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U-2003.06 Liberty Update

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April 10, 2003

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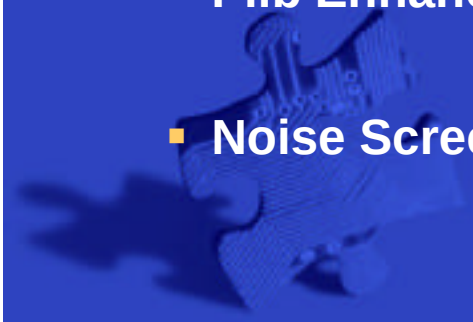
Outline

- Liberty Modeling Enhancements
- Advanced Leakage Power Model
- Plib Enhancements
- Noise Screener



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Cell EM Modeling Enhancement

- **Motivation**
  - Support more accurate cell EM model
- **Features**
  - Use of a polynomial to model “each” cell em value
  - Support of state dependency with “when”

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Current Cell EM Model

- A lookup table for maximal toggle rate violation check
- Input pin: 1-D table based on input transition time
- Output pin: 2-D table based on input transition time and output capacitive load
- Allow temperature degradation adjustment

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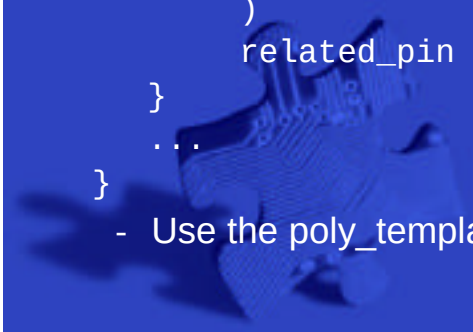
Cell EM Model Enhancement

```
cell(cell_name) {
   em_temp_degradation_factor: float;
   pin(pin_name) {
        electromigration() {
               when : "boolean expression";
               em_max_toggle_rate(template_name_string) {
                      orders (”integer,..., integer”);
                      coefs (”float,..., float”);
               }
               ...
        )
        related_pin : “ name string ... name string “;
   }
   ...
}
```

- Use the poly_template group to specify the polynomial template



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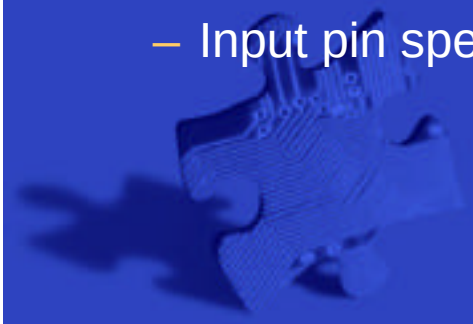
Delay/Slew Pin Threshold Enhancement

- Motivation
  - Support better accuracy of delay calculation
- Features
  - Input pin specific delay and slew thresholds



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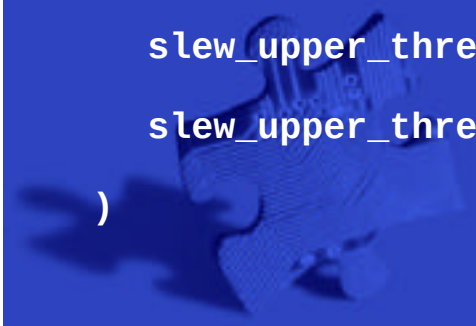
Delay/Slew Pin Threshold Enhancement

```
pin(pin_name) {
   input_threshold_pct_rise : float;
   input_threshold_pct_fall : float;
   slew_lower_threshold_pct_rise : float;
   slew_lower_threshold_pct_fall : float;
   slew_upper_threshold_pct_rise : float;
   slew_upper_threshold_pct_fall : float;
)
```



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Advanced Leakage Power Model

- Motivation
  - Extend liberty syntax to support both polynomial representation and single float value to represent leakage power
  - Provide a model to support pvt variation effect
- Features
  - Use the poly_template to specify the voltage, temperature
  - Use the leakage_power group to specify the polynomial equation
  - Use the when statement to specify state dependency

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Advanced Leakage Power Model

```
power_poly_template(leakage_3D) {
    variables(temperature, voltage,
  voltage1);
    variable_1_range(-40.00,120.00);
    variable_2_range(0.6000,1.2000);
    variable_3_range(0.6000,1.2000);
    mapping(voltage1, VDD1 );
    }
```

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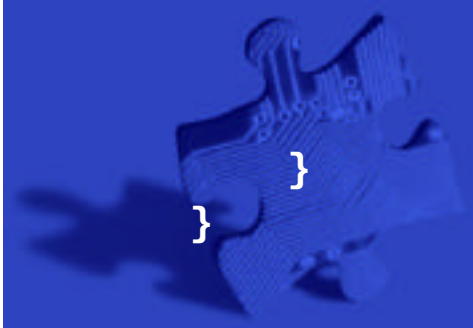
Advanced Leakage Power Model

```
cell (name) {
 leakage_power () {
        when :"A&Y";
        power(leakage_3D) {
          orders("1 2 1");
          coefs("5.25943, 1.08313, 1.99065,
                -0.329791, -0.0706993, \
                 0.820298, 5.25943, 1.08313, \
                 1.99065, -0.329791,   \
                 -0.0706993, 0.820298");
        }
    }
```



