Has WebAssembly been lost in the AI hype?

Could it be the key to sustainable computing?

Stuart Harris, 15th Oct 2024

A path to more sustainable computing

- ➔ WebAssembly
- ➔ WebAssembly Components
- ➔ Vertical scaling and scale-to-zero
- ➔ Next generation platforms
- ➔ Carbon, cost, and sustainability
- ➔ How do enterprises get there?

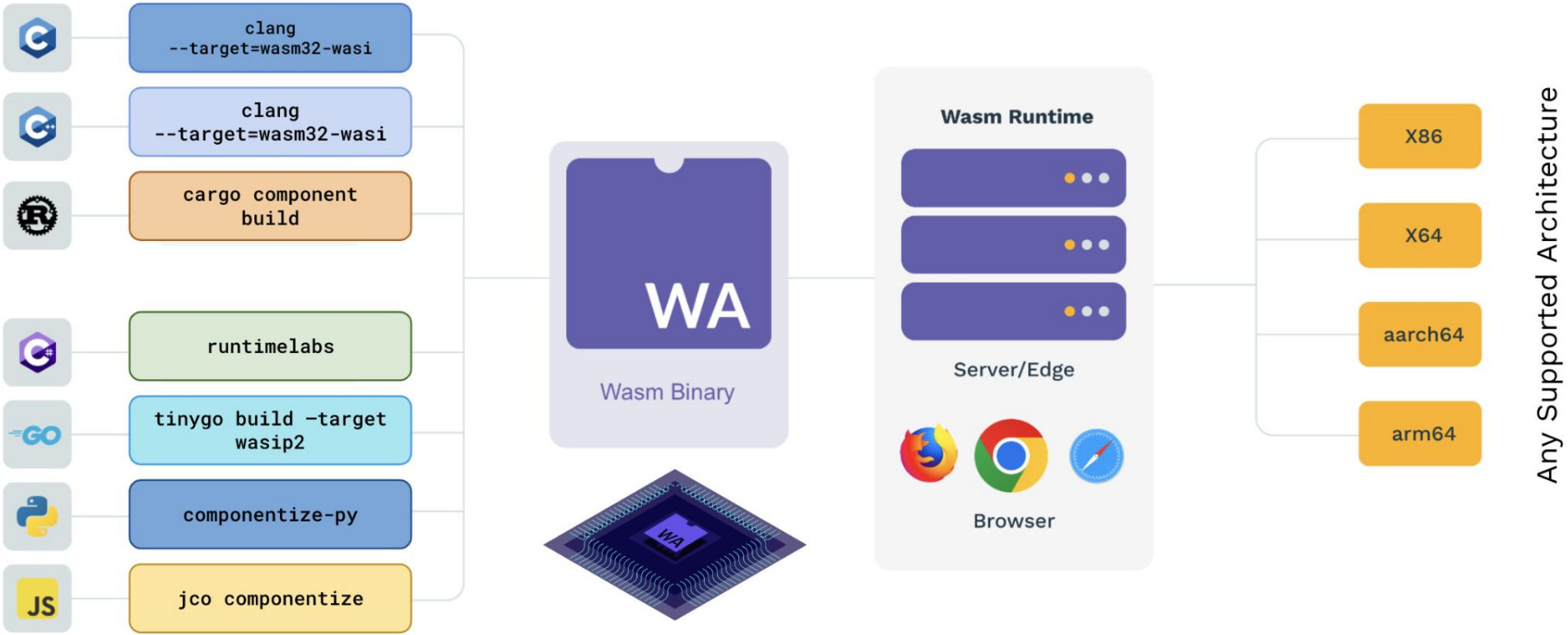
Hi, I’m Stu

- ➔ Software engineer
- ➔ Founder and Chief Scientist
- ➔ @stuartharris

RED BADGER

WebAssembly (Wasm)

