

Level 3

DAY 1

ASIC

ASIC

Has 3 stuff under it rtl development, eda tools and pka data

In RTL dev there's over thousands of them, In github alone there is approx 7000

Some others are *librecores.org* and *opencores.org*

In EDA tools

The open source stuff are magic, spice simulator

Nowadays we have better tools like Openroad, open lane

Then PDK

What's pdk

PDK = Process Design Kit

Collection of files used to model a fabrication process for the EDA tools used to design an IC

Process Design Rules: DRC, LVS, PEX

Device Models

Digital Standard Cell Libraries

I/O Libraries

Google worked with Sky water for THE FIRST Open source PDK on June 30 and 2020

IS 130Nm fast?

YES , Till now there is Intel P4EE @ 3.46 GHz (Q4'04) the osu team reported that their pipelined version can achieve 1GHz clock



Now in ASIC the first thing is SYNTH/synthesis

It converts the rtl to a circuit out of components from the standard cell library (SCL)

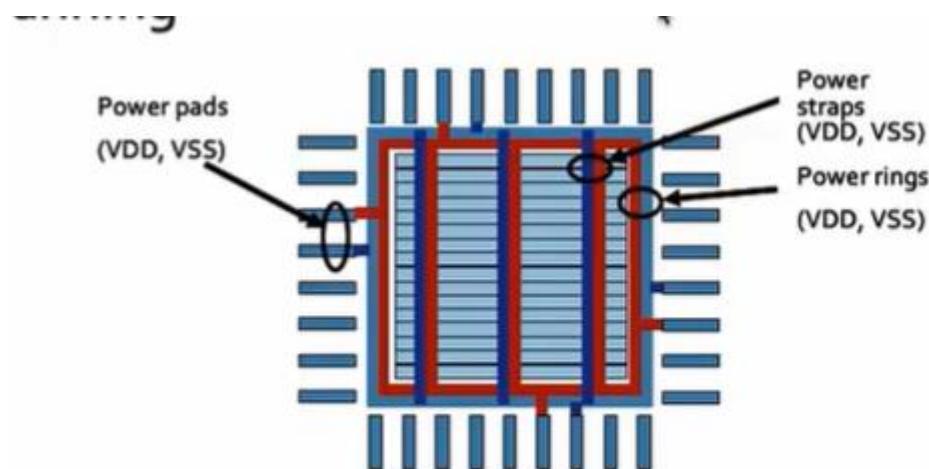
Standard cells have regular layout

Next Floor and power planning

FP+PP

Macro floor planning Dimensions pin layout rows definition

Power planning



Next Placement

Place the floor plans rows aligned with the sites

Its mostly done in 2 steps : Global and detailed

Next Clock tree synthesis or CTS

To create a clock distribution network

To deliver the clocks to all sequential elements (example FF)

With less skew its hard to get 0

Its in good shape,

Its like a tree

Route implement interconnect using available metal layers

The metal tracks form grid the grid is huge Its divide and conquer

Lastly Sign off

Physical verification

(Design rules checking) DRC

(Layout vs schematic) LVS

Timing verification

(static time analysis)sta

But its harder if we use open source eda

NOW WE GO TO OPENLANE 😊

It comes with apache 2.0

It was started with a open source flow for a a true opensource tape out experiment

