"Open Source Silicon eco-system"

AIST Solutions

Producer Jun-ichi OKAMURA

Biography

- 1986 : Joined SDEL in Toshiba as a researcher for DRAM development
- 1996 : Worked in the US for IBM/Toshiba/Siemens alliance project
- 1999 : Joined THine Electronics, startup in Japan (before IPO)
- 2006 : Established Trigence Semiconductor with two Toshiba colleagues
- 2009 : Got a grant fund from JST [illegible] JPY
- 2012 : Seed fund from INTEL capital 150M JPY
- 2014 : Series A 600M JPY
- 2015 : Series B 840M JPY
- 2018 : Seri[illegible] 650M JPY
- [illegible] : Failed Series D fundraising Total 2,480M JPY
- 2022 : Liquidated Trigence, then join AIST as an invited researcher
- 2023 : Join AIST Solutions as a producer of semiconductor sector
- 2024 : Established non-profit OpenSUSI and be representative director

※ IEEE Senior member

Neither a researcher nor a professor, am an entrepreneur.

BIO: LinkedIn

https://www.linkedin.com/in/jun-ichi-okamura-6b8bb2b/

A new alternative trend of semiconductor design


日本経済新聞　2024年(令和6年)5月10日(金曜日)　12版　ビジネス2　16

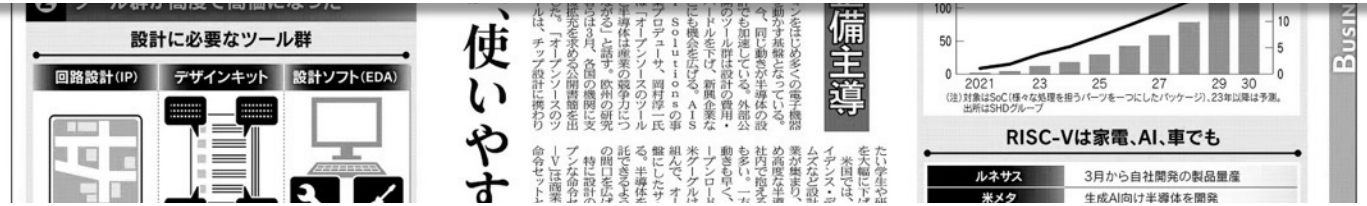
半導体設計、オープン化の波

半導体の設計に、無償で一般公開された「オープンソース」が活用され始めた。高度化によるコスト増や技術者不足などの構造問題の解決に向けて、誰でもアクセスできるツール群を使おうという試みだ。産業技術総合研究所（産総研）や米グーグルは利用環境の整備に動く。オープン規格を採用する企業も増えている。

AIST and Google lead semiconductor design “opening” initiative:

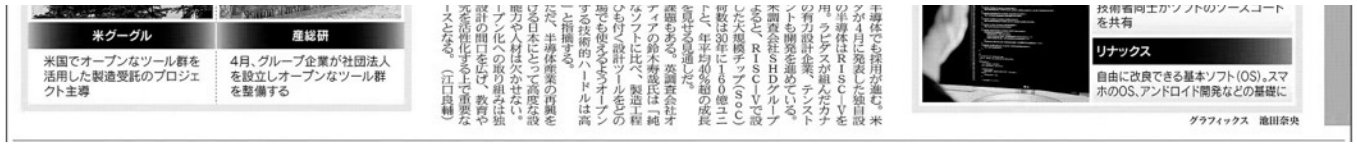
2024/May/10 Nihon Keizai Shimbun, #1 economic newspaper in Japan

https://www.nikkei.com/article/DGXZQOUC228690S4A420C2000000/



Open Source Utilized Silicon Initiatives (OpenSUSI) purpose

OpenSUSI is established to provide an environment for the industry that is long-tail chip users to compete with dedicated semiconductors by Japanese domestic semiconductor assets (chip manufacturing capacity) into a platform that lowers the barriers to entry for original chip design.



Agenda

- What is Open Source Silicon ?
- Why Open Source Silicon is focused on?
- When Open Source Silicon activity was rebooted?
- Why does it focus on the legacy process?
- How it works in eco-system?
- What is the OpenSUSI intention?
- Summary for Device modeling

What is Open Source Silicon ?

