2025
DESIGN AND VERIFICATION™
DVCON
CONFERENCE AND EXHIBITION
EUROPE
MUNICH, GERMANY
OCTOBER 14-15, 2025

How Docker containers can make chip development more productive

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accellera
SYSTEMS INITIATIVE

Welcome to your first at $chipcorp

- Wait for some permissions to be granted.
- Install these tools
- Learn from colleagues how to use those tools.
- Never click on this button.
- ….

Welcome to your first at $newproject

- Wait for some permissions to be granted.
- Install these tools
- Learn from colleagues how to use those tools.
- Never click on this button.
- ….

Welcome to your first at $newproject

- Wait for some permissions to be granted.
- Install these tools
- Learn from colleagues how to use those tools.
- Never click on this button.
- ….

Hours and hours wasted!

Can we do better?

Can we do better?

Make developers happy with a **great development experience**.

Make managers happier by being **more productive**.

We at IBM found containers to be a great way to get there. This is our story. Can it inspire you?

I’m Philipp

cocotb

lowRISC

opentitan

open source initiative

IBM

Philipp Wagner

Reach out at
phw@ibm.com
for questions.

We build mainframes

A Telum II (z17) CP

- 5 nm Samsung
- 600 mm2
- 43 billion transistors
- 5.5 GHz
- 8 cores (Z/Architecture)
- DPU

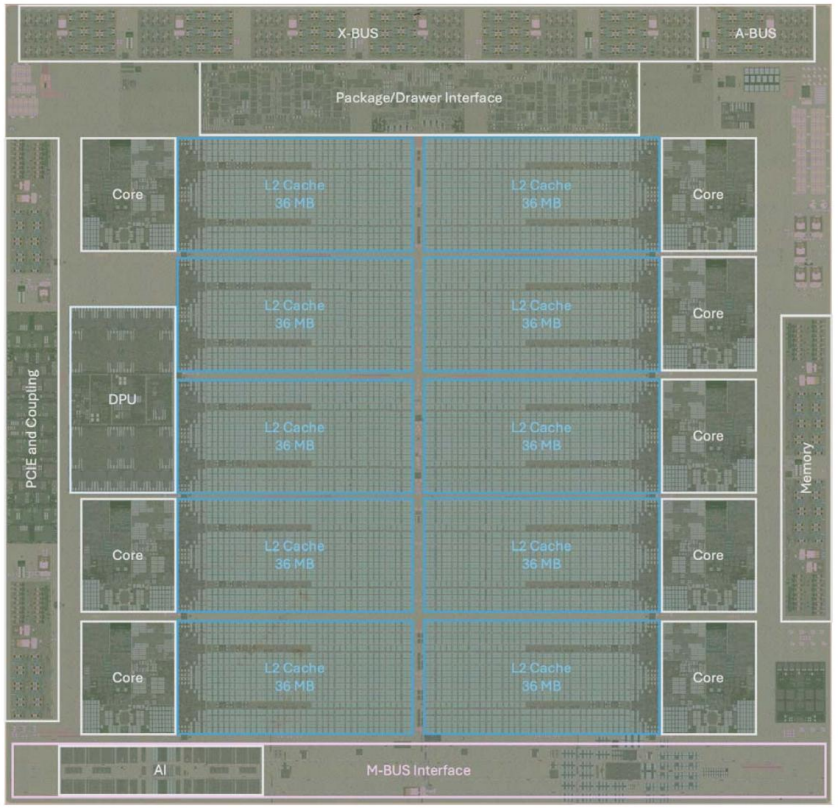


Figure 2.2.7: Telum II die photo.

