

# Automation and AI in PEX Qualification

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# Introduction



Automation and AI are changing the way organizations and employees work. One of the key areas for improvement is how automation and intelligent systems can simplify tasks, letting engineers focus on more complex assignments.

In this presentation, we will discuss how GlobalFoundries make use of Automation and AI along with StarRC tools, to further enhance PDK development and QA work.

# What is Artificial Intelligence

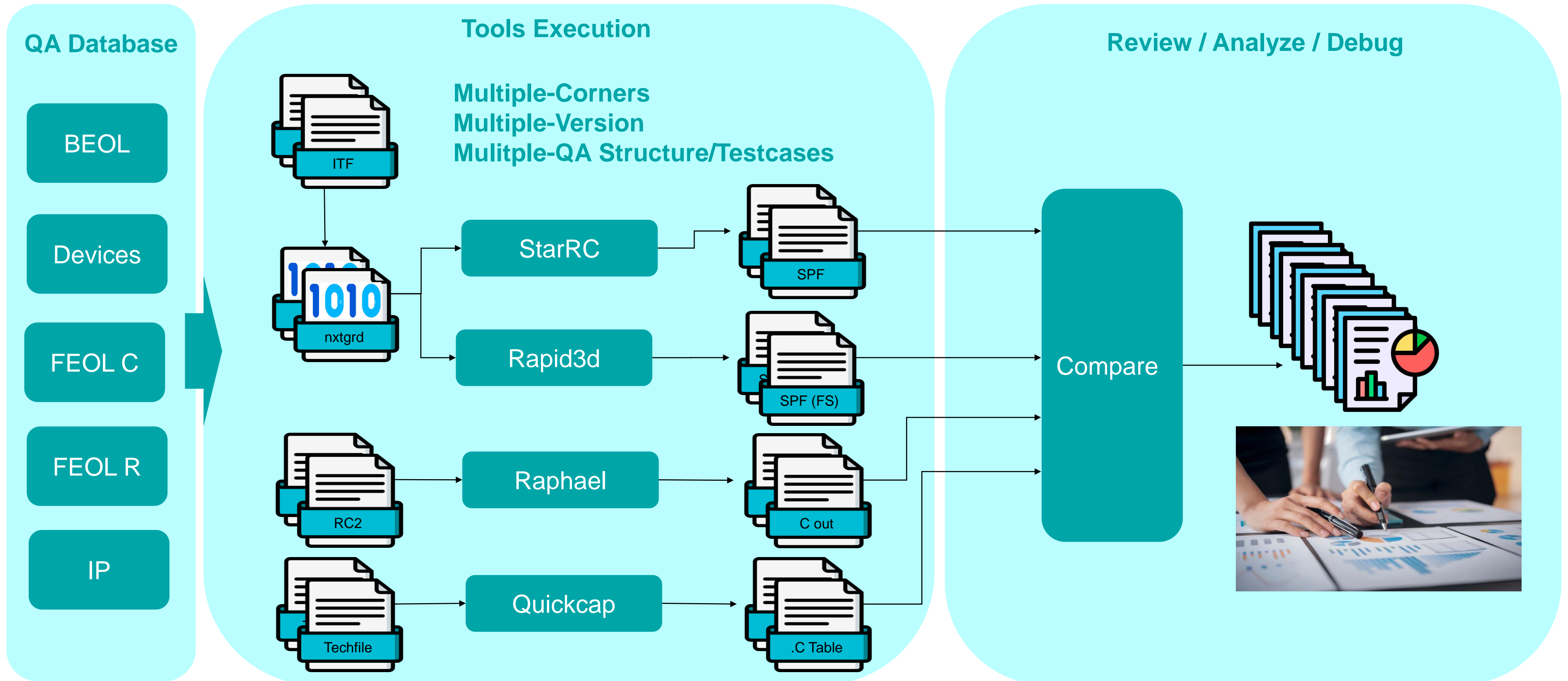


Artificial intelligence (AI) refers to computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems.

The benefits of AI include efficiency through task automation, data analysis for informed decisions, assistance in diagnosis.

