Open source silicon ecosystem

New shuttles, PDK releases, and tools

Aaron Cunningham

aacunningham@google.com

" We bring all the value of open source to Google and all the resources of Google to open source. "

Mission statement
Google Open Source

Google

Google is Built With
Open Platform / Open Source

Google

10%
Full-time Alphabet employees contribute to open source
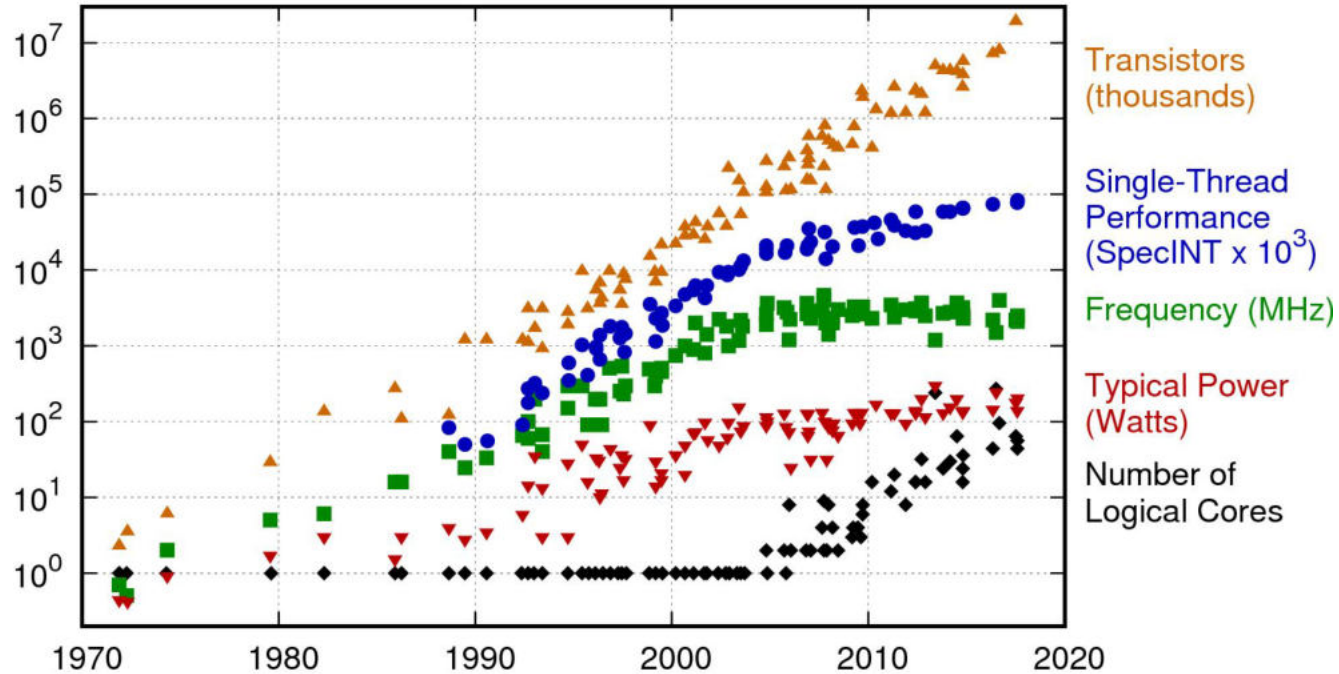
75K
Repositories acted on by Googlers

10K+
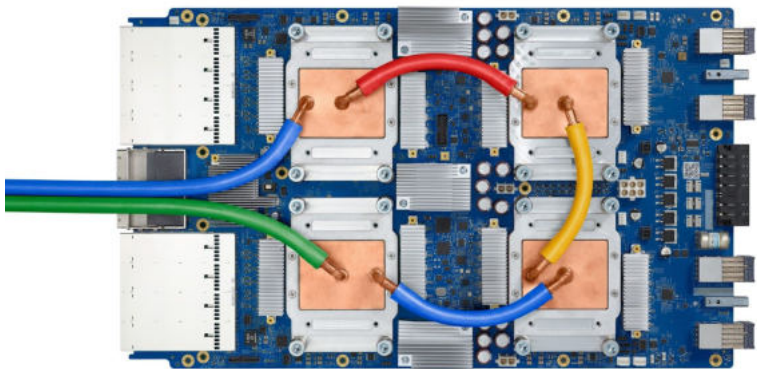Google hosted repositories

75%
GitHub pull requests by Alphabet were outside of Google-managed organizations

