
Design Constraints Working Group

Kick-off Meeting

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1

Meeting Agenda

- Opening Statement, Self-introductions 1:00 (30 minutes)
Who are we, and why are we here?
- Background 1:30 (45 minutes)
- Discussion: Nature of Design Constraints 2:15 (45 minutes)
- Break 3:00 (15 minutes)
- Discussion: Ways to Define Constraints 3:15 (30 minutes)
- Getting Started 3:45 (60 minutes)
 - ◆ Ways to Make the WG Successful
 - ◆ Meeting Logistics
 - ◆ Charter, Scope, Deliverables, Timeline
 - ◆ Topics for Investigation
- Wrap-up 4:45 (15 minutes)
 - ◆ Points of View Line-up
 - ◆ Action Items

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Goals For Today's Meeting

- **Build a common knowledge base**
- **Share ideas and build consensus**
 - ◆ What to work on
 - ◆ What not to work on
 - ◆ What the end result should be
 - ◆ What is achievable, and when
 - ◆ Priorities
 - ◆ How to proceed
- **Prepare for subsequent meetings**

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Background

- **Why develop a constraint standard?**
- **How would a constraint standard be used?**
- **Organizational framework**
 - ◆ Where does this WG fit in?
 - ◆ VSIA Relationship
- **Prior work**
 - ◆ Observations from SC-WG
- **Preliminary charter**

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Why Develop A Constraint Standard?

- Tower of Babel today
 - ◆ Many different formats for describing constraints
 - ◆ Inconsistent syntax
 - Requires re-entering or translating constraints
 - ◆ Inconsistent semantics
 - May not be able to translate constraints
 - Contributes to lack of convergence
 - ◆ Wasted effort
 - Designers must spend significant time understanding what each tool supports and getting the constraints into each tool
 - EDA developers wind up defining new formats for each new tool
 - IP providers must supply the same data in multiple formats
 - IP integrators may have to translate internal constraints for IPs to get through their particular flow
 - Semiconductor vendors have a harder time qualifying tools

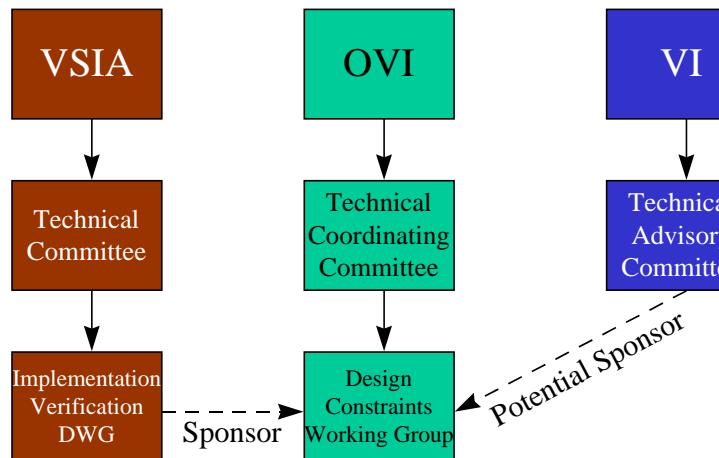
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How Would A Constraint Standard Be Used?

- By designers
 - ◆ As a single, consistent way to describe their intent
- By EDA tool developers
 - ◆ As a standard way to read, write, and interpret constraints
- By IP providers
 - ◆ To describe their intent for partially implemented IP blocks
 - ◆ To describe restrictions on how IP blocks may be used
- By IP integrators
 - ◆ To complete the implementation of IP blocks
- By semiconductor vendors
 - ◆ As part of tool qualification
 - ◆ In creating design flows and kits

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Where Does This Working Group Fit?