# Current PEX QA System

# Current GlobalFoundries PEX QA System





# Problems

# Problems

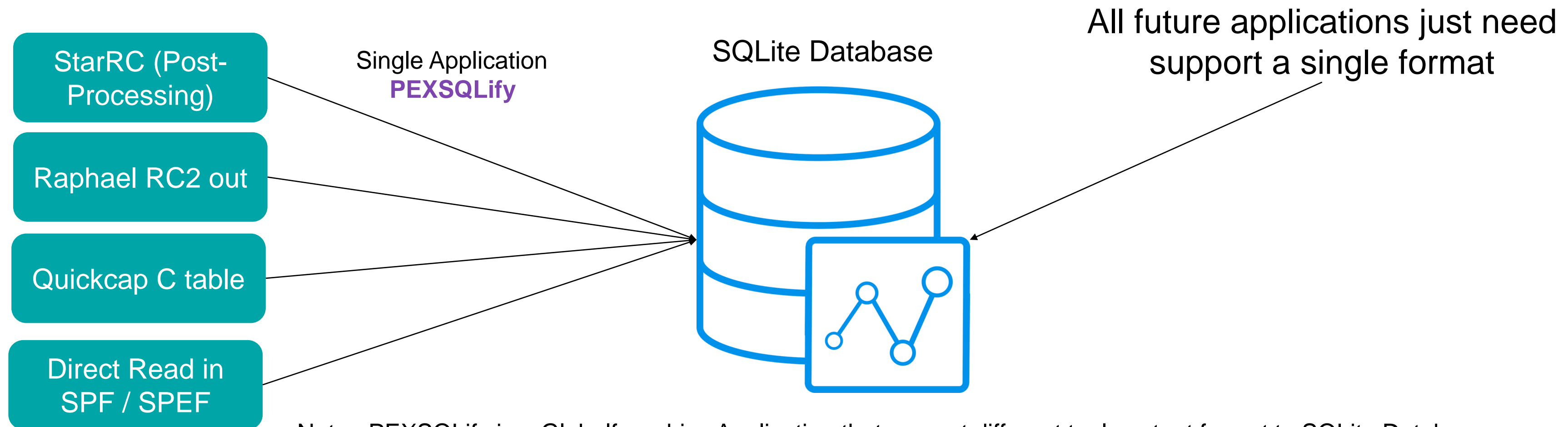
- Relying on various applications to compare RC results between tools
- Need to support different output formats from different tools.
- Different applications generate duplicate reports in different structure and formats.
  - Different formats, some reports in excel, some in text files
  - Different structure, some reports have different structures but showing similar results.
  - Different types of report
    - Compare report between different version.
    - Compare report between different tools
- User need to manually review and analyze every reports

# Solution



# Why the need for a new database

- Just need 1 application to convert multiple tools format to a single format.
- All newly developed applications just need support 1 database format.
- GlobalFoundries choose Sqlite Database format as standard format for full PDK system.



Note : PEXSQLify is a Globalfoundries Application that convert different tools output format to SQLite Database