So striVe is a family FOR EVERYTHING

SoC Features

striVe Sky130 SCL + Synthesized 1 Kbytes SRAM

striVe 2 Sky130 SCL + 1 Kbytes openram block

striVe 2a striVe 2 with a single chip core module

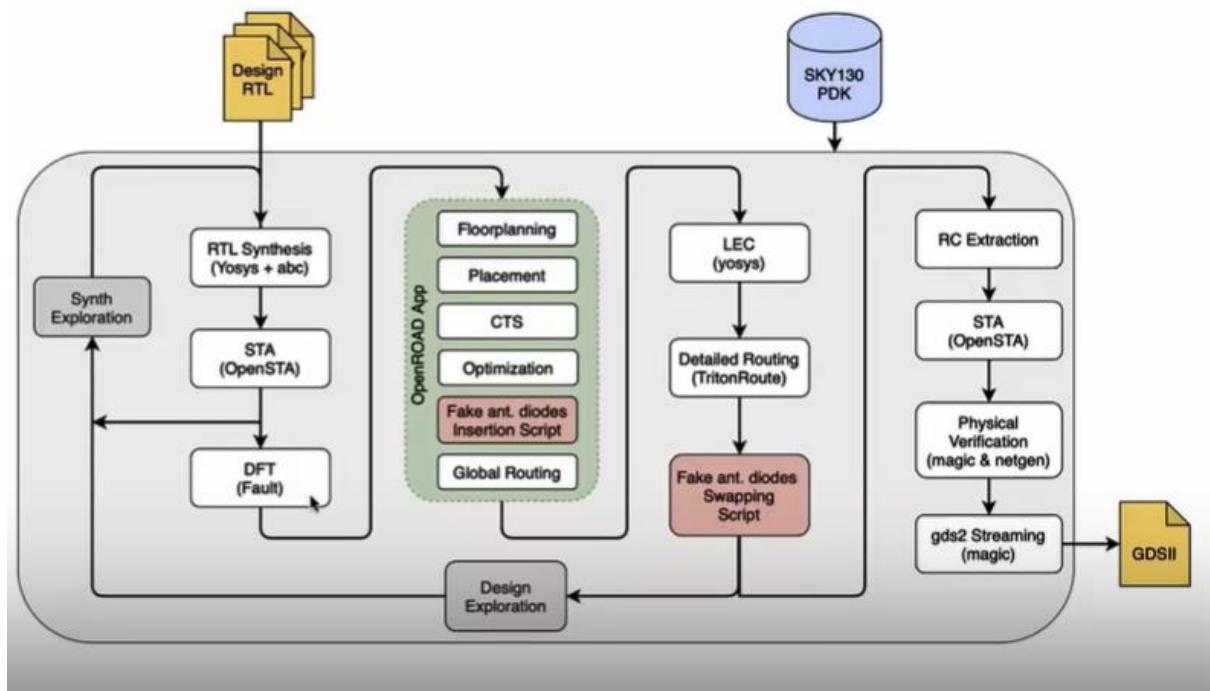
striVe 3 Osu scl + Synthesized 1 Kbytes SRAM

striVe 5 Sky130 SCL + 8 x 1 Kbytes Openram banks

striVe 6 striVe 2 with dft

So basically the point of this open lane is to produce a clean open gdsii with no human intervention

