

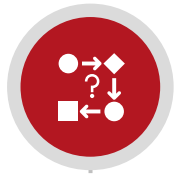


SILVACO

Viso, Belledonne, Brenner

Accelerate Post-layout Parasitics Analysis and Avoid
Wasted Simulation Time

Contents



01 - TODAY'S CHALLENGE OF PARASITICS



02 - SILVACO'S ANALYSIS AND DEBUG TOOLS



03 - OVERVIEW: COMPARE WITH BRENNER AND BELLEDONNE



04 - OVERVIEW: EXPLORE AND ANALYZE WITH VISO



05 - SUMMARY



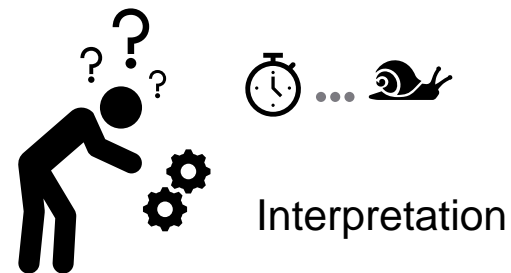
Today's Challenge of Parasitics

- Parasitic elements growing exponentially with advanced nodes
- At 60nm, RC delay from interconnects is already more important than gate delay
- Interconnects and layout parasitics black-boxes now creating significant problems
- Timing, distortion, cross-coupling, noise, IR drop, EM, ESD, etc.



Today's Challenge of Parasitics

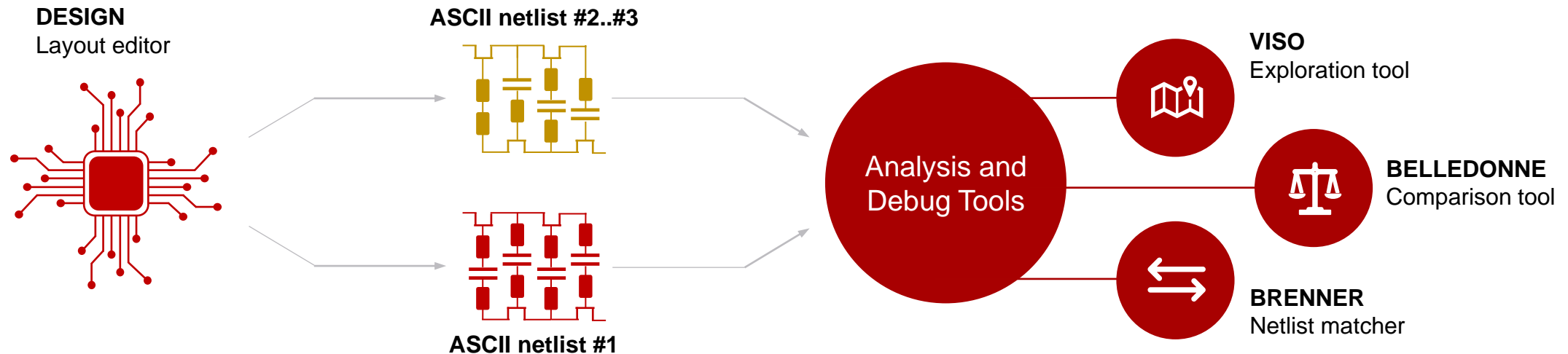
- To counter the impact of the parasitics on project schedules, a possible solution is to improve the simulation runtime
- There is a constant race to deliver the fastest simulator from different EDA vendors
- However, the interpretation of the simulation results and its complexity is underestimated
- Parasitics effect in advanced technologies leads to an overall rethink of the design flow, its optimization and its debug which takes way longer than a simulation.