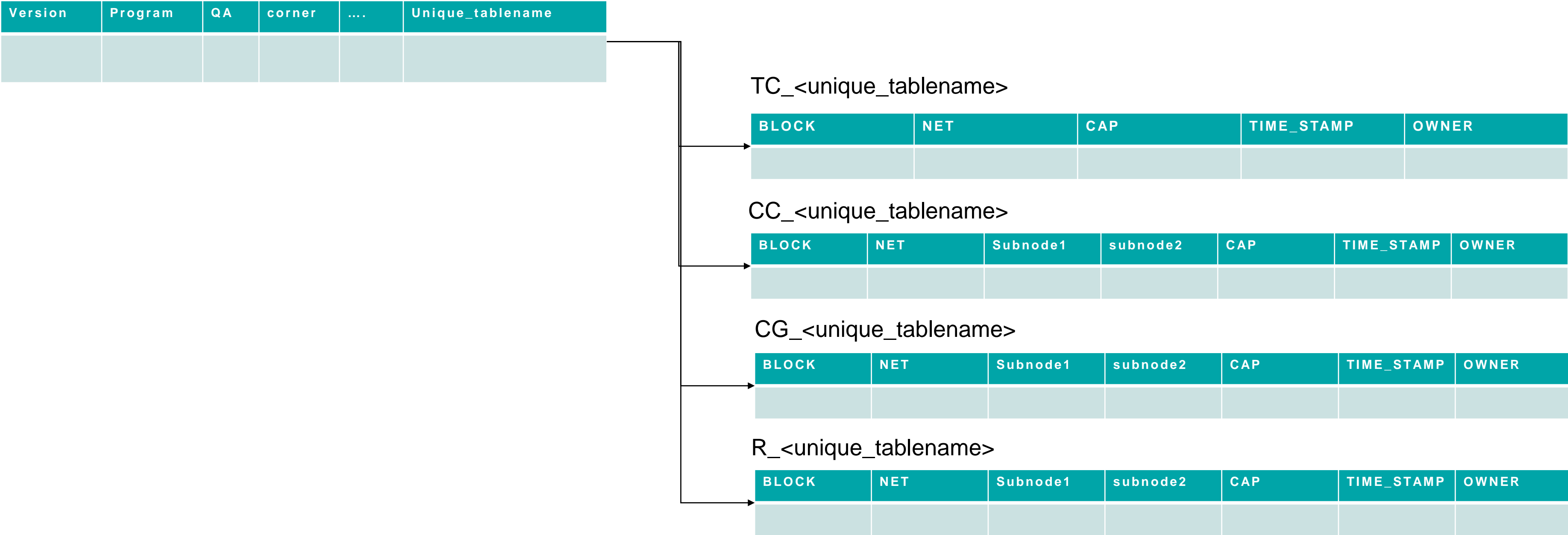
# Why SQLite

- Advantages for SQLite
  - Light weight
  - Better Performance
  - No installation Needed
  - Reliable
  - Portable
  - Accessible
  - Reduce Cost and Complexity

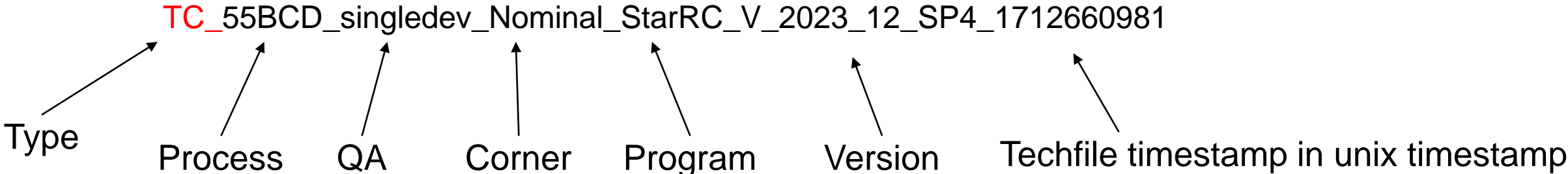
SQLite Database



# Example SQLite Database Format



Example of Total Cap tablenamee



# Example of SQLite browser



DB Browser for SQLite - S:\PycharmProjects\pex\_report\bin\pex\_data\_cap\\_raphael\_rc2\data.dat

File Edit View Tools Help

New Database Open Database Write Changes Revert Changes Open Project Save Project Attach Database Close Database

Database Structure Browse Data Edit Pragmas Execute SQL

Table: TC\_55BCD\_BEOL\_Nominal\_RAPHAEL\_RC2\_P\_2019\_1 Filter i...