It was tuned for open source pdk 130nm

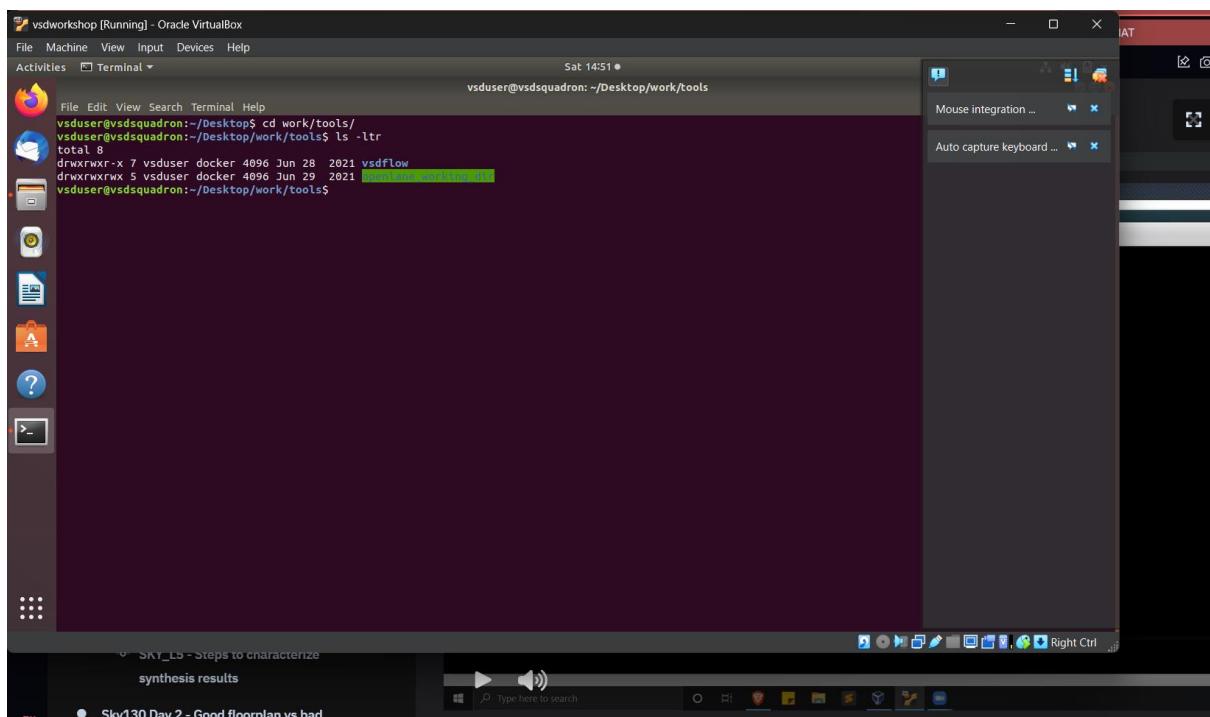


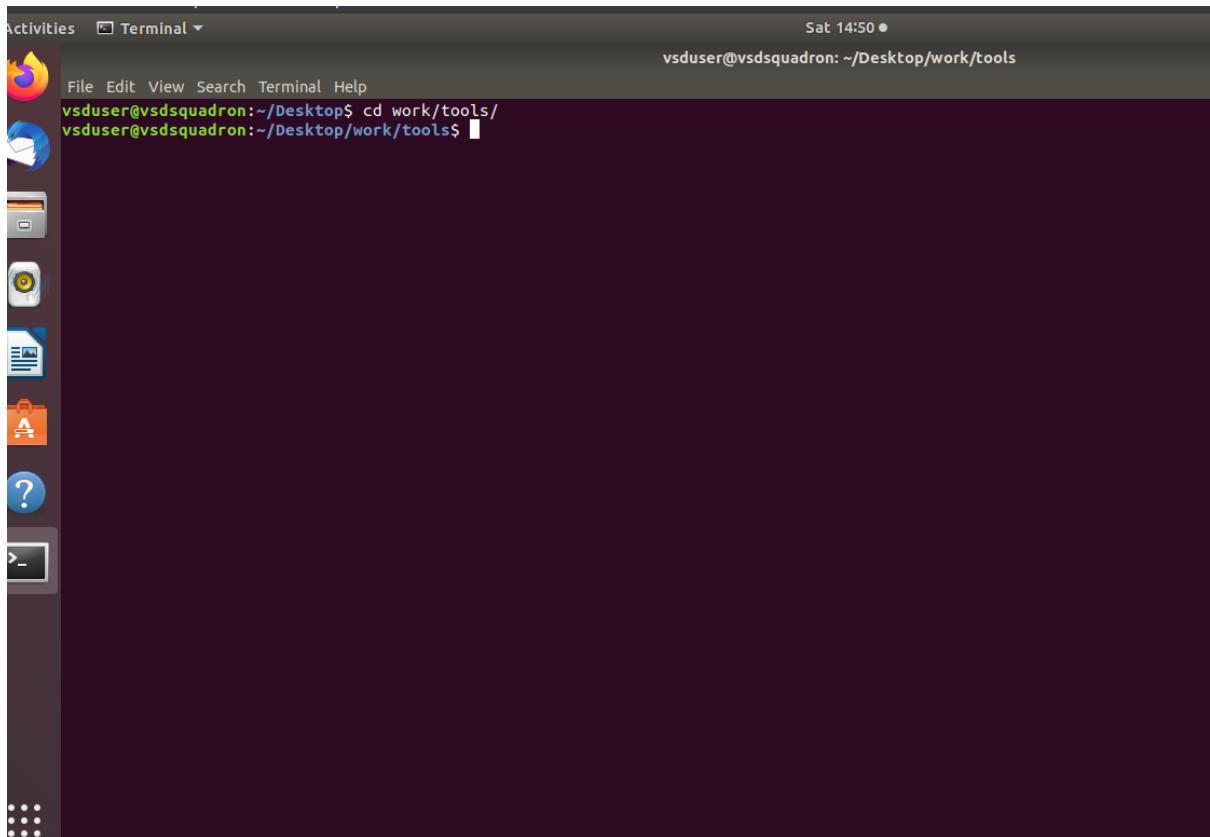
This is the open lane layout

Openlane is also based one some other stuff like openroad etc..

IN open lane if u type ls- ltr

It will list everything in choromological manner





This will change the trajectory

If u type the command name and tryp “—help

It will help u 😊

```

vsdworkshop [Running] - Oracle VirtualBox
File Machine View Input Devices Help
Activities Terminal Sat 14:53
vsduser@vsdsquadron: ~/Desktop/work/tools

File Edit View Search Terminal Help
-S
--sort=WORD
--time=WORD
--time-style=STYLE
-t
-T, --tabsize=COLS
-u
-v
-W, --width=COLS
-X
-Z, --context
-1
--help
--version

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$ 
vsduser@vsdsquadron:~/Desktop/work/tools$ 

```

```

jackson_4096 Jul 28 09:37 skywater-pdk
jackson_4096 Jul 28 09:40 open_pdks
jackson_4096 Jul 28 09:44 sky130A
lBox:~/Desktop/work/tools/openlane_working_dir/pdks$ 

```

So we can CD into pdk and see

The skywater pdk has every PDK related-file

The open pdk is made to work with commercial tools

SKY130A is a variant of PDK

```
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks/sky130A/libs.ref
File Machine View Input Devices Help
Activities Terminal
File Edit View Search Terminal Help
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd SKY130A
bash: cd: SKY130A: No such file or directory
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd sky130A
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ ls -l
total 12
drwxr-xr-x 11 vsduser docker 4096 Jun 28 2021 libs.tech
drwxr-xr-x 14 vsduser docker 4096 Jun 28 2021 libs.ref
-rw-r--r-- 1 vsduser docker 170 Jun 28 2021 SOURCES
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd sky130AS
cd sky130AS
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ ls -l
total 48
drwxr-xr-x 10 vsduser docker 4096 Jun 28 2021 sky130_oss_sc_t18
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_ms
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_ls
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hs
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hdll
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hndl
drwxr-xr-x 9 vsduser docker 4096 Jun 28 2021 sky130_gran_macros
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hvl
drwxr-xr-x 11 vsduser docker 4096 Jun 28 2021 sky130_fd_lo
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_hd
drwxr-xr-x 13 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_ip
drwxr-xr-x 13 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_ip
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ sky130A/libs.ref$
```