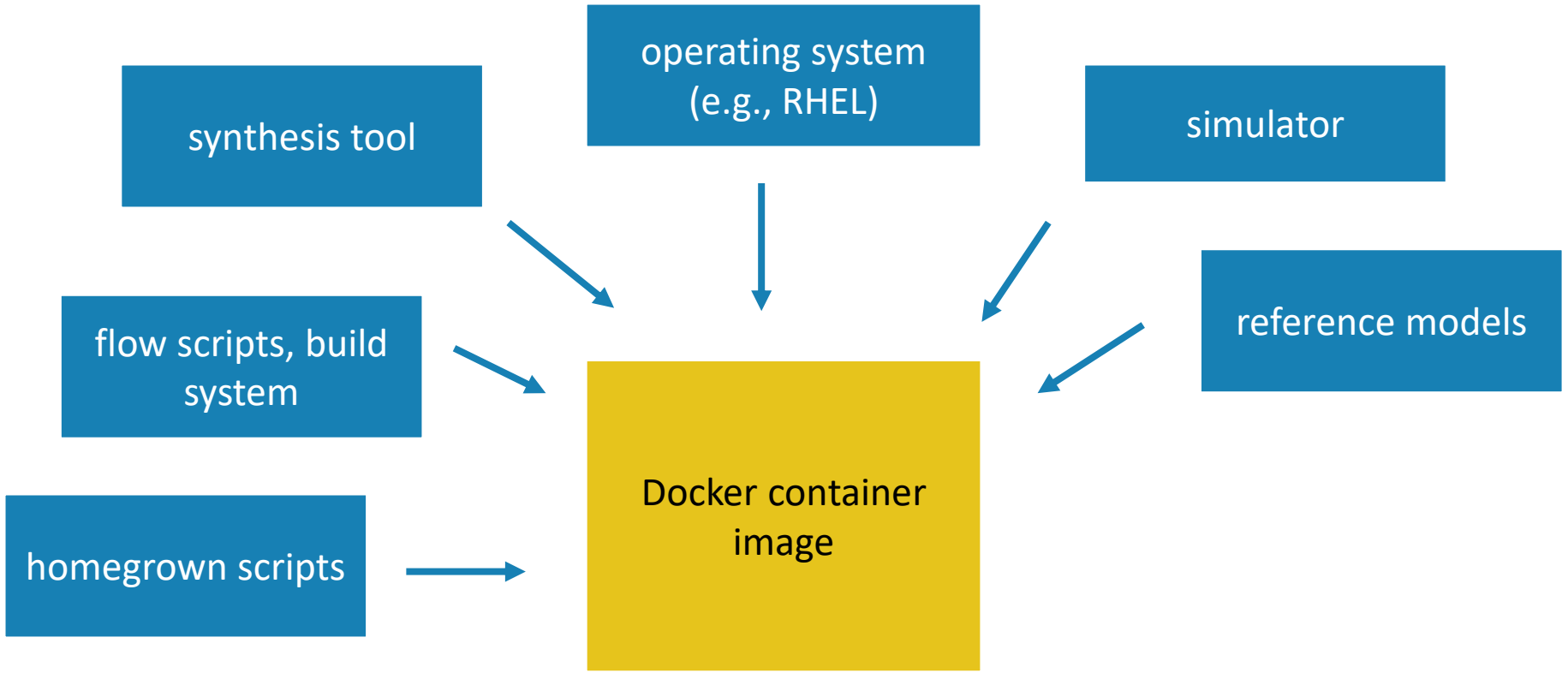
Strevig et al, "IBM Telum II: Next Generation 5.5GHz Microprocessor with On-Die Data Processing Unit and Improved AI Accelerator"