	id	block	net	cap	gen_time_stamp	owner
	Filter	Filter	Filter	Filter	Filter	Filter
1	1	NA	M	89.99501	Wed Jul 10 14:15:47 2024	tnguye14
2	2	NA	M	18.45438	Wed Jul 10 14:15:47 2024	tnguye14
3	3	NA	M	18.32161	Wed Jul 10 14:15:47 2024	tnguye14
4	4	NA	M	18.32411	Wed Jul 10 14:15:47 2024	tnguye14
5	5	NA	M	18.32161	Wed Jul 10 14:15:47 2024	tnguye14
6	6	NA	M	18.45438	Wed Jul 10 14:15:47 2024	tnguye14
7	7	NA	M	96.27149	Wed Jul 10 14:15:47 2024	tnguye14
8	8	NA	M	143.8294	Wed Jul 10 14:15:47 2024	tnguye14
9	9	NA	M	33.16965	Wed Jul 10 14:15:47 2024	tnguye14
10	10	NA	M	33.16954	Wed Jul 10 14:15:47 2024	tnguye14
11	11	NA	M	33.16954	Wed Jul 10 14:15:47 2024	tnguye14
12	12	NA	M	33.16954	Wed Jul 10 14:15:47 2024	tnguye14
13	13	NA	M	33.16963	Wed Jul 10 14:15:47 2024	tnguye14
14	14	NA	M	146.8084	Wed Jul 10 14:15:47 2024	tnguye14
15	15	NA	M	118.6032	Wed Jul 10 14:15:47 2024	tnguye14
16	16	NA	M	27.12803	Wed Jul 10 14:15:47 2024	tnguye14
17	17	NA	M	27.18338	Wed Jul 10 14:15:47 2024	tnguye14
18	18	NA	M	27.18338	Wed Jul 10 14:15:47 2024	tnguye14
19	19	NA	M	27.18338	Wed Jul 10 14:15:47 2024	tnguye14
20	20	NA	M	27.12804	Wed Jul 10 14:15:47 2024	tnguye14
21	21	NA	M	122.5753	Wed Jul 10 14:15:47 2024	tnguye14

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Mode: Text

1

Type of data currently in cell: Text / Numeric  
1 character(s) Apply

Remote

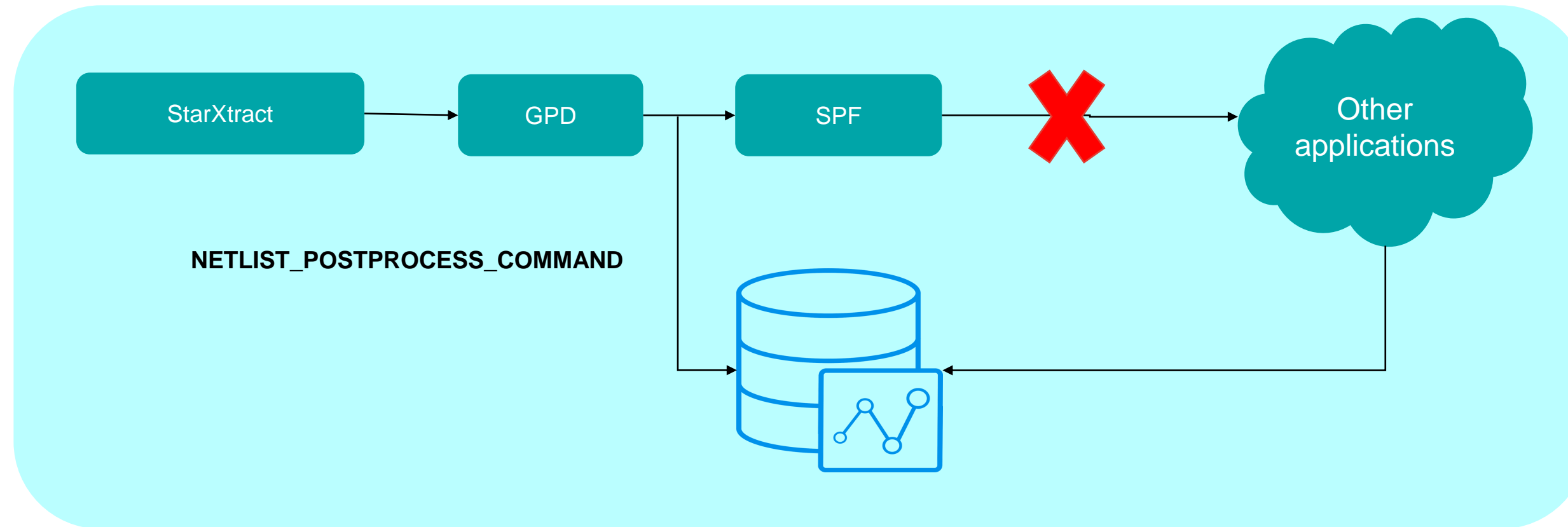
Identity Select an identity to connect

DBHub.io Local Current Database

Name	Last modified	Size
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SQL Log Plot DB Schema Remote

