Notes on Constraint Transformations

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Outline

- Levels of Abstraction and Transitions
- Constraint Transformations
- Architectural Considerations
- Constraint Structure
Top-down design methodology

Each partition corresponds to
- a step down in abstraction
- a constraint transformation
Constraints and levels of abstraction

Complexity of enforcement & validation

System level

Frequency, power, cost, weight, reliability manufacturability, maintainability EMC, ...

RTL level

power area, SI timing

Physical level

parasitics, geom. area, SI, timing

constr. management has limited usefulness

constr. management useful

# of constraints
Internal vs. External Constraints

Current constraints ("external")

Derived constraints ("internal")

Become new transformation

Current constraints ("external")

Derived constraints ("internal")

Bottom-up verification

Level of abstraction A

Partition

Level of abstraction B
Levels of Abstraction

- Similar to data states
  - characterized by *sign-off points*
  - need well-defined *transitions* between “states”

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Synthesizable RTL
FloorPlanned RTL
Verified Gate Netlist
Physical Floorplan
Optimized Placement
Global Routed
Routed
Verified
```
Transitions between abstraction levels

- Two types of transitions:
  - Major transitions
    - Well-defined sequence/progression or reconvergence point reaching a sign-off point
  - Minor transitions
    - Incremental changes in data
    - May be done in any order
Concepts: Transitions

- Most applications require a design object to have reached a certain sign-off point
  - e.g., final cross-talk verification may require parasitics from a 2.5d extractor
- If the object is not in the required state, data can be derived by either:
  - abstracting from data at a later state or
  - estimating from data at an earlier state
- A confidence factor can be derived based on how much estimation or abstraction was required to provide the data to the application.
Constraint transformations (phys.des.)

“High-level”
electrical & phys. constraints

General
- Timing
- Power
- Area
- Yield

Analog
- Matching
- Symmetry
- freq., DC

Noise, EMI

Constraint Generator
Transformations and mapping
electrical ==> physical
electrical ==> electrical
physical ==> physical

Physical and electrical constraints

Floorpl.
Mod. gener.
Placement
Gl. Routing
Det. Routing
Compaction

estimates
Architectural considerations

- Bottom-up model abstraction
- Data flow
- Tool
- Constr, bus (standard format)
- Stimuli
- Expected response
- Extraction
- Analysis
- Verification
- Annotation
Constraint structure

- Verification stimuli & expected response are part of definition for constraints

- **Contents, attributes**
- **Budgeting info (dependencies)**
- **Data State (model) Sub-task / block**
- **Analysis & verif. (stimuli, response)**

**Semantic**

**Hierarchy**

**Scope**

**Verification context**
Constraint structure

- Budgeting info is defined by constraint dependencies / transformation
- Scope is defined by design data hierarchy
- Multiple scopes (models) can be available with same constraint semantic
- Verification contexts can vary with scope
- Version control / multiple constraint sets