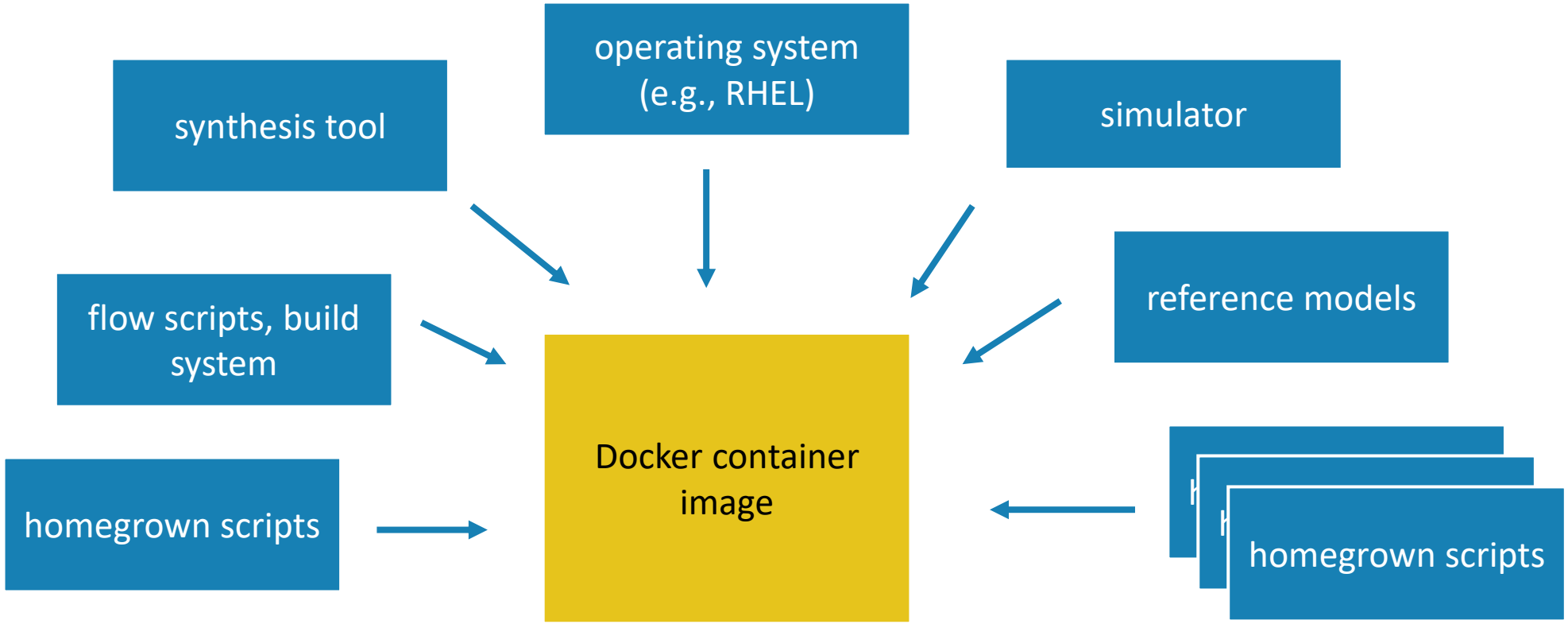
Topics for today

- How Docker containers work
- Dev Containers are great for chip design
- Container checkpointing can speed up functional verification

Docker containers

- Lightweight virtualization, provided by the Linux kernel
- Share a full userland in a container image
- Mature ecosystem to build, distribute, run, orchestrate containers by Docker, podman, Kubernetes, …


synthesis tool
operating system (e.g., RHEL)
simulator
flow scripts, build system
reference models
homegrown scripts
Docker container image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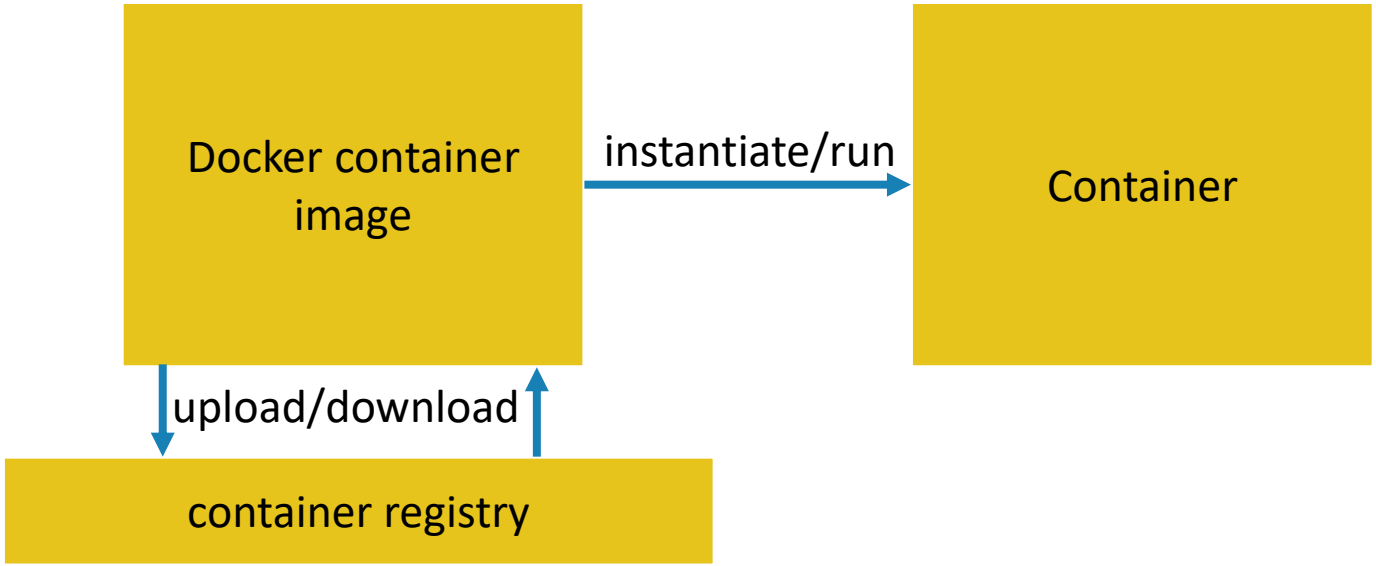

Docker container image
instantiate/run
Container
upload/download
container registry

Containers in chip design

- More productive day-to-day development
- Automated testing (CI, regressions)
- Project archiving
- Speed up functional verification
- …

Why can make containers day-to-day development more productive?

We are focusing on front-end development
(C++, VHDL, Python, waveform viewing, scripting).

What we expect from a productive development environment

Integrated

Keeps developers “in the flow.” Give developers all they need at their fingertips.

Fast/predictable

Make short tasks fast to avoid context switches.

