

AGE of ROADS: design of an IC
was tightly coupled
with in manufacturing
process available 😊

Ti intel Fairchild

structured design methodology based on 'X' rules

Lynn Conway and Carver Mead

PDK - Process Design Kit

intention b/w Fair & Lagarias 😊

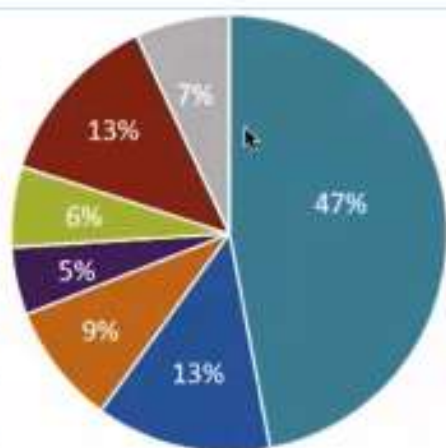


These PDKs are distributed under **Non-Disclosure** agreement ☹️

Google + SKY WATER

FoSS 130nm Production PDK - Jun 30, 2020

130nm OIP ?



→ 6% market share (2019)

→ Don't need much performance for every application

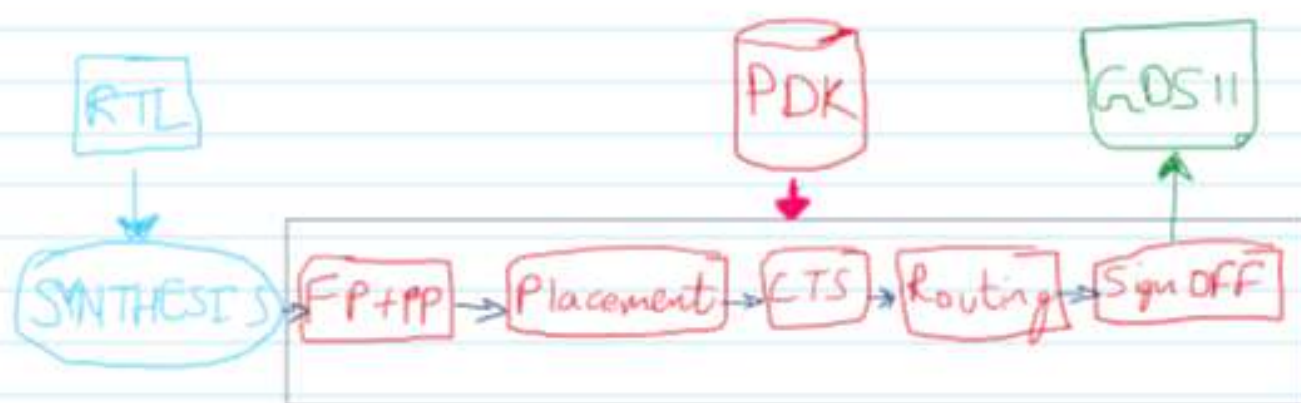
→ Cost cutting as high process nodes requires more sophisticated manufacturing machines.