a

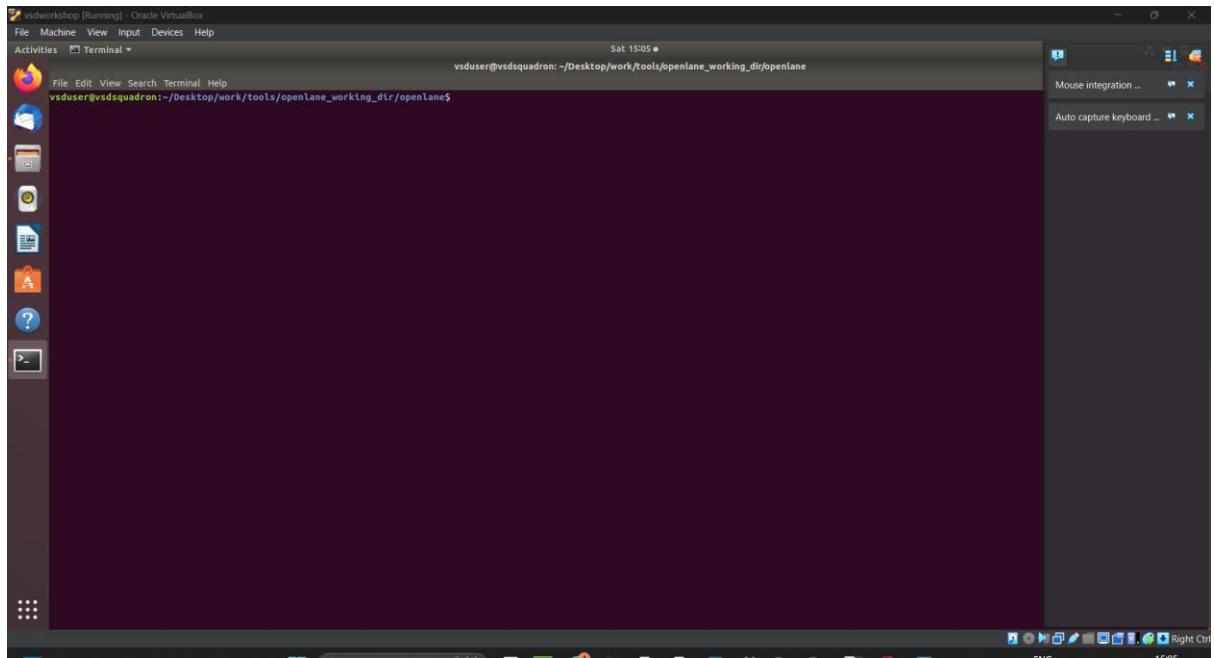
After changing the trajectories a bit

And to redo the thing we type

cd ..

```
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd SKY130A
bash: cd: SKY130A: No such file or directory
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd sky130A
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ ls -l
total 12
drwxr-xr-x 11 vsduser docker 4096 Jun 28 2021 libs.tech
drwxr-xr-x 14 vsduser docker 4096 Jun 28 2021 libs.ref
-rw-r--r-- 1 vsduser docker 170 Jun 28 2021 SOURCES
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd sky130AS
cd sky130AS
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ ls -l
total 48
drwxr-xr-x 10 vsduser docker 4096 Jun 28 2021 sky130_oss_sc_t18
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_ms
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_ls
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hs
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_fd_sc_hdll
drwxr-xr-x 8 vsduser docker 4096 Jun 28 2021 sky130_fd_pr
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_gran_macros
drwxr-xr-x 11 vsduser docker 4096 Jun 28 2021 sky130_fd_lo
drwxr-xr-x 4 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_hd
drwxr-xr-x 12 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_ip
drwxr-xr-x 13 vsduser docker 4096 Jun 28 2021 sky130_ml_xx_ip
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ cd ..
vsduser@vdsquadron:~/Desktop/work/tools/openlane_working_dir/pdks$ sky130A/libs.ref$
```

And always when working be in



And clear will clear everything \

Before workin in open lane u should type docker and

Type ./flow.tcl -interacvtive

And the package stuff

Then prep -design picorv32a

Then do run_synthesis

And some stuff happens 😊

In github everythin about open lane is there heres the link for it :3

<https://github.com/efabless/openlane/>

so here we can just learn about all the coding in openlane