OpenAccess: The EDA Infrastructure
Created by the User, For the User

April, 2009

Sumit DasGupta
Senior Vice President, Engineering
Silicon Integration Initiative (Si2)
9111 Jollyville Road, Suite 250
Austin, TX 78759
Silicon Integration Initiative

Introduction
Who We Are

• Si2 Mission
  ♦ Improve *interoperability* and *integration* across silicon design flows
    ➢ Advantages in cost, time to market, and IC performance
    ➢ Includes integration with manufacturing

• Membership (as of 04/01/2009)
  ♦ 89 corporate members
  ♦ See updated list on [Si2 Member List](http://www.si2.org/?page=28)

• Philosophy
  ♦ Business focus on collaborative solutions to shared problems
  ♦ Customer-centric, but leveraging strong supplier partnerships

• Approach
  ♦ Dedicated technical staff and infrastructure for complex needs
  ♦ Holistic approach to market-oriented adoption success
Value Proposition: Economics of Collaboration

- Cost sharing offers “1/N” leverage
- Standards can enable new growth
- No one has monopoly on good ideas
- Partner with leaders in supply chain
  - Confidence by being a co-owner
  - Shared control of industry destiny
OpenAccess Goals

- Provide IC design tool infrastructure that yields
  - Integrated systems rather than sequential flows
  - Choice of design tools and provider
  - Technology transfer of innovative research
  - Collaborative design capability for ICs

- Promote an open standard for IC design data access

- Gain adoption of the standard within the EDA industry and university research programs
OpenAccess Success Examples

IBM’s “z6” Microprocessor:

- High-frequency z-arch. microprocessor core
  - 4+ GHz system operation
- 4 cores per die
- 3MB level-2 cache per core
- 24MB shared level-3 cache
- 4 levels of concurrent hierarchy
- Accelerator engines
  - Data compression
  - Cryptographic functions
  - Decimal floating point
- Integrated SMP communications
- System Interfaces
  - 2 x 48 GB/sec SMP Hub
  - 4 x 13 GB/sec Memory
  - 2 x 17 GB/sec I/O

Technology Details:
- 65nm SOI process
- 991 million transistors
- 6 KM of copper wire
- 21.7mm x 20mm (434 sq. mm) die
- 1188 signal / 8765 total chip I/O’s

References:
Charles Webb, “IBM z6 – Next Generation Mainframe Microprocessor”
Joe Morrell, “OA Adoption: End-User Perspective – An Update”
Innovation Through Collaboration

OpenAccess Success Examples

Renesas’ Prototyping Environment

System Design
(User Interface)

Prototyping

Physical Design
(background method)

Function Blocks

Logical-Physical Collaboration

C Level designs

System Spec.
Black Box
RTL

Netlist

Floorplan

Generate FP

Path Analysis

Design Topology

SDC

Path Analysis

Wire/hierarchy

Layer/Area

Area Timing Power

OpenAccess v2.2 or later

Silicon Integration Initiative

Renesas’ Prototyping Environment

Tr. Level

Library
OpenAccess Success Examples

Cadence Mixed Signal Solution on OpenAccess

Custom / Analog Chip Assembly & Finishing

Digital Chip Assembly & Finishing

ECO sees all non-P&R objects

OpenAccess enables easy concurrent data transfers

Virtuoso

Encounter
Complete & Comprehensive Solution from Synopsys

• Unified environment on OpenAccess
• Familiar look and feel
• Full custom chip and block authoring flows
OpenAccess Success Examples

Traditional Approach
- Multiple Tools & DBs
- File Based Integration

Multi-Vendor Chip Implementation Flow
- Single Common OA-based Repository
- Shared In-memory Run-Time-Model
- Flow Integration Through Tcl

OpenAccess-Based Chip Implementation Flow

Shell Scripts
Innovation Through Collaboration

OpenAccess Success Examples

SoftJin’s OA to OASIS Translator

Bi-Directional OpenAccess to OASIS Translator

Enables direct conversion of design files from the OpenAccess database to OASIS and OASIS back to OpenAccess, without going through any intermediate format.