Open Source Software Development

Android SDK

python™

Visual Studio Code

GitHub

OpenAI

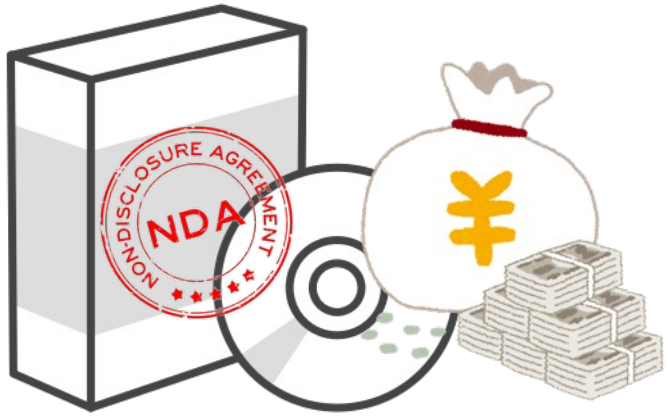
PyTorch

Silicon Device Development

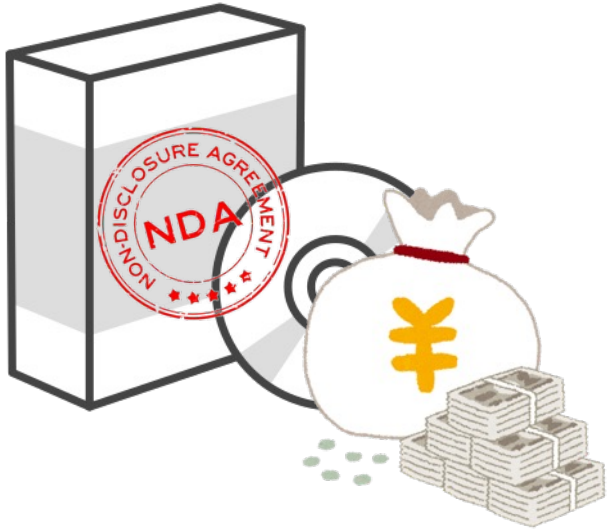
Simulation

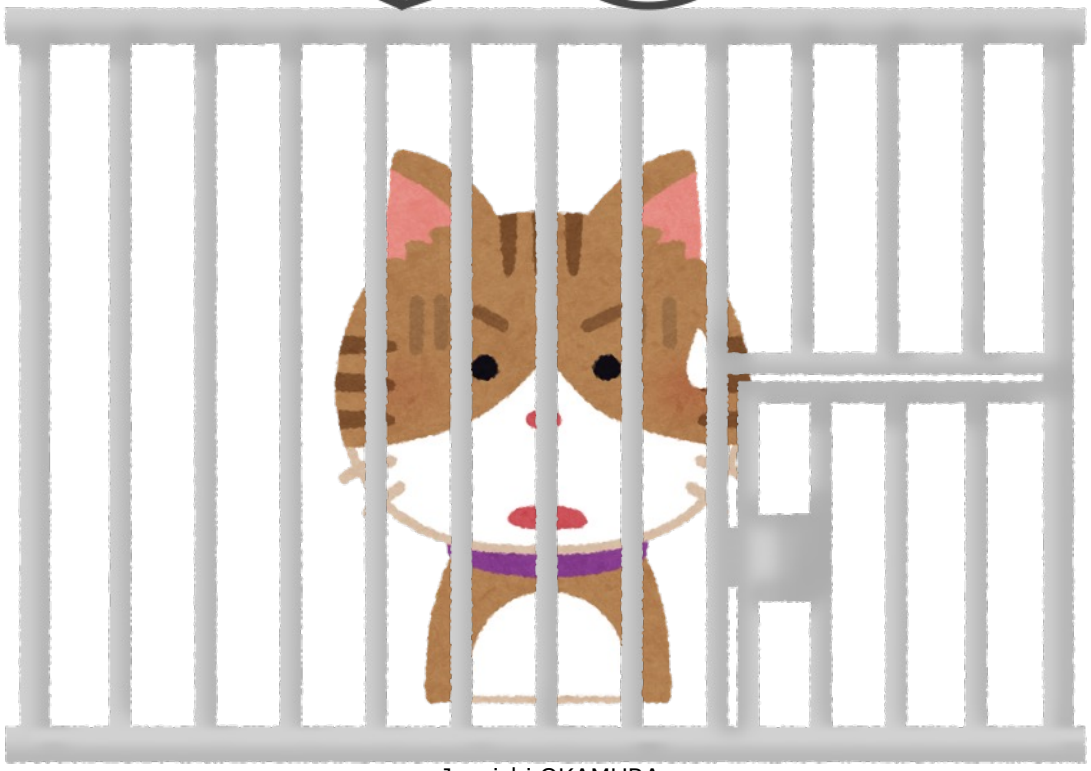
Layout

Test



Synthesis





Prototyping

High entry wall of semiconductor startup

A high burn rate means a high entry wall

Open Source Silicon is …

1. Designing using **Open Source EDA** tools, original design and synthesized data (netlist and GDSII) could be shared within the design community and re-used, transferred, and evaluated without any restrictions if the designer would like to open it.