Make long-running tasks predictable, to enable efficient context switching (c.f. [1])

Ready-to-use

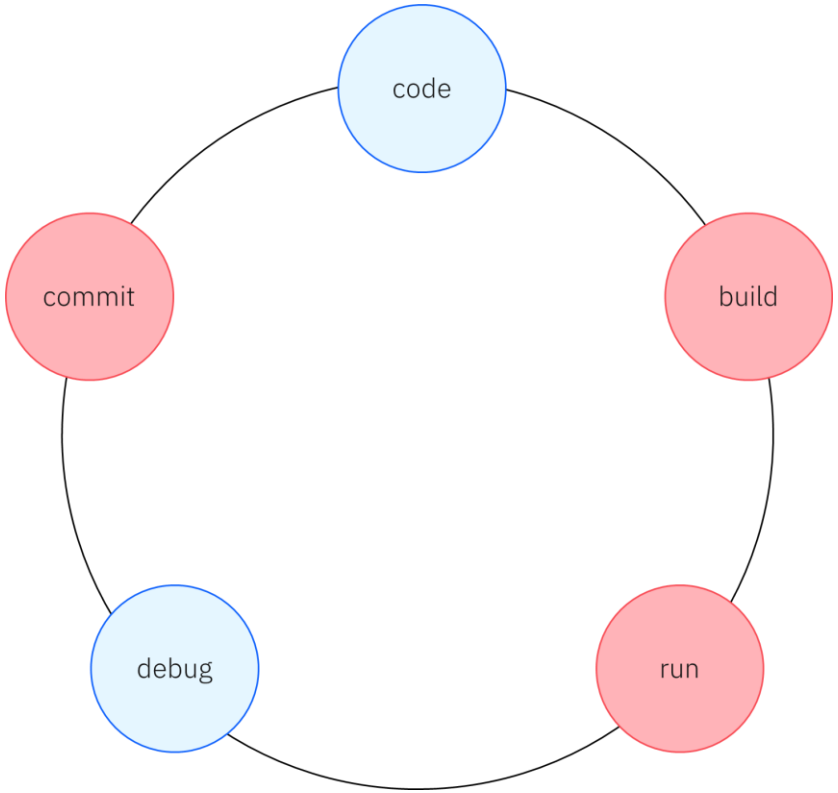
Give the project the ability to define a known-good development environment.

Customizable

Every developer is different. Give them the ability to customize their work environment to fit their individual needs.

[1] Jaspan, Ciera, and Collin Green. “Developer Productivity for Humans, Part 4: Build Latency, Predictability, and Developer Productivity.” IEEE Software 40, no. 4 (July 2023): 25–29. https://doi.org/10.1109/MS.2023.3275268.

Talking about “fast”: Iteration speed matters



Make developers productive == minimize tax

What we expect from a productive development environment and where it comes from

Integrated

Keeps developers “in the flow.” Give developers all they need at their fingertips.

VS Code

Fast/predictable

Make short tasks fast to avoid context switches.

Make long-running tasks predictable, to enable efficient context switching.

local

Ready-to-use

Give the project the ability to define a known-good development environment.