Key Advantages

• Cuts down conversion time of OpenAccess to OASIS and vice-versa by half as compared to the conventional approach of going through GDSII

• Minimizes storage space during conversion - Direct conversion avoids this data size explosion.

• Prevents any loss of information during the conversion process


Innovation Through Collaboration
OpenAccess Components

The Standard

- API Interface (C++ Binding)
- Information Model (Graphical)
- API Specification (HTML)

Non-Core Contributions

- Translators: LEF/DEF, Verilog, SPEF, GDS2
- Python
- OA Debug
- Symbol Library
- OA Gear
- PCell Caching
- OA Viewer

Applications

OA Core

- RunTime Model
- Persistent Store
- Base Model

The Reference Implementation

OA Extensibility Technology

Plug-In Enabler
Design Flows aka Nightmares Past!

Life in the Slow and Not-So-Easy Lane!

Tool from Vendor A

App 1 → Trans 1 → App 2

Tool from Vendor B

Trans 2

Writing translators: Compelling job description for a PhD?
Or, how to drive him/her to your competition!

Reality Check:
- Translators needed with or without internal tools, e.g., between tools from different vendors or different tools from same vendor
Life in the Fast Lane:

OpenAccess:
- Designed to:
  - Enable tool interoperability
  - Reduce need for translators
  - Create common syntax and semantics
- RTM is application-specific and memory-efficient
- Private RTM may be application-specific and can be considered, case-by-case, as temporary / transitional solution
OpenAccess Benefits: End-user - Design

- Single storage per data type, hence no duplication, conflict, confusion

- Significant reduction in data translation, leading to optimized, higher performance flows
  - Simpler design flows, hence simpler scripts for same complexity of design
  - Reduces/eliminates performance impact on design flows

- Strong enabler for distributed design teams
  - Modern integrated database removes headache of managing large, loosely-connected set of files
OpenAccess Benefits: End-user - EDA

- **Saves investment in proprietary API, data model & database solution**
- **Enhances interoperability with vendor tools**
  - Reduces/eliminates investment to develop/maintain translators
  - Plug-and-play access to new tools reduces integration costs
  - Reduces/eliminates performance impact of translators on design flows
- **Allows focus on core competencies, i.e., developing value-added internal tools and customized flows**
- **Leverages collective knowledge base and contributions of OpenAccess community at reduced cost (~1/N), including academia**
OpenAccess Benefits: EDA Companies

- **Large EDA companies:**
  - Easier access to customers
    - Simpler integration into their flows
  - Less interfacing effort
    - Focus on tool development
  - Easier to integrate tools when purchasing small vendors

- **Small EDA companies (start-ups):**
  - Reduces barrier to entry, i.e., quicker “startups”, faster ROI
    - Focus on tool development, not custom infrastructure
    - Custom infrastructure often barrier to acceptance
  - Less interfacing effort
    - Quickly sell to a larger market
OpenAccess Benefits: Universities

- **Access to commercial database and its users**
  - Ability to influence standard
  - Early training of students on industry standard

- **Potential for research on tightly-coupled applications and flows**
  - Access to industry benchmark examples by breaking the "Benchmarking Conundrum"

- **Ability to streamline technology transfer**
  - Research tools can be more readily integrated into commercial flows
Benchmarking Today:

**Industrial Design Environment**
- Identifies critical problems as part of leading-edge design efforts
- Works with academia to identify and solve above problems, but,…
- Unwilling to release leading-edge test cases to evaluate academic research results for fear of losing IP

**Academic Research Environment**
- Researches & solves problems identified by industry
- Requires cutting-edge, industrial-grade benchmark test cases to verify solution that addresses problem

**Tool to be benchmarked**
Innovation Through Collaboration

Benchmarking: A New Paradigm!

