Towards Foundry PDKs on Free CAD Tools

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Summary

- Introduction
- CMP Viewpoint on PDKs & CAD Tools
- Full-Custom Design Flow : What's needed ?
- Free CAD's PDK development at CMP
- Perspectives

Introduction

- **CMP started in 1981 offering MPW runs for Universities / Research Labs.**

Long experience on CAD tools and PDK development, distribution and support.

- **Free Layout Editors in the 80's :**
  - 1980 **: MAGIC** made by University of Berkeley and distributed by MOSIS, USA
  - 1984 **: LUCIE** made and distributed by CMP, France

- **CAD tools supported at CMP**
  - 1986 : University Program CAD distribution : CNFM, France
  - 1989 : University Program CAD distribution : Eurochip, then Europractice.
  - Till Today : CAD tools distributed by CNFM in France & Europractice in EU.

(CAD tools mainly from the big three : Cadence, Mentor, and Synopsys)

- **PDKs developments, distribution, and support at CMP**
  - 1990 : First Complete PDK for AMS 1.2µ CMOS (Analog & Digital design-flows)
  - Several PDK developments made by CMP on commercial CAD tools.
  - Today : More than 20 different foundry's design-kits distributed and supported.

CMP Viewpoint on PDKs & CAD Tools

PDK and CAD Tools :

- PDK : A set of files and configurations embedding Foundry's tech. data.
- CAD : Computer Engine assisting the design automation.

PDK for a given CAD Tool :

- Foundry's Tech. data written in formats supported by the CAD tool.
- Need to be foundry certified.
- Need to be updated as CAD tools evolve.

Free CAD Tool requirements for a viable Foundry's PDK :

- Foundry's tech. data could be translated into the Free CAD Tool Format.
- Support of standard CAD formats (GDSII, Spice, Verilog, Oasis, LEF, DEF, CDL, …)
- Foundry reference flow could be implemented.
- Passing benchmarks similar to the Foundry's reference PDK.
- Having a continuous updates and support.