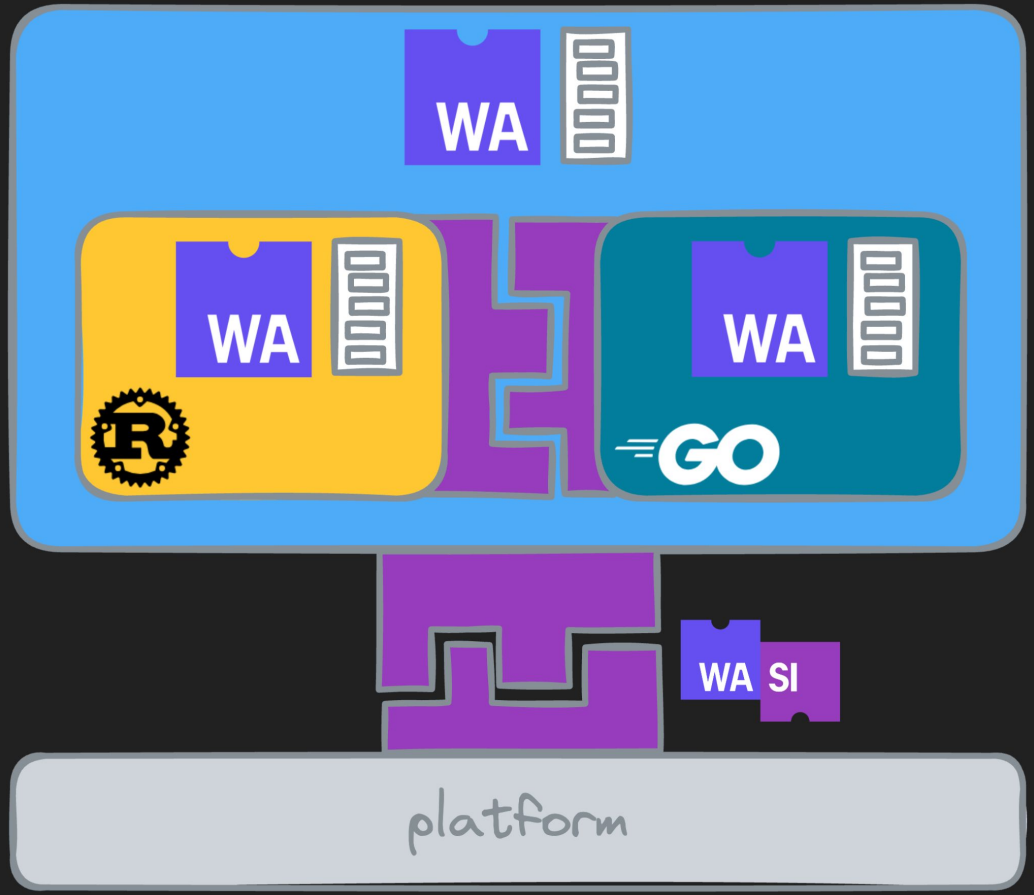
WebAssembly



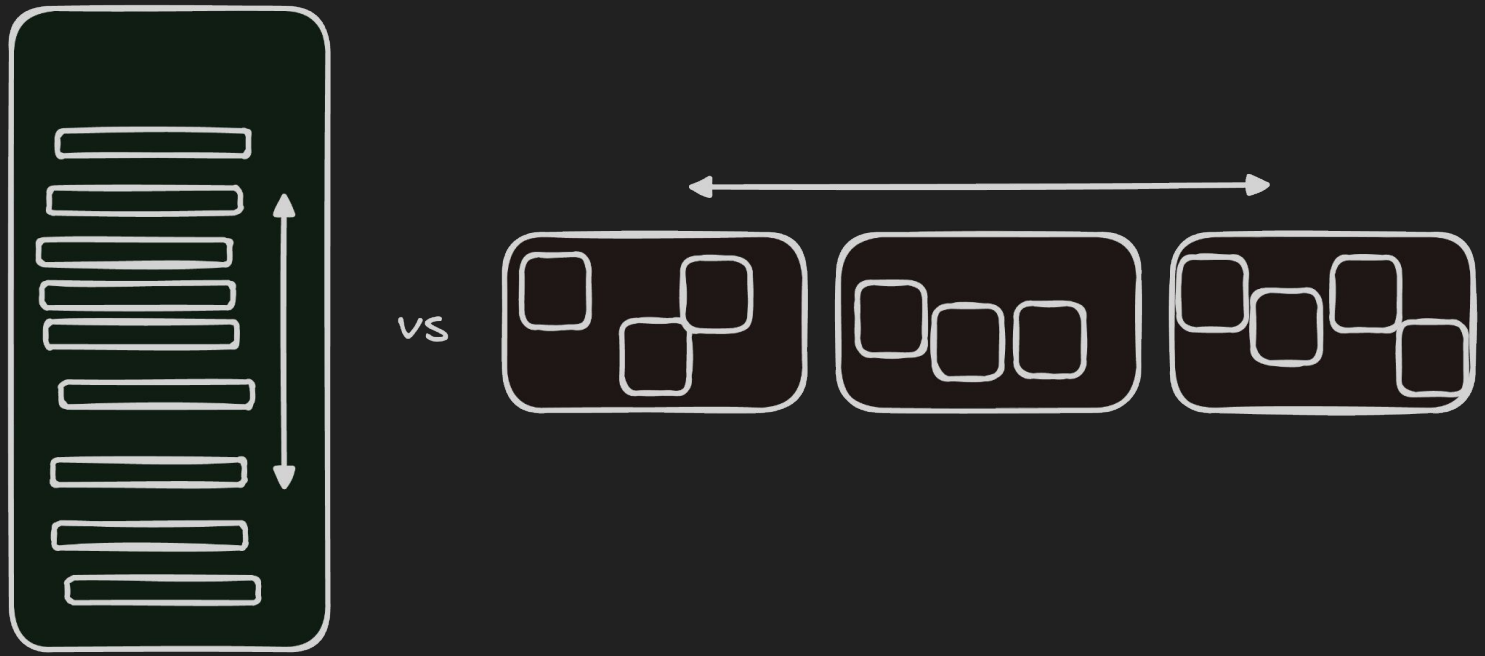
```
stuartharris ~/wasm 14:34
→ cargo new hello-world
    Creating binary (application) `hello-world` package
note: see more `Cargo.toml` keys and their definitions at https://doc.rust-lang.org/cargo/reference/manifest.html

stuartharris ~/wasm 14:35
→ cd hello-world/

stuartharris …/hello-world master ? v1.81.0 14:35
→ bat ./src/main.rs
       File: ./src/main.rs
   1   fn main() {
   2       println!("Hello, world!");
   3   }

stuartharris …/hello-world master ? v1.81.0 14:35
→ cargo build --target wasm32-wasip1 --release
   Compiling hello-world v0.1.0 (/Users/stuartharris/wasm/hello-world)
    Finished `release` profile [optimized] target(s) in 0.60s

stuartharris …/hello-world master ? v1.81.0 14:35
→ eza -la ./target/wasm32-wasip1/release/hello-world.wasm
.rwxr-xr-x 64k stuartharris 14 Oct 14:35 ./target/wasm32-wasip1/release/hello-world.wasm

stuartharris …/hello-world master ? v1.81.0 14:35
→ wasmtime run ./target/wasm32-wasip1/release/hello-world.wasm
Hello, world!

stuartharris …/hello-world master ? v1.81.0 14:35
→
```