Today's Challenge of Parasitics

- Silvaco has developed tools that ease parasitic extraction flow setup, save simulation time and enable powerful physical design debug
 - BRENNER: netlist matcher
 - BELLEDONNE: comparison tool
 - VISO: exploration tool

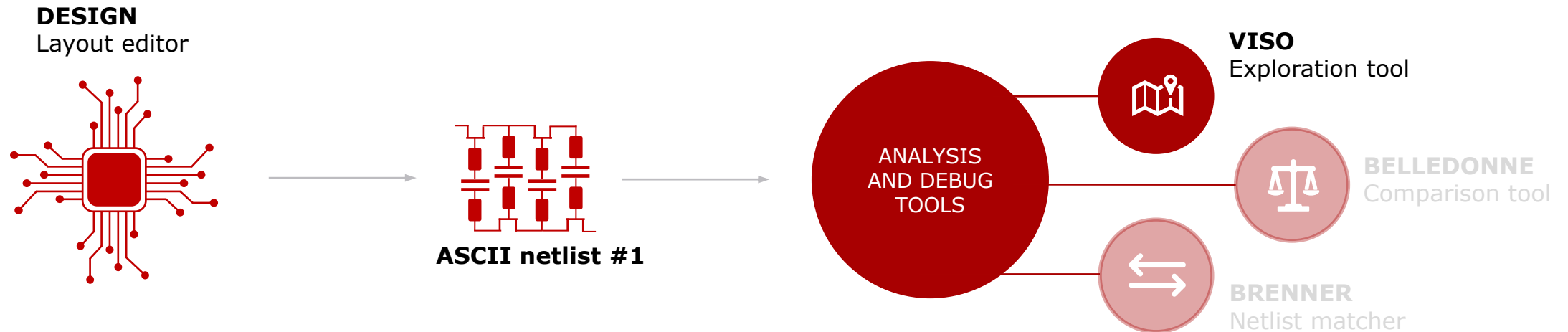




Viso

Parasitics Analysis and Exploration

- VISO: analysis and exploration of parasitics
 - All interconnect related problems
 - Key parameters: resistance, capacitance, RC delay
 - Detailed analysis, smart tabular views
 - Graphics with 2D and 3D view, batch mode

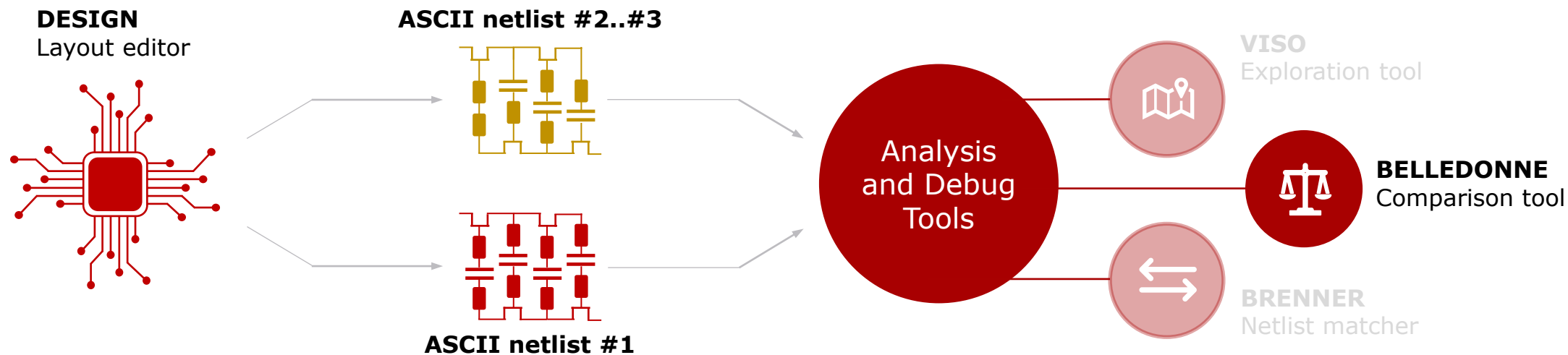




Belledonne

Comparison of Extracted Netlists with Parasitics

- BELLEDONNE: comparison of extracted netlists with parasitics
 - Comparison of two or more extracted netlists
 - Input: any extracted netlists of similar layout
 - Compares statistics, P2P resistances and RC delays, NET to NET capacitances
 - Batch mode and graphical user interface