2. Designing utilizing open source process information, **Open Source PDK**, then design assets (circuit diagrams, GDSII layouts) and source design files can be made public, verified, improved, and replicated by third parties and shared with the community.

3. A fab service that manufactures and supports **Open Source Silicon devices** designed in steps 1 and 2 above exists, and the operation of the designed hardware **can be verified as intended in real-world applications.**

Why Open Source Silicon is focused on?

Why Open Source Silicon is focused on?

【On Educational】

- The increasing cost of education in semiconductor design and development is becoming a significant barrier, particularly for undergraduate students at the entry level. This rising expense not only limits opportunities but also discourages interest among potential future innovators.

- It is important to nurture young students who express an interest in semiconductor design and development. These talented individuals are crucial, not only for passing on knowledge and skills but also for ensuring the creation of secure devices. Additionally, developing domestic expertise is essential to reduce reliance on foreign sources.

Why Open Source Silicon is focused on?

- Students engaged in semiconductor design must develop proficiency in Linux and VPN connections to securely use commercial EDA tools. Additionally, they are required to sign NDAs to gain access to commercial PDKs, which are critical for device design and advancing to tape-out stages.

- In Japan, the utilization of academic licenses for commercial EDA tools is strictly limited to research and development purposes, in line with the licensing agreements. As a result, the availability of licenses for proof of concept (PoC) development for new startups or crowdfunding efforts is quite limited, even within the academic community.

Why Open Source Silicon is focused on?

【On Security】

- Large-scale integrated (LSI) semiconductor devices are crucial for our modern technology, and we rely heavily on them every day. It’s important to monitor the origins of these devices, including the software versions they employ.

- Keeping track of the manufacturers and the software of LSI devices is essential. This is not only for preventing errors but also for protecting against security risks like Trojans or backdoors. Strict oversight is vital for ensuring the reliability and security of our semiconductor devices.

Why Open Source Silicon is focused on?

- The Open Source EDA toolchain offers a viable option for expanding design opportunities, particularly for those just starting out in semiconductor design. This not only broadens access but also cultivates a deeper interest in the field.

- Open Source PDKs facilitate the full transferability of IP and provide significant opportunities for sustainable development within the semiconductor design arena.

- By integrating both Open Source EDA tools and Open Source PDKs, we can spearhead the development of an Open Source Silicon ecosystem. This integration aims to foster a transparent design community and ensure the availability of secure, traceable design resources and the integrity of semiconductor products.

Why Open Source Silicon is focused on?

USA: 2023/Nov/02

NSF Integrated Circuit Research, Education and Workforce Development Workshop Final Report

https://arxiv.org/pdf/2311.02055

EU: 2023/Nov/03

Recommendations and roadmap for the development of open-source silicon in the EU

https://wiki.f-si.org/images/1/19/Recommendations_and_roadmap_open_silicon_2023_11_03.pdf

EU: 2024/Mar/08

Importance of Open-Source EDA Tools for Academia

https://open-source-eda-letter.eu/

When Open Source Silicon activity was rebooted?

Jun-ichi OKAMURA

When Open Source Silicon activity was rebooted?

- 2018 **DARPA** founded Open Source EDA tool development
- 2019 **efabless** approached google to fund the release of the SkyWater's S130 PDK under the Apache 2.0 license.
- 2020 Google and efabless started **OpenMPW** program
- 2021 **IEEE SSCS** sponsored **Chipathon** design contest with Open Source Silicon
- 2023 **OpenMPW** reached over **700** applicants and over **400** TO projects.
- 2024 **ChipsAlliance** started new sub-group for Open Source PDK
- 2024 **OpenSUSI** was established in Japan to support Open Source Silicon eco-system

Only last 5 years

When Open Source Silicon activity was rebooted?