Intel Pentium @ 3.46GHz
130nm

WooooY! Lets design an IC ourself 😊
⊗ It really Complicated ☹️

RTL to GDSII

Flow to achieve a proper layout that could be sent to fab 😊

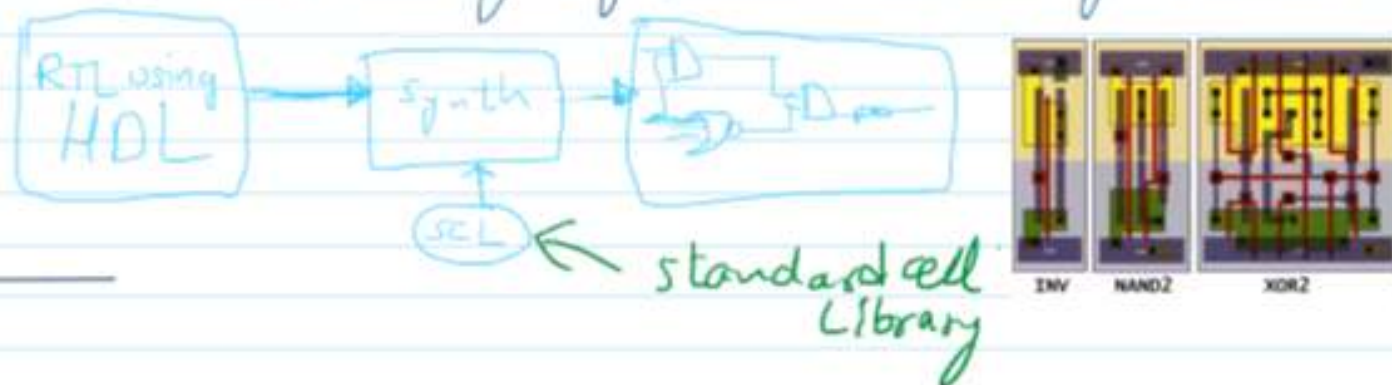


Why end stage in the flow is **sign off**

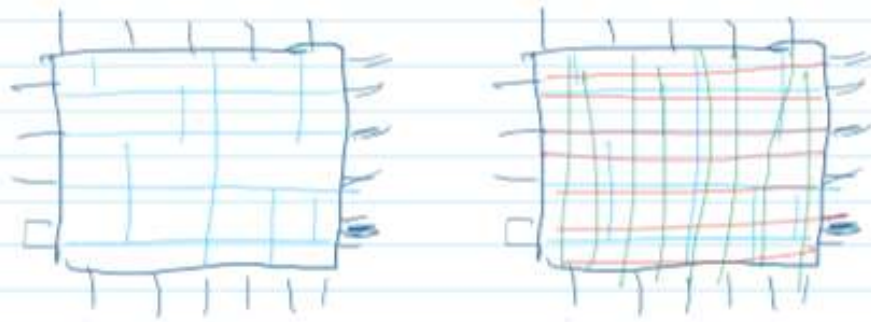
Why not Layout 😊

Interpretation: After going through entire RTL-GDSII flow, an IC design is tested for proper timing, power consumption, signal integrity, DRC etc, thus confirming its appropriate functionality acc to specs.

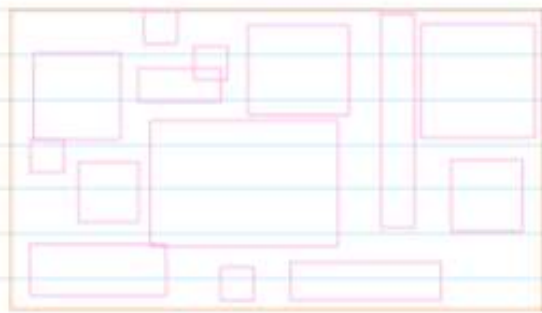
Layout information is sent in Binary file GDSII Graphic Design System II which can be understood by Fab manufacturing equipment interfaced by software



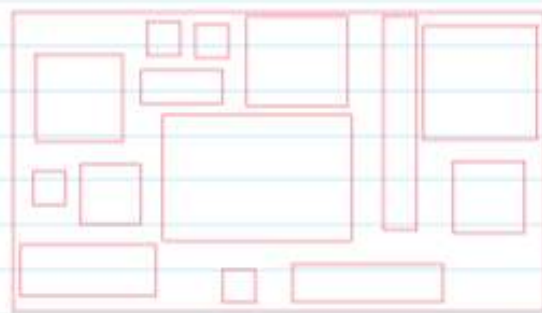
Floor Planning + Power Planning



Placement (😊)



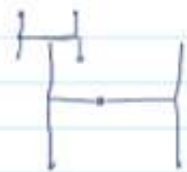
Global Placement
(Optimal Places for cells)



