OpenAccess:
Goals and Status

DAC, 2003
Outline

- OpenAccess Goals
- OpenAccess Coalition (OAC) Structure, Process and Participation
- OpenAccess Technology
- OA Proliferation and Progress
- OpenAccess Status/Summary
Openness Requires...!

- Accessible by all parties:
  - Anyone can use, change, embed, or redistribute according to clearly established terms

- Reasonable cost:
  - Established prices (if any) are based on service value and do not present an undue barrier to any company, regardless of size

- Managed migration by stakeholders:
  - Controlled evolution of the technology by an elected Change Team

OpenAccess meets these criteria
OpenAccess Goals

- Provide an 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 Benefits: End-users

- Saves investment (people and dollars) in proprietary API/data model/database solution

- Enhances interoperability with vendor tools
  - Saves 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

- Leverage collective knowledge base and contributions of OA community, including academia
Open Access 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:**
  - Reduces barrier to entry, i.e., quicker “startups”, faster ROI
    - Less infrastructure to develop
    - Custom infrastructure may be barrier to acceptance
    - Focus on tool development
  - Less interfacing effort
    - Quickly sell to a larger market
OpenAccess Benefits: Universities

- Access to commercial database and its users
- Ability to influence standard
- Access to industry benchmark examples
- Potential for research on tightly-coupled applications and flows
- Ability to streamline technology transfer
EDA Interoperability Genealogy

Process level integration

Multi-vendor integrated systems

01/2003

Single vendor integrated systems

Proprietary Data APIs

Loosely coupled systems

Open File Formats

Tool-Data Binding

Proprietary File Formats

Open Data API

Design to Manufacturing Data Sharing

Open Source ... Open Architecture ... Open Industry ... Open for Business
Outline

- OpenAccess Goals
- OpenAccess Coalition (OAC) Structure, Process and Participation
  - OpenAccess Technology
  - OA Proliferation and Progress
  - OpenAccess Status/Summary
Coalition members have specific rights and responsibilities

- Share in funding
- Operate to open, unbiased decision-making policy
- Abide by OpenAccess Participation agreement terms, and joint funding for development and facilitation
- Guide future of API and Reference Code
- Elect Change Team to manage revisions

Coalition member benefits

- Early access to planned/future releases of reference database code
- Participate in Change Team and Working Groups
- Set direction and vote on development priorities
- All things equal, higher priority for member requests
- Discounted training, support and access to Si2
OpenAccess Change Team

- **Makeup**
  - 12 annually-elected Coalition company representatives
    - 1 representative per company, 1 vote per company
    - Max of 5 EDA companies (4 plus Cadence)
  - Chaired by 2 architects who must be CT members (Cadence and 1 elected non-EDA company)
  - Approval of change requires 9 “Yes” votes

- **Responsibilities**
  - Approving body for API & Reference DB changes
  - Specifies changes to code integrator
  - Caretakers for OA Technical Roadmap
  - Charters working groups to analyze/solve key problems
  - Change Team may collectively agree to delegate vote to architects in which case both must agree to approve the change
  - If Change Team has less than 12 members and a proposed change receives 75% approval, then architects (by unanimous vote) make up missing votes
Chartered to analyze specific problems and recommend solutions to Change Team

**Current working groups:**

- **Tech:** Solve problem of representing technical manufacturing constraints and rules, considering current applications for SIPPS standards.
- **DDM:** Analyze and solve problem for library directory structure optimization. Activity targeted for Rel. 2.2.
- **Golden Gate:** Analyze bridging between Milky Way and OA. Initial effort focused on creating mapping document to show mapping between OA and Milky Way and roadmap for 2003 & 2004. Bridging software to be based on mapping document.

**Completed working groups:**

- **Occurrence and L/P:** Defined approach for occurrence model and means to represent both logical and physical hierarchies in design in unified manner (Embedded Module Hierarchy). Results will be in Rel. 2.1 (07/2003)
- **Extensibility:** Develop requirements and specs for capability to extend common model and associated functions with new elements, attributes and relationships without requiring change to OA API standard
- **Parasitics:** Define means to efficiently/comprehensively represent RLC parasitic data in OA model. Currently dormant.
Open Source … Open Architecture … Open Industry … Open for Business

OpenAccess Structure/Membership

<table>
<thead>
<tr>
<th>Cadence</th>
<th>Philips</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP</td>
<td>Sagantec</td>
</tr>
<tr>
<td>IBM</td>
<td>ST Microelectronics</td>
</tr>
<tr>
<td>Intel</td>
<td>Sun</td>
</tr>
<tr>
<td>LSI Logic</td>
<td>Synchronicity</td>
</tr>
<tr>
<td>Mitsubishi</td>
<td>Synplicity</td>
</tr>
<tr>
<td>Motorola</td>
<td>Tektronix</td>
</tr>
<tr>
<td>Nassda</td>
<td>Artisan*</td>
</tr>
</tbody>
</table>

OpenAccess Community

Governing Coalition

12 Member Change Team

Two Architects

Working Groups
Outline

- OpenAccess Goals
- OpenAccess Coalition (OAC) Structure, Process and Participation
- OpenAccess Technology
- OA Proliferation and Progress
- OpenAccess Status/Summary
What is OpenAccess?