【Foundries activity and concerns】

- 2022 Global Foundries announced to join OpenMPW
- 2023 iHP(Germany) released OpenPDK for their 130nm
- 2024 ChipsAlliances starts OpenPDK sub-group

In the semiconductor industry, fabricators (fabs) generally do not release Process Design Kits (PDKs) without NDAs. This is largely because semiconductor process technology is often subject to confidentiality measures, even for technologies developed over few decades ago. Fabs may be reluctant to open these resources due to concerns about the maintenance quality or lack of comprehensive documentation of the PDKs.

When Open Source Silicon activity was rebooted?

【 Expanding International User Development

Open Source PDKs offer the exciting possibility of international user development. With just internet access, individuals and organizations worldwide can engage in design and tape-out activities.

【Maintenance and Support by the Community】

The Open Source Silicon Community holds significant potential to maintain and sustainably enhance PDKs, similar to the model followed by Open Source Software. This community-driven approach ensures continuous improvements and support, fostering a robust ecosystem for semiconductor development.

Why does it focus on the legacy process?

Components of chip cost

Design cost

Production cost

Mask cost

Wafer

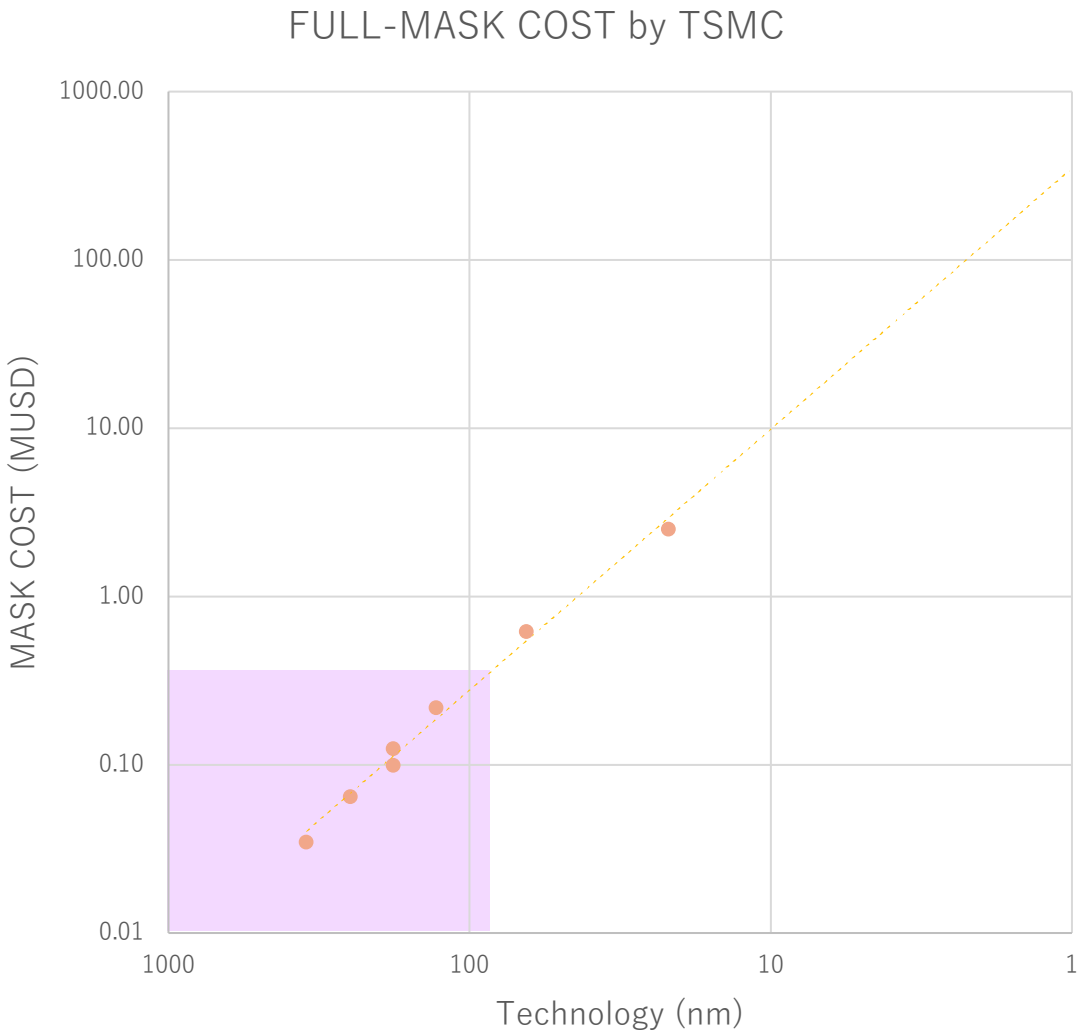
$$\text{Chip cost} = \frac{\text{EDA } tools + \text{IP}}{\#\ of\ productios} + \frac{mask \times Layers}{\#\ of\ productios} + \frac{Wafer\ price}{Gross}$$