Google

Moore's Law is slowing

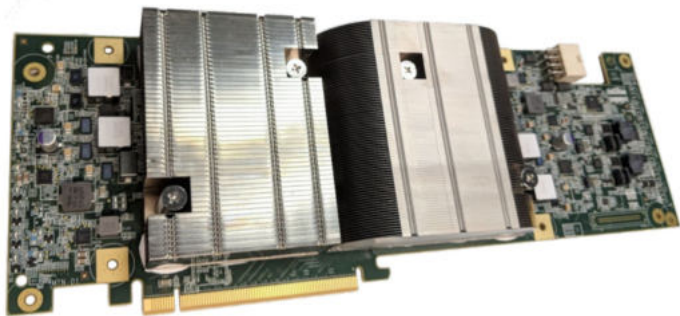Google

Shifting to ASICs

Tensor Processing Unit

15-30x faster than
conventional processors
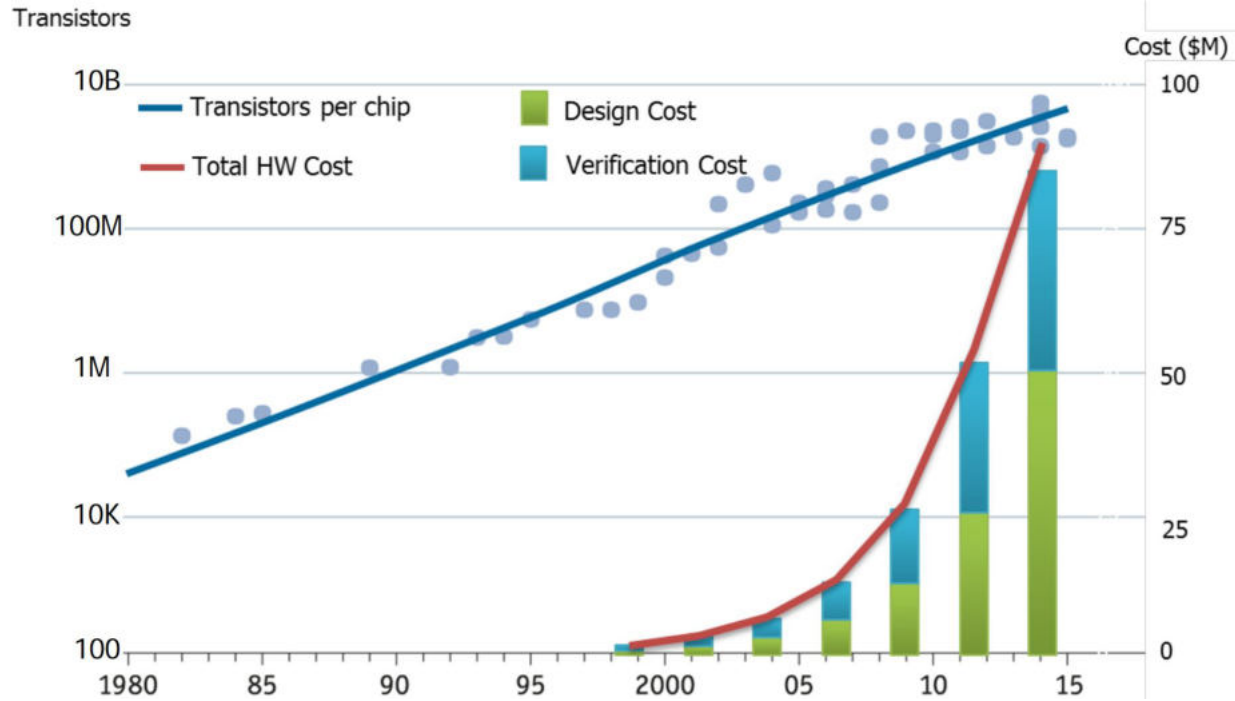
30x-80x operations per watt