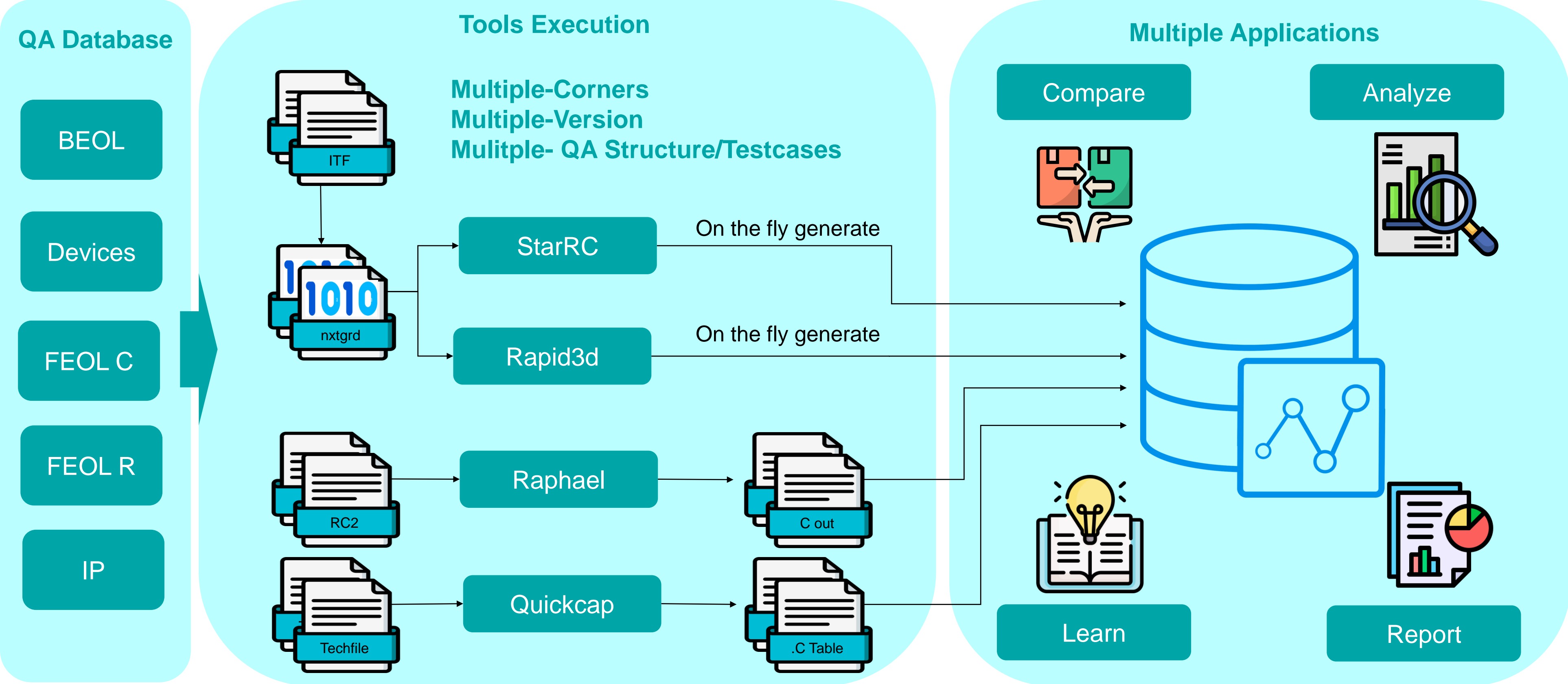
# Making use StarRC Post Processing Feature



**NETLIST\_POSTPROCESS\_COMMAND : PEXSQLify -process 55BCD -qa BEOL -pex\_data <path>/pex\_data**

- Using NETLIST\_POSTPROCESS\_COMMAND, GlobalFoundries don't need to modify current QA flow. Just need one additional command in star\_additional\_cmd
- Operation to create new database is in real time.
- Writing to SQLite database concurrently while StarRC is writing out text netlist.
  - Can write out empty SPF file if not required (Disk saving)
- Reduce workload to post process multiple entire netlists after they are saved.

# New GlobalFoundries PEX QA System





# Implementing AI application



- Most applications require some knowledge of the tool commands in order to access database.