$$\alpha \cdot x^{-1.16} \qquad \rho \cdot x^{-1.55} \qquad \sigma \cdot x^{-0.75}$$

$$\approx 50\%up \qquad \approx 70\%up \qquad \approx 30\%up$$

Low Volume Production = Design and Mask are major cost

Mask cost limit for a reasonable budget



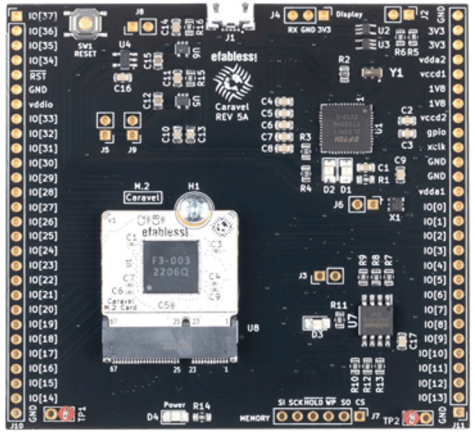
NRE COST

10K ~ 400KUSD for full mask, 250~10KUSD for shuttle die (40/reticle)

New ASIC Development Platform, what chipignite is?

40 Dies/Reticle

$9,750
100 QFN
+
Evaluation board



Skywater nand2 size 3.753um2 = 3.9M Gates

4KB single port SRAM : 0.118mm2

Can integrate RISC-V 32 I/E

～120K Gate + Cash (4～16KB)

What does chipIgnite drive?

- **Low Cost:**

  130nm/100 QFNs/$9,750 by chipIgnite protype service

- **Real experience:**

  RTL design to REAL silicon evaluation

- **Satisfaction:**

  Only one “Chip” in the world by own idea

- **Design Community:**

  No-NDA means open and transferable

- **Easy entry:**

  Just works on your PC, no-VPN and no Servers,

How it works in eco-system?

How Open Source Silicon works in eco-system?