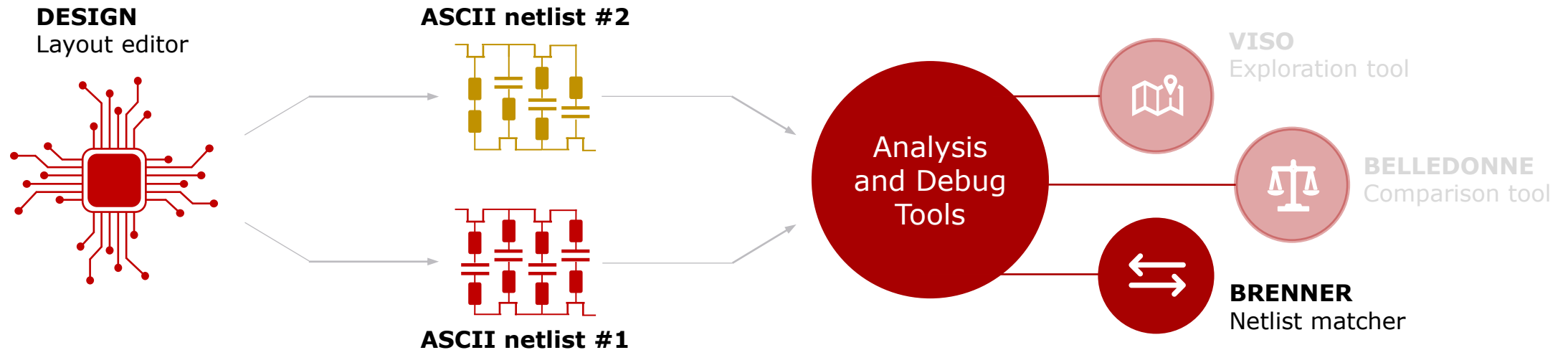




Brenner

Netlist Matcher

- BRENNER: netlist matcher
 - Matching of two different netlists at finger level
 - Matches instances, pins, NETs. Comparison of devices parameters.
 - Often used in conjunction with BELLEDONNE. Mandatory if corresponding NET and pin names do not match