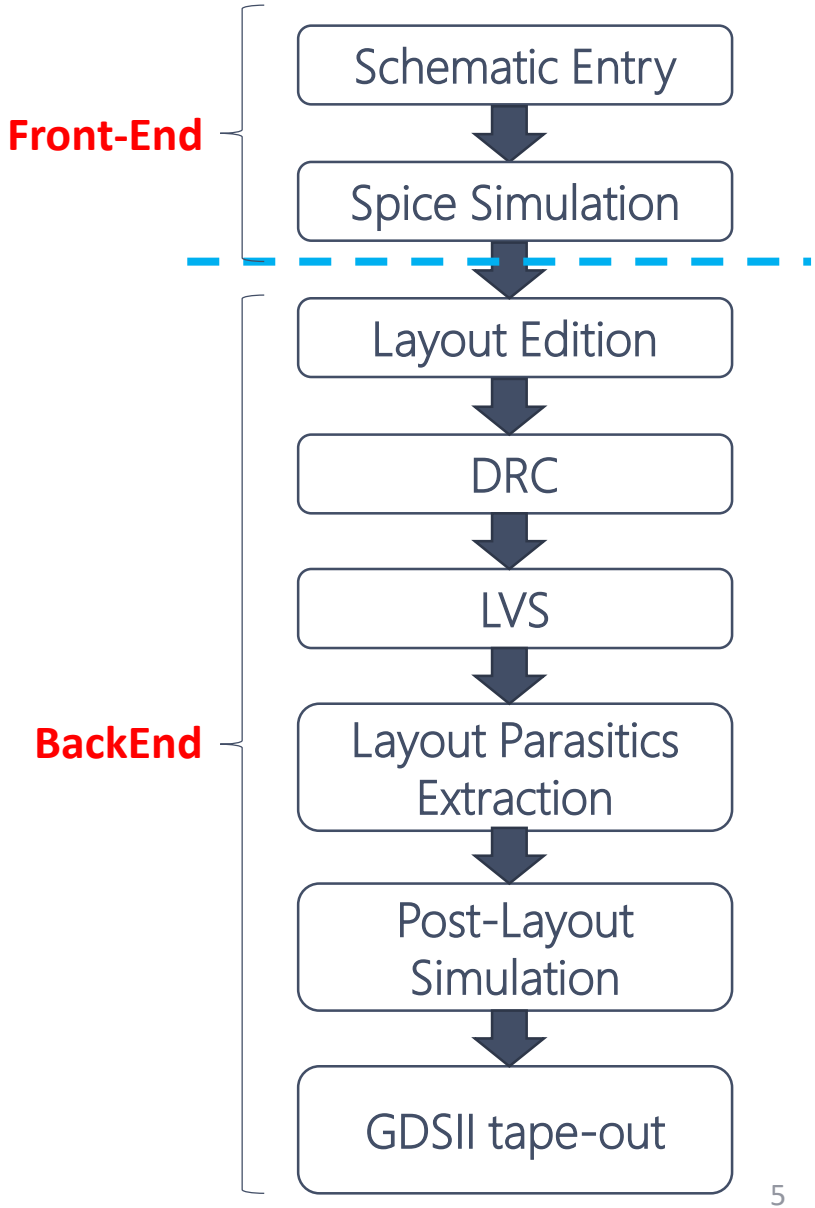
Conventional Full-Custom Design Flow

- **Free front-end CAD Tools :**
  - Schematic entry / Spice simulation tools widely available:

Xcircuit, ngspice, Spice3f5, SpiceOpus, gEDA, LTSpice, Alliance, etc …

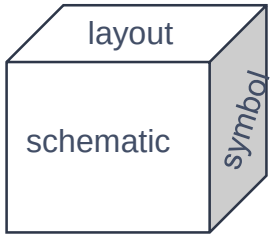
- **Free backend CAD Tools :**
  - Several Freeware layout tools are available:

