# SILVACO

# PEX Certify

## Parasitics Extraction Flow Qualification

# Burden of Parasitics

## Introduction

- As process geometries grow smaller the number of parasitic elements grow at a dramatic rate.

- Interconnects and layout parasitics network is more and more complex, and often considered as an unfathomable black-box.

- This complexity leads to longer design iterations, particularly caused by increased simulations runtimes.
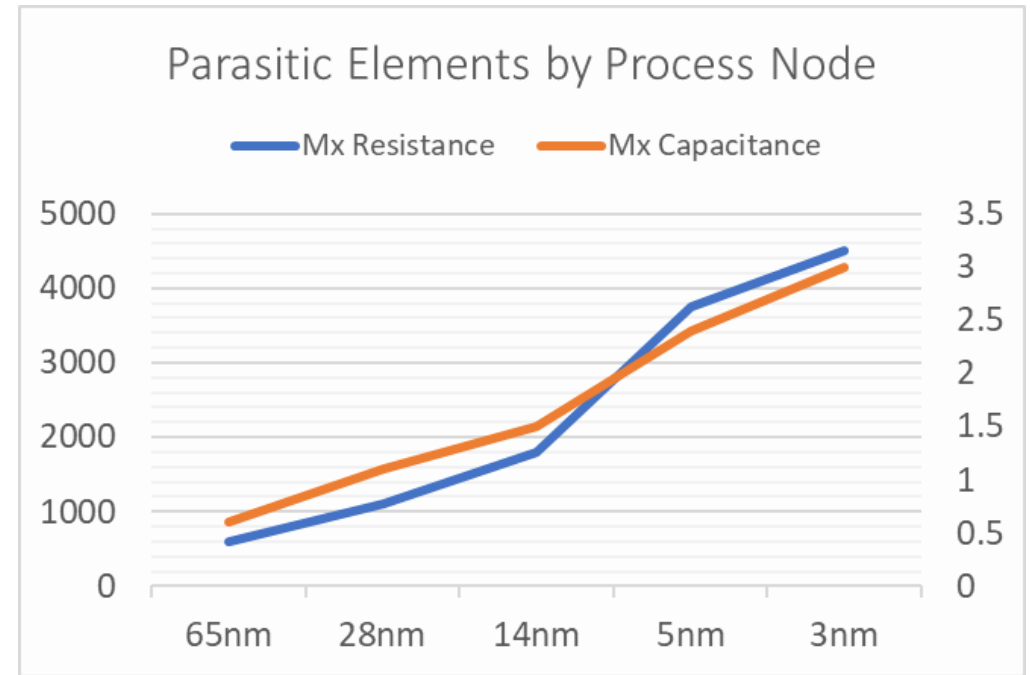