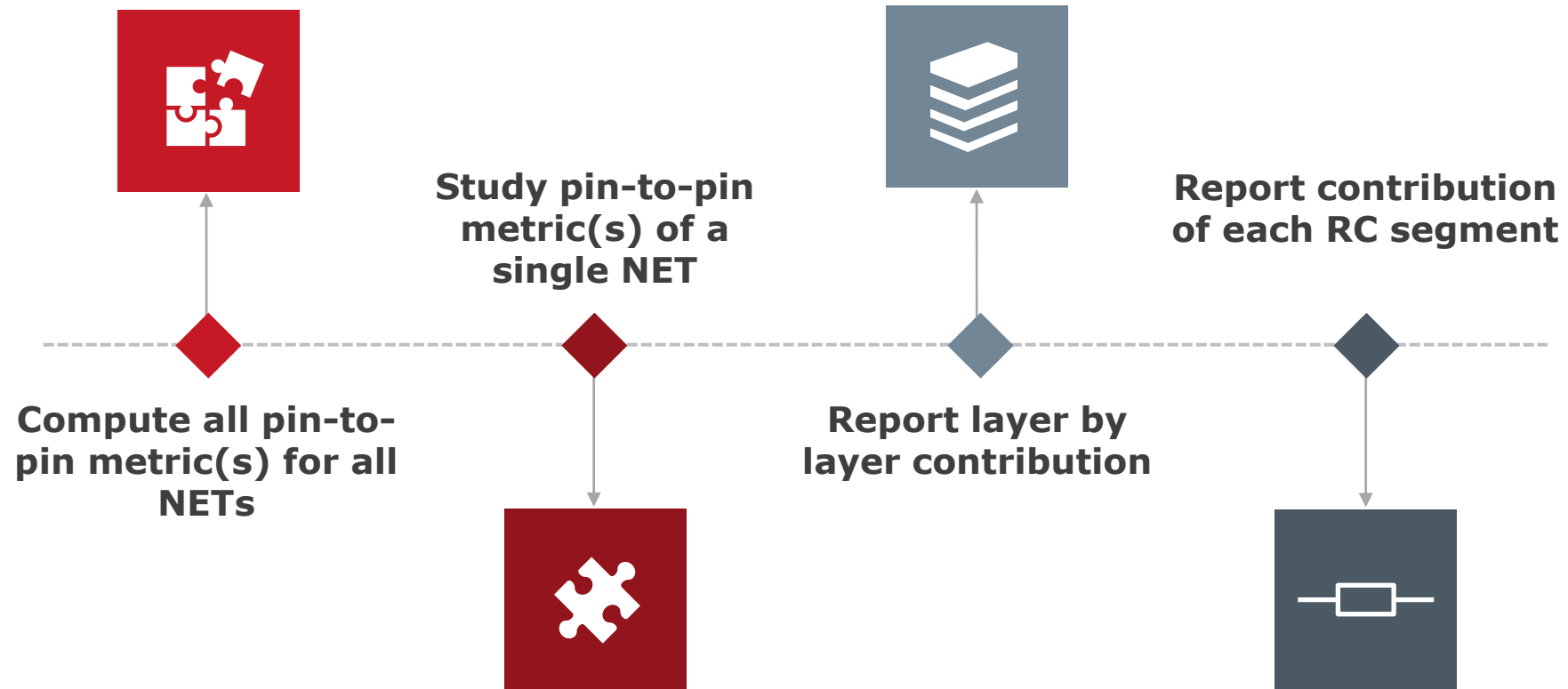




Viso and Belledonne

Parasitics Analysis and Abstraction

- VISO and BELLEDONNE analyses enable different levels of abstraction
 - From compiled results for a given metric to a very detailed level