Benchmarking based on OpenAccess:

Industrial Design Environment

- Tools
- OA API
- OA DB

- Works with academia to identify and solve above problem, but,...
- Identifies critical problem as part of leading-edge design efforts
- Assists academic partner benchmark solution using leading-edge design within corporate network, then transfers normalized results to academic partner
- Industry gets proven solution to problem inhibiting progress without releasing IP

Academic Research Environment

- Tools
- OA API
- OA DB

- Researches & solves problem identified by industry
- Installs solution in industrial partner’s internal design system to benchmark in partner’s environment
- Academics get proof-of-concept and publication data

Experimental tool
**2003 Membership**
- Single tier membership
- Member companies: 16

**2009 Membership**
- New revenue-based membership
- Current membership: 30 and growing

**14 New Members**
Adoption Progress & Presentations

- **Early adopters**
  - LSI, HP, and Cadence, of course
- **Active ongoing adoption by OAC members**
  - AMD, IBM, Intel, NXP, PA Semi (Apple), Renesas, Sun
  - AnaGlobe, Atrenta, Ciranova, Dolphin Integration, Entasys, Gradient, HP, In2Fab, JEDAT, Magma, MatrixOne, Mentor Graphics, Pulsic, Pyxis, Sequence, SIINT, SpringSoft, Synopsys, and of course, Cadence
- **Other active OpenAccess community members**
  - Altera, AMI Semiconductor (On), Apache Design, ARM, Avago, ClioSoft, eASIC, Freescale, Infineon, Marvell, Micron, National Semiconductor, Sagantec, SoftJin, Voom
- **University / Research interest in OpenAccess (past/present)**
  - Courses using OpenAccess – UCB, UCLA, NCSU
  - Research Projects – UCLA, NCSU, (UCSD, U. Michigan & CMU) with CBL
  - Growing interest in Asian academic institutions
  - **OA Gear** – Timing engine, GUI, placement engine, …

Note:

See next slide for available hyperlinked presentations
Names in “green” have adopted OpenAccess, rest in process of adoption/evaluation
Adoption Presentations

- HP (http://www.si2.org/events_dir/2008/oacfall2008/hp.pdf)
- Cadence (http://www.si2.org/events_dir/2008/oacfall2008/Cadence.pdf)
- IBM (http://www.si2.org/events_dir/2008/oacspring2008/ibm.pdf)
- Renesas (http://www.si2.org/events_dir/2008/oacfall2008/Renesas.pdf)
- Atrenta (http://www.si2.org/events_dir/2008/oacfall2008/Atrenta.pdf)
- Ciranova (http://www.si2.org/events_dir/2008/oacfall2008/ciranova.pdf)
- Pyxis (http://www.si2.org/events_dir/2008/oacspring2008/pyx.pdf)
- Synopsys (http://www.si2.org/events_dir/2008/oacfall2008/Synopsys.pdf)
- AMI Semiconductor (On) (http://www.si2.org/events_dir/2006/oaconfspring2006/AMIS.pdf)
- eASIC (http://www.si2.org/events_dir/2008/oacfall2008/eASIC.pdf)
- OA Gear (http://www.si2.org/events_dir/2006/oaconfspring2006/oagear.pdf)
## Adoption Progress in EDA Industry