Magic, Electric, Klayout, LayoutEditor, Toped, Electric, Glade, Alliance, etc …

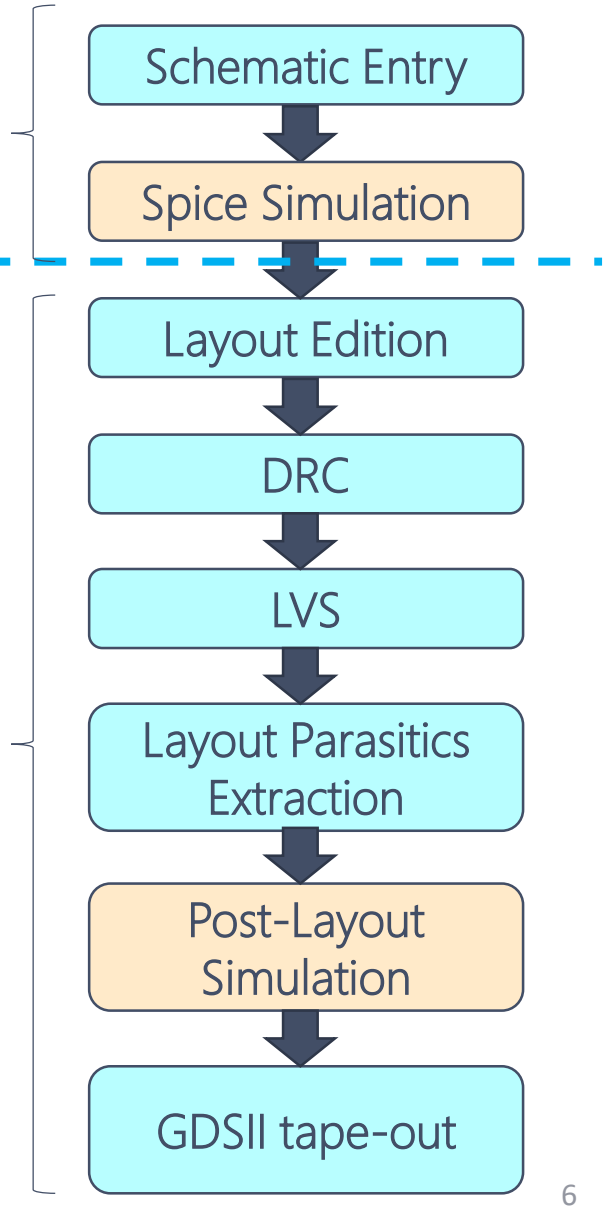


Free CAD's PDK development at CMP

- **Glade :** http://www.peardrop.co.uk
  - Support of Linux, Windows & Mac.
  - Support of standard CAD formats : GDSII, Oasis, CDL, EDIF, Verilog, LEF, DEF, etc …
  - Support of Python programming language.
  - Unified cellview concept :
    - layout, schematic, symbol, netlist, extracted

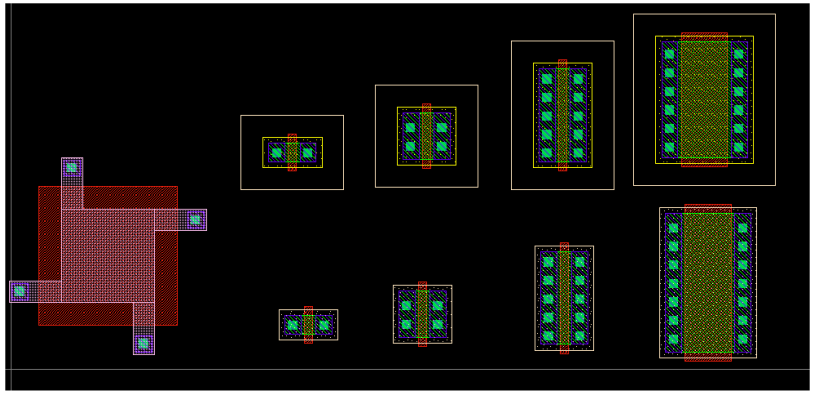


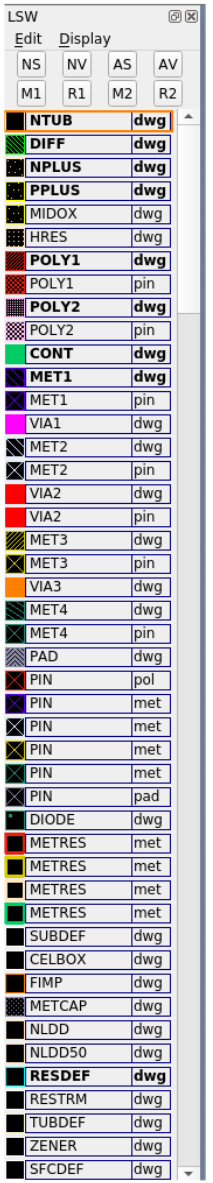
- **Spice3f5 or SpiceOpus :**
  - Running form the Spice netlist output from Glade.
  - Include waveform viewer.
  - SpiceOpus Supports standard models : BSIM3, BSIM4, BSIMSOI, EKV, etc …
  - Run on Linux and Windows.