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Plib Enhancements

- New syntax added for Milkyway support

```
max_current_density : float ;
res_temperature_coefficient :float ;
/*1st order temp.coefficient for res_per_sq*/
stub_spacing ( float, float );
/*spacing, max_length_threshold */
min_overhang ( string, string, float );
/* layer1, layer2, value : min. layer1 overhang when overlapping
   layer2 */
```

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Signal EM in Plib

```
phys_library( phys_library_name ) {
current_density_lut_template ( template_name ) {
/* contact_area is only for contact layer */
/* routing_width is only for routing layer */
variable_1 : temperature | frequency | contact_area |
   routing_width;
variable_2 : temperature | frequency | contact_area |
   routing_width;
variable_3 : temperature | frequency | contact_area |
   routing_width;
index_1 ( "float, float, float, ..." );
index_2 ( "float, float, float, ..." ); index_3 ( "float,
   float, float, ..." );
}
```

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Liberty for Galaxy

- .lib - source format for logical libraries
- plib - source format for technology information
  - Consolidate all other formats, i.e. TF, ITF, in use
  - TF contains technology information
  - ITF contains process parameters for RC calculation
- plib is also used as the text format to describe geometry information
- Liberty (.lib & plib) continues to be open under TAP-in Open Source program

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Liberty Screener for noise modeling

- Liberty screener version 7.0 has been enhanced to screen noise libraries
- Available for download on the Tap-in site

  www.synopsys.com/tapin
- Based on Liberty parser version 1.9
- Help menu available for usage

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Noise Characterization Checklist

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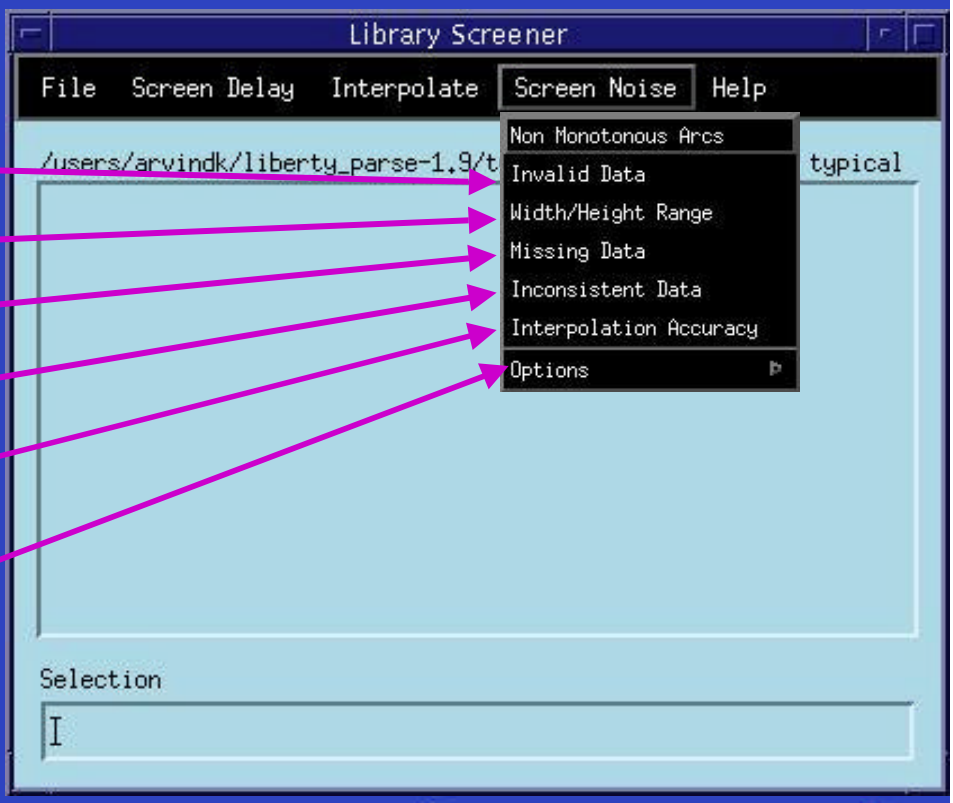
- Data Monotonicity
- Data Validity
- Data Range
- Data Required
- Data Consistency
- Data Interpolation Accuracy



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Command Line Mode

Report non-monotonous noise arcs in typ.lib

libscr -lib typ.lib -chk_noise_mono

Report noise tables with less than recommended range

libscr -lib typ.lib -chk_noise_range

Report all potential problems to typ.report, under wc operating condition

libscr -lib typ.lib -chk_noise_all -out typ.report -set_oc wc

Report all timing arcs with missing noise detection data

libscr -lib typ.lib -chk_noise_missing -chk_NDD

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Summary

- New features in Liberty (SPDM and SPPM, Cell EM, Noise, Leakage Power)
- Key information in the Milkyway technology file (tf) can be modeled in plib. Support for signal EM
- New Noise Screener for screening your noise libraries for best results
- What would you like to see in future ??

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