Viso and Belledonne

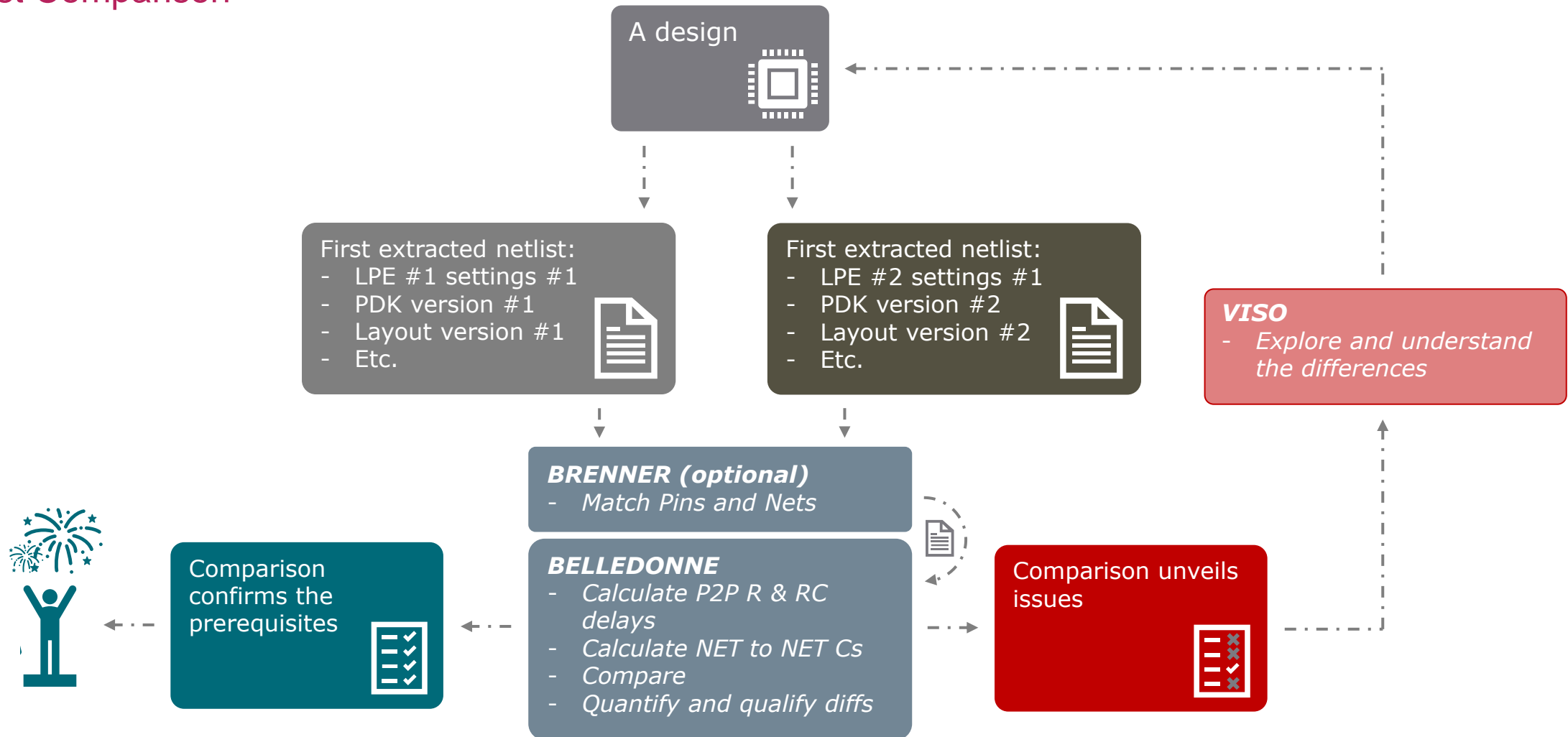
Flexibility

- VISO and BELLEDONNE offer flexibility through three different flows
- Graphical User Interface (GUI)
 - Allows to access to all the options
 - Powerful to debug and inspect results
- Command line
 - Support most of commands / options
 - Powerful to trigger batch runs
- XML file
 - Support all commands / options
 - Can be scripted to trigger batch runs



Brenner and Belledonne

Netlist Comparison

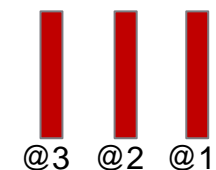
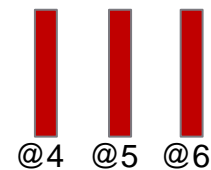
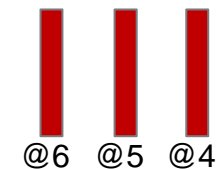
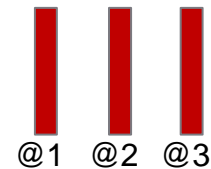




Brenner and Belledonne

Netlist Comparison

- BELLEDONNE relies on NET and pin names to compare data
 - When NETs or pins name does not match, one need to use BRENNER
- Typical cases where BRENNER needs to be used first:
 - Different strategies for NET and pin naming:
 - F1250 vs net72_2
 - XM1:src vs XM1:s
 - Different delimiters
 - ":" vs "#"
 - Fingers scrambling



Reference netlist

Comparison netlist



Brenner and Belledonne

Netlist Comparison

- BELLEDONNE combines two capabilities
 - Computation of parasitics related metrics
 - Number of pins / NETs / Rs / Cs / etc. (statistics)
 - Pin to pin Rs
 - Pin to pin RC delays
 - NET to NET Cs
- Report of differences
 - Qualify and quantify the differences
 - Display the differences using the GUI with a possibility to continue the exploration into VISO
- BELLEDONNE for end users
 - Extraction QA
 - Any kind of comparison



Brenner and Belledonne

Netlist Comparison

Applications Places System
Wed May 5, 15:12

Parasitics comparison

visualize X range window: 0.001 to 1000 Y range window: 0.001 to 1000

Value comp

NET name	ref ET name	comp	gest abs. erro	r gest rel. erro	of compared	# go
1	C5_MINUS	C5_MINUS	-17.2388	-83.9209	1	0
2	L5_PLUS	L5_PLUS	-23.3828	-87.9291	1	0
3	C19_MINUS	C19_MINUS	-0.000195722	-0.0155371	1	1
4	XR0 net1	XR0 net1	0	0	1	1
5	XR22 net1	XR22 net1	5.68434e-14	7.63366e-14	1	1
6	XR2 net1	XR2 net1	0	0	1	1
7	XR22 net2	XR22 net2	0	0	1	1
8	XR2 net2	XR2 net2	0	0	1	1
9	L3_PLUS	L3_PLUS	-0.00170082	-0.185781	2	2
10	XR24 net1	XR24 net1	0	0	1	1

selected : 0 | location : 0.617 8.37

Layers' contributions : L5_PLUS - F3593 ; F6433

Input file : ref.dspf Input file : comp.dspf
 Net's name : L5_PLUS Net's name : L5_PLUS
 Component's name : R3916 Component's name : R1067