Example, StarRC Parasitic Explorer

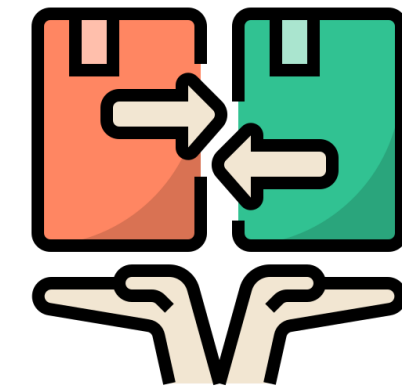
```
starrc_shell > report_capacitance -of [get_net XXX]
```

- To reduce learning cycle, GlobalFoundries explore and develop on a PEX Virtual Assistant to support the current SQLite database.

# Comparing Parasitic Databases

```
PexBot : Hello gan! I am your Virtual Assistant PexBot. How can I assist you today?  
gan : hi  
PexBot : Hey!  
  
gan : who are you  
PexBot : I'm PexBot, your AI chatbot. How can i assist you today?  
  
gan : Can you compare the pex databases  
PexBot : All Right then. Here you are.  
-----  
Summary of compare results  
-----  
Process : 55BCD. Corner : 55BCD. QA Type : "BEOL"  
Program : StarRC ( V-2023.12-SP2 ) vs RAPHAEL_RC2 ( P-2019.03 )  
-----  
Total Nets Compare : 1237  
Total Nets Violated : 0  
Max ABS Value : 0.92ff  
Min ABS Value : -2.23ff  
Max Delta : 2.09%  
Min Delta : -4.25%  
  
Congratuation. All Passed!  
  
gan : Thanks  
PexBot : Sure, No Problem!  
  
gan : exit  
PexBot : Goodbye!
```

Compare



# Analyzing results

```
Gan : Can you compare the pex databases
PexBot : Sure! This is the result.

-----
Summary of compare results
-----
Process : 55BCD, Corner : 55BCD, QA Type : "singledev"
Program : Rapid3D ( R-2020,09-SP5-4 ) vs StarRC ( R-2020,09-SP5-4 )
-----

Total Nets Compare : 3
Total Nets Violated : 1
Max ABS Value : 0,06ff
Min ABS Value : -1,29ff
Max Delta : 3,97%
Min Delta : -132,10%

Gan : show me the Nets that fail
PexBot : The Violated Net(s) are as follow :
- SX_IO

Gan : Can you list all compare nets
PexBot : This is the compare nets :
- SX_IO
- G_IO
- SD_IO

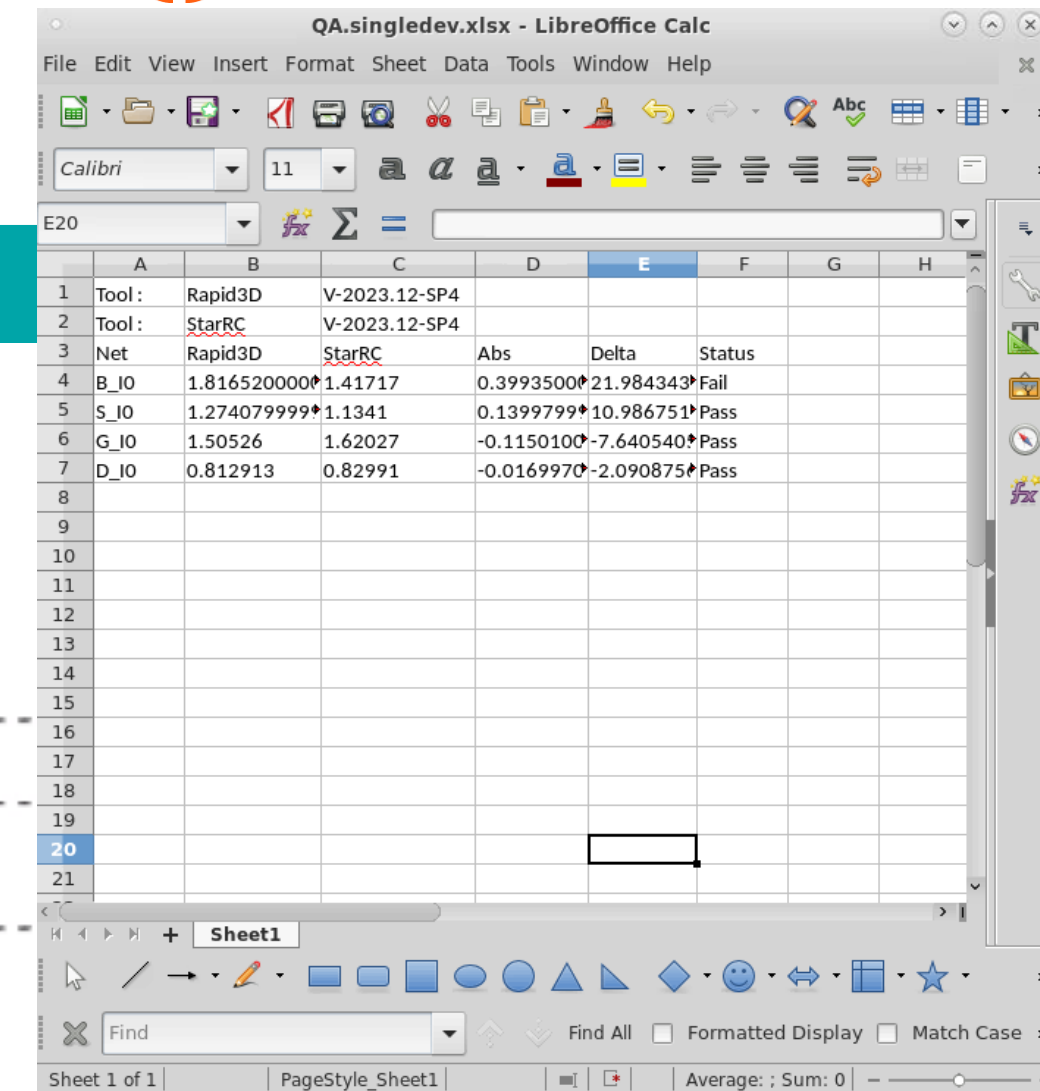
Gan : Show me the total cap of net SX_IO
PexBot : Total Capacitance for Net SX_IO in StarRC ( R-2020,09-SP5-4 ) is 2,2723299999999997ff
Total Capacitance for Net SX_IO in Rapid3D ( R-2020,09-SP5-4 ) is 0,979019ff

Gan : █
```