WebAssembly components

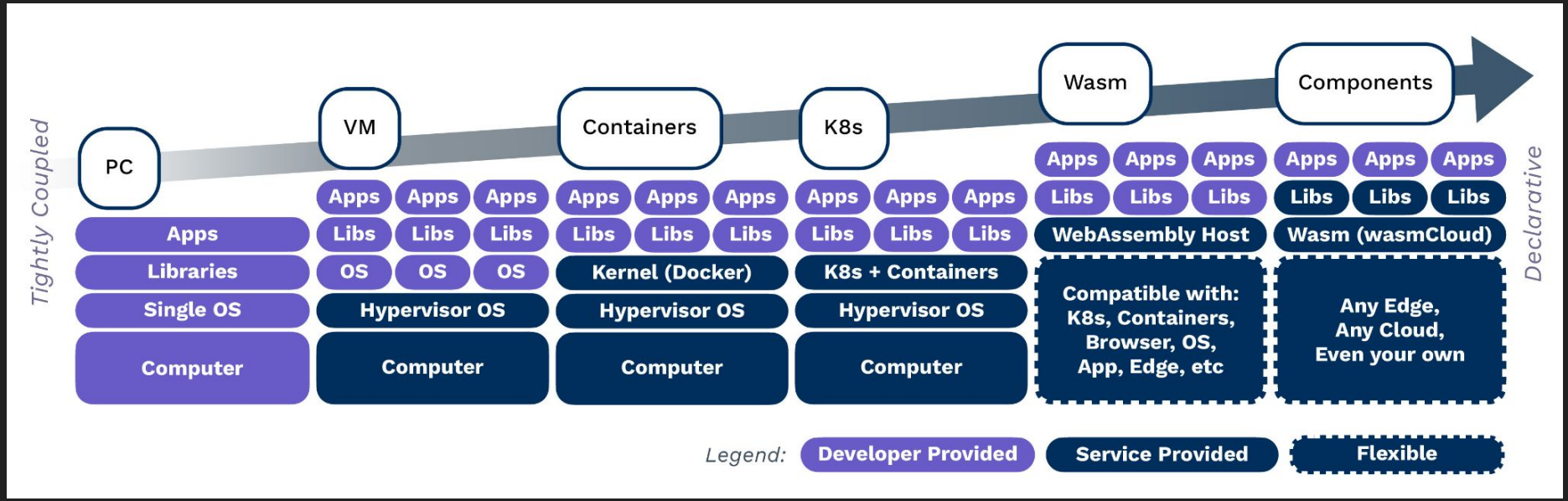
WebAssembly components



Scaling Vertically and Scale-to-zero

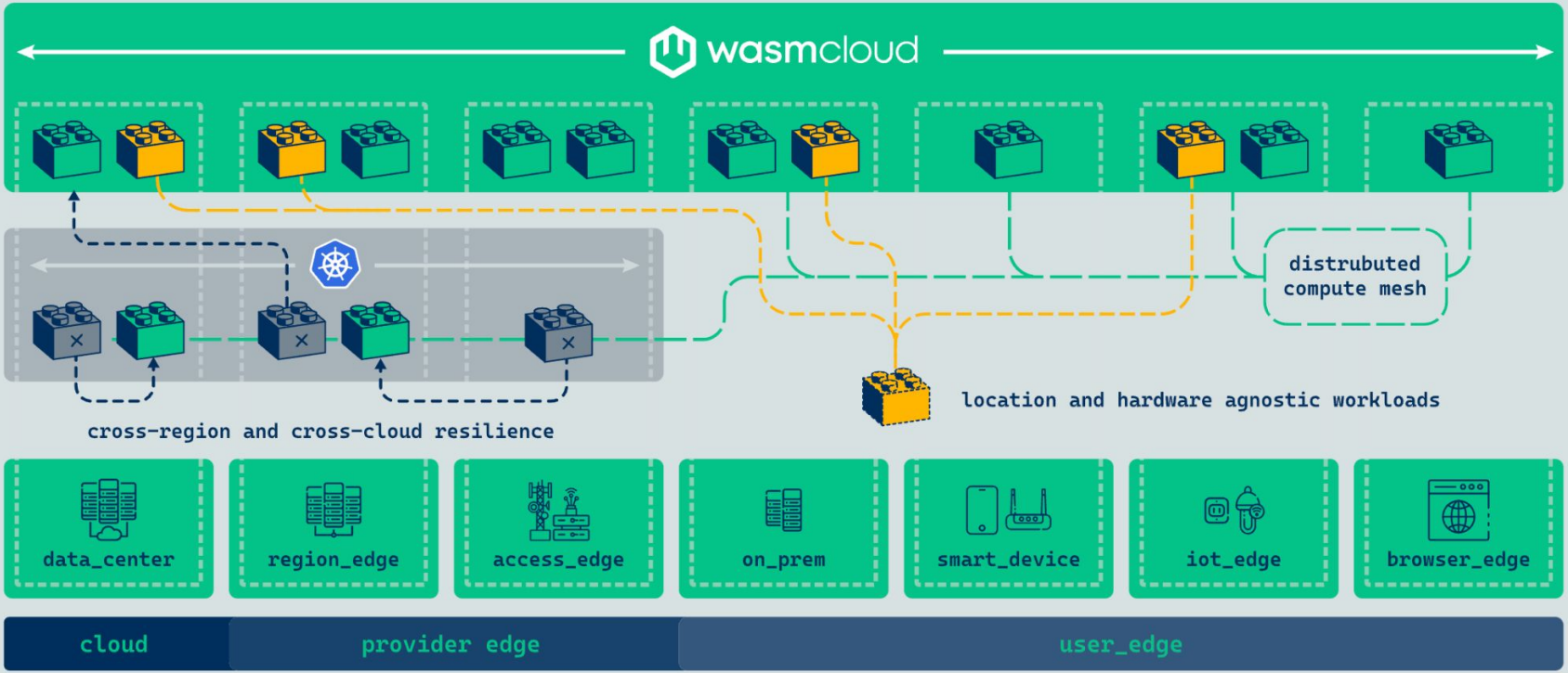


Platform evolution



wasmCloud

cosmonic

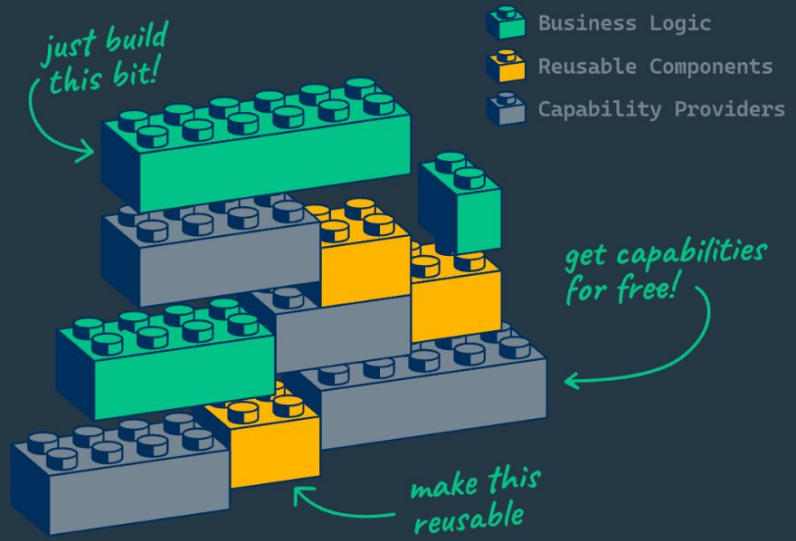


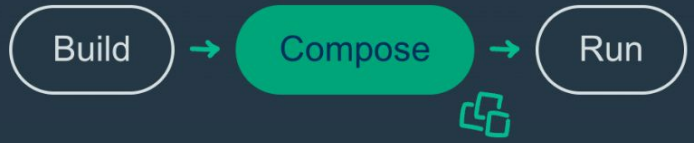
Build

Faster Development Cycles
Leverage reusable, polyglot, Wasm components on a reliable, distributed platform.

Centrally Maintainable Apps
Reusable, version-controlled components empower platform teams to maintain thousands of diverse apps centrally.

Integrate with Existing Stacks
wasmCloud has first-tier support for Kubernetes, AWS, Azure, GCP, Jenkins, Github Actions, ArgoCD, Backstage, Chainguard, Databases, Messaging, and more.





Compose

Development Without Lock-In

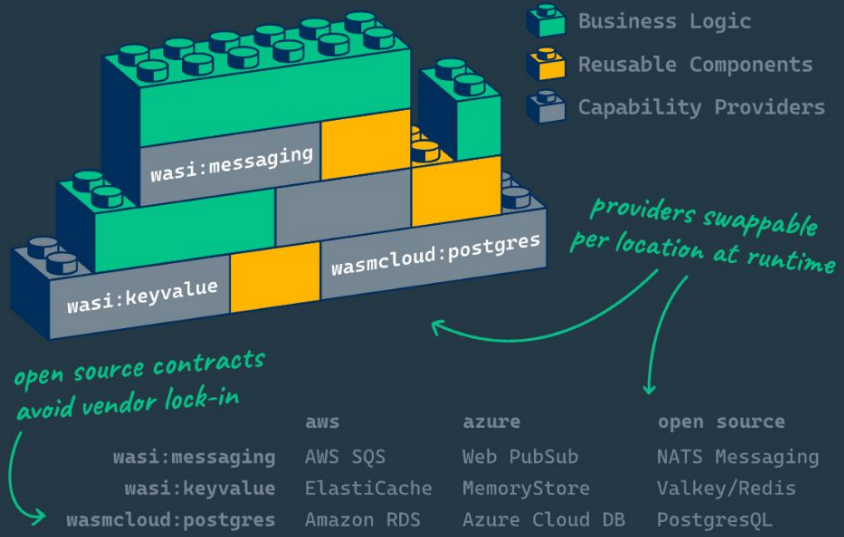
Define application dependencies at runtime via contract driven interfaces leveraging different vendors across deployments, dev, QA, or prod.

Truly Portable Apps

Run the same Wasm application across operating systems and architectures—no new builds required. Linux, MacOS X, Windows, ARM, x86, and more.

Custom Capabilities

Easily extend the secure wasmCloud host at runtime to support custom dependencies, hardware, or business contracts.



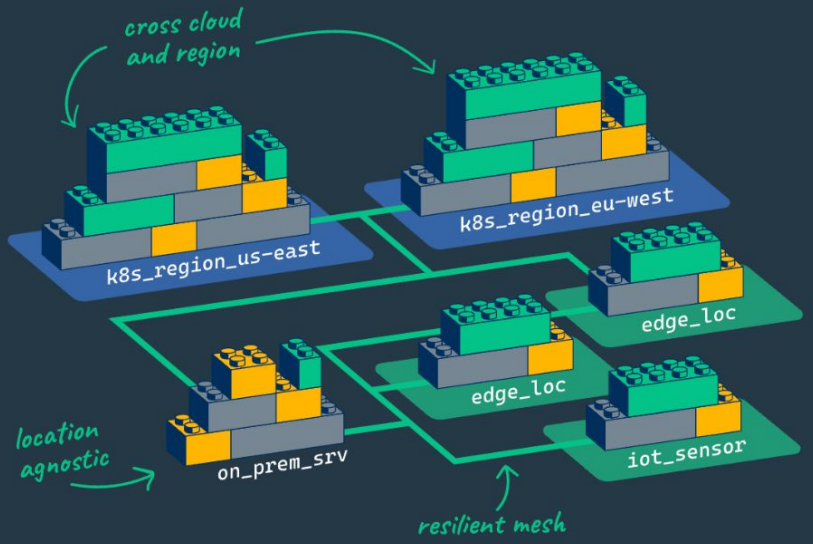
Build → Compose → Run

Run

Scale-to-Zero with Zero Cold Starts
Sub-millisecond start times and vertical autoscaling means workloads scale to the demand.

Reliable, Fault-Tolerant Apps
Horizontal scaling with automated fail-over gives apps capability-level resiliency, reliability, and scalability.