Pin source : F3593 (133, 22.5) - type = I Pin source : F3593 (133, 22.5) - type = I
 Pin target : F6433 (47.4, 30.3) - type = I Pin target : F6433 (47.4, 30.3) - type = I

Value : 26.5928 Value : 3.21

Layer name	Value	% of total value
1 ✓ M4	0.557177	2.09522
2 ✓ VIA3	0.257678	0.968975
3 ✓ VIA2	0.110572	0.415797
4 ✓ M3	12.3778	46.5456
5 ✓ M2	12.5723	47.2769
6 ✓ VIA1	0.0131249	0.0493553
7 ✓ M1	0.112151	0.421734
8 ✓ M2_IND...	0.592052	2.22636

rows : 8

Layer name	Value	% of total value
1 ✓ M4	0.517316	16.1158
2 ✓ VIA3	0.266892	8.31439
3 ✓ VIA2	0.0458989	1.42988
4 ✓ M3	0.857756	26.7214
5 ✓ VIA1	0.013243	0.412554
6 ✓ M2	0.826109	25.7355
7 ✓ M1	0.0907293	2.82646
8 ✓ M2_IND...	0.592052	18.444

rows : 8

STATISTICS

0% 100%
■ Good values ratio - 93.1677%
■ Bad values ratio - 6.8323%

	All	Filtered
#good values	150	150
#bad values	11	11
Max. absolute error	-23.38	-23.38
Max. relative error (%)	-87.93	-87.93
Global Weighted RMS	10.1	10.1
Global weighted standard deviation	9.986	9.986
Global weighted relative standard deviation	6.702	6.702
Mean of value comp over adj. value ref	0.9511	0.9511
Std dev of value comp over adj. value ref	0.1763	0.1763

reference : ref.dspf
 comparison : comp.dspf

PARAMETERS

Error computation :
 Error max (%) : 5
 Min. resistance (ohms) : 0.001
 Min. R filtering (ohms) : 0.001
 Offset R (%) : 0
 Show borders
 Recompute



Viso

Explore and Analyze

- VISO provides analyses for a deep understanding and debug of the designs combined with a powerful GUI for the visualization
 - Parasitic related analysis
 - Node to node Rs and RC delay; resistance and RC delay path
 - NET to NET Cs
 - Comparison of NETs (buses, differential pair, etc.)
 - Static IR drop
 - Grid resistance / delay distribution
 - Detection of cut NETs, sanity checks
 - Exploration through the GUI
 - 2D and 3D view with the GDSII on top of the parasitics
 - Interpretation of results simplified through graphics
 - Ease of use



Viso

Explore and Analyze

- VISO for end users
 - Verify balance of R, RC delays and NET to NET C
 - Delay skew checker
 - Diff pair matching control
 - Extraction QA
 - Debug
 - Sanity checks
 - EM/IR quick analyzer
 - Parasitic explorer
 - Build up customized analysis flows

- VISO helps designers to solve parasitic issues without having to rely on costly simulation



Viso

Explore and Analyze

File Analysis Visualization View

create load load nets results preferences

INTERACTIVE COMPUTATIONS

Single Multiple Path

- rp_0 27.98... x v
- net valid
- source valid:1
- target valid:...