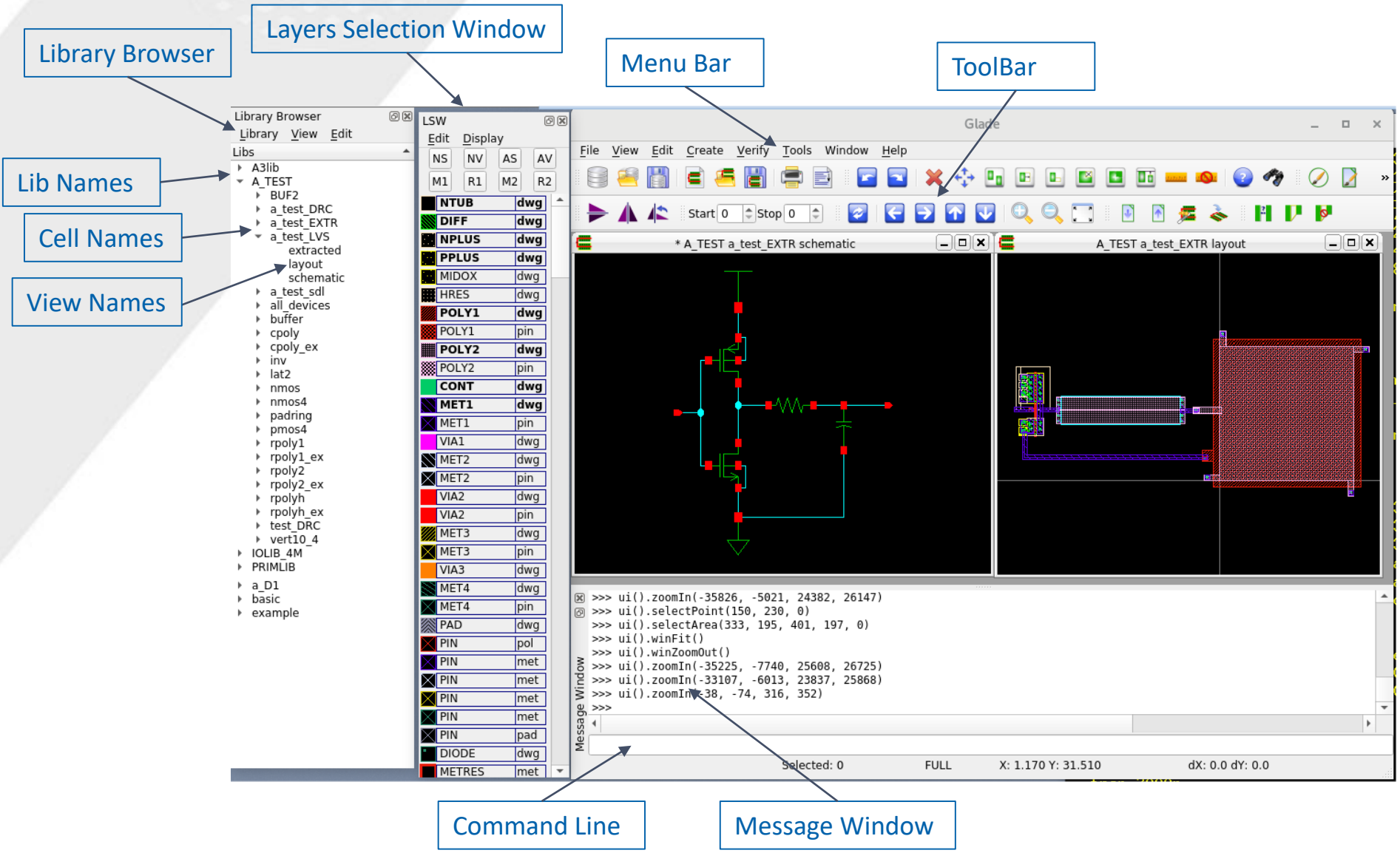
Glade PDK on 0.35µ CMOS

- **Tech library :** Layer names, GDSII numbers, design rules, Via rules, colors and stipples, multi-parts paths, etc … **exactly the same** as the foundry reference PDK (Cadence Virtuoso).
- **Pcells :** Same as the reference PDK.
- **Schematic entry :** Same as the reference PDK.
- **Schematic driven Layout.**
- **DRC : about 90% implemented**
- **Extraction & LVS for all devices**
- **2D LPE (Layout Parasitics extraction)**





Glade Main Overview



Conclusion & Perspectives

- Complete full-custom design flow compatible with the foundry's reference flow.

- Need Foundry agreements to officially support Free CAD PDKs :
  - CMP in discussion with some.

- Define some policies and rules for supporting such tools.
  - Comercial tools still remain the reference.
  - Free CAD PDKs are not a replacement. They need to be a complementary offer helping in some situations (SMEs, …)
  - Free CAD Tools could be used freely, while PDKs are subject to NDA.

- Next planned PDKs : 0.18µ, 130nm CMOS. (in discussion with the foundries).