Deploy Across Clouds
Close to your users, with local-first routing and at-most-once delivery, wasmCloud delivers cross-region, cross-cloud, and cross-edge capability-level resiliency to every deployment



Data Centres in Ireland

- **82** operational
  14 under construction
  52 planned ref
- Consume **21**% of the nation's electricity, that's more than all urban homes (18%), and projected to rise to **33**% within **3** years ref
- **50.7**% fossil fuels in 2023, including coal, peat and oil, and not including imports ref

DEEP GREEN

HOW DEEP GREEN HEATS A POOL

SAVING THE POOL
over **£20,000** a year and reducing their carbon emissions by **25.8 tonnes.**

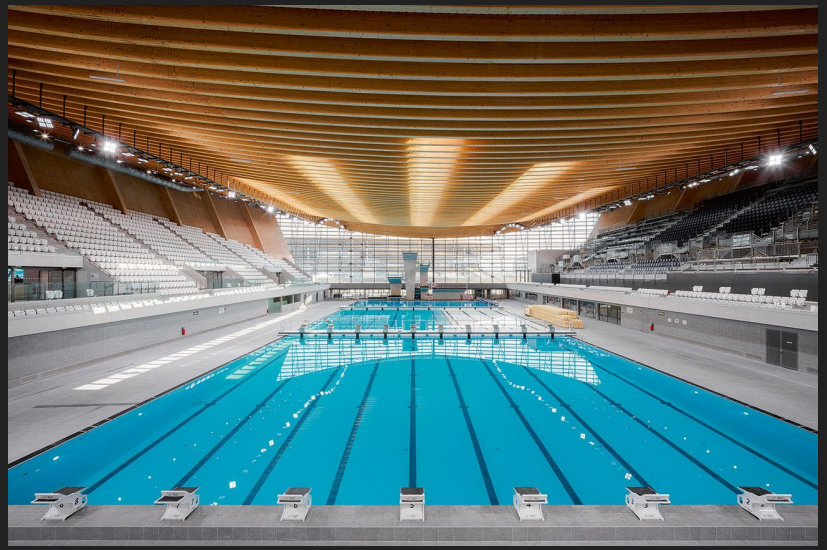
GAS BOILER 4
Only tops up the water temperature if it is needed.
Reduction of over **62%** of gas required to heat the pool.

DEEP GREEN UNIT 2
We immerse our computers in biodegradable mineral oil, which captures the heat the computers generate.
Around **96%** of the energy needed to run the unit will be efficiently transformed into consistent, reliable, low-carbon heat, available for the pool.

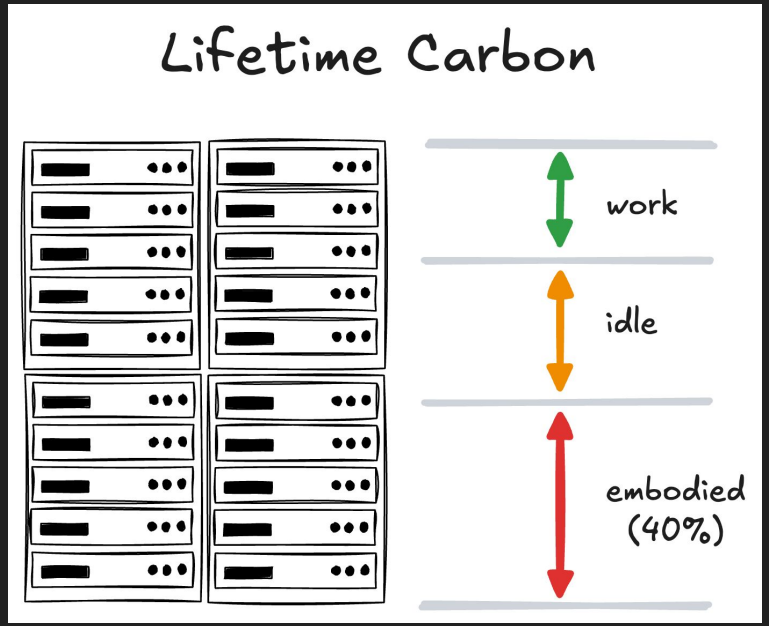
3 **HEAT EXCHANGER**
Heat is transferred from the Deep Green oil into the cold pool water via a heat exchanger.

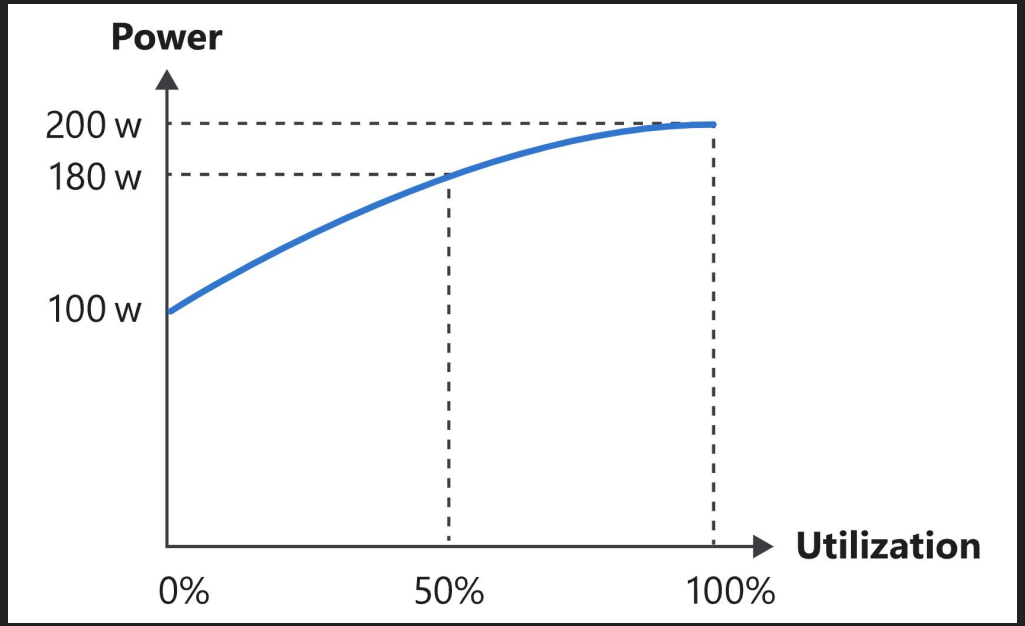
1 **ELECTRICITY**
Only renewable power used.