VSI Virtual Socket Interface Alliance
OVI Open Verilog International
VI VHDL International

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VSIA Relationship

- Formal Sponsorship: VSIA will
 - ◆ Recruit members
 - ◆ Provide requirements specifically for IP mix and match
 - ◆ Endorse the standardization effort
 - Based on commitment to address VSIA requirements
 - ◆ Review draft specification, provide feedback
 - ◆ Adopt the standard when approved
 - Provided it meets VSIA requirements
 - ◆ Promote the standard after approval

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Prior Work

- Synthesis Constraints Working Group (SC-WG)
 - ◆ Formed in March, 1996 under OVI
 - ◆ Joint OVI/VI sponsorship in August, 1996
 - ◆ Charter
 - Synthesis tool interoperability
 - ◆ Focus
 - Definition of the General Constraint Language (GCL), a constraint command language for user entry
 - ◆ Problem
 - Consolidation of synthesis tools
 - ◆ Status
 - Fairly good progress on timing constraints
 - Inactive since October 1997
 - ◆ Details at <http://www.vhdl.org/pub/scwg/index.html>

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Prior Work (2)

- General Constraint Format (GCF)
 - ◆ An exchange format for tool-to-tool communication
 - ◆ Cadence-proprietary format
 - Provided to SC-WG for review
 - ◆ Status
 - Initial emphasis on timing
 - Some area, power, parasitics constraints
 - Supported by many Cadence tools
 - Joint work with Ambit to write GCF
 - ◆ Plans
 - Continue to evolve to cover additional constraints
 - Consistent semantics with DC-WG command language
 - Possible standardization

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Observations from SC-WG

- A constraint standard
 - ◆ Should express the designer's intent
 - Aspects of how the design should be implemented which aren't covered by functional descriptions
 - Aspects of the environment in which the design will operate
 - ◆ Should not describe tool-specific behavior or control flow
- Constraints need to be updated throughout the design flow
 - ◆ Designers change constraints based on progress in implementation
 - ◆ Tools generate additional constraints (budgeting, transformations)
 - ◆ Information about the tradeoffs between constraints changes as you go through the flow

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Observations from SC-WG (2)

- Hierarchy is important
 - ◆ Many constraints apply to both logical and physical hierarchy
 - Need to relate user specifications based on logical hierarchy to the physical hierarchy
 - ◆ Design object names may change as hierarchy is flattened or regrouped
 - ◆ Some tools are flat
 - Need to flatten hierarchical constraint descriptions

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Observations from SC-WG (3)

- A constraint command language
 - ◆ Should
 - Define a set of constraint-related commands and their arguments
 - Be easy for a designer to enter
 - Provide powerful and expressive ways to specify which design objects are affected by a constraint
 - Macros, regular expressions
 - Allow constraint commands to be embedded in common extension languages, particularly Tcl
 - ◆ Should not
 - Be an extension language itself
 - No variables, looping, other programming language constructs
 - Avoid competition with tool-specific extension languages
 - ◆ Is relatively hard for tools to read

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Observations from SC-WG (4)

- A constraint interchange format should
 - ◆ Define a set of constraint-related constructs
 - ◆ Be easy for tools to interpret and update
 - Provide limited ways to specify which design objects are affected by a constraint
 - ◆ Share semantics with a standard constraint command language

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Preliminary Charter

- Original Proposal:
 - ◆ Define
 - A constraint command language (entered by users)
 - A corresponding interchange format (tool-to-tool)
 - ◆ Covering
 - Logic architecture
 - Timing
 - Area
 - Power
 - Test
 - Clocking
 - Physical Implementation
 - Environment/Operating Conditions
 - ...
 - ◆ Supporting language independence (Verilog, VHDL)

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Nature of Design Constraints

Some thoughts to lead off discussion

- Major categories
 - ◆ High level design goals
 - Throughput, reliability, error rates, cost
 - ◆ Boundary conditions and operating environments
 - What is the environment around each block?
 - ◆ Budgets
 - Hierarchical partitioning of design goals
 - ◆ Special cases (exception handling)
 - ◆ Modes of operation
 - Don't care conditions
 - Mutually exclusive conditions
 - Infeasible states (false paths, feedback loops)
 - ◆ Detailed implementation controls

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Nature of Design Constraints (2)

- Constraint Domains
 - ◆ Timing
 - ◆ Area
 - ◆ Power
 - ◆ Signal Integrity
 - ◆ Logic Architecture
 - ◆ Clocking
 - ◆ Test
 - ◆ Manufacturability
 - ◆ Reliability/Lifetime

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Nature of Design Constraints (3)