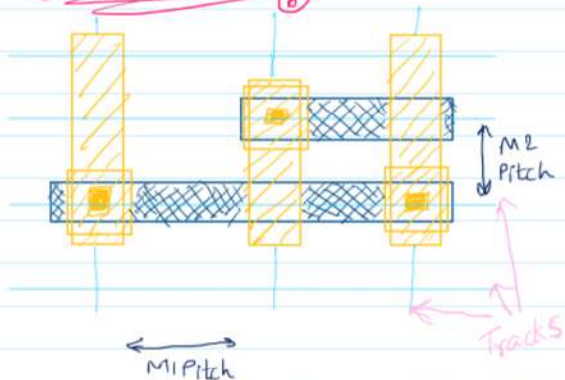
Detailed Placement
(altered a bit)

Clock Tree Synthesis (CTS):

- deliver clock to all sequential elements (FF)
- with min. skew (arrival of clock signal @ elements)
- good shape (H tree, X tree, Wishbone)



Routing:



- Metal tracks form routing grid
- Routing grid is huge
 - ↳ Global Route
 - ↳ Detailed Route: actual wiring

Sign Off:-

- Physical Verification
 - 1) Design Rule Checking (DRC)
 - 2) Layout vs Schematic (LVS)
- STA Analysis (Timing)

Open Lane:

Being everything together in one place where all the necessary open EDA tools like openSTA, magic, netgen etc, are aligned in a flow. Thus, achieving automated RTL to GDSII flow.

docker?

run applications or even "OS" on a host OS

To get openlane interactive features, we use docker!



WORK → tools → openlane → magic →

open pdk

↳ skywater130 is

a pdk; it supports only

Commercial tools!

open-pdk makes skywater pdk

compatible with openEDA tools by using some scripts

skywater pdk → sky130A

pdk/sky130A - ls

↳ libs.tech ← tools

↳ libs.ref

sky130-fd-sc-hd
boundary ↓ high density
standard cell

less config.td
bypasses any older configurations

```
# All Configs
set :env(CLS_OF_ROOTDIR) 0.1
set :env(CORE_AIA_PATH) 0
set :env(CLOCK_PERIOD) "24.75"
set :env(FP_CORE_UTIL) 25
set :env(FP_TARGET_DENSITY) [ expr $( :env(FP_CORE_UTIL) ) / 100.0 ]
```