Equinix PA10

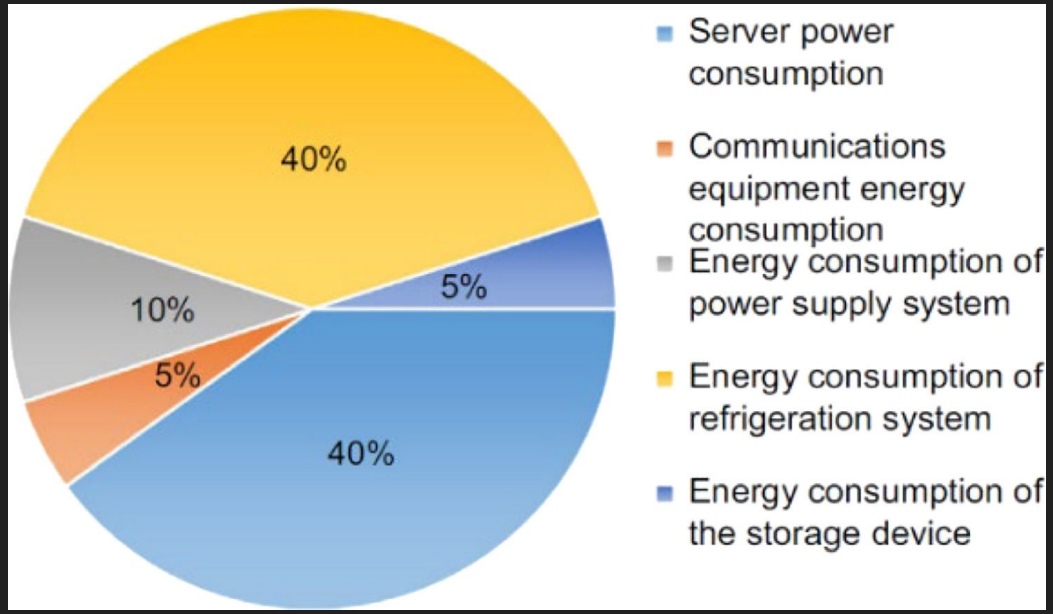


Carbon

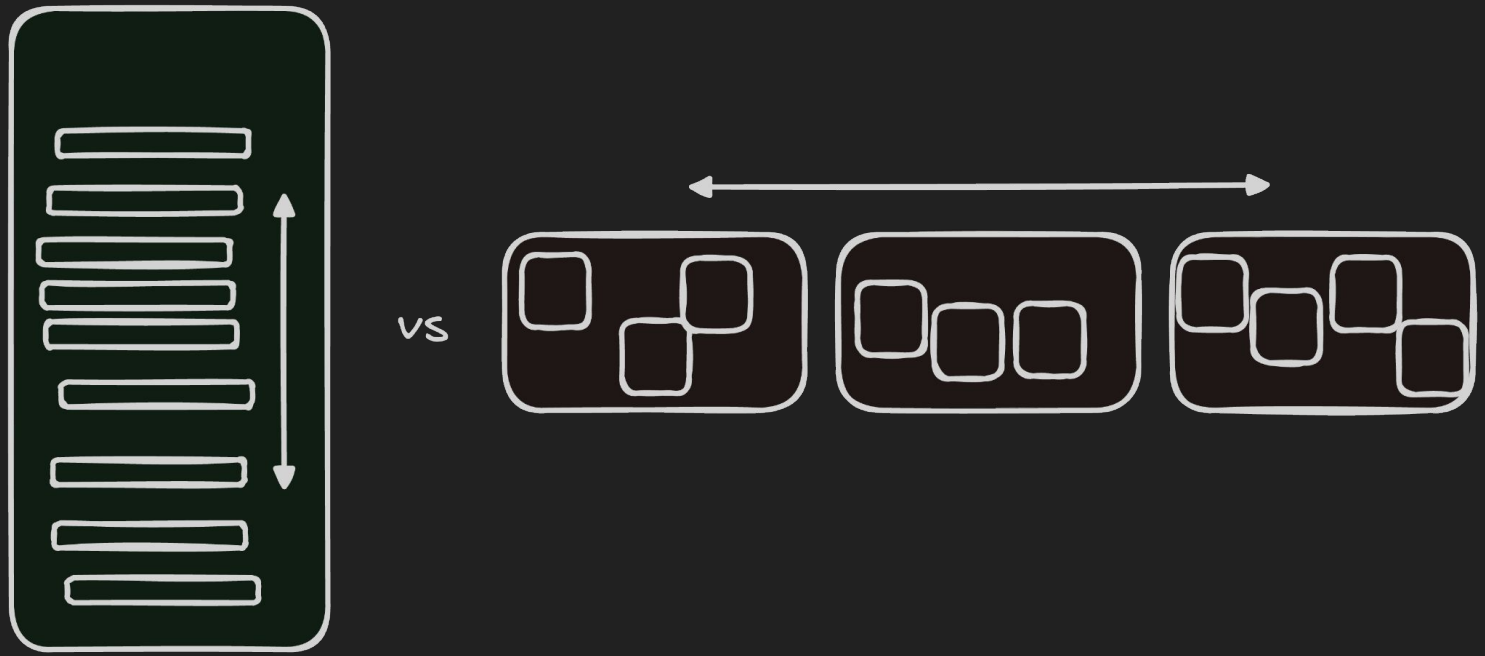

Lifetime Carbon
work
idle
embodied
(40%)


Power
200 w
180 w
100 w
Utilization
0%
50%
100%

Cooling


40%
5%
10%
5%
40%
Server power consumption
Communications equipment energy consumption
Energy consumption of power supply system
Energy consumption of refrigeration system
Energy consumption of the storage device