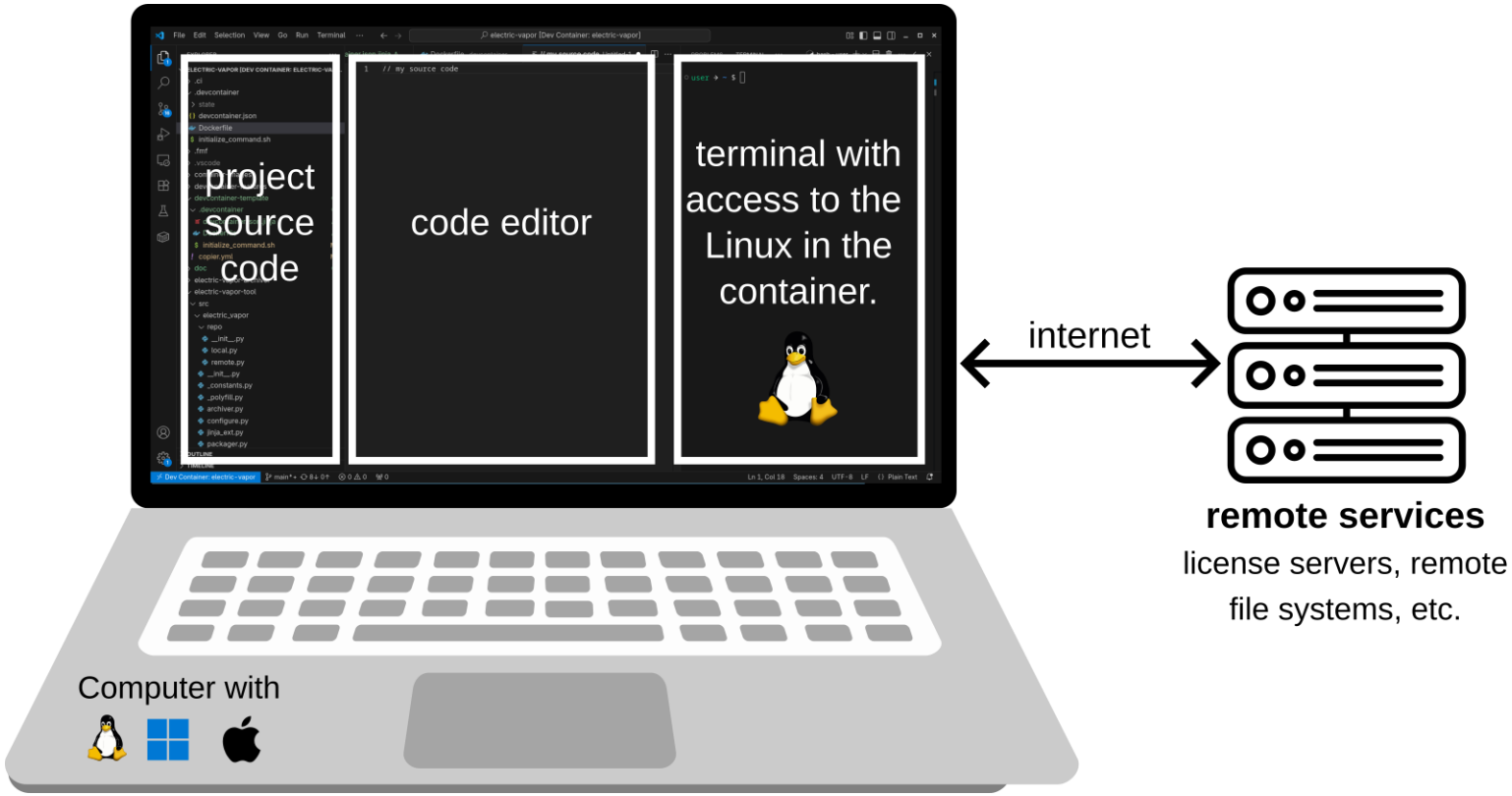
Containers

Customizable

Every developer is different. Give them the ability to customize their work environment to fit their individual needs.