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Tool</th>
<th>Description</th>
<th>Web Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrenta</td>
<td>1Team: Implement</td>
<td>Unified physical planning, design, implementation</td>
<td><a href="http://www.atrenta.com">http://www.atrenta.com</a></td>
</tr>
<tr>
<td>CiraNova</td>
<td>PyCell Studio</td>
<td>Creation &amp; re-use of interoperable, parameterized cells (PCells)</td>
<td><a href="http://www.ciranova.com/">http://www.ciranova.com/</a></td>
</tr>
<tr>
<td></td>
<td>Poell Xtreme</td>
<td>Enables OpenAccess tools from multiple vendors to utilize PCells written in any language</td>
<td><a href="http://www.ciranova.com/">http://www.ciranova.com/</a></td>
</tr>
<tr>
<td>Dolphin Integration</td>
<td>SoC GDS</td>
<td>GDS viewer</td>
<td><a href="http://www.dolphin.fr">http://www.dolphin.fr</a></td>
</tr>
<tr>
<td>In2Fab</td>
<td>OsiRIS</td>
<td>Design migration software</td>
<td><a href="http://www.in2fab.com/">http://www.in2fab.com/</a></td>
</tr>
<tr>
<td>OASIS Tooling</td>
<td>OpenAccess-Oasis Translators</td>
<td>Translators</td>
<td><a href="http://www.oasistooling.com">http://www.oasistooling.com</a></td>
</tr>
<tr>
<td>Pulsic Limited</td>
<td>Unity</td>
<td>Complete physical design platform</td>
<td><a href="http://www.pulsic.com">http://www.pulsic.com</a></td>
</tr>
<tr>
<td>Pyxis</td>
<td>NexusRoute</td>
<td>Yield-aware router</td>
<td><a href="http://www.pyxis-tech.com">http://www.pyxis-tech.com</a></td>
</tr>
<tr>
<td>Sequence Design</td>
<td>PowerArtist</td>
<td>RTL power reduction tool</td>
<td><a href="http://www.sequence-design.com">http://www.sequence-design.com</a></td>
</tr>
<tr>
<td>Si2</td>
<td>Si2 things debug</td>
<td>Displays OpenAccess objects, their attributes and associations with other objects</td>
<td><a href="http://www.si2.org/openeda.si2.org/">http://www.si2.org/openeda.si2.org/</a></td>
</tr>
<tr>
<td></td>
<td>Si2 Delta</td>
<td>Displays difference between 2 versions of OA API documentation</td>
<td><a href="http://www.si2.org/openeda.si2.org/">http://www.si2.org/openeda.si2.org/</a></td>
</tr>
<tr>
<td>Silicon Navigator</td>
<td>RDE Framework</td>
<td>Complete design and development environment</td>
<td><a href="http://www.sinavigator.com">http://www.sinavigator.com</a></td>
</tr>
<tr>
<td></td>
<td>OA-OASIS Translator</td>
<td>Translators</td>
<td><a href="http://www.oasistooling.com">http://www.oasistooling.com</a></td>
</tr>
<tr>
<td>Teklatech</td>
<td>FloorDirector</td>
<td>Floorplanning and clock distribution</td>
<td><a href="http://www.teklatech.com">http://www.teklatech.com</a></td>
</tr>
<tr>
<td>VOOM</td>
<td>Mower</td>
<td>Milkyway-to-OTA Translator</td>
<td><a href="http://www.voom.net">http://www.voom.net</a></td>
</tr>
</tbody>
</table>

Please contact Si2 for additions/corrections: [http://www.si2.org/?page=455](http://www.si2.org/?page=455)
OpenAccess Adoption Support

- **OpenAccess evolution**
  - Si2.org hosts coalition, Change Team, working groups, and provides related support services through multiple wiki-sites

- **OpenAccess training for tool developers and designers**
  - Comprehensive training regime: Si2 eBook in PDF and online course
  - Online documents provide searchable, instant access to documentation

- **OpenAccess development and debugging support provided via multiple contributions**
  - Python bindings (from LSI)
  - FreePDK45 Generic Open Cell Library (from Nangate) based on 45nm FreePDK Base Kit (from NCSU)
  - Si2oaDebug (from Si2) simplifies debugging OpenAccess implementation, tools, data
  - oaDff (from Si2)
  - oaViewer (from Synopsys)
OpenAccess Adoption Support

- **OpenAccess dissemination**
  - OpenEDA website
    - Common distribution point for code, specs, application notes
    - Trackers, forums to organize, archive and exchange information
    - Centralized repository for related areas: OMC, DTMC
  - OpenAccess public wiki-site
    - Promotes community collaboration and communication
  - OpenEDATools website
    - Enabler for community, university collaborative development
  - OpenAccess events
    - 2 OpenAccess Conferences per year
    - Multiple panel sessions at external conferences
    - Press releases and articles in industry newsprint, e.g., EE Times
  - OpenAccess Tools List
    - Lists OpenAccess-compatible applications
For more information, visit:

www.si2.org

Contacts:

Sumit DasGupta (dasgupta@si2.org)

Nick English (nenglish@si2.org)

Thank you for your time!