Scaling Vertically and Scale-to-zero



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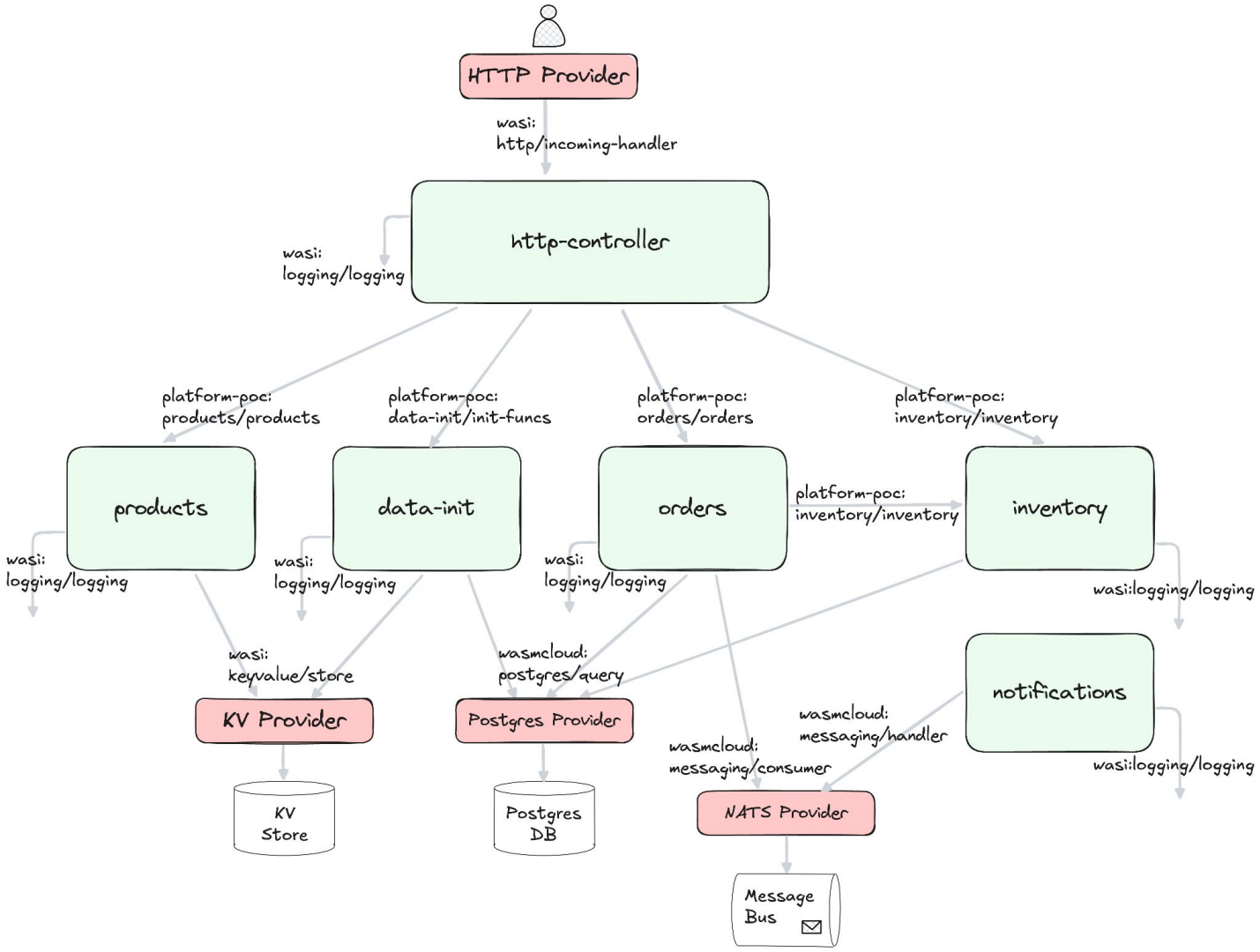
HTTP Provider
wasi:
http/incoming-handler
http-controller
wasi:
logging/logging
platform-poc:
products/products
platform-poc:
data-init/init-funcs
platform-poc:
orders/orders
platform-poc:
inventory/inventory
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wasi:
keyvalue/store
wasmcloud:
postgres/query
notifications
KV Provider
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wasmcloud:
messaging/consumer
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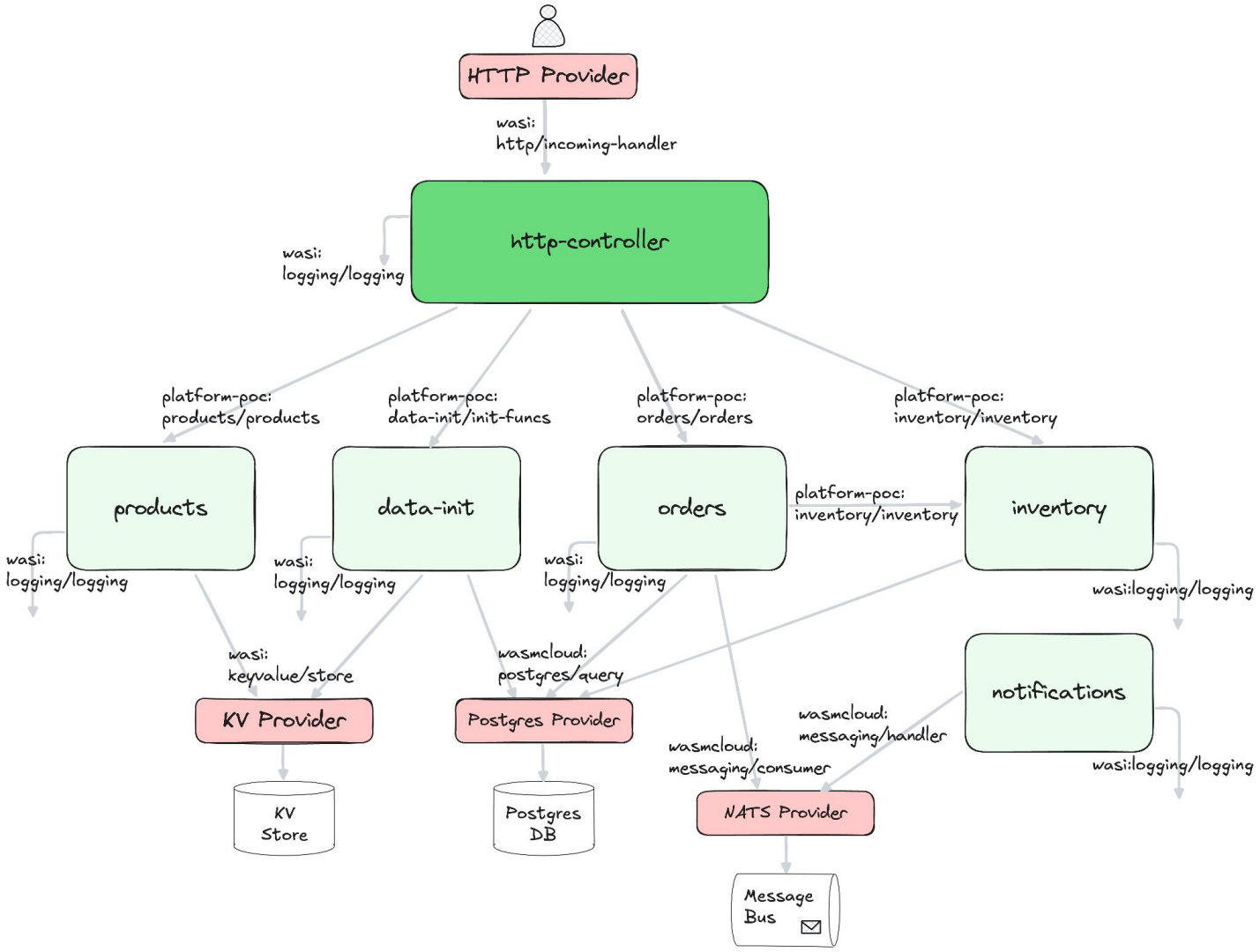
KV
Store
Postgres
DB
NATS Provider
Message
Bus