Number of parasitic resistors increased by 3.5X in between 28nm and 3nm

# PDK Challenges and Solutions

## Extraction Flow Qualification
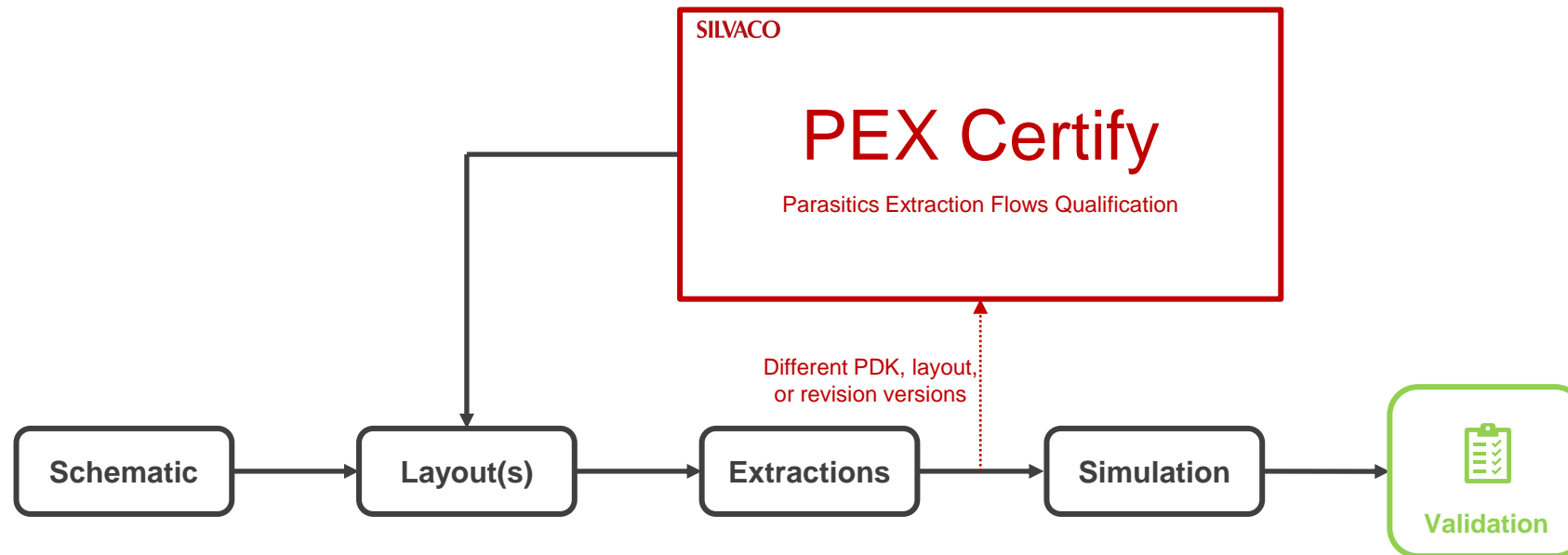
- PDK main challenge when it comes to parasitic extraction is to ensure that the sign-off flows are correct. CAD engineers have to make sure that:

    - The results provided by an extraction tool are understood and the results validated.

    - A comparability, a compatibility, and a stability exist in between different extraction tools, versions or settings.

- CAD engineers rely on different solutions:

    - Use of simple, but unscalable, test structures to compare to physics.

    - Use of minimalist debug / exploration options provided by vendors.

    - Use of hard to maintain scripts to convert parasitics into comparable physical metrics or rely on endless SPICE benches.

# PEX Certify
## Your All-in-one Solution

**PEX Certify** gives you confidence in your parasitics extractions and designs revisions



SILVACO

# PEX Certify

Parasitics Extraction Flows Qualification

Different PDK, layout, or revision versions

| Schematic | → | Layout(s) | → | Extractions | → | Simulation | → | Validation |

# Master You Extraction, Control Your Parasitics
A Dedicated Tool (1/2)

- **PEX Certify** will seamlessly replace internal verification scripts, often seen as a burden to maintain, and will be able to deal with the complexity and size of advanced designs.

- Its unique ability to deal with different naming conventions used by different vendors allows CAD engineers to ensure the quality and reliability of their extraction flows.