Google

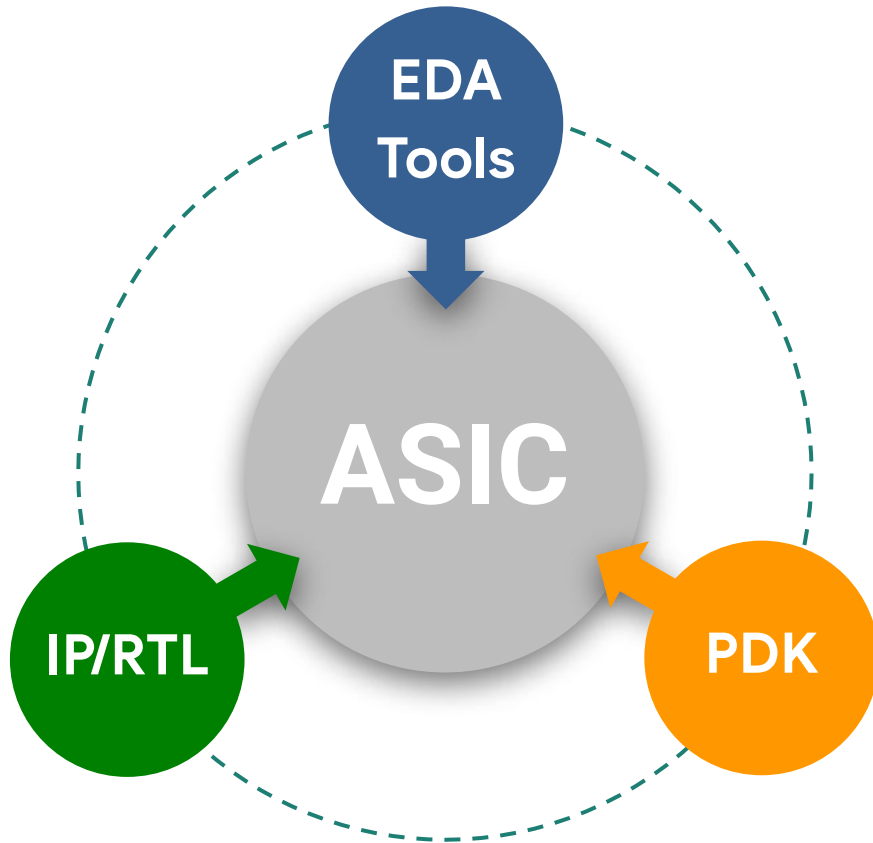# Shifting to ASICs

Video (Trans)Coding Unit

20-33x more efficient than conventional processors at encoding VP9 and H.264

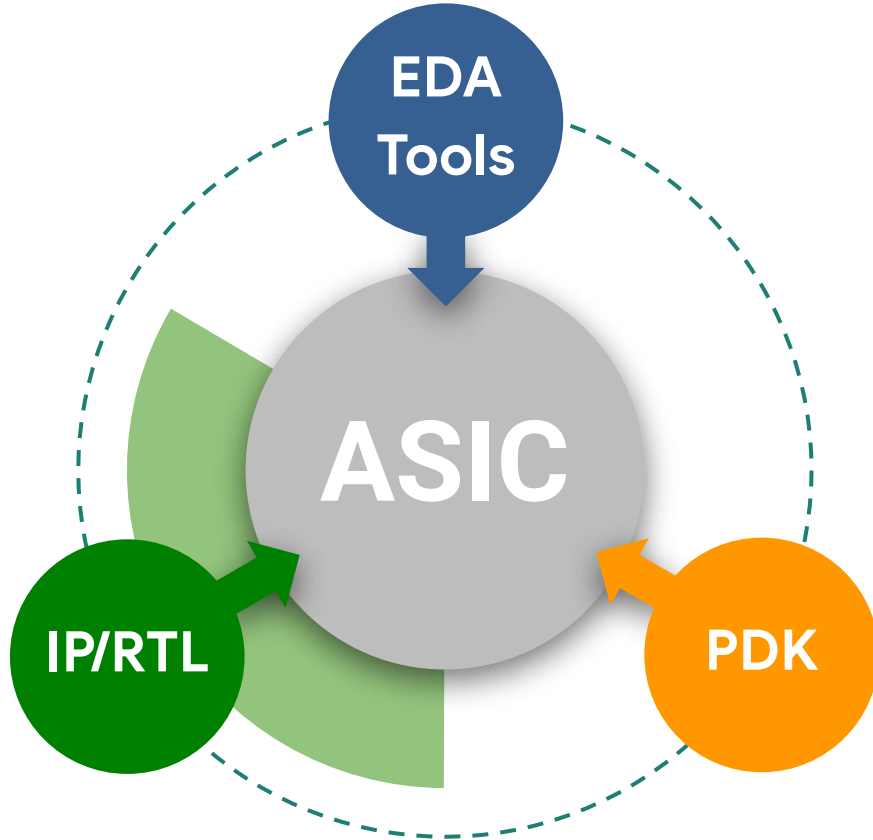Google

Design costs are increasing

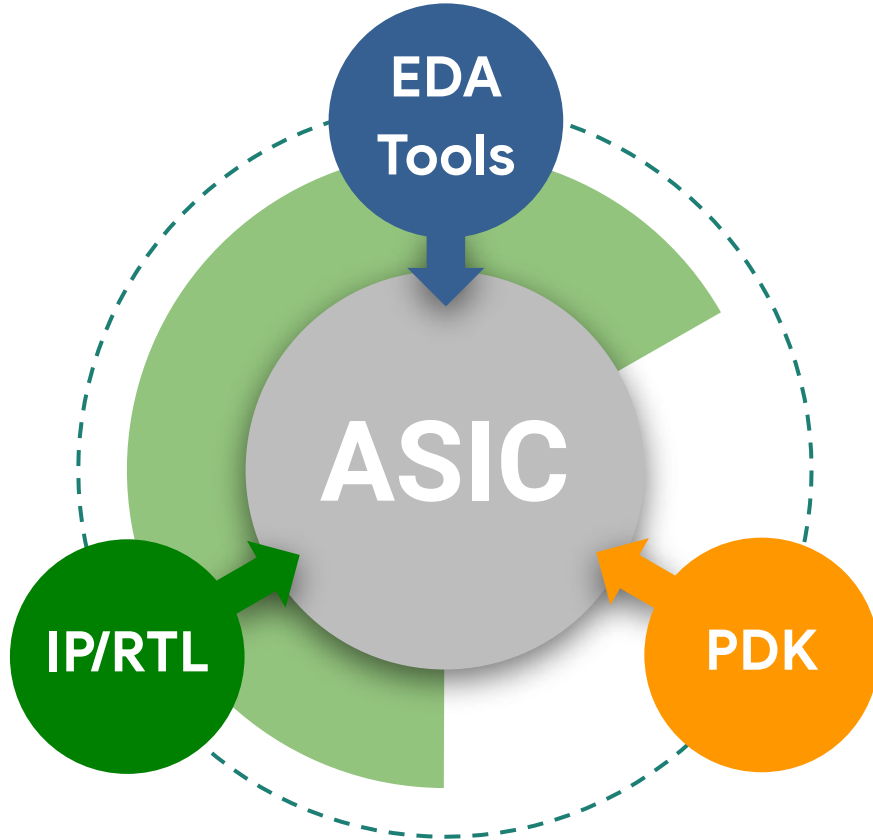Google

ASIC design has 3 parts

ASIC design has 3 parts

IP/RTL

- OpenCores
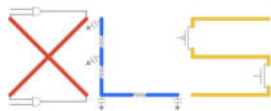- OpenRISC
- RISC-V

Google

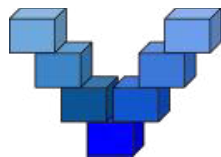# ASIC design has 3 parts

EDA Tools
- OpenROAD
- klayout
- magic
- yosys
- Alliance / Coriolis
- Commercial Tools

Google

Google projects

High Level Synthesis
XLS
github.com/google/xls

System Verilog Tooling
Verible
github.com/chipsalliance/verible

Layout generator
gdsfactory
github.com/gdsfactory/gdsfactory

Google

ASIC design has 3 parts
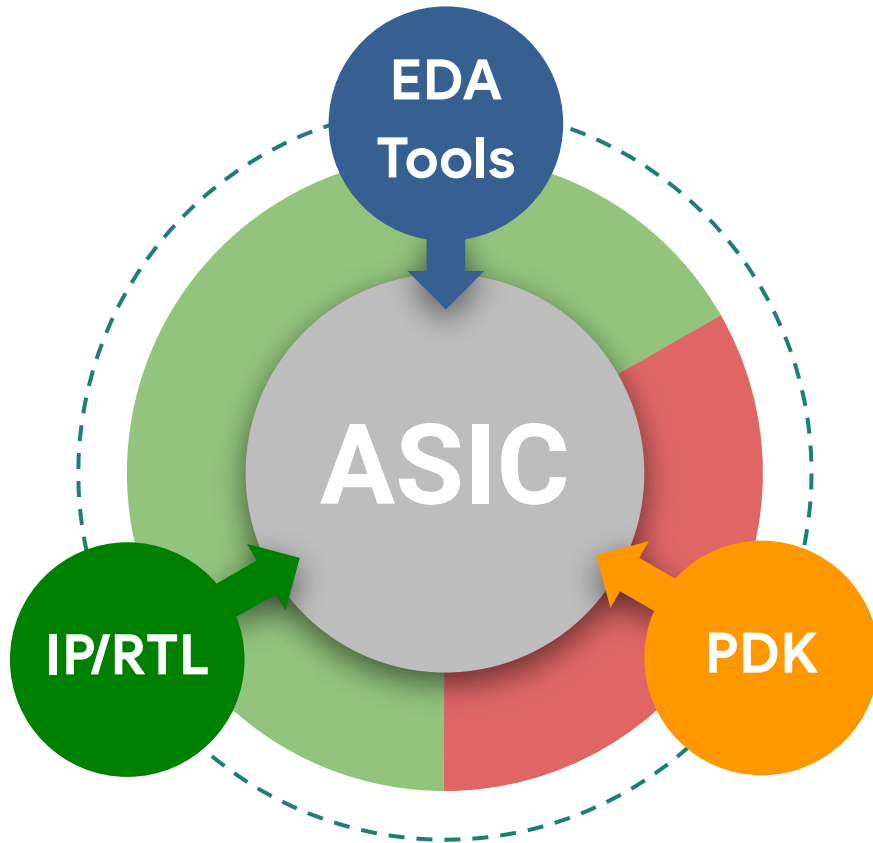
Accessible and Manufacturable PDKs

- ???