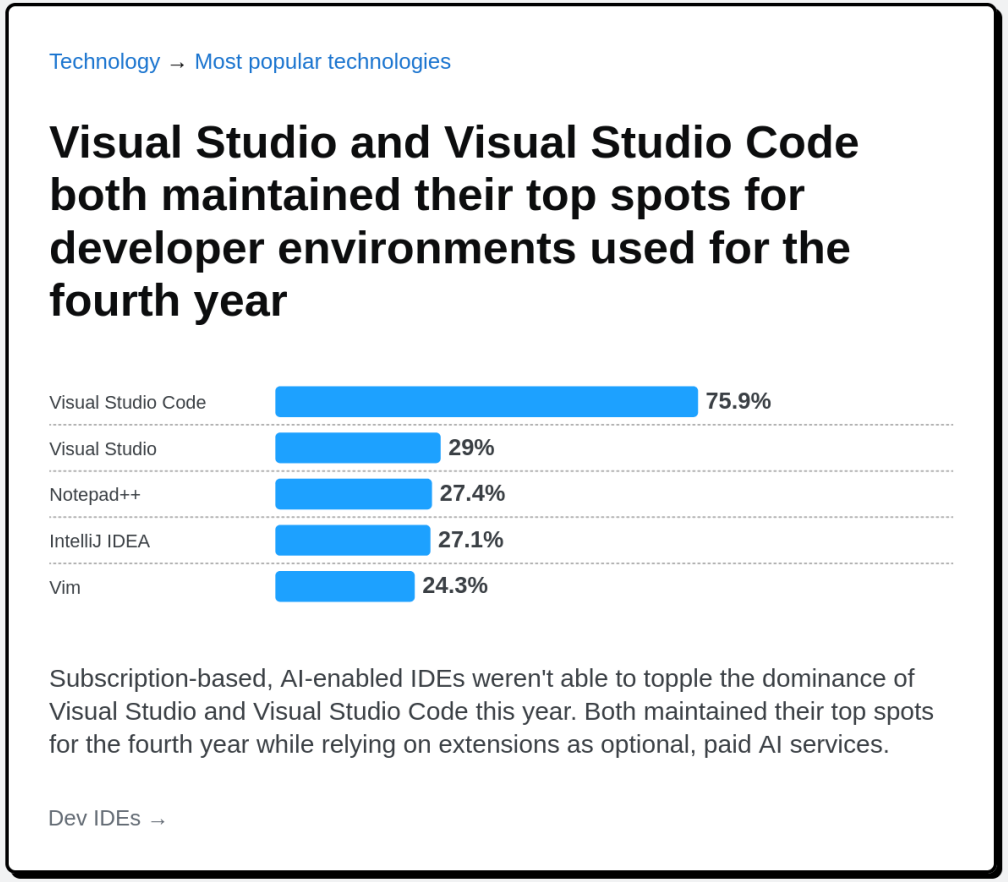
VS Code

That’s our dev environment



VS Code

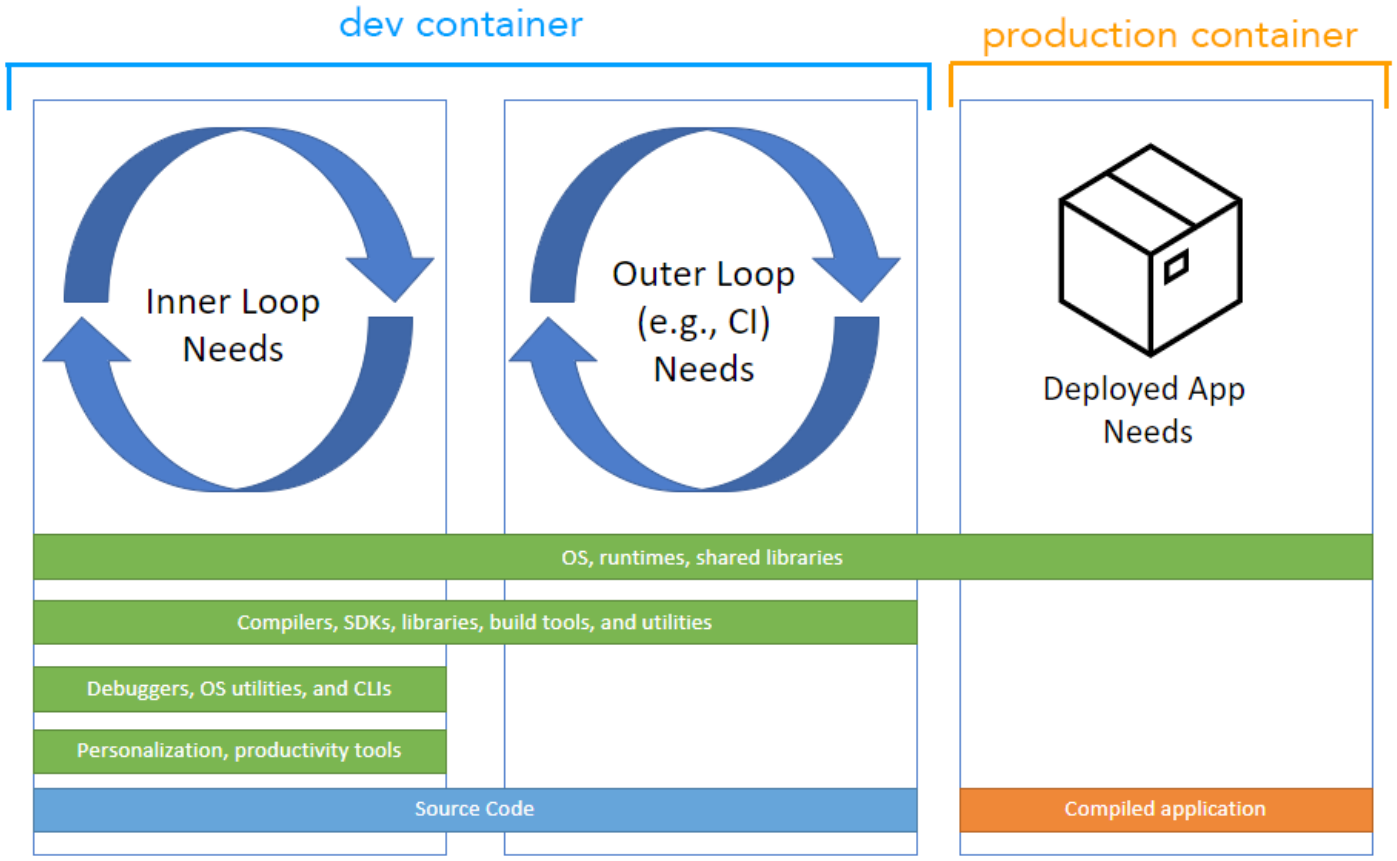
- Very popular IDE
- free/open source
- Powerful extension ecoystem



https://survey.stackoverflow.co/2025

Dev Containers

- Containers for human developers
- Nicely integrated in VS Code
- Also usable without VS Code