Example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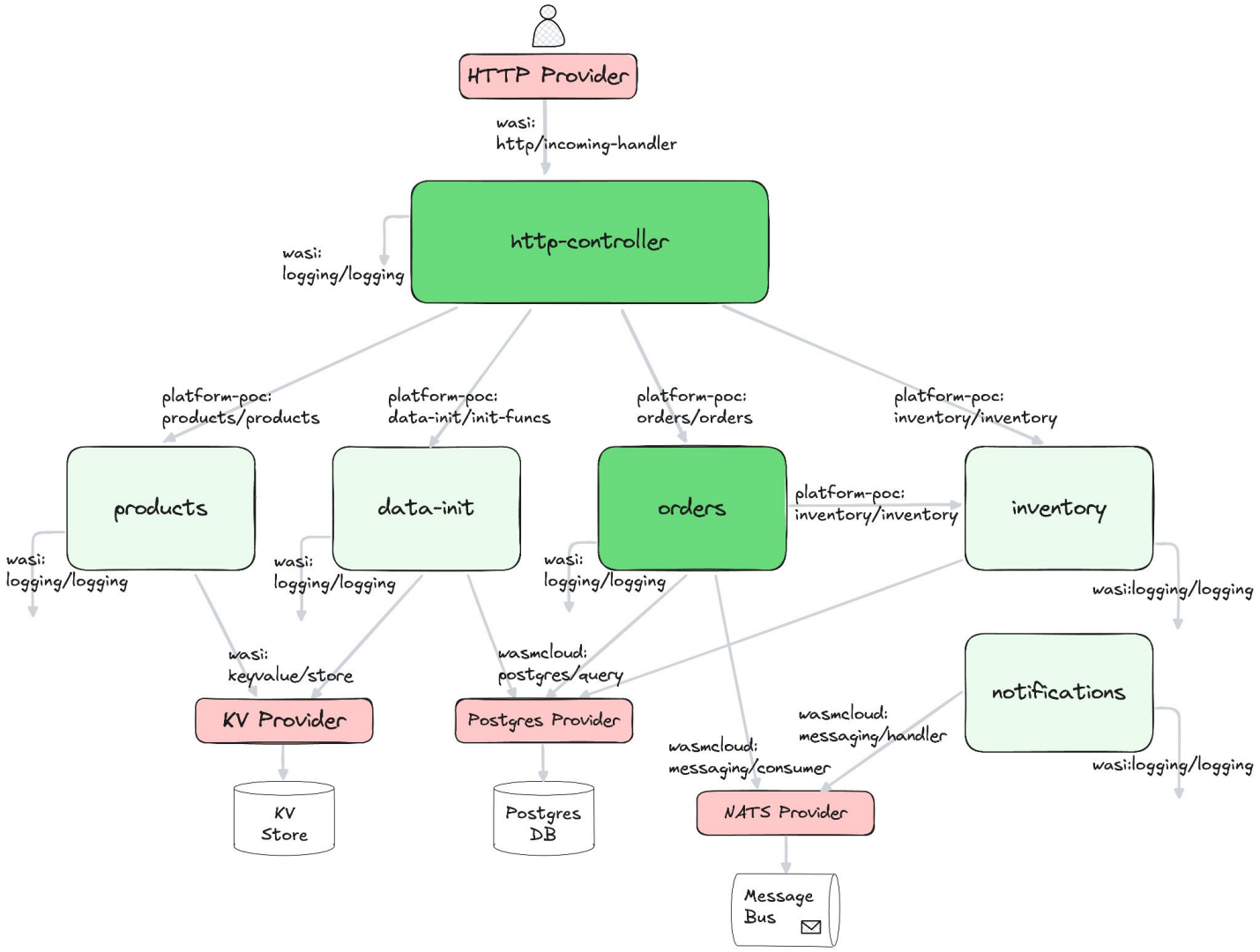
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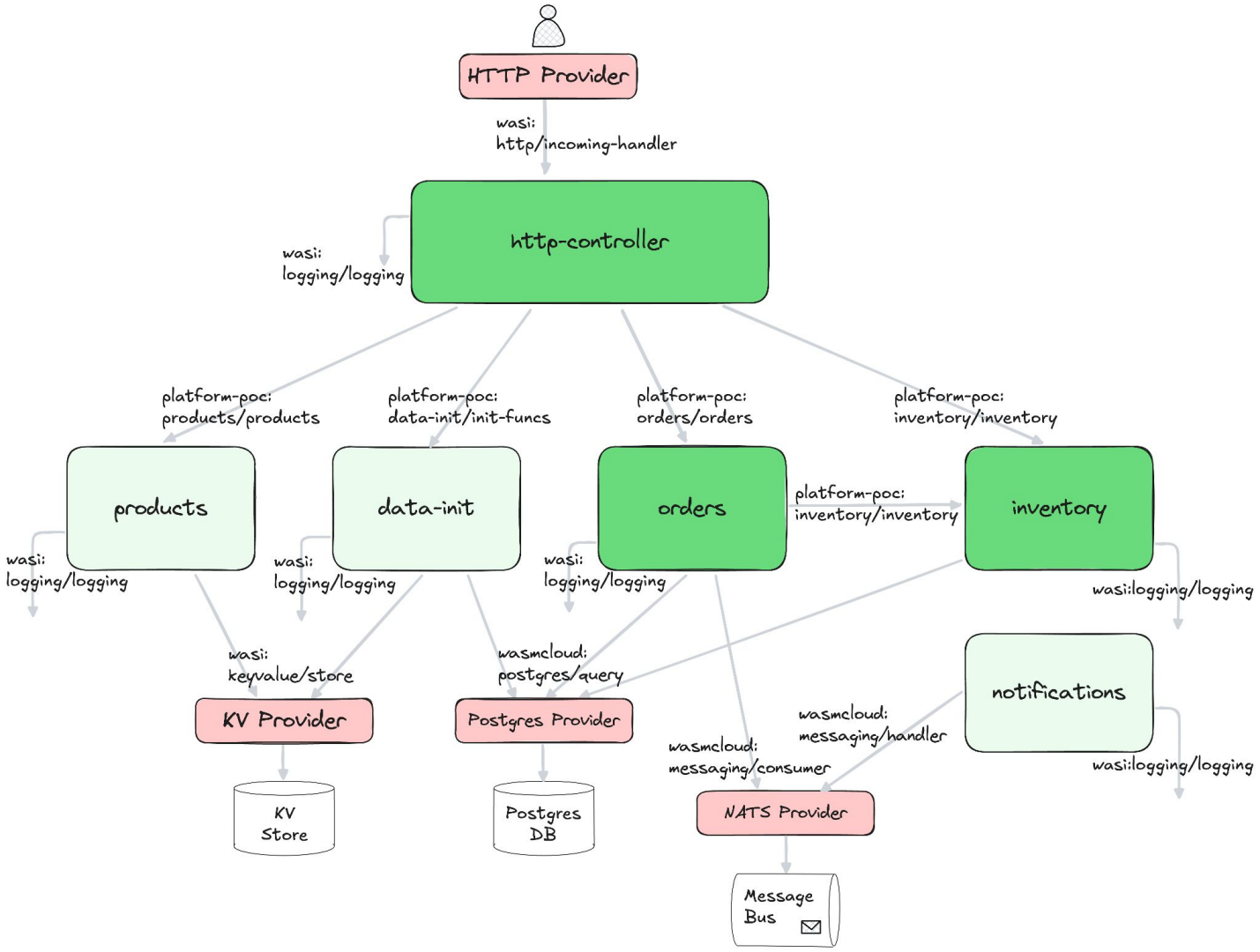
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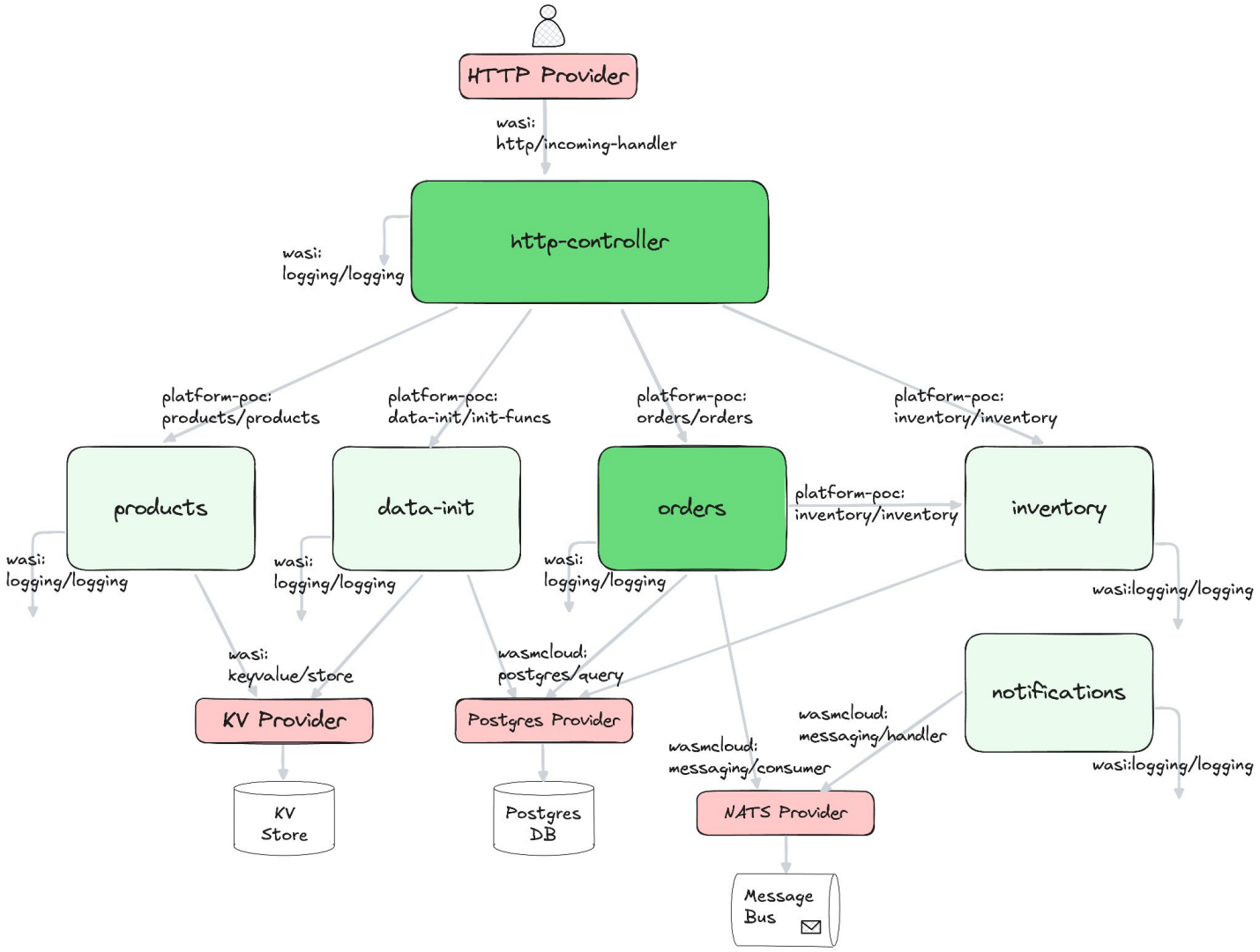