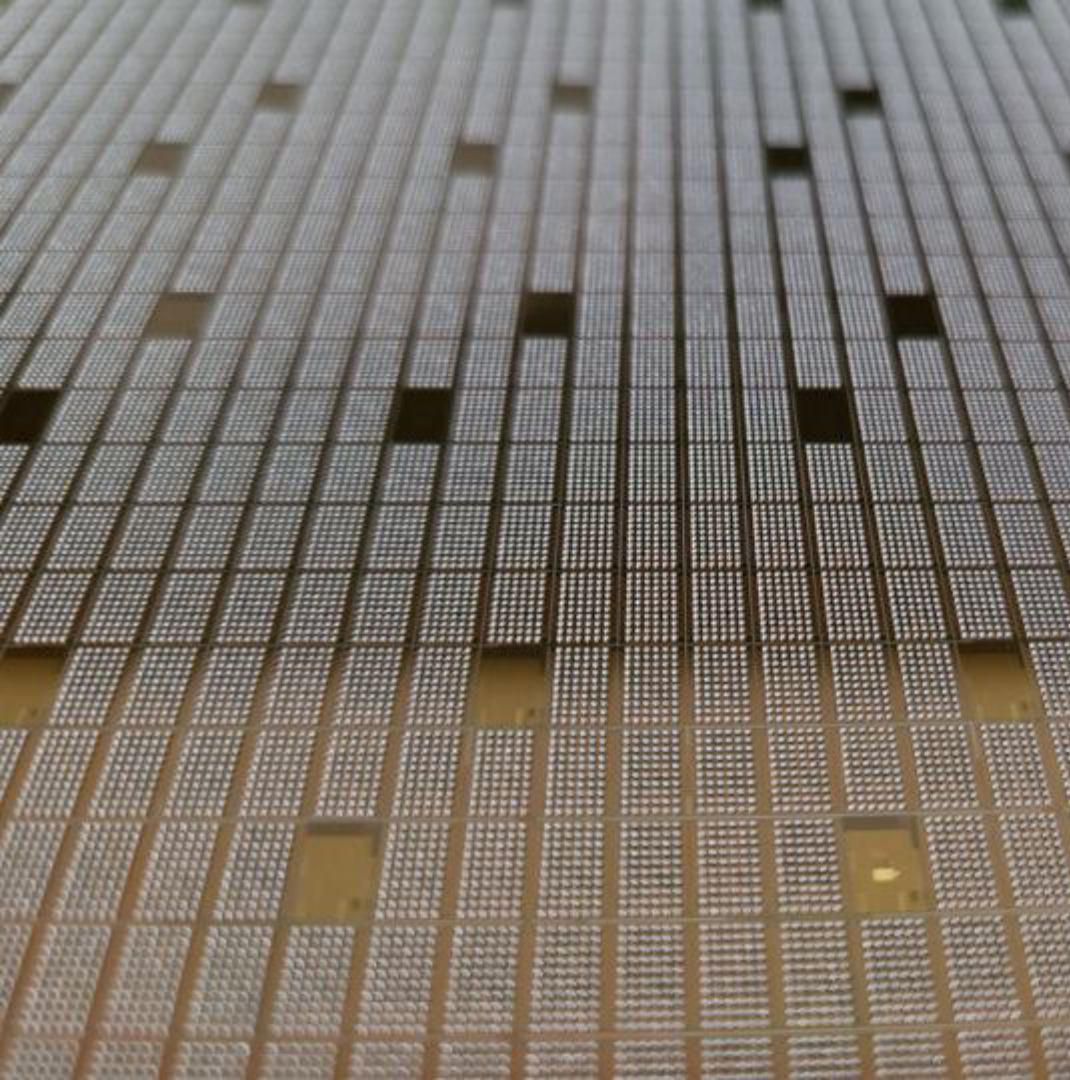**Open source, manufacturable 130nm PDK**
No NDA required, just clone.

github.com/google/skywater-pdk

Apache 2.0 License

Open Source and Manufacturable

Google

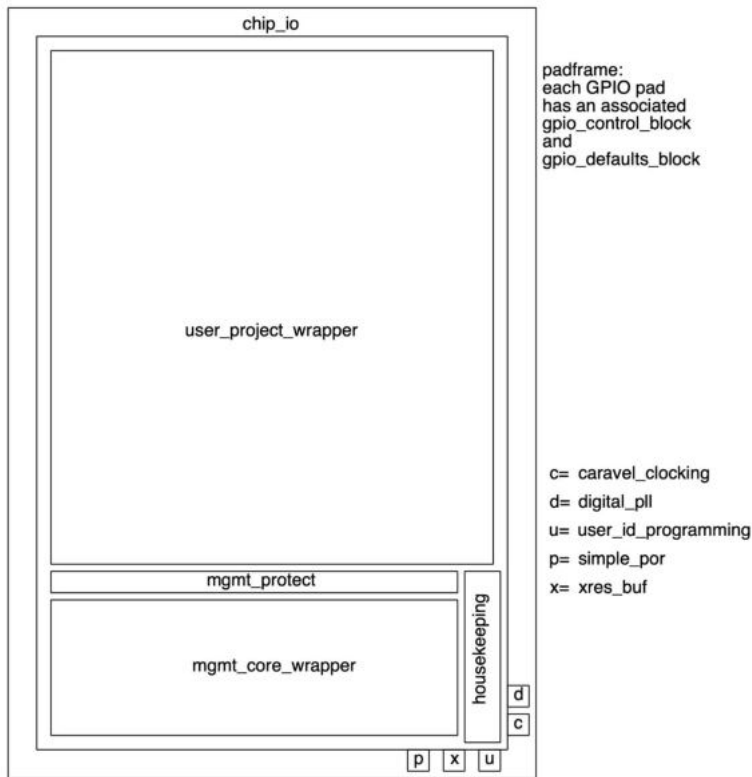# Silicon Realization Program

SKY130

"Open MPW Shuttle Program"

is **managed** by efabless,

sponsored by Google and

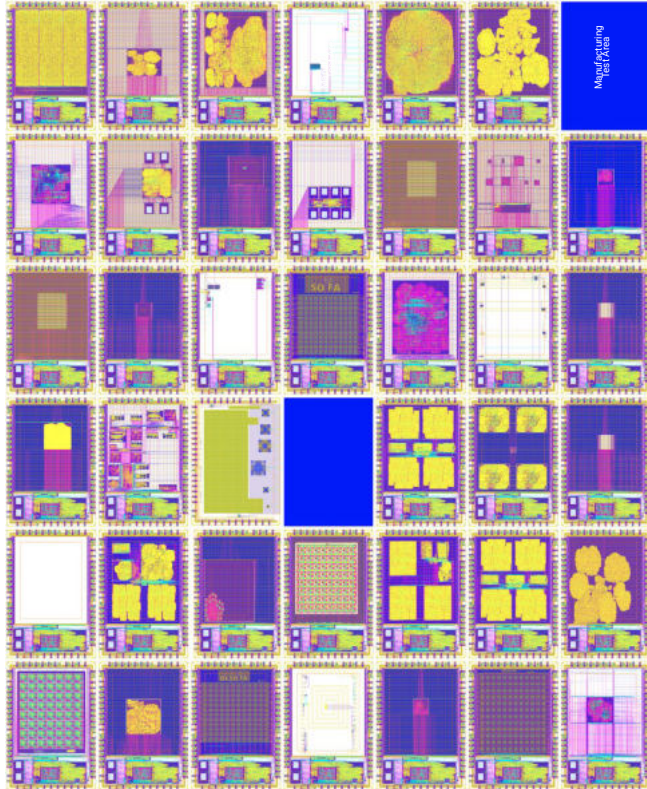**manufactured** by SkyWater.

