Liberty/ALF Harmonization Project

October 16, 2003
Motivation

• Complexity of design flows and tools
  • Multiple library views for increasing number of tools
• Expensive library preparation
  • Frequent version change of tool-specific libraries
• Advantages of standard library description
  • Reduced cost, increased quality
  • Resource and time saving for library creation and validation, leverage 3rd party library sources
  • Facilitate tool interoperability
  • Anticipate and prepare for technology innovations
Assessment

- Liberty and ALF are the strongest candidates for a unified library standard
- Liberty is the most popular library format
  - De-facto standard for commodity libraries
  - Supported by virtually every EDA tool in RTL-to-GDSII flow
- ALF is the most comprehensive library format
  - Approved IEEE standard
  - Designed to support library modeling for next generation applications
  - Supported by sizable number of EDA tools today
  - A true superset of liberty
ALF is more than a format

Scope of IEEE 1603-2003 (ALF) PAR

• ALF shall serve as the data specification of library elements for design applications used to implement integrated circuits. The range of abstraction shall include from the register-transfer level (RTL) to the physical implementation level.

• The ALF language shall model behavior, timing, power, signal integrity, physical abstraction and physical implementation rules of library elements.
### EDA tool support for ALF today

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Tool category</th>
<th>ALF support item</th>
<th>ALF support status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequence</td>
<td>Power calculation</td>
<td>power</td>
<td>Pervasive in industry</td>
</tr>
<tr>
<td>Tera Systems</td>
<td>RTL analysis &amp; prototyping</td>
<td>timing &amp; physical abstraction</td>
<td>production</td>
</tr>
<tr>
<td>Magma</td>
<td>IC implementation</td>
<td>signal integrity, electromigration</td>
<td>production</td>
</tr>
<tr>
<td>ASC inc.</td>
<td>Library compiler</td>
<td>all</td>
<td>production</td>
</tr>
<tr>
<td>Sequence</td>
<td>Layout optimization, STA &amp; signal integrity analyses</td>
<td>function, timing, signal integrity, electromigration</td>
<td>production</td>
</tr>
<tr>
<td>Synopsys</td>
<td>Place &amp; route</td>
<td>electromigration</td>
<td>under evaluation</td>
</tr>
<tr>
<td>Cadence</td>
<td>Delay calculation</td>
<td>timing</td>
<td>under evaluation</td>
</tr>
<tr>
<td>V-cube</td>
<td>ATPG for power</td>
<td>function, power</td>
<td>new tool</td>
</tr>
<tr>
<td>ASC inc.</td>
<td>Behavioral synthesis</td>
<td>power abstraction</td>
<td>new tool</td>
</tr>
</tbody>
</table>

*This list is not necessarily exhaustive or complete*
## Technology library support for ALF today

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agere</td>
<td>ASIC vendor</td>
</tr>
<tr>
<td>ARM</td>
<td>IP vendor</td>
</tr>
<tr>
<td>Artisan</td>
<td>fabless library vendor</td>
</tr>
<tr>
<td>Intel</td>
<td>silicon vendor</td>
</tr>
<tr>
<td>Library Technology Inc.</td>
<td>library characterization tool vendor</td>
</tr>
<tr>
<td>Motorola</td>
<td>silicon vendor</td>
</tr>
<tr>
<td>NEC</td>
<td>ASIC vendor</td>
</tr>
<tr>
<td>NurLogic</td>
<td>fabless library vendor</td>
</tr>
<tr>
<td>Philips</td>
<td>ASIC vendor</td>
</tr>
<tr>
<td>Silicon Metrics</td>
<td>library characterization tool vendor</td>
</tr>
<tr>
<td>Virage Logic</td>
<td>IP vendor</td>
</tr>
<tr>
<td>Virtual Silicon</td>
<td>fabless library vendor</td>
</tr>
</tbody>
</table>

*This list is not necessarily exhaustive or complete*
EDA tool and library support for liberty today

*Everywhere, however ...*

- Although liberty is predominantly used in the industry, it does not cover all modeling domains.
- Many EDA vendors invent ad-hoc extensions to liberty or even new tool-specific library formats today.
- Library harmonization and interoperability is needed to avoid fragmentation.
# Modeling domains covered by ALF, but not by liberty

<table>
<thead>
<tr>
<th>Modeling item</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical driver/load model</td>
<td>High-end delay calculation, signal and power integrity</td>
</tr>
<tr>
<td>Transient waveform for electrical current</td>
<td>Transient voltage drop analysis</td>
</tr>
<tr>
<td>Concurrently activated timing arcs</td>
<td>Advanced timing analysis</td>
</tr>
<tr>
<td>Parasitic estimation models with obstructions</td>
<td>Physical design planning and prototyping</td>
</tr>
<tr>
<td>Geometric models associated with regions and patterns</td>
<td>Design for manufacturability</td>
</tr>
<tr>
<td>Formal declaration of language extensions</td>
<td>Any application</td>
</tr>
</tbody>
</table>
Library harmonization project proposal

- Specify formal requirements and semantics for library description
  - Use ALF and liberty as description vehicles
  - Study commonalities and differences between ALF and liberty to discover and resolve semantic issues
- Started as informal study group in April 2003
  - Created sample libraries to study liberty/ALF xref
- Proposed as official Accellera project in Sep. 2003
  - Approved unanimously by the Accellera board
Library harmonization project plan

• Phase 1
  • Establish a formal cross-reference between liberty and ALF
    > Specification of common semantics
    > Mapping table between liberty and ALF
    > Sample library templates
  • This work has already started
    > Can be completed within 6 months

• Phase 2
  • Develop reference tools/utilities
    > Solicit donations from EDA vendors and users
    > “golden” parser with API suitable for application development
    > Bi-directional translators
Library harmonization benefits

- Win-win situation for the industry
  - Increase in library quality
  - Decrease in library development cost
  - No more destructive competition on library formats
- Establishment of a truly industry-owned library standard
  - Accellera projects will eventually become IEEE standards
Perspective

• Harmonize liberty and ALF in the domain of common applications
  • Accept the fact that de-facto library formats are persistent and hard to change
  • Both liberty and ALF syntax will co-exist
  • Focus on the requirements for library contents and semantics
• Leverage ALF in the domain of new applications
  • Make sure that future liberty extensions are in sync with ALF
More information

• **Library harmonization kickoff meeting**
  October 20, 2PM – 5PM, hosted by Synopsys

• **Documentation available on**
  http://www.eda.org/alf

• **To receive regular information, subscribe**
  To: majordomo@eda.org
  Subscribe alf <your_email_address>

• **Or write email to**
  wroethig@eda.org