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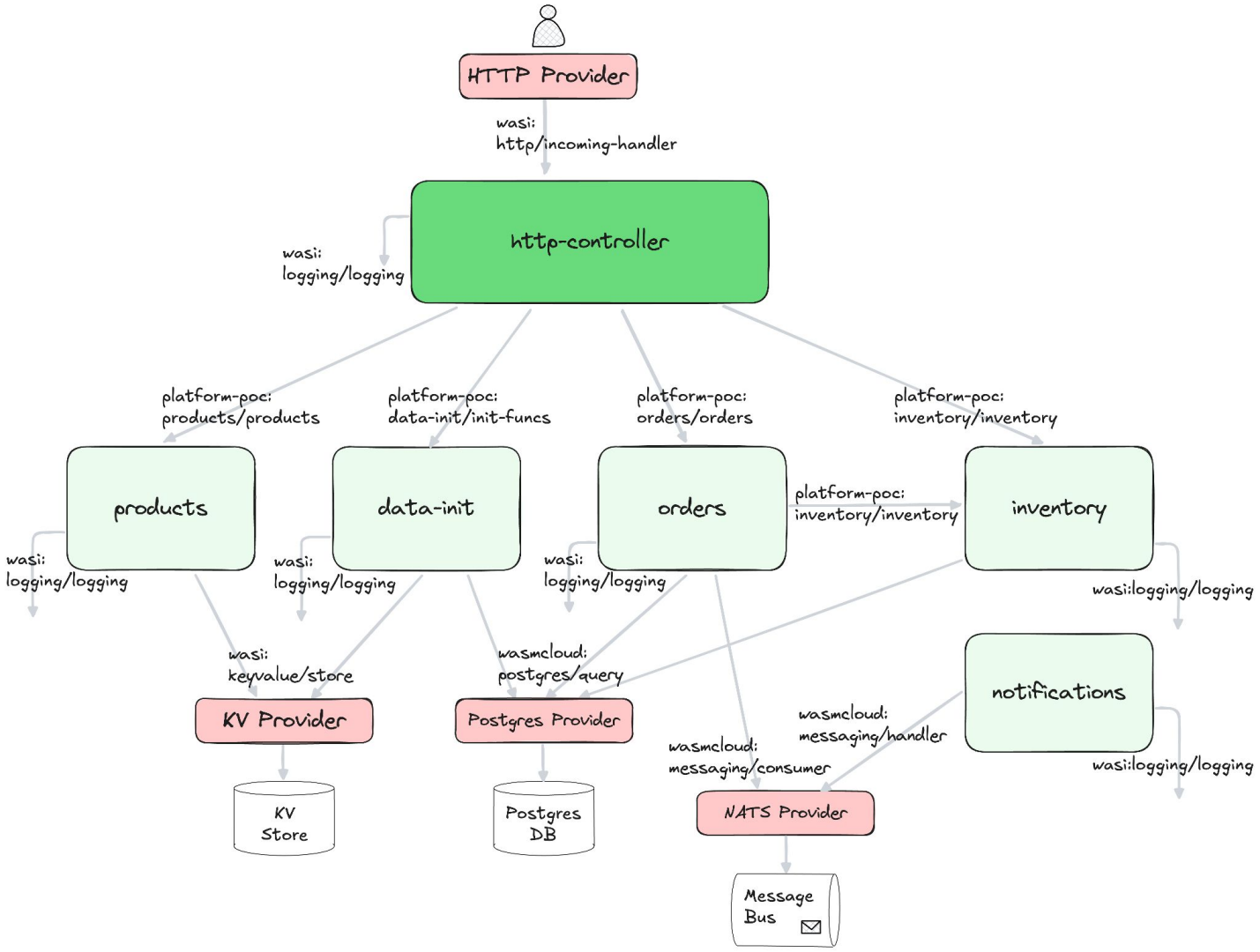
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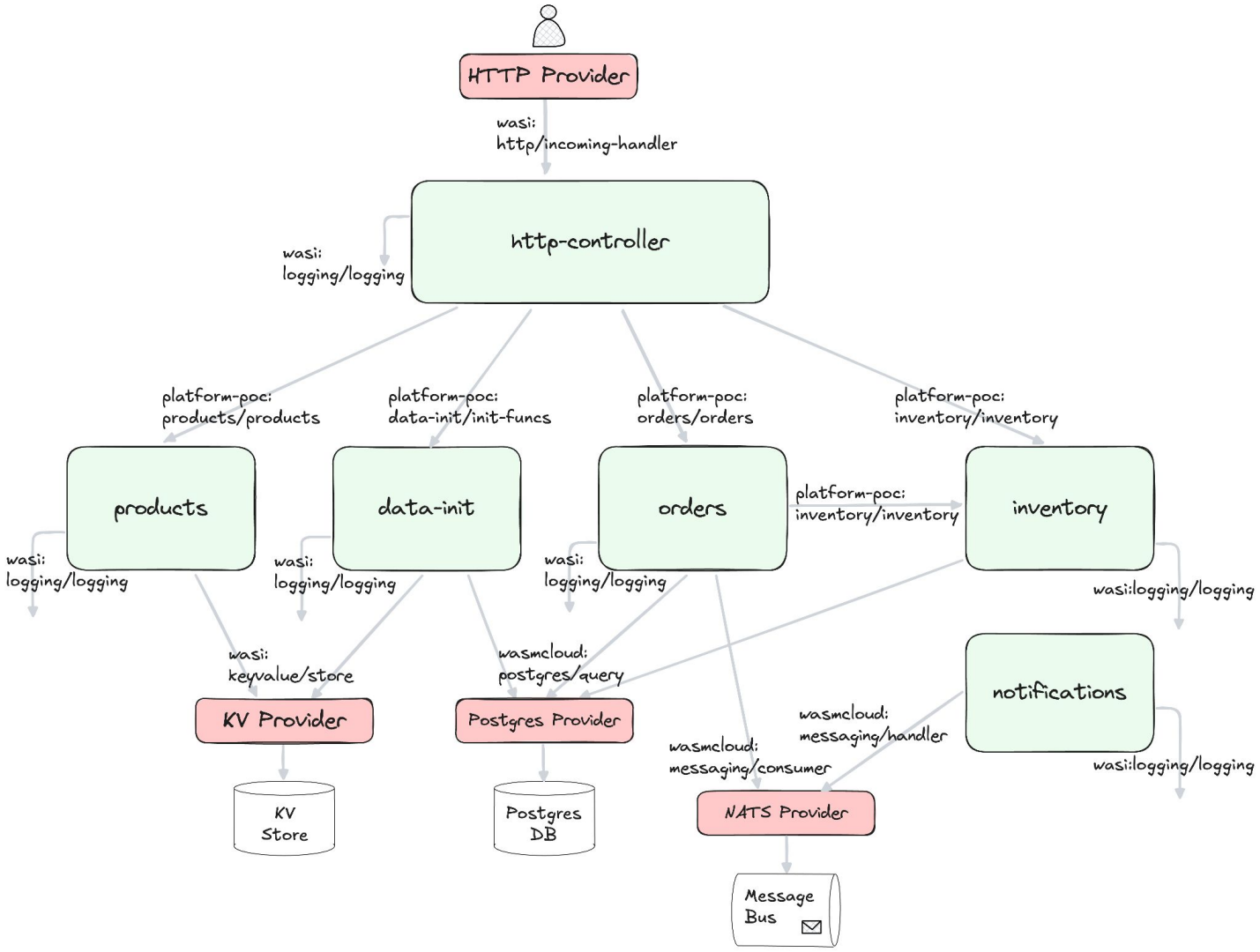
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