DAY1

Openlane directory structure:

```
File Edit View Search Terminal Help
vsduser@vsdsquadron:~$ ls
Desktop Documents Downloads examples.desktop magic Music OpenSTA Pictures Public Templates Videos yosys
vsduser@vsdsquadron:~$ cd Desktop/
vsduser@vsdsquadron:~/Desktop$ ls
work work.zip
vsduser@vsdsquadron:~/Desktop$ ls
work work.zip
vsduser@vsdsquadron:~/Desktop$ cd work/
vsduser@vsdsquadron:~/Desktop/work$ ls
tools work
vsduser@vsdsquadron:~/Desktop/work$ cd tools/
vsduser@vsdsquadron:~/Desktop/work/tools$ ls -ltr
total 0
drwxrwxr-x 7 vsduser docker 4096 Jun 28 2021 vsdflow
drwxrwxrwx 5 vsduser docker 4096 Jun 29 2021 
vsduser@vsdsquadron:~/Desktop/work/tools$ ls --help
Usage: ls [OPTION]... [FILE]...
List information about the FILES (the current directory by default).
Sort entries alphabetically if none of -cftuvSUX nor --sort is specified.

Mandatory arguments to long options are mandatory for short options too.
  -a, --all                do not ignore entries starting with .
  -A, --almost-all        do not list implied . and ..
  -l, --long                with -l, print the author of each file
  -b, --escape              print C-style escapes for nongraphic characters
  -B, --block-size=SIZE    scale sizes by SIZE before printing them; e.g.,
                           '--block-size=M' prints sizes in units of
                           1,048,576 bytes; see SIZE format below
  -C, --ignore-backups     do not list implied entries ending with ~
  -c, --sort=CTIME          with -lt: sort by, and show, ctime (time of last
                           modification of file status information);
                           with -l: show ctime and sort by name;
                           otherwise: sort by ctime, newest first
  -C, --color[=WHEN]       list entries by columns
                           colorize the output; WHEN can be 'always' (default
                           if omitted), 'auto', or 'never'; more info below
  -d, --directory          list directories themselves, not their contents
  -D, --dired              generate output designed for Emacs' dired mode

to non-recent files and FORMAT2 to recent files;
if STYLE is prefixed with 'posix-', STYLE
takes effect only outside the POSIX locale
sort by modification time, newest first
assume tab stops at each COLS instead of 8
with -lt: sort by, and show, access time;
with -l: show access time and sort by name;
otherwise: sort by access time, newest first
do not sort; list entries in directory order
natural sort of (version) numbers within text
set output width to COLS. 0 means no limit
list entries by lines instead of by columns
sort alphabetically by entry extension
print any security context of each file
list one file per line. Avoid '\n' with -q or -b
--help    display this help and exit
--version output version information and exit

The SIZE argument is an integer and optional unit (example: 10K is 10*1024).
Units are K,M,G,T,P,E,Z,Y (powers of 1024) or KB,MB,... (powers of 1000).

Using color to distinguish file types is disabled both by default and
with --color=never. With --color=auto, ls emits color codes only when
standard output is connected to a terminal. The LS_COLORS environment
variable can change the settings. Use the dircolors command to set it.

Exit status:
 0 if OK,
 1 if minor problems (e.g., cannot access subdirectory),
 2 if serious trouble (e.g., cannot access command-line argument).

GNU coreutils online help: <http://www.gnu.org/software/coreutils/>
Full documentation at: <http://www.gnu.org/software/coreutils/ls>
or available locally via: info '(coreutils) ls invocation'
vsduser@vsdsquadron:~/Desktop/work/tools$ clear
```

```
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```



```
File Edit View Search Terminal Help
vdsuser@vdsquadron:~/Desktop/work/tools$ clear

vdsuser@vdsquadron:~/Desktop/work/tools$ ls
vdsflow
vdsuser@vdsquadron:~/Desktop/work/tools$ cd openlane_working_dir/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir$ ls
openlane openlane_old pdks
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir$ cd pdks/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ ls
open_pdks sky130A skywater-pdk
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd sky130A/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ ls
libs.ref libs.tech SOURCES
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ cd libs.ref/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref$ ls -ltr
total 48
drwxr-xr-x 10 vdsuser docker 4096 Jun 28 2021 sky130_osu_sc_t18
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_ns
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_ls
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_hs
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_hdll
drwxr-xr-x 8 vdsuser docker 4096 Jun 28 2021 sky130_fd_pr
drwxr-xr-x 9 vdsuser docker 4096 Jun 28 2021 sky130_sram_macros
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_hvl
drwxr-xr-x 11 vdsuser docker 4096 Jun 28 2021 sky130_fd_io
drwxr-xr-x 4 vdsuser docker 4096 Jun 28 2021 sky130_nl_xx_hd
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_lp
drwxr-xr-x 12 vdsuser docker 4096 Jun 28 2021 sky130_fd_sc_hd
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref$ cd ../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ cd libs.tech/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.tech$ ls -ltr
total 36
drwxr-xr-x 9 vdsuser docker 4096 Jun 28 2021 xschem
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 xcircuit
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 qflow
drwxr-xr-x 10 vdsuser docker 4096 Jun 28 2021 openlane
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 ngspice
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 netgen
```