- Combined with **Viso** exploration tool, it saves weeks of debugging or putting in place the parasitic extraction flows. Parasitic extraction bugs are quickly found and reported.
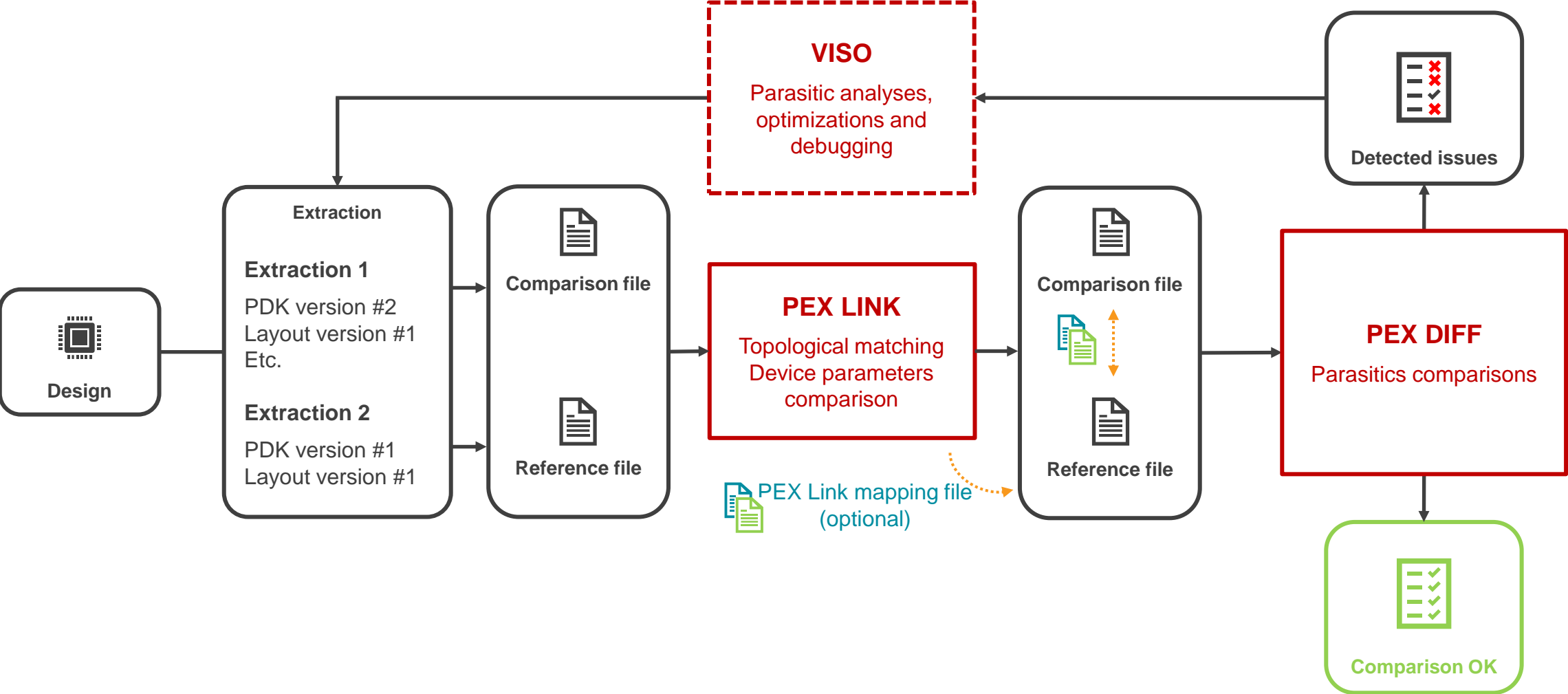
# Master You Extraction, Control Your Parasitics
A Dedicated Tool (2/2)

- **PEX Certify** is not only able to qualify and quantify parasitics related differences, but it also compares devices parameters to ensure the validity of the instance section.

- It can replace long lasting post-layout debugging and optimization, including:

  - In static timing analysis, to accurately determine the impact on insertion delay due to manual changes in the routing without running simulations.

  - When migrating a technology, to determine the change in capacitive load on all wires moving from one technology to the next.

  - Revision of different versions of layout/design to qualify and quantify the parasitics differences, and cover potential unanticipated side-effects.

# Seamless Integration
## CAD And Layout Engineers flow



**VISO**

Parasitic analyses, optimizations and debugging

**Detected issues**

**Extraction**

**Extraction 1**

PDK version #2
Layout version #1
Etc.