Analyze



# Writing Report



Net	Rapid3D	StarRC	Abs	Delta	Status
B_I0	1.816520000	1.41717	0.3993500	21.98433	Fail
S_I0	1.274079999	1.1341	0.1399799	10.98675	Pass
G_I0	1.50526	1.62027	-0.1150100	-7.64054	Pass
D_I0	0.812913	0.82991	-0.0169970	-2.090875	Pass

```
PexBot : Hello alejandro! I am your Virtual Assistant PexBot. How can I assist you today?
alejandro : Hi Pexbot
PexBot : Hi there!

alejandro : please compare the dataases
PexBot : All Right then. Here you are.
-----
Summary of compare results
-----
Process : 55BCD. Corner : 55BCD. QA Type : "singledev"
Program : Rapid3D ( V-2023.12-SP4 ) vs StarRC ( V-2023.12-SP4 )
-----
Total Nets Compare : 4
Total Nets Violated : 1
Max ABS Value : 0.40ff
Min ABS Value : -0.12ff
Max Delta : 21.98%
Min Delta : -7.64%

alejandro : I need excel report
PexBot : Got it!
Output xlsx : ./QA.singledev.xlsx

alejandro : thank
PexBot : No Problem!

alejandro : exit
PexBot : Goodbye!
```

Report



# Summary



- Moving to SQLite database will benefit GlobalFoundries in many aspects. Reduce application development cost and time, consolidation of all reports and applications.
- PexBot AI application is the first application that GlobalFoundries develop to support PEX SQLite database.
- PexBot AI application will improve efficiency of engineer day to day in terms comparing, analysing and reporting.

# Future Milestones



- Expand more features in PexBot.
- Improve structure of SQLite Database to support more applications.
- Build more applications to support GlobalFoundries SQLite database.
- Use AI to analyze results and propose the best tool version.



***THANK YOU***

Our  
Technology,  
Your  
Innovation™