Google

Silicon Realization Program

padframe:
each GPIO pad
has an associated
gpio_control_block
and
gpio_defaults_block

c= caravel_clocking
d= digital_pll
u= user_id_programming
p= simple_por
x= xres_buf

No cost

Open source design

Reproducible

User Project Area

RISC-V Management Area

MPW-ONE

45 designs in 30 days

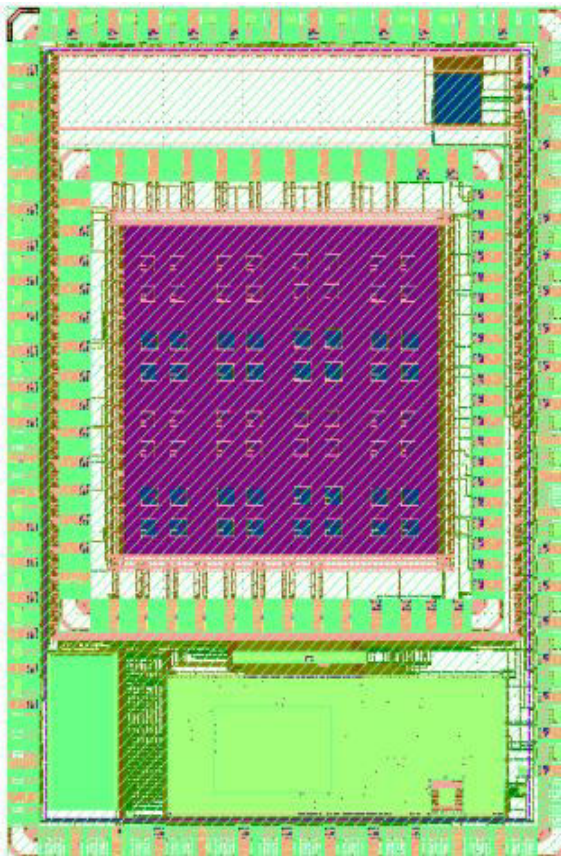**60%** by **first time** designers

Experienced
40.0%

New
60.0%

Google
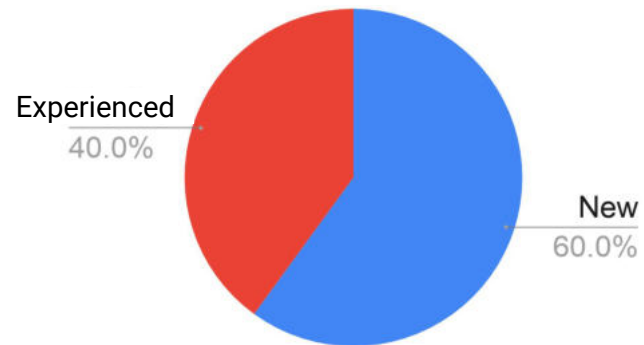
Total number of Open MPW designs

+5	+37	+57	+53	+52	+75	+90	+106
Test ICs	MPW-1	MPW-2	MPW-3	MPW-4	MPW-5	MPW-6	MPW-7

Google
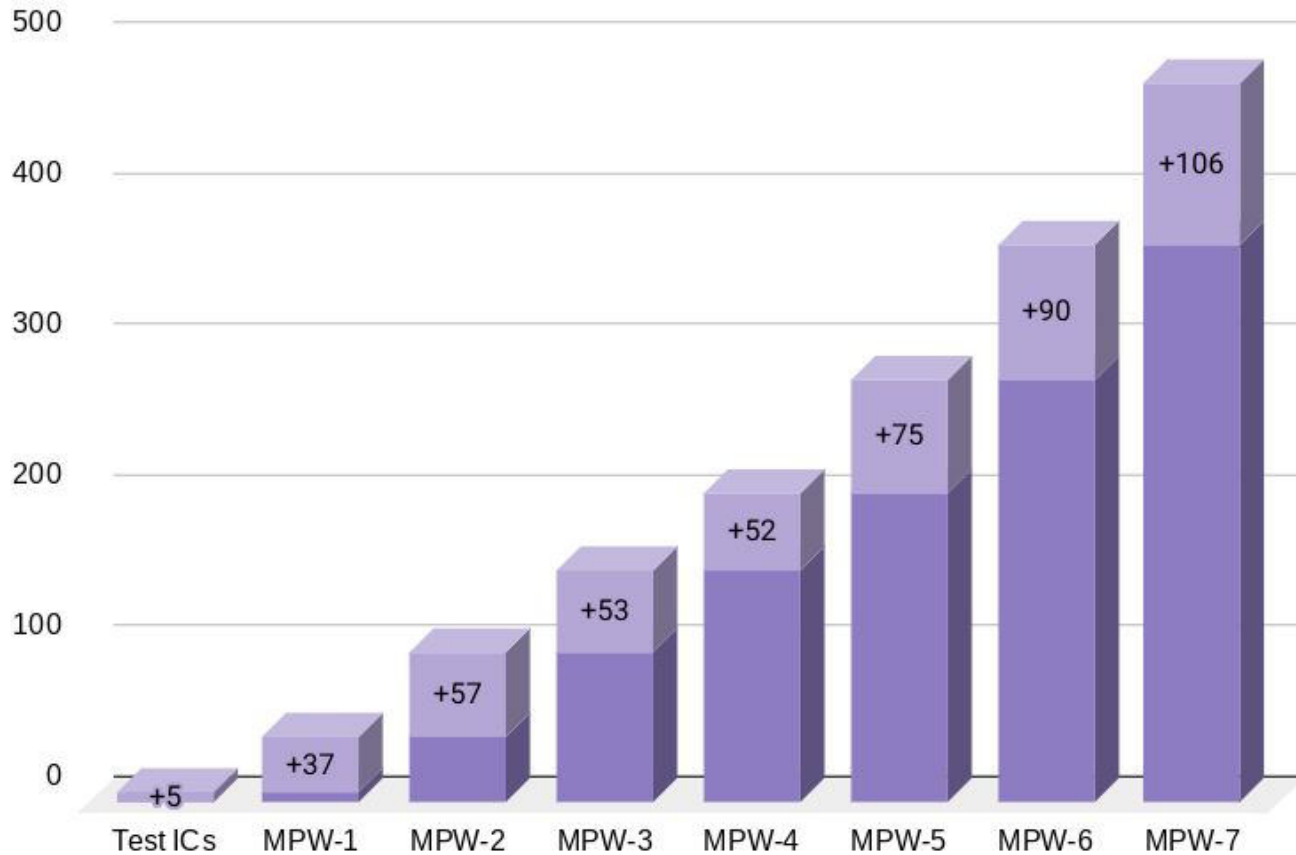
OpenFASoC

Analog layout generator

Temperature sensors

LDO

PLL

Generated programmatically

Portable (SKY130, GF12)

