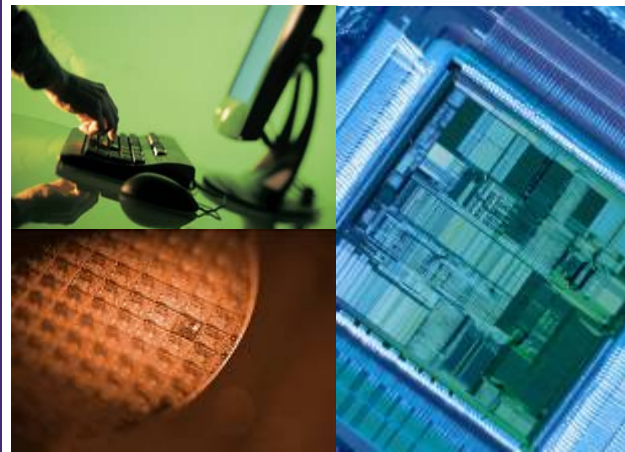


Liberty & Liberty TAB Update

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10/25/2007



SYNOPSIS[®]
Predictable Success

Agenda

- **2007.03 Liberty Update**
- **Latest Liberty Extensions**
 - **Conditional / Moded Pin**
 - **Retain Arc**
 - **Level Shifter Extension**
(see Tom Chau's presentation on Liberty UPF/Low Power)
 - **Always On Cell**
(see Tom Chau's presentation on Liberty UPF/Low Power)
- **Looking Forward**

Liberty Technical Advisory Board (LTAB)

- Technical Advisory Board to steer future evolution of Liberty, meets ~2-4 times per year
- Enhancements and extensions to Liberty Format
 - Reviewed and voted on by Liberty TAB
- Proposals focus on new challenges and technology
- Specifications available on Synopsys and Si2 webpage
 - <http://www.synopsys.com/cgi-bin/tapin/login1.cgi>

Additions to 2007.03 Liberty

Approved by Liberty Technical Advisory Board (12/06)

Base curve technology	Provides compact way to store CCS data (2.5X smaller)
Variation-aware extensions	Combines process variation in single CCS library for statistical STA
Retention cell definition	No longer subset of switch cells
New level shifter attributes	Better support for multi-voltage optimization and analysis
Removal of fine-grain MTCMOS cell	No industry acceptance of fine-grain approach
Liberty sensitization language	Enable unambiguous correlation and re-characterization

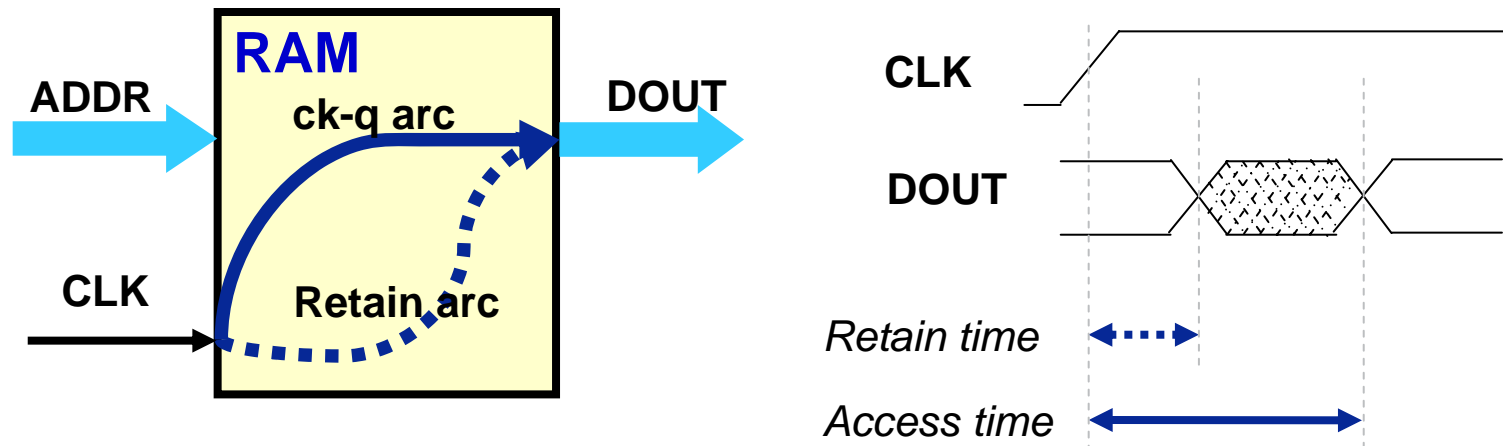
Latest Liberty Extension

Approved by Liberty Technical Advisory Board (7/07)

Conditional / Mode Pin	Extend conditional data modeling.
Retain Arc	CCS and Variation aware support for Memories
Level Shifter Enhancement	Extension to pin based voltage range attributes
Always on cell	Attribute for synthesis tools to identify always on Cells and pins

CCS Retain Arc

- Retain time : shortest delay from the input port to the output port
- Access time : longest delay from the input port to the output port.
- Between retain delay and access time the output value is uncertain



CCS Retain Arc (Cont.)

- NLDM liberty syntax supports retain attributes in timing group:
 - retain_rise, retain_fall, retain_rise_slew and retain_fall_slew
- New CCS retain arc syntax in timing group:
 - Expand CCS
 - ccs_retain_rise and ccs_retain_fall
 - Compact CCS
 - compact_ccs_retain_rise and compact_ccs_retain_fall
 - VA CCS
 - va_compact_ccs_retain_rise and va_compact_ccs_retain_fall.

Conditional CCS Timing and Noise Extension

- Existing conditional CCS Timing and Noise model:
 - “mode” and “when” attributes supported in timing group for
 - CCS driver model
 - arc-based receiver model
 - arc-based noise model
 - “when” attribute supported in pin-based noise model
- New Extensions:
 - “mode” and “when” support in pin-based receiver model
 - “mode” support in pin-based noise model

Moded Pin-based CCS Noise Example

```
cell(inv0) {
    mode_definition(rw) {
        mode_value(read) {
            when : "I";
            sdf_cond : "I == 1"; }
        mode_value(write) {
            when : "!I";
            sdf_cond : "I == 0"; }
    }
    pin(ZN) {
        direction : output;
        ...
        /* pin-based CCS noise last stage for Condition 1 */
        ccs_last_stage () {
            mode(rw, read);
            ...
        }
    }
}
```

Liberty Roadmap

- For consideration by Liberty TAB in 2H 2007
 - New Capability: Variation aware Leakage model
 - New Capability: Macro Cell power switch
 - Breadth of Cell support: Extensions to CCS Noise for un-buffered latch
 - New Capability: Programmable driver
- For consideration by Liberty TAB in 2008 and beyond
 - Library Size: Compact CCS Power format
 - Breadth of Cell support: Expanded Function Definition
 - Improved Correlation: Characterization settings in library
 - New Capability: Variation aware CCS Noise

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