- Different levels of abstraction
 - ◆ Many transformations of system design goals into detailed implementation constraints
 - ◆ Need ways to track derivation history
 - ◆ Low level constraints may be directly entered, rather than derived from higher level constraints
- Different levels of flexibility
 - ◆ Goals/objectives versus design rules
 - ◆ Tradeoffs between constraints
 - Smallest area which meets timing
 - Fastest design which meets power
- Multiple sources
 - ◆ System designers
 - ◆ Logic, physical designers (novice through expert)
 - ◆ IP providers
 - ◆ Cell library developers
 - ◆ Semiconductor vendors
 - ◆ Tools

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Nature of Design Constraints (4)

- Multiple contexts
 - ◆ Constraint Entry/Management
 - ◆ Analysis
 - ◆ Estimation
 - ◆ Resource planning
 - ◆ Partitioning
 - ◆ Implementation
 - ◆ Optimization
 - Timing, area, power
 - ◆ Correction
 - Design rule violations
 - Signal integrity
 - ◆ Verification
 - ◆ Process Migration

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Nature of Design Constraints (5)

- Multiple applications
 - ◆ Design Estimation
 - ◆ RTL Synthesis
 - ◆ Design Planning (floorplanning)
 - ◆ Timing Analysis
 - ◆ Timing-driven Layout
 - ◆ Timing (gate-level signoff) simulation
 - ◆ Post-layout or Location-based Optimization
 - ◆ Power Analysis

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Ways to Define Constraints

Some thoughts to lead off discussion

- Command Language
 - ◆ Example: GCL
 - ◆ Mature methodology and compiler technology
 - ◆ Low cost way to achieve interoperability
 - ◆ Yet another language for designers to learn
 - ◆ Possible strategy: co-existence versus replacement
- Information Model and API
 - ◆ Example: DPCM
 - ◆ Object oriented, easy to evolve
 - ◆ Major investment in database, API, and programming language
 - ◆ Not for everyday designers

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Ways to Define Constraints (2)

- Formal Specification
 - ◆ Example: EXPRESS
 - ◆ Top-down, applying theorem proving techniques
 - ◆ Hardest to implement
 - ◆ Not for every designer
- Attribute Dictionary
 - ◆ Designers can input in tabular form, like a spreadsheet
 - ◆ Tools to extract symbolic or physical values from the table
 - ◆ Not able to define semantics precisely
 - ◆ Not general enough to cover all conditions, 20-80 solution

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Ways to Make the WG Successful

Some thoughts to lead off discussion

- Charter, Scope, Deliverables
 - ◆ Focus on expressing the designer's intent
 - ◆ Consider the design flow as a whole
 - ◆ Leverage previous work
 - Consider backward compatibility, but don't be driven by it
 - ◆ Avoid
 - Describing tool-specific behavior
 - Defining a mixture of extension language and constraints
 - A win-lose outcome
 - ◆ Add value to mix-and-match IP exchange

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Ways to Make the WG Successful (2)

- Process
 - ◆ Begin with the end in mind
 - Start out with a paper pilot project
 - Define the roadmap from beginning to end
 - ◆ Break work into phases
 - Provide useful results early to build momentum
 - ◆ Break phases into sub-projects/sub-groups
 - Allow people to focus their time and effort on selected areas
 - ◆ Use the “Point of View” approach to build consensus

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Ways to Make the WG Successful (3)

- Process (continued)
 - ◆ Prepare proposals off-line, circulate through e-mail
 - ◆ Use meetings to discuss proposals, not create them
 - ◆ Build high visibility
 - Press coverage
 - Presentations/tutorials at conferences
 - Endorsements
 - Companies, other standards organizations
 - Pilot projects

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Getting Started

- Meeting Logistics
 - ◆ Bi-weekly teleconferences (2 hours)
 - What time?
 - Mornings are best for European, East Coast members
 - Can reduce time if enough work is being done off-line
 - VSIA will cover cost
 - ◆ Quarterly face-to-face meetings (1/2 day)
 - Coordinate with conferences to minimize travel
- Charter, Scope, Deliverables, Timeline
 - ◆ Focus on process for developing these
 - Not enough time to finalize today
 - Want to let people think about it

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Getting Started (2)

- Topics for investigation
 - ◆ VI Sponsorship
 - Preliminary discussions with Gabe Moretti, Steve Schulz, Victor Berman
 - Technical Activities meeting this week
 - ◆ Constraint dictionary spreadsheet
 - ◆ Mixed signal constraints

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Wrap-Up

- Points Of View

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Wrap-Up (2)

- Action Items

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