https://containers.dev/overview

Our users like it

30 % of devs opted into using the container daily

50 % tried it at least once

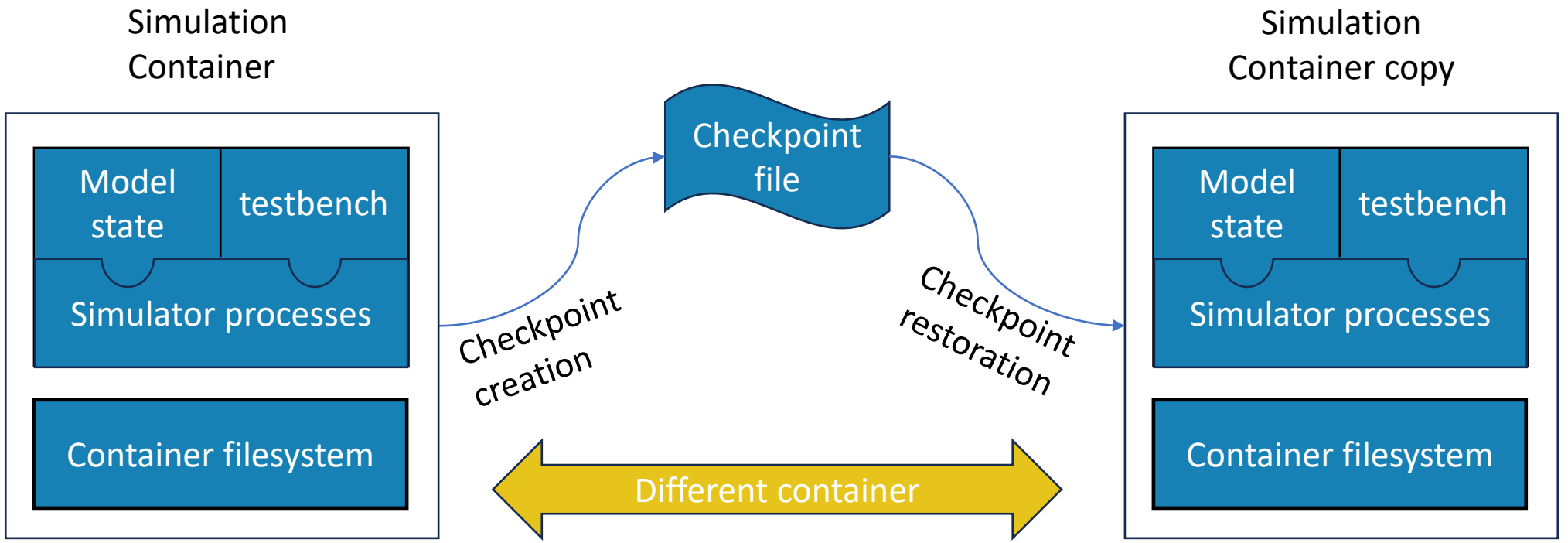
88 % feel the container made them more productive

The Dev Container environment has been available since March 2025 for a target audience of around 200 engineers.

Another container use case

Containers make checkpoint/restore of complex applications easy.

Checkpoint/restore: An overview



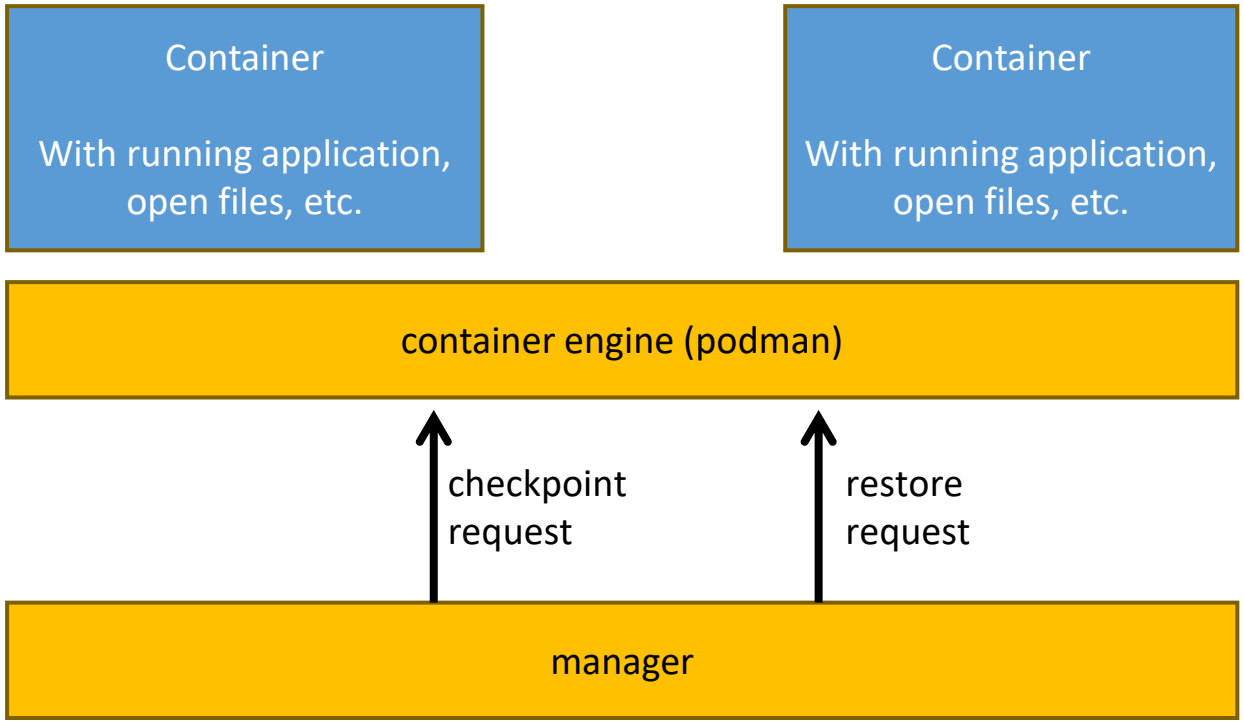
Simulation output:

```
…
Cyc 0000000: InitHW:     000.013 sec elapsed,  ps v …
Cyc 0000014: PostInitHW: 000.013 sec elapsed,  p …
Waiting for checkpoint creation
```