OpenPDK (=Commercial PDK) @Github

Apache 2.0

Git pull

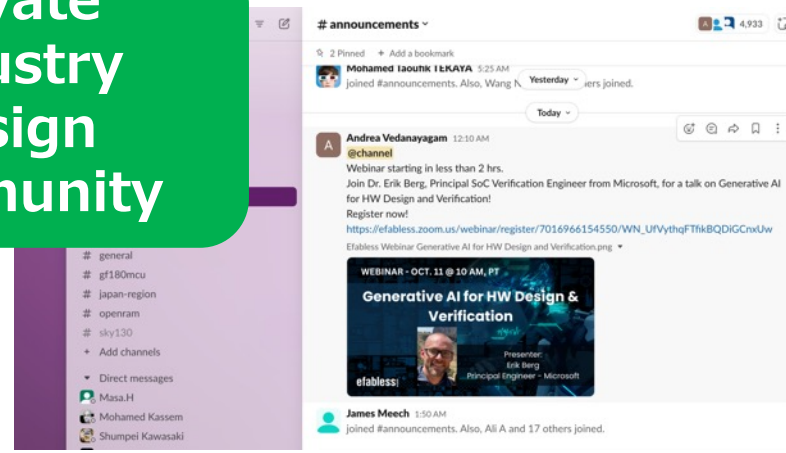
GitHub

Foundary Commercial PDK

No support
No NDA

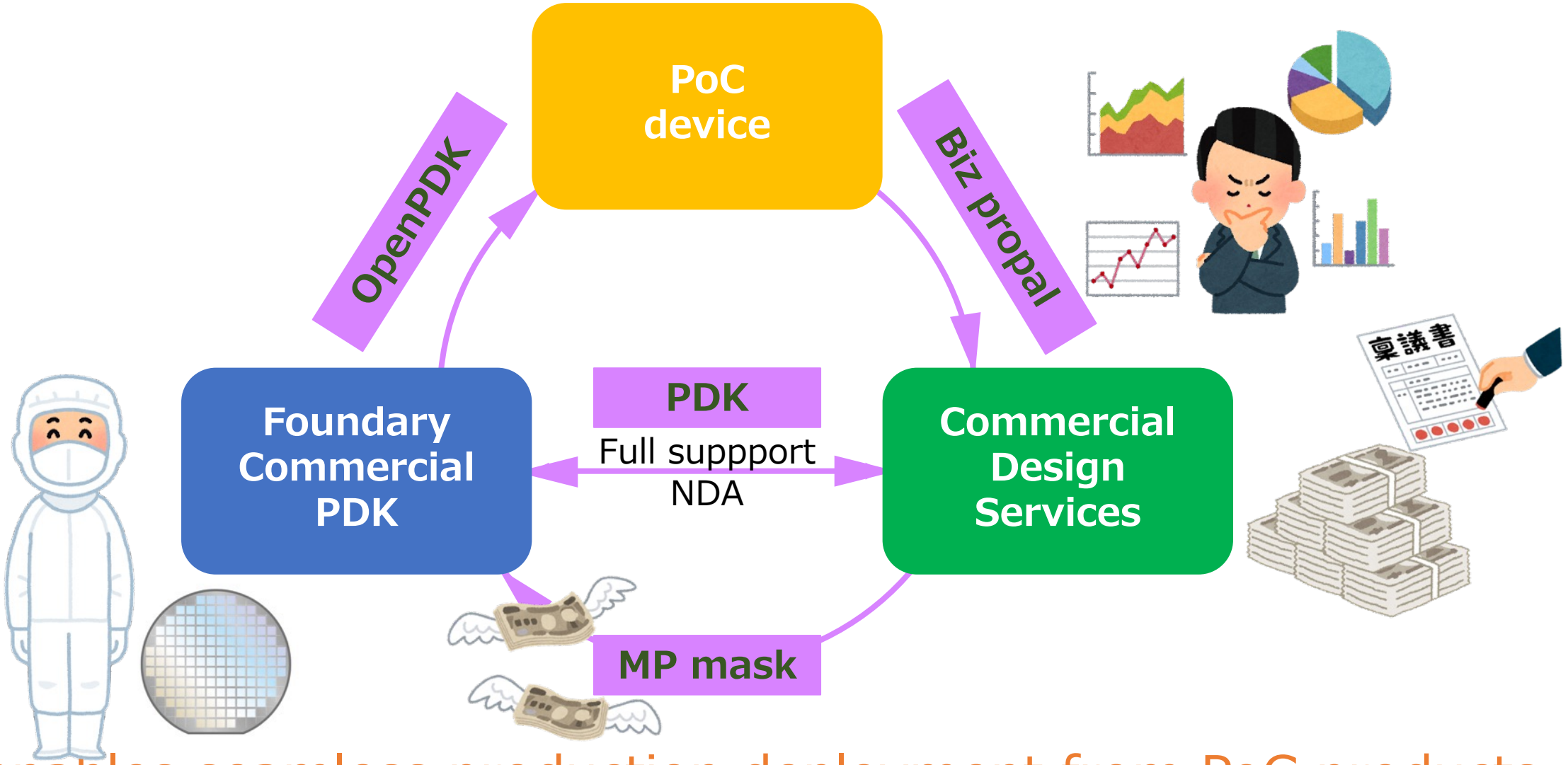
Private Industry Design Community

OpenMPW



Anyone can freely download the PDK and design chips.
The fab incurs no new investment or support obligation.