github.com/idea-fasoc/OpenFASOC

Group submissions
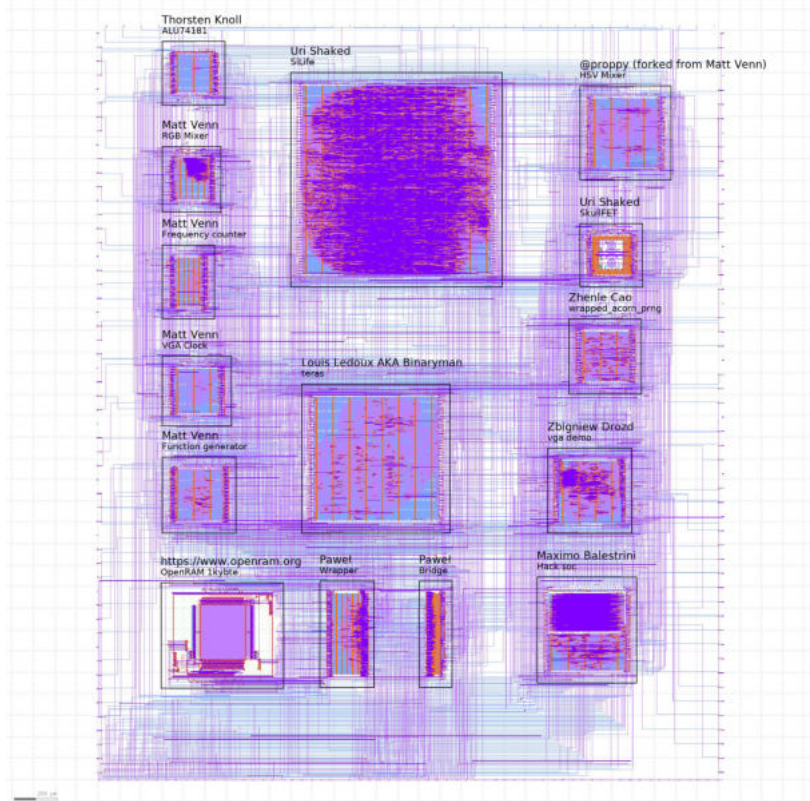
up to **16** projects in **1** slot

MPW1: 8
MPW2: 9
MPW3: 16
MPW4: 13
MPW5: 15
MPW6: 14

zerotoasiccourse.com
github.com/mattvenn/multi_project_tools

TinyTapeout
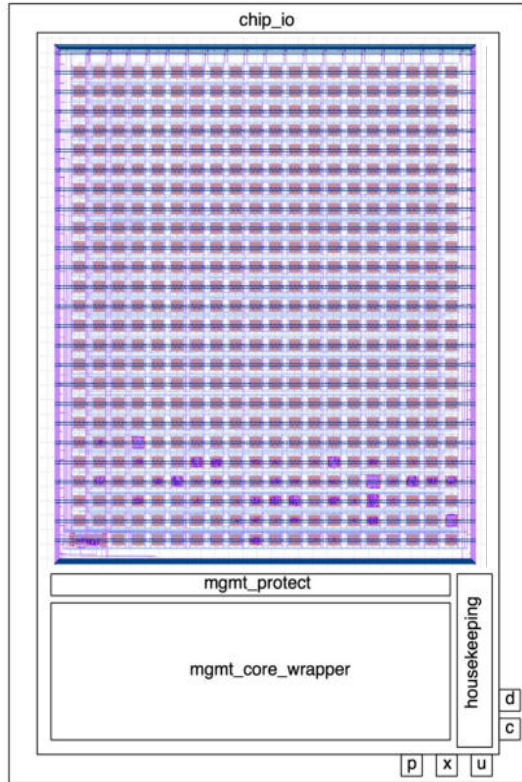
152 projects in **1** slot

Submitted to MPW-7

tinytapeout.com

Google

Japan Submissions
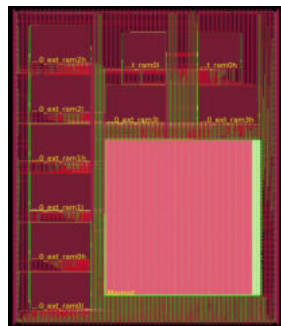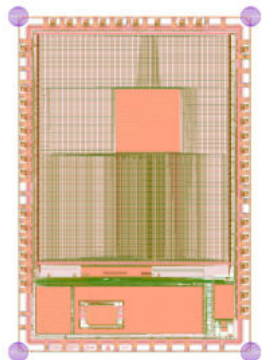
MPW3: 1
Jacaranda-8 (8-bit ISA)

MPW5: 1
PMU

MPW6: 5
Marmot: Linux capable RISC-V SoC
NNgen ML accelerator
Ramen Timer
HP35 RTL clone
Color convertor

Google

Recent 2022 announcements

- New developer portal:

developers.google.com/silicon

Google

Recent 2022 announcements

- New open source PDK: SkyWater Technology commercial **90nm FDSOI** CMOS process

