Std. 1800-2013 with more enhancements
- **Free tutorial on IEEE Standards Education website**

SystemVerilog Spawned an Entirely New Business Segment

- Enabled/accelerated IP (design blocks) market segment
  - One language to write complex design blocks
  - Same language to verify design blocks
  - Make IP once, sell many times
- Many IP providers for design and verification reuse
  - Networking, wireless, and consumer applications
- Verification IPs as much in demand as design IPs
  - New methodologies invented
    - UVM, Assertion based verification, testbench automation
- Clear inflection point in the industry to deal with large System-on-Chips

Case Study: IEEE 1801/UPF A Low-Power IC Standard

- Ever-growing need for low-power ICs in mobile/portable devices and data centers
- Industry recognized need for low-power IC standard
  - Common way for design and verification engineers to describe IC's low-power properties
- EDA users and vendors came together to develop a format and methodology
  - Effort started in 2006 under Accellera
  - Merged 6 technology donations for multi-faceted requirements
  - Unified Power Format (UPF) created in 6 months
- Ratified as IEEE Std. 1801-2009
  - Less than 18 months under entity process

Case Study: IEEE 1685 IP-XACT

- Meta-data about semiconductor IP
- Composing systems using/reusing IP – consistent, complete
- Originally developed under The SPIRIT Consortium
- Ratified as SPIRIT standard in 2007 (version 1.0, 1.5)
- XML Schemas published
- IP-XACT 1.5 donated to IEEE P1685
- Ratified as IEEE Std. 1685-2010

accellera SYSTEMS INITIATIVE

Standards: Foundation for Research

- Describe new designs/architectures using existing standards
  - SystemVerilog, SystemC
- New algorithms for design optimization, transformation
  - SystemC → SystemVerilog
- New methodologies
  - Low power, System verification
- Power optimization with better testability
- 3D design, verification and test methods (new standards?)
- Analog/mixed-signal automation
- IP integration and validation
- Software development using virtual hardware

New Standards: Area for Research

- What makes a good EDA standard?
  - Language/format
  - API (Procedural Interface)
  - Open Source Implementation
  - More …
- Application specific standards?
  - EDA for Automotive applications, Health Devices, …
- Patents and IP Rights

- Make your research 'industry-relevant'
  - Demonstrate use through formal or de facto standards

Importance of Standards Education

- Standards education recognizes the key role standards play within the engineering, technology and computing fields.
- Knowledge of standards can help facilitate the transition from classroom to professional practice by aligning educational concepts with real-world applications.
- Incorporating standards into the curriculum …
  - Benefits students and faculty mentors as they face challenging design processes
  - Provides tools for use in learning about standards and their impact on design and development
- Visit **standardseducation.org**
  - Grants for standards based projects

Summary

- ✓ EDA users and vendors have embraced IEEE standards for three decades.
- ✓ Large user community active in development of standards along with vendors.
- ✓ Standards help broaden infrastructure for the entire industry and academia.
- ✓ Education of EDA standards in engineering curriculum is highly significant.
- ✓ Standards based research accelerate innovation.

Thank you!

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