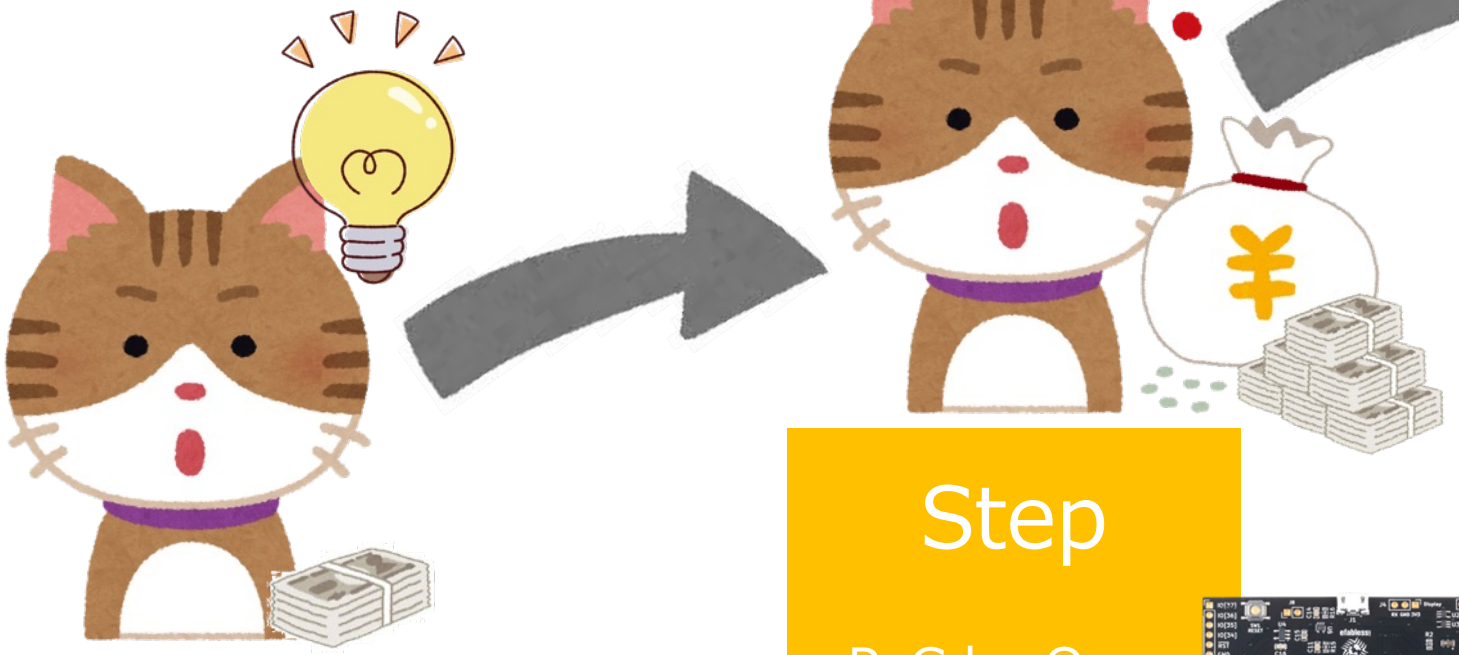
How Open Source Silicon works in eco-system?



This enables seamless production deployment from PoC products.
Commercial use of PDK is supported by dual licensing.

How Open Source Silicon works in eco-system?

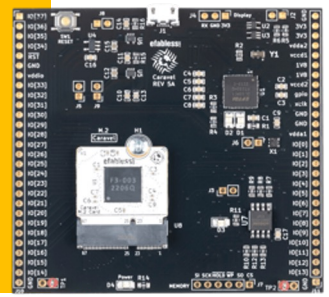
This can be lowering the entry wall to encourage chip development and success..



Hop
Idea

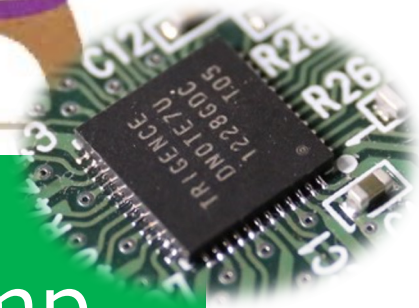
Step

PoC by Open Source Silicon



Jump

MP by NDA and commercial tools



What is the OpenSUSI intention?

Open Source Utilized Silicon Initiatives

Encouraging diverse industry sectors to leverage semiconductor advancements by establishing pragmatic design and manufacturing platforms