https://developers-jp.googleblog.com/2022/08/skywater-google-90nm.html

Google

Recent 2022 announcements

- New partnership and open source PDK: **GlobalFoundries 180MCU** technology platform
- Now in testing: gf180mcu-pdk.rtfd.io
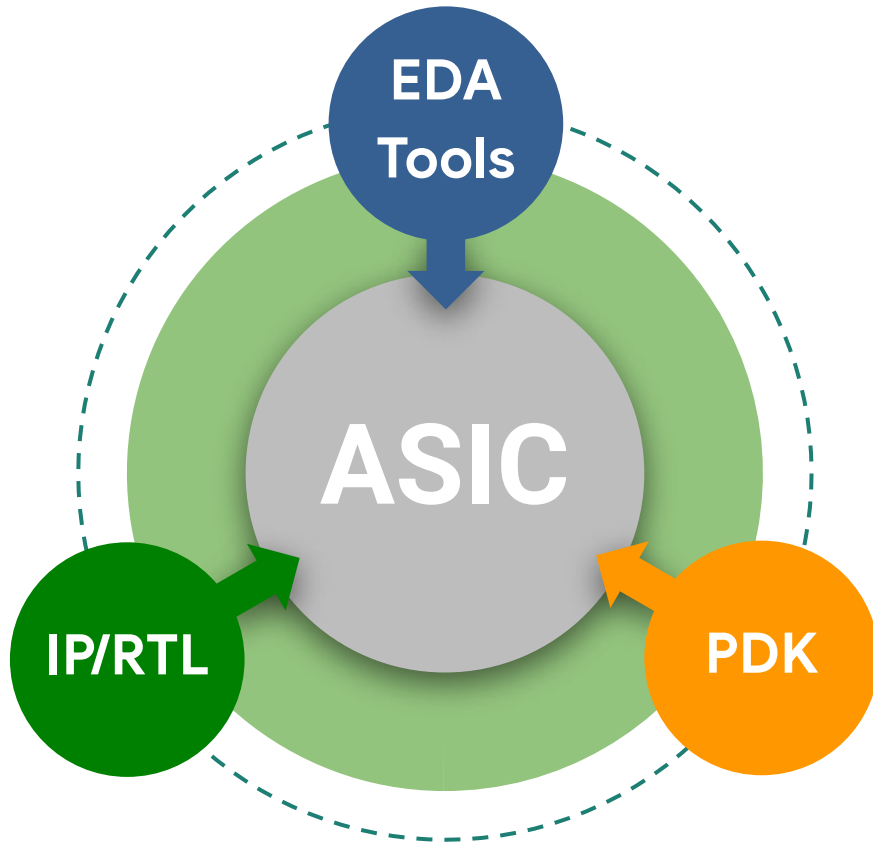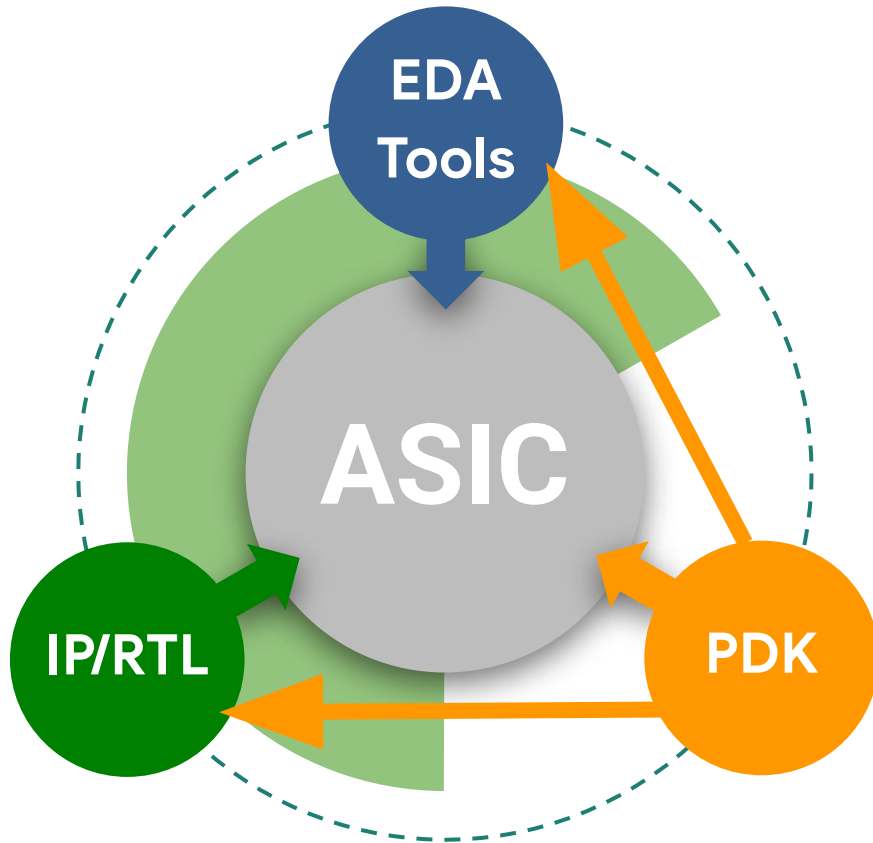
Google
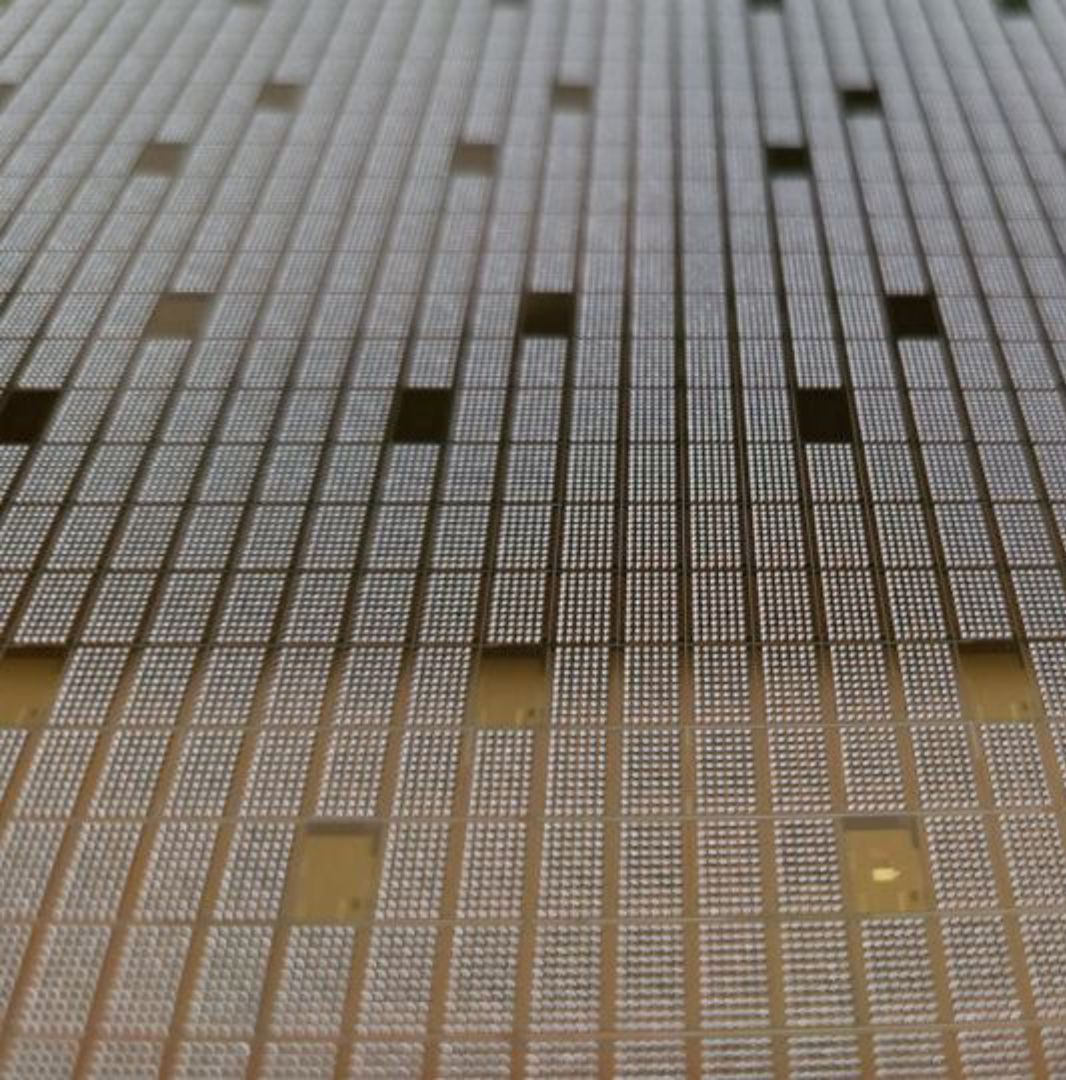
"Mature" process technologies