Simulation output:

```
Continuing simulation
Cyc 0000014: Evaluate:   259.120 sec elapsed,  ps …
Cyc 0001014: Evaluate:   Last 1000 cycles took 00 …
…
```

Host-driven checkpoint/restore

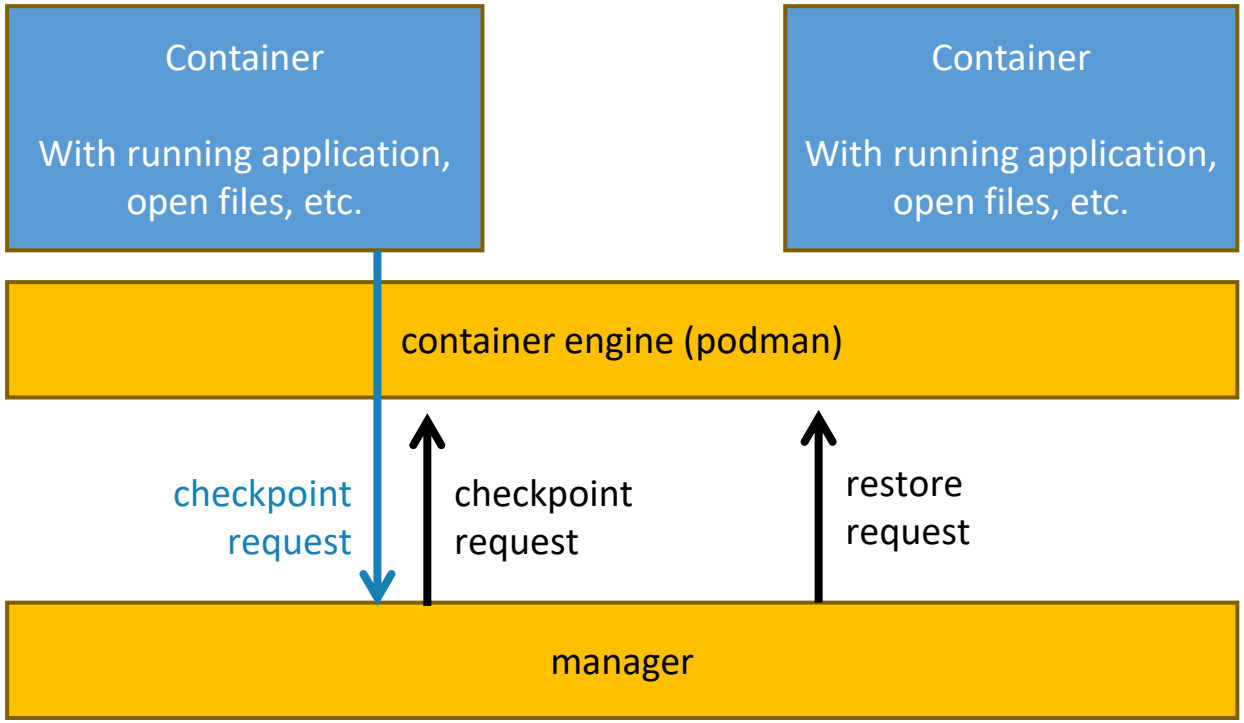


The host decides when to checkpoint/restore. The application doesn't notice anything.

Typical use cases:

- Service migration (e.g., for rolling updates of the host)
- Crash recovery

Application-driven checkpoint/restore



The application decides when a good time is for a checkpoint and requests one. It's also aware of the restore.

Typical use cases:

- Skip initialization phases
- Interval checkpointing ("save games")

Summary

- Containers are great for chip development
- VS Code Dev Containers give us real-world productivity benefits
- Container checkpointing is a promising solution for long-running simulations.