```
File Edit View Search Terminal Help
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd ../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ ls
libs.ref libs.tech SOURCES
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ cd libs.re
bash: cd: libs.re: No such file or directory
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A$ cd libs.ref
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref$ ls
sky130_fd_io sky130_fd_sc_hd sky130_fd_sc_hs sky130_fd_sc_lp sky130_fd_sc_ns sky130_osu_sc_t18
sky130_fd_pr sky130_fd_sc_hdll sky130_fd_sc_hvl sky130_fd_sc_ls sky130_nl_xx_hd sky130_sram_macros
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref$ cd sky130_fd_sc_hd
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ ls
cdl doc gds lef lib mag maglef spice techlef verilog
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ cd lib/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lib$ ls
sky130_fd_sc_hd_ff_100C_1v65.lib sky130_fd_sc_hd_ff_n40C_1v95.lib sky130_fd_sc_hd_ss_n40C_1v44.lib
sky130_fd_sc_hd_ff_100C_1v95.lib sky130_fd_sc_hd_ss_100C_1v40.lib sky130_fd_sc_hd_ss_n40C_1v60_ccsnoise.lib
sky130_fd_sc_hd_ff_n40C_1v56.lib sky130_fd_sc_hd_ss_100C_1v60.lib sky130_fd_sc_hd_ss_n40C_1v60.lib
sky130_fd_sc_hd_ff_n40C_1v65.lib sky130_fd_sc_hd_ss_n40C_1v28.lib sky130_fd_sc_hd_ss_n40C_1v76.lib
sky130_fd_sc_hd_ff_n40C_1v76.lib sky130_fd_sc_hd_ss_n40C_1v35.lib sky130_fd_sc_hd_tt_025C_1v80.lib
sky130_fd_sc_hd_ff_n40C_1v95_ccsnoise.lib sky130_fd_sc_hd_ss_n40C_1v40.lib sky130_fd_sc_hd_tt_100C_1v80.lib
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lib$ cd ../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ ls -ltr
ls: cannot access 'ltr': No such file or directory
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ ls -ltr
total 88
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 verilog
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 techlef
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 spice
drwxr-xr-x 2 vdsuser docker 28672 Jun 28 2021 maglef
drwxr-xr-x 2 vdsuser docker 28672 Jun 28 2021 mag
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 lib
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 lef
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 gds
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 doc
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 cdl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ cd lef/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lef$ ls
```



```

sky130_fd_sc_hd__ff_100C_1v65.lib      sky130_fd_sc_hd__ff_n40C_1v95.lib      sky130_fd_sc_hd__ss_n40C_1v44.lib
sky130_fd_sc_hd__ff_100C_1v95.lib      sky130_fd_sc_hd__ss_100C_1v40.lib      sky130_fd_sc_hd__ss_n40C_1v60_ccsnoise.lib
sky130_fd_sc_hd__ff_n40C_1v56.lib      sky130_fd_sc_hd__ss_100C_1v60.lib      sky130_fd_sc_hd__ss_n40C_1v60.lib
sky130_fd_sc_hd__ff_n40C_1v65.lib      sky130_fd_sc_hd__ss_n40C_1v28.lib      sky130_fd_sc_hd__ss_n40C_1v76.lib
sky130_fd_sc_hd__ff_n40C_1v76.lib      sky130_fd_sc_hd__ss_n40C_1v35.lib      sky130_fd_sc_hd__tt_025C_1v80.lib
sky130_fd_sc_hd__ff_n40C_1v95_ccsnoise.lib sky130_fd_sc_hd__ss_n40C_1v40.lib      sky130_fd_sc_hd__tt_100C_1v80.lib

vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lib$ cd ../
ls: cannot access 'ltr': No such file or directory
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ ls -ltr
total 88
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 verilog
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 techlef
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 spice
drwxr-xr-x 2 vdsuser docker 28672 Jun 28 2021 maglef
drwxr-xr-x 2 vdsuser docker 28672 Jun 28 2021 mag
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 lib
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 lef
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 gds
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 doc
drwxr-xr-x 2 vdsuser docker 4096 Jun 28 2021 cdl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ cd lef/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lef$ ls
sky130_ef_sc_hd_decap_12.lef sky130_ef_sc_hd_fakediode_2.lef sky130_ef_sc_hd_fill_12.lef sky130_fd_sc_hd.lef
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/lef$ cd ../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd$ cd techlef/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/techlef$ ls -ltr
total 20
-rwxr-xr-x 1 vdsuser docker 18007 Jun 28 2021 sky130_fd_sc_hd.tlef
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/techlef$ cd ../../../../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd ../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir$ ls -ltr
total 12
drwxr-xr-x 5 vdsuser docker 4096 Jun 28 2021 pdks
drwxr-xr-x 10 vdsuser docker 4096 Jun 29 2021 openlane_old
drwxr-xr-x 10 vdsuser docker 4096 May 20 2023 openlane
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir$ cd openlane
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane$

```

```

# Design
set ::env(DSIGN_NAME) "picorv32a"

set ::env(VERILOG_FILES) "-./designs/picorv32a/src/picorv32a.v"
set ::env(SDC_FILE) "-./designs/picorv32a/src/picorv32a.sdc"

set ::env(CLOCK_PERIOD) "5.000"
set ::env(CLOCK_PORT) "clk"

set ::env(CLOCK_NET) $::env(CLOCK_PORT)

set filename $::env(OPENLANE_ROOT)/designs/$::env(DSIGN_NAME)/$::env(PDK)_$::env(STD_CELL_LIBRARY)_config.tcl
if { [file exists $filename] == 1 } {
    source $filename
}
config.tcl (END)

```



```
File Edit View Search Terminal Tabs Help
vdsuser@vdsquadron: ~/Desktop/work/tools/openlane_working_dir/openlane
vdsuser@vdsquadron: ~/Desktop/work/tools/openlane_working_dir/openlane$ docker
bash-4.2$
bash-4.2$ pwd
/openLANE_flow
bash-4.2$ ls -ltr
total 136
drwxr-xr-x 15 1000 997 4096 Jun 29 2021 scripts
-rw-r--r-- 1 1000 997 20787 Jun 29 2021 run_designs.py
-rw-r--r-- 1 1000 997 7898 Jun 29 2021 report_generation_wrapper.py
drwxr-xr-x 3 1000 997 4096 Jun 29 2021 regression_results
-rwxr-xr-x 1 1000 997 6519 Jun 29 2021 flow.tcl
drwxr-xr-x 5 1000 997 4096 Jun 29 2021 docs
drwxr-xr-x 44 1000 997 4096 Jun 29 2021 docker_build
drwxr-xr-x 2 1000 997 4096 Jun 29 2021 designs
-rw-r--r-- 1 1000 997 5514 Jun 29 2021 configuration
-rwxr-xr-x 1 1000 997 966 Jun 29 2021 clean_runs.tcl
-rw-r--r-- 1 1000 997 25509 Jun 29 2021 README.md
-rw-r--r-- 1 1000 997 7273 Jun 29 2021 Makefile
-rw-r--r-- 1 1000 997 11350 Jun 29 2021 LICENSE
-rw-r--r-- 1 1000 997 1285 Jun 29 2021 CONTRIBUTING.md
-rw-r--r-- 1 1000 997 709 Jun 29 2021 AUTHORS.md
-rw-r--r-- 1 1000 1000 963 May 19 2023 default.cvcrc
bash-4.2$ ./flow.tcl -interactive
[INFO]:
OPENLANE
[INFO]: Version: v0.21
[INFO]: Running interactively
% package require openlane 0.9
0.9
```