- More technologically accessible
- Enables innovating using known techniques / well understood substrate
- Published on and used for many years and potentially by many customers over that time
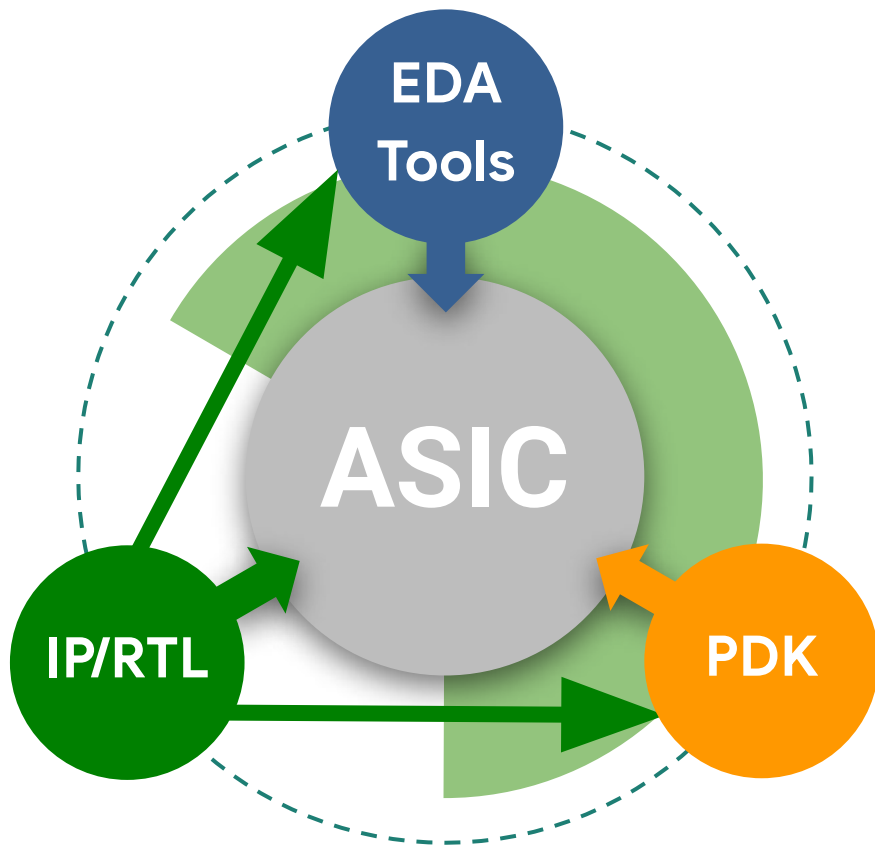
Ecosystem benefits

Ecosystem benefits

More PDKs enable

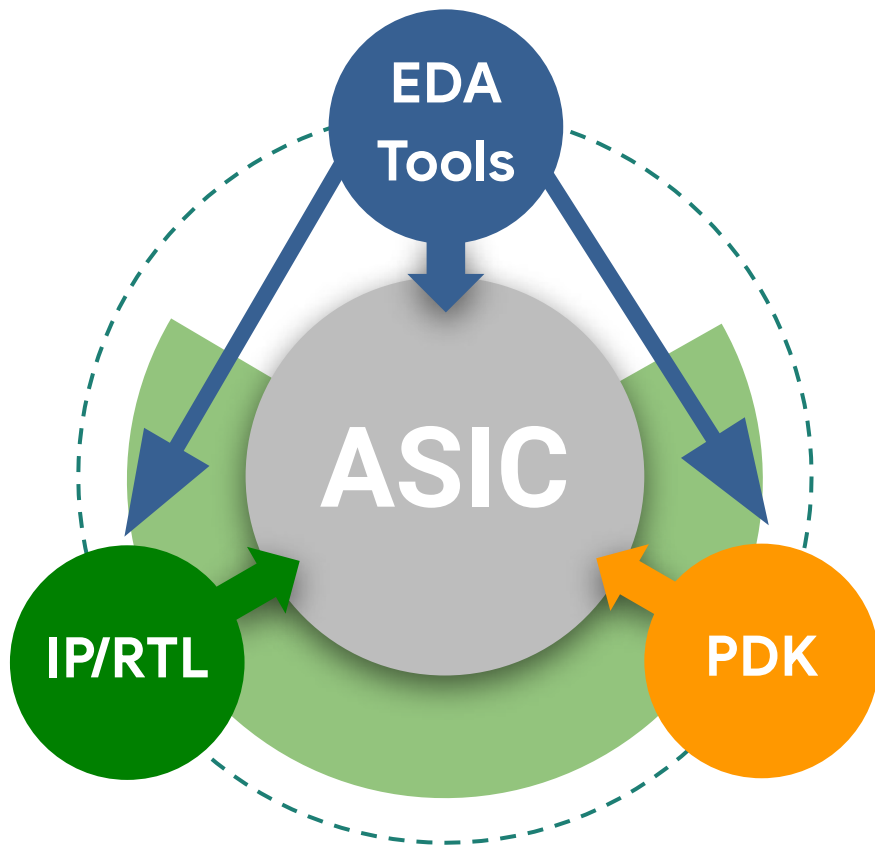- Better designs
- Tool improvements
- More shuttles

Google

Ecosystem benefits

More designs enable:
- Finding PDK bugs
- Tool improvements
- More shuttles

Google

Ecosystem benefits

Tool improvements enable:

- Better designs
- PDK portability
- Better shuttles

Google

Community

↓

Group submission

↓

Open MPW shuttles

↓

Private shuttles

↓

Full wafer

↓

Industry

Google

More information

developers.google.com/silicon

Slack Community
open-source-silicon.dev

Google