- Commercial EDA Tools
- Internal Proprietary Tools
- University Research

HDL

Standard API

Reference Database

Cores/Cells

Gates

Transistors

Layout

Founded on a Technology Transfer from Cadence Design Systems
Scope of Applications

- Synthesized RTL to Silicon
- Digital and Analog
- Std. Cell and Custom
- Macro cells to Transistors
- Logical and Physical
- Batch or Interactive
OA features:
- Standard information model for IC design data
- Standard C++ interface (API) to access, manipulate and store data
- Reference, commercial-grade database compliant with API
- Translators to industry-standard formats
- Development support aids

OA provides:
- Greater design productivity
  - Standard Model & API provide for choice & tighter design flows
- Reduced development and support cost
  - Reference DB provides solution for IC designers and EDA developers right out of the box
- Better interoperability
  - Reference Database provides “golden behavior” for development & test, & for interoperability issue resolution
API Features

- **Strongly typed**
  - Less chance of errors

- **Data representation independent of machine width**
  - 32 bit, 64 bit support

- **Multi-platform support**
  - Automatic byte-swapping

- **Thread-safe (07/2003)**
  - Support parallel processing
### Design Data
- Hierarchical connectivity
- Floorplan information
- Physical layout
- Special routing types
- Shapes
- Pins and vias
- Parasitics (detailed and reduced)
- Scan chains
- Extension objects (groups, properties, etc)
- Timing (through extensibility feature now, will be added as part of design data after definition of timing data specs)
- Occurrence model and EMH (07/2003)

### Technology Data
- Layer constraints
- Technology characteristics
- Technology constraints

### Library Management
- Design hierarchy
- Access control
Open Source ... Open Architecture ... Open Industry ... Open for Business

Open Access Deliverables

The Standard

- Information Model (Graphical)
- Data Model (C++ Headers)
- API Specification (C++ Binding)

The Reference Implementation

- Runtime Memory
- API Implementation (Solaris/HP-UX/Linux, C++ Binding)
- Persistent Store

Application(s)
Application Integration

File Exchange

- File Format
- Translator
- OpenAccess API
- OA Runtime

Tightly Coupled (Cooperative, Incremental)

- Applications
- DLL
- OpenAccess API
- OA Runtime
- Persistent Store

Data Exchange

- Application
- Private Runtime
- OpenAccess API
- OA Runtime
Life in the Slow Lane:

App 1 → Trans 2 → App 2 → Trans 3

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

Life in the Fast Lane:

App 1 Internal → App 2 Internal → App 3 Vendor → App 4 Vendor

OpenAccess API

OA RTM → OA DB

App 4 RTM

By design, OA:
- Enables tool interoperability
- Reduces need for translators
- Creates common syntax and semantics even in non-ideal case
- RTM is context-sensitive and memory-efficient
- Private RTM may be application specific and can be considered, case-by-case, as temp. solution
Example of API Benefits

900k gates + 4 rams
260k cells, 250k nets

45 secs vs. 110 mins
Outline

- OpenAccess Goals
- OpenAccess Coalition (OAC) Structure, Process and Participation
- OpenAccess Technology
- OA Proliferation and Progress
- OpenAccess Status/Summary
Connecting With EDA Industry & Users

- **DAC, 2003: OpenAccess adoption is reality!**
  - **Compelling base** of OA functionality available from OpenEDA website
  - **Strong leadership** from EDA/end-user companies to drive standard
  - OpenAccess evolving with greater capabilities – **Roadmap defined!**
  - **Multiple EDA/end-user companies** creating/porting tools to OA
    - 7 showing products at booth
  - **Downloads** from OpenEDA website rising daily
    - 744 downloads/month, 800 licenses issued in 2003!

LSI Logic
Synchronicity
Sagantec
MicroEDA
1N2FAB
Silicon Canvas
Focus on US Universities
- NCSU
  - Rhett Davis teaching OA-based course
  - Submitted research proposals to SRC for OA-based flow research
- U. of Michigan
  - Student trained to apply OA to GSRC P&R algorithm research
- UC, Santa Cruz
  - Student trained and starting to apply OA to algorithm research
  - Has ported OA 2.0 to Linux and donated to Si2
- Others
  - Students from UCLA and UC, San Diego trained in OA
  - UT, Austin planning to download OA for training & evaluation

Focus on European Universities
- Meetings held during DATE week to begin engagement
- Discussions underway with universities/organizations in Germany:
  - U. of Hannover (Barke)
  - U. of Bonn (Korte)
  - Edacentrum (Haase)
- Universities/organizations in France:
  - U. PMC has signed OA source license agreement to download, evaluate and use for research
Moving Forward: OA Roadmap!