```
% prep -design picorv32a
[INFO]: Using design configuration at /openLANE_flow/designs/picorv32a/config.tcl
[INFO]: Sourcing Configurations from /openLANE_flow/designs/picorv32a/config.tcl
[INFO]: PDKs root directory: /home/vsduser/Desktop/work/tools/openlane_working_dir/pdks
[INFO]: PDK: sky130A
[INFO]: Setting PDKPATH to /home/vsduser/Desktop/work/tools/openlane_working_dir/pdks/sky130A
[INFO]: Standard Cell Library: sky130_fd_sc_hd
[INFO]: Sourcing configurations from /openLANE_flow/designs/picorv32a/config.tcl
[INFO]: Current run directory is /openLANE_flow/designs/picorv32a/runs/26-04_11-35
[INFO]: Preparing LEF Files
[INFO]: Extracting the number of available metal layers from /home/vsduser/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.
[INFO]: The number of available metal layers is 6
[INFO]: The available metal layers are li1 met1 met2 met3 met4 met5
[INFO]: Merging LEF Files...
mergeLef.py : Merging LEFs
sky130_fd_sc_hd.lef: SITES matched found: 0
sky130_fd_sc_hd.lef: MACROS matched found: 437
sky130_ef_sc_hd_fill_12.lef: SITES matched found: 0
sky130_ef_sc_hd_fill_12.lef: MACROS matched found: 1
sky130_ef_sc_hd_decap_12.lef: SITES matched found: 0
sky130_ef_sc_hd_decap_12.lef: MACROS matched found: 1
sky130_ef_sc_hd_fakediode_2.lef: SITES matched found: 0
sky130_ef_sc_hd_fakediode_2.lef: MACROS matched found: 1
mergeLef.py : Merging LEFs complete
[INFO]: Running Liberty...
[INFO]: Generating Exclude List...
[INFO]: Storing configs into config.tcl ...
[INFO]: Preparation complete
%
```



```
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane$ cd ../openlane/designs/picorv32a/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs$ cd picorv32a/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ ls -ltr
total 28
drwxr-xr-x 2 vdsuser docker 4096 Jun 29 2021 src
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ms_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ls_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hs_config.tcl
-rwxr-xr-x 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hdll_config.tcl
-rwxr-xr-x 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hd_config.tcl
-rwxr-xr-x 1 vdsuser docker 444 Jun 29 2021 config.tcl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ less config.tcl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ less sky130A_sky130_fd_sc_hd_config.tcl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ cd ../../
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane$ cd designs/picorv32a/
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ clear
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ ls -ltr
total 28
drwxr-xr-x 2 vdsuser docker 4096 Jun 29 2021 src
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ms_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ls_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hs_config.tcl
-rwxr-xr-x 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hdll_config.tcl
-rwxr-xr-x 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hd_config.tcl
-rwxr-xr-x 1 vdsuser docker 444 Jun 29 2021 config.tcl
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$ ls -ltr
total 32
drwxr-xr-x 2 vdsuser docker 4096 Jun 29 2021 src
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ms_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_ls_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hs_config.tcl
-rw-r--r-- 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hdll_config.tcl
-rwxr-xr-x 1 vdsuser docker 209 Jun 29 2021 sky130A_sky130_fd_sc_hd_config.tcl
-rwxr-xr-x 1 vdsuser docker 444 Jun 29 2021 config.tcl
drwxr-xr-x 3 vdsuser vdsuser 4096 Apr 26 17:05 runs
vdsuser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/openlane/designs/picorv32a$
```