Global Statistics Pins x Net - 'valid' x Resistance path - 'valid' - rp_0

Resistance path analysis results Layers' contributions

[filter table | sort table | columns | save as]

	Net Name	Layer	Contribution	of contribuc	Sensitivity
1	valid	net_via2_m...	4.8	17.1542	0.571429
2	valid	net_via1	1.2	4.28855	0.333333
3	valid	met1	0.468125	1.67298	0.97877
4	valid	met2	6.11692	21.8606	0.508928
5	valid	met3	15.3964	55.0236	0.949832

Views Manager

Loaded Views

name	type	net
x parasitics	block	--
x pins	pins	--
x netlist	netlist	valid
x rp_0	respath	valid
x layout	layout	--

View Options

Visualize data

Visualization Options:

opacity: [slider]

display value: vsum

wire width based on: W

wire width default value: 0.01

vias area according to: A

via area default value: 0.01

show polygons borders:

show colormap:

Layers visibility: on off switch

LAYERS

Name	Type	Status
NTUB	drw	<input type="checkbox"/>
DIFF	drw	<input checked="" type="checkbox"/>
NPLUS	drw	<input type="checkbox"/>
PPLUS	drw	<input type="checkbox"/>
POLY1	drw	<input type="checkbox"/>
CONT	drw	<input type="checkbox"/>

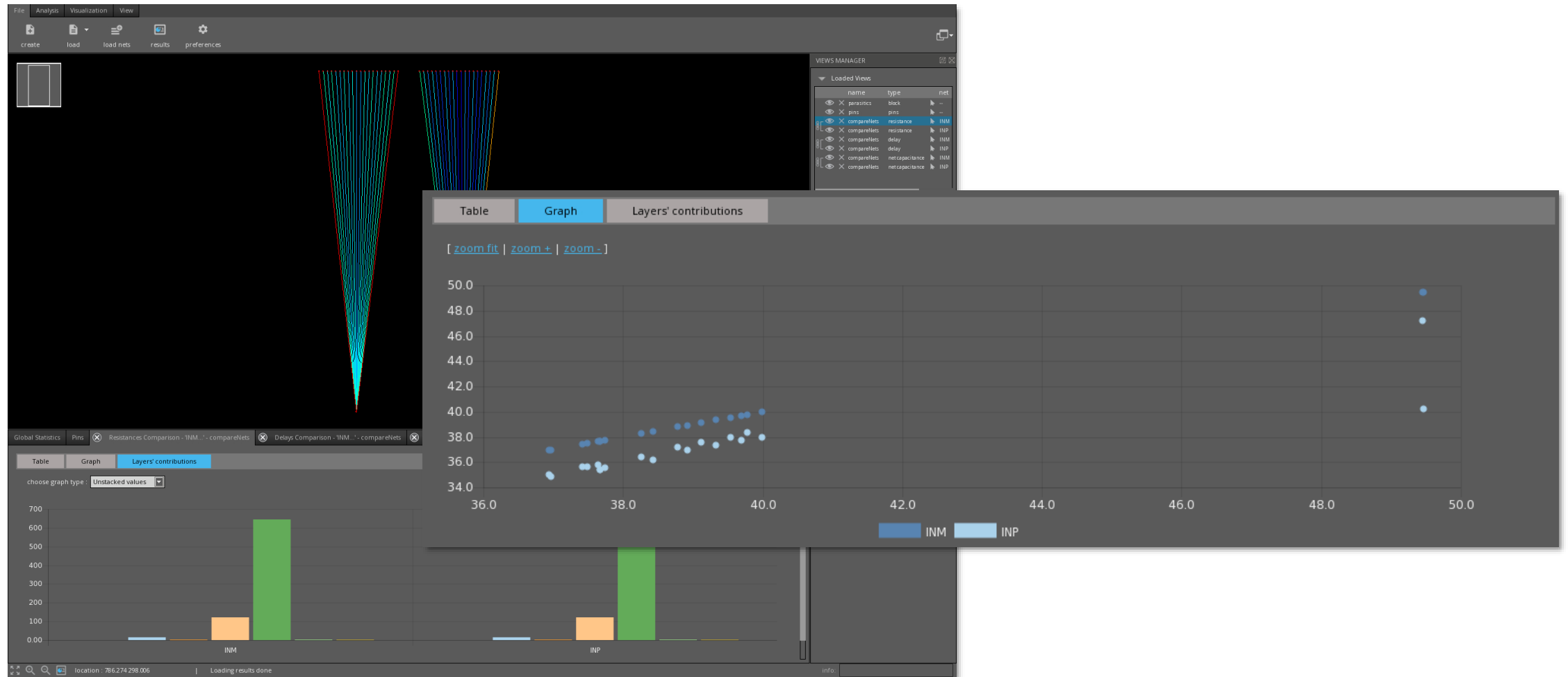
pin source: [input]