Key items for OA 2.1:
- Occurrence Model / EMH
- Multi-threading
- Plug-in for custom region query
- Data loading by LPP
- ........

Key items:
- Support timing/electrical constraints
- X-routing support
- Standardized process modeling for RLC extr.
- Functional model support.
- Enhanced tech. data support (for OPC/PSM & package-level analysis)
- Additional translators for industry-standard formats,.....

Key items:
- Support design-to-manufacturing
- Library modeling
- System-in-package
- Library & design data management
- Manufacturing test
- IP security
- Control-level tool communication APIs,.....

Key items:
- Formal transistor-level modeling support
- Support behavioral-level data models
- Support architectural-level data models,.....
GoldenGate Data Exchange Usage

...its implementation  ...and its performance benefits

User Automation

Database Pump

using incremental data transfer

MW App

API
rt
MW

MW db

OA App

API
rt
OA

OA db

Open Source ... Open Architecture ... Open Industry ... Open for Business
GGWG Goals

Potential Short-Term Goal

OA Apps

OA API

OA RTM

Ref. DB

MW Apps

MW API

MW RTM

MW DB

Bridge

Long-Term Goal

OA Apps

OA’ API

OA’ RTM

Ref. DB

MW Apps

MW DB
### GGWG Roadmap Targets

<table>
<thead>
<tr>
<th>Objective</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preliminary Mapping between OA and MW complete:</strong></td>
<td>07/2003</td>
</tr>
<tr>
<td>- Identify Basic Objects for physical, hierarchical connectivity</td>
<td></td>
</tr>
<tr>
<td>- Identify the Correspondence between MW and OA for these objects</td>
<td></td>
</tr>
<tr>
<td>- Identify Basic Operations required on basic objects</td>
<td></td>
</tr>
<tr>
<td>- Initial Mapping Rules</td>
<td></td>
</tr>
<tr>
<td><strong>Preliminary Development Logistics:</strong></td>
<td>07/2003</td>
</tr>
<tr>
<td>- Ownership / Copyright plan from Si2/Synopsys</td>
<td></td>
</tr>
<tr>
<td>- Identified sites and resources for collaborative development</td>
<td></td>
</tr>
<tr>
<td>- Identification of Alpha and Beta customers</td>
<td></td>
</tr>
<tr>
<td><strong>Prototype software:</strong></td>
<td>TBD</td>
</tr>
<tr>
<td>- Write bi-directional emulation layers for subset of basic objects</td>
<td></td>
</tr>
<tr>
<td>- Prepare test data for &quot;round trip&quot; tests</td>
<td></td>
</tr>
<tr>
<td>- Verify emulation layers AND mapping accuracy with Alpha customer data</td>
<td></td>
</tr>
<tr>
<td><strong>Real Software, Beta Phase:</strong></td>
<td>TBD</td>
</tr>
<tr>
<td>- Re-write prototype software, as needed</td>
<td></td>
</tr>
<tr>
<td>- Beta test with customers, verify completeness</td>
<td></td>
</tr>
<tr>
<td>- Begin performance tuning</td>
<td></td>
</tr>
<tr>
<td><strong>First release of “Bridge” software:</strong></td>
<td>TBD</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UDM - Common Data Model Concept

**Design**
- Tape Out
  - Layer Filtering
  - Scaling/Shrinking
  - RET
  - Logical-Physical Verification
- Data Prep
  - Tonality/Mirroring
  - Sizing
  - Fracturing
  - Job Composition
- Mask Making
  - Writing
  - Inspection/Repair
  - Metrology
- Wafer Fabrication
  - Lithography
  - Metrology
  - Yield Analysis
  - Test

**Common datamodel and access**
- read/write
- incremental
- 64-bit
- thread safe
- ...

OpenAccess
Outline

- OpenAccess Goals
- OpenAccess Coalition (OAC) Structure, Process and Participation
- OpenAccess Technology
- OA Proliferation and Progress
- Next Steps
OpenAccess : Call to Action

- **Formulate: Your corporate strategy, re: OA**
  - Download, evaluate (“kick the tires”) the code
  - If end-user, determine your ROI, push your suppliers
  - If EDA company, check what your customers want
  - Buy the book and accelerator kit
  - Sign up for training

- **Get involved: Support the goals of the coalition**
  - Port your code to OA
  - Push your suppliers towards OA
  - Join coalition to guide OA strategy to keep it aligned to your corporate strategy

- **Si2 connections:**
  - Bob Carver: bobc@si2.org
  - Sumit DasGupta: dasgupta@si2.org
  - Bayer: bayer@si2.org