```
License GPLv3: GNU GPL version 3 <http://gnu.org/licenses/gpl.html>
This is free software, and you are free to change and redistribute it
under certain conditions; type 'show_copying' for details.
This program comes with ABSOLUTELY NO WARRANTY; for details type 'show_warranty'.
Warning: /home/vdsuser/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/tlib/sky130_fd_sc_hd_ff_n40C_iv9
5.lib line 31, default_operating_condition ff_n40C_iv95 not found.
Warning: /home/vdsuser/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref/sky130_fd_sc_hd/tlib/sky130_fd_sc_hd_ss_100C_iv6
0.lib line 32, default_operating_condition ss_100C_iv60 not found.
create_clock [get_ports $::env(CLOCK_PORT)] -name $::env(CLOCK_PORT) -period $::env(CLOCK_PERIOD)
set input_delay_value [expr $::env(CLOCK_PERIOD) * $::env(IO_PCT)]
set output_delay_value [expr $::env(CLOCK_PERIOD) * $::env(IO_PCT)]
puts "[INFO]: Setting output delay to: $output_delay_value"
[INFO]: Setting output delay to: 4.946000000000001
puts "[INFO]: Setting input delay to: $input_delay_value"
[INFO]: Setting input delay to: 4.946000000000001
set_max_fanout $::env(SYNTH_MAX_FANOUT) [current_design]
set_clk_idx [lsearch [all_inputs] [get_port $::env(CLOCK_PORT)]]
#set rst_idx [lsearch [all_inputs] [get_port resetn]]
set all_inputs_wo_clk [lreplace [all_inputs] $clk_idx $clk_idx]
#set all_inputs_wo_clk_rst [lreplace $all_inputs_wo_clk $rst_idx $rst_idx]
set all_inputs_wo_clk_rst $all_inputs_wo_clk
# correct resetn
set_input_delay $input_delay_value -clock [get_clocks $::env(CLOCK_PORT)] $all_inputs_wo_clk_rst
#set_input_delay 0.0 -clock [get_clocks $::env(CLOCK_PORT)] {resetn}
set_output_delay $output_delay_value -clock [get_clocks $::env(CLOCK_PORT)] [all_outputs]
# TODO set this as parameter
set_driving_cell -lib_cell $::env(SYNTH_DRIVING_CELL) -pin $::env(SYNTH_DRIVING_CELL_PIN) [all_inputs]
set_cap_load [expr $::env(SYNTH_CAP_LOAD) / 1000.0]
puts "[INFO]: Setting load to: $cap_load"
[INFO]: Setting load to: 0.01765
set_load $cap_load [all_outputs]
tns -759.46
wns -24.89
[INFO]: Synthesis was successful
%
```



```

Number of wires:          14596
Number of wire bits:      14978
Number of public wires:   1565
Number of public wire bits: 1947
Number of memories:       0
Number of memory bits:    0
Number of processes:      0
Number of cells:          14876
sky130_fd_sc_hd__a2111o_2  1
sky130_fd_sc_hd__a211o_2   35
sky130_fd_sc_hd__a211oi_2  60
sky130_fd_sc_hd__a21bo_2   149
sky130_fd_sc_hd__a21boi_2  8
sky130_fd_sc_hd__a21o_2    57
sky130_fd_sc_hd__a21oi_2   244
sky130_fd_sc_hd__a221o_2   86
sky130_fd_sc_hd__a22o_2    1013
sky130_fd_sc_hd__a2bb2o_2  1748
sky130_fd_sc_hd__a2bb2oi_2 81
sky130_fd_sc_hd__a311o_2   2
sky130_fd_sc_hd__a31o_2    49
sky130_fd_sc_hd__a31oi_2   7
sky130_fd_sc_hd__a32o_2    46
sky130_fd_sc_hd__a41o_2    1
sky130_fd_sc_hd__and2_2    157
sky130_fd_sc_hd__and3_2    58
sky130_fd_sc_hd__and4_2    345
sky130_fd_sc_hd__and4b_2   1
sky130_fd_sc_hd__buf_1     1656
sky130_fd_sc_hd__buf_2     8
sky130_fd_sc_hd__conb_1    42
sky130_fd_sc_hd__dfxtp_2   1613
sky130_fd_sc_hd__inv_2     1615
sky130_fd_sc_hd__mux2_1    1224
sky130_fd_sc_hd__mux2_2    2
sky130_fd_sc_hd__mux4_1    221
sky130_fd_sc_hd__nand2_2   79

```

Task1: no.of dff cells/total cells=1613/148760=0.108
0.108X100=10.8%