**Extraction 2**

PDK version #1
Layout version #1

**Design**

**Comparison file**

**Reference file**

**PEX LINK**

Topological matching
Device parameters comparison

PEX Link mapping file (optional)

**Comparison file**

**Reference file**

**PEX DIFF**

Parasitics comparisons

**Comparison OK**

**SILVACO**

# PEX Certify Details
## PEX Diff and PEX Link

- **PEX Link**: matching of two different netlists at finger level to link each instance, pin, and net. Comparison of devices parameters.

- **PEX Diff**: comparison of two or more extracted netlists in terms of pin-to-pin resistances and RC delays, net to net capacitances.



**PEX Diff**
Comparison tool

**PEX Link**
Netlist matcher

**PEX Certify**
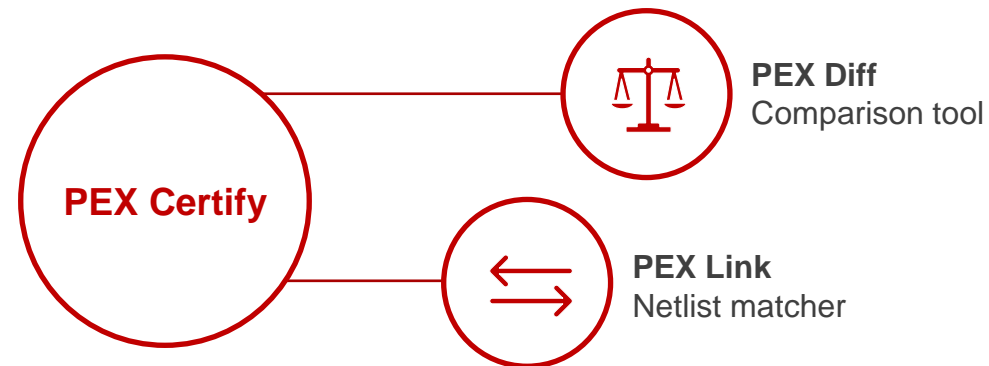
- **Viso** (optional): analyze and exploration of the parasitics through an extensive set of analyses to address interconnect related issues.
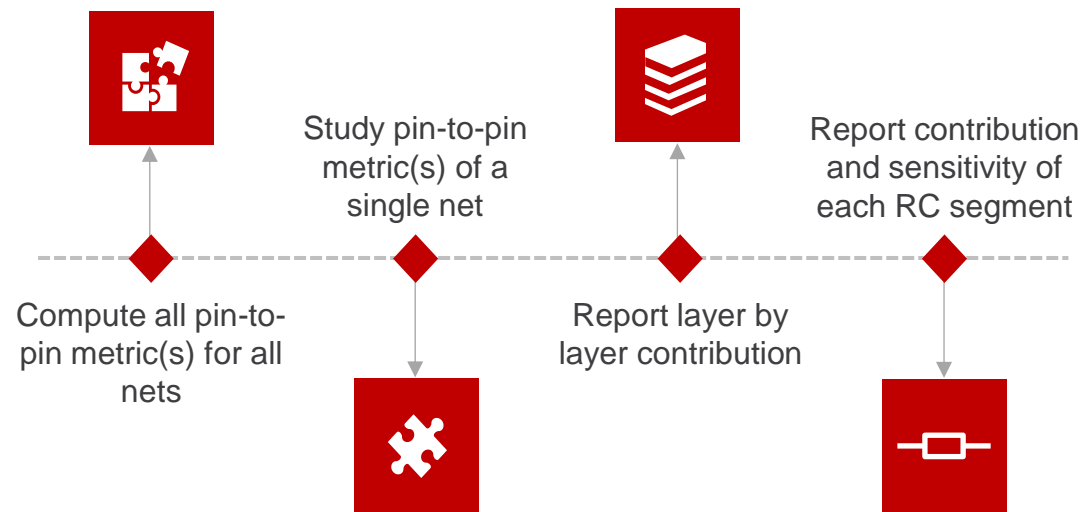
**SILVACO**

# Flexibility and Ergonomics
Key Features (1/2)

- Supports all major ASCII netlists and OpenAccess extracted views comparison (including cross-format).