location: 131.282 163.053 | Loading results done



Viso

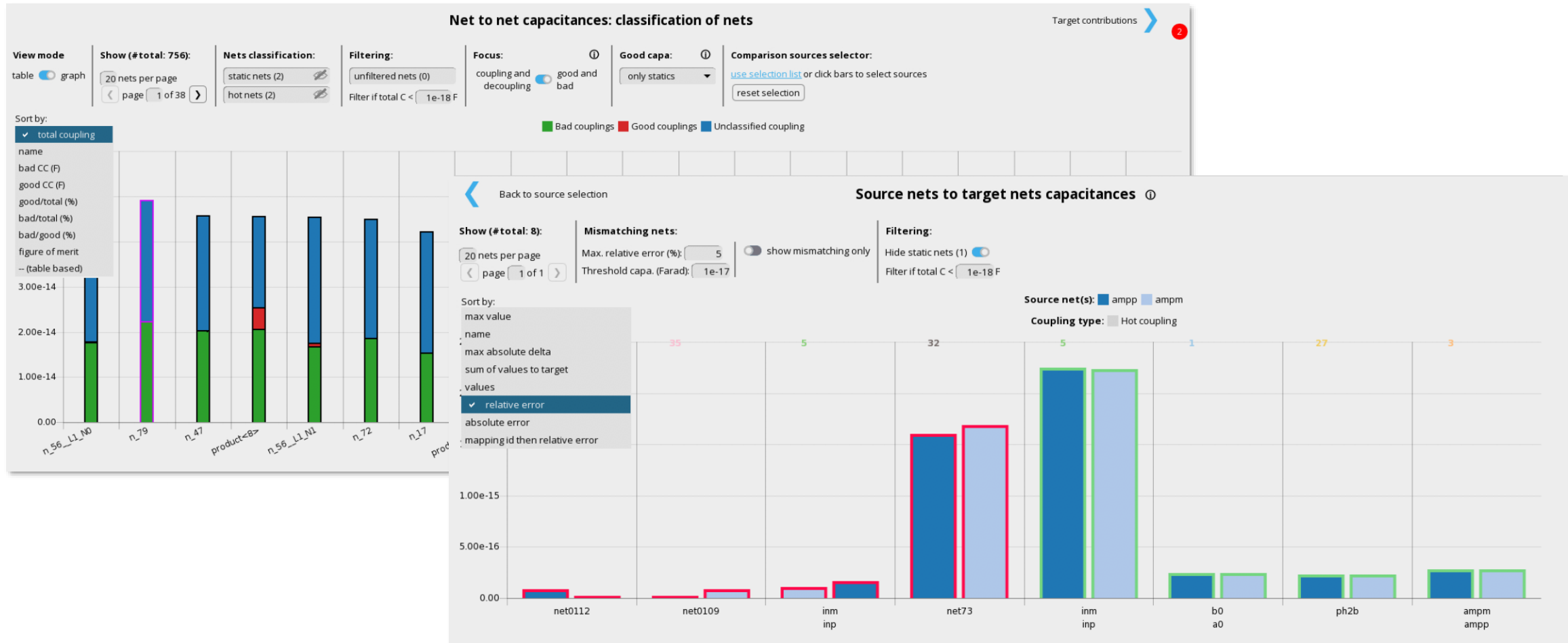
Explore and Analyze





Viso

Explore and Analyze





Viso, Belledonne, Brenner

Summary

- Simulations become less relevant when the results cannot be interpreted correctly
- Additional solutions are now a must have to provide insight when diving in the parasitics black-box
- BRENNER, BELLEDONNE and VISO powerful capabilities combined with the user knowledges offer countless possibilities
 - Build an extraction QA methodology
 - Pre-simulation debugging of the design
 - Critical path optimization