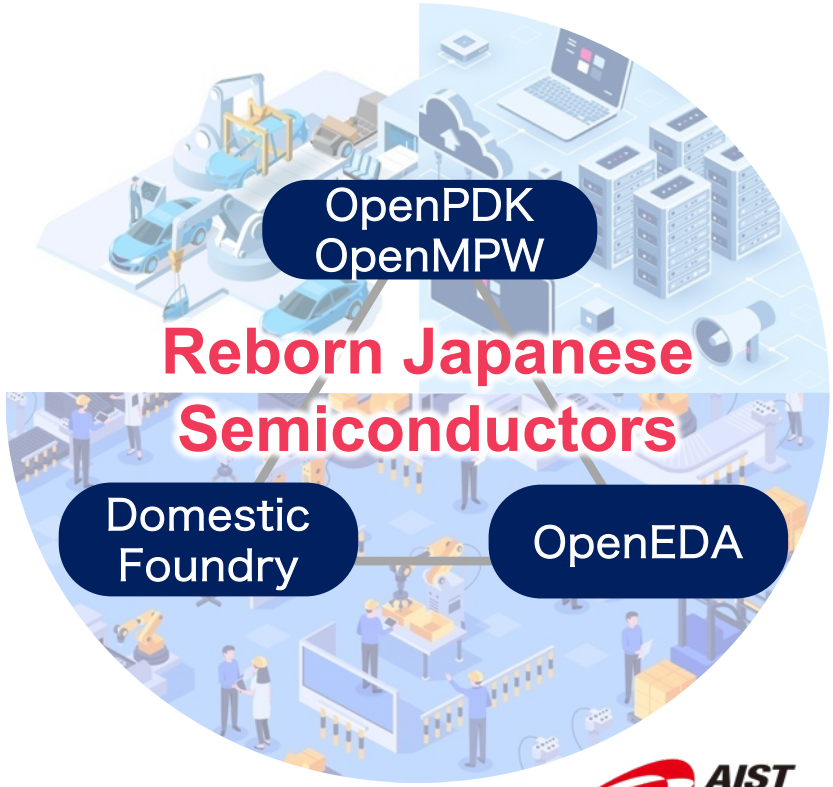
OPENSUSi

Open Source Silicon for Japan

As an AIST Solutions Business Design platform

“Accelerate of real users and actual demands”

Collaborate with domestic foundry ＋Google to achieve PoC



Target Users

Embedded device development company

Board development using commercial semiconductors and FPGAs. Want to convert to ASICs to compete and differentiate from overseas companies, but development costs are an issue

Software development company

Developing IoT-related software and devices that use CPUs and GPUs. Want to develop ASICs for differentiation through low power consumption and miniaturization, but development costs are an issue.

Industrial equipment development company

Developing equipment using commercial semiconductors and FPGAs. Want to convert to ASICs to differentiate from overseas companies, hide technology, and improve performance, but development costs are an issue.

The "target" companies are those that are not strong enough to develop their own ASICs on their own by installing expensive commercial EDA tools. The purpose is not to change the focus from commercial to open tool. It provides a platform that enables organizations and companies that have not been able to afford commercial EDA tools to conduct a PoC to differentiate their products with ASICs.

Purpose and Article

Open Source Utilized Silicon Initiatives (OpenSUSI) purpose

OpenSUSI is established to provide an environment for the industry that is long-tail chip users to compete with dedicated semiconductors by Japanese domestic semiconductor assets (chip manufacturing capacity) into a platform that lowers the barriers to entry for original chip design.

We believe that open-source EDA tools and the Open Source Silicon ecosystem can contribute to the competitiveness, innovation, education, independence, cyber resilience, and environmental sustainability of the semiconductor industry and that the OSS has not only economic benefits but also social benefits that extend throughout the industry. We believe the development and evangelization of this activity is our mission.

【Article】

1. Planning, development and provision of open source PDK (design information) for semiconductors.
2. Provision of open source or economically fair price semiconductor prototyping services.
3. Planning and operation of Open Source Silicon design communities and human resource development through these communities.
4. Accumulation and disclosure of semiconductor open source PDK (design information) know-how.
5. Development, management and protection of intellectual property rights related to semiconductors.
6. Planning and operation of lectures, exhibitions, symposiums and seminars, production and sales of books, magazines and printed materials.
7. Exchange of information and cooperation with domestic and foreign institutions, organizations, research institutes, and educational institutions related to semiconductors.
8. Other activities necessary to achieve the objectives of the society.

Summary for Device modeling?

Jun-ichi OKAMURA

Summary for Device modeling

- Open Source Electronic Design Automation (EDA) and Open Source Process Design Kits (PDK) are critical platforms that **platform the Open Source Silicon movement**, an ongoing alternative trend in chip development. This movement is gaining maturity, offering significant benefits such as IP portability, design reuse, as well as transparency in chip functionality and traceability of design sources.
- While **it is unclear** the full impact this movement will have on **device model development**, it is evident that it is influencing these areas as well. As this trend evolves, it is crucial to maintain close communication to monitor and understand how it would be innovated.

Contact

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