- In command line or through a GUI, computes parasitics related metrics: pin-to-pin resistances and RC delays, net-to-net capacitances.

- Reports qualified and quantified differences:

  - Data is stored in ASCII files, displayable in the GUI.

  - Possibility to continue the exploration into Silvaco's exploration tool Viso

- PEX Diff relies on net and pin names to compare data. When nets or pins name do not match, PEX Link is mandatory.

**SILVACO**

# Flexibility and Ergonomics
## Key Features (2/2)

- From global results for a given metric to a very detailed level, provides information on your parasitics, highlighting key contributors and providing sensitivity-related metrics.

Study pin-to-pin metric(s) of a single net

Report contribution and sensitivity of each RC segment

Compute all pin-to-pin metric(s) for all nets

Report layer by layer contribution

**SILVACO**

# Compare What Is Comparable

Strengthen the Mapping with PEX Link

- Comparison reliability is mainly driven by the capability to identify the nets and combinations to match.

- Multiple parasitic extractor, or even a different version of the same one are sources of potential to identify the correct combinations.

- In such situation, PEX Link is necessary to create an association file linking elements from the different input netlists. Typical cases are:

  - Different naming strategies (e.g: XM1:src vs XM1:s).

  - Different delimiters set (e.g: ":" vs "#").

  - Fingers scrambling.
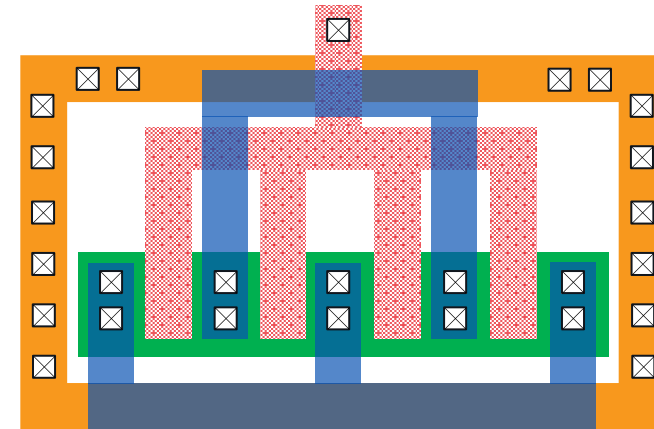


Corresponding instance name of each finger might be different from one extraction to another

# Active Device Comparison with PEX Link

Control More Than Parasitics

- PEX Link embbeds the ability to read instances parameters (width, length, etc.) and compare them to validate the active devices parameters extraction.

```
MI167 MI167:d MI167:g MI167:s MI167:b MODP L=0.35U W=1.6U AD=1.36P AS=0.76P PD=3.30001U PS=1.45001U
wtot=1.6e-06
```

```
MI167 MI167:drn MI167:gte MI167:src MI167:blk MODP L=0.35U W=1.55U AD=1.36P AS=0.76P PD=3.30001U
PS=1.45001U wtot=1.6e-06
```

- The default mode allows to trigger an automatic comparison that will compare all parameters of the different existing models, easily handling swapping problematics.

- PEX Link also provides flexibility by offering the possibility to the users to create their own rules files and thus adapt the comparison and only focus on the model and parameters of interest.

# A Simple but Powerful GUI

## Example of Comparison Results and Layers Contributions Details

# PEX Certify to Control Your Parasitics
## Conclusion

- Powerful batch mode that can be used to implement verification scripts.

- Quick and accurate computed parasitics related metrics at a large scale for blocks/chips.

- Embedding a visual exploration of the comparison results.

- Possibility to map and compare instances parameters.

- Compare all results to identify the few sets where differences occur.

- Deal with differences in naming or format from various vendors.

- Plug and Play approach, no complicated preparations. Seamlessly integrated and easy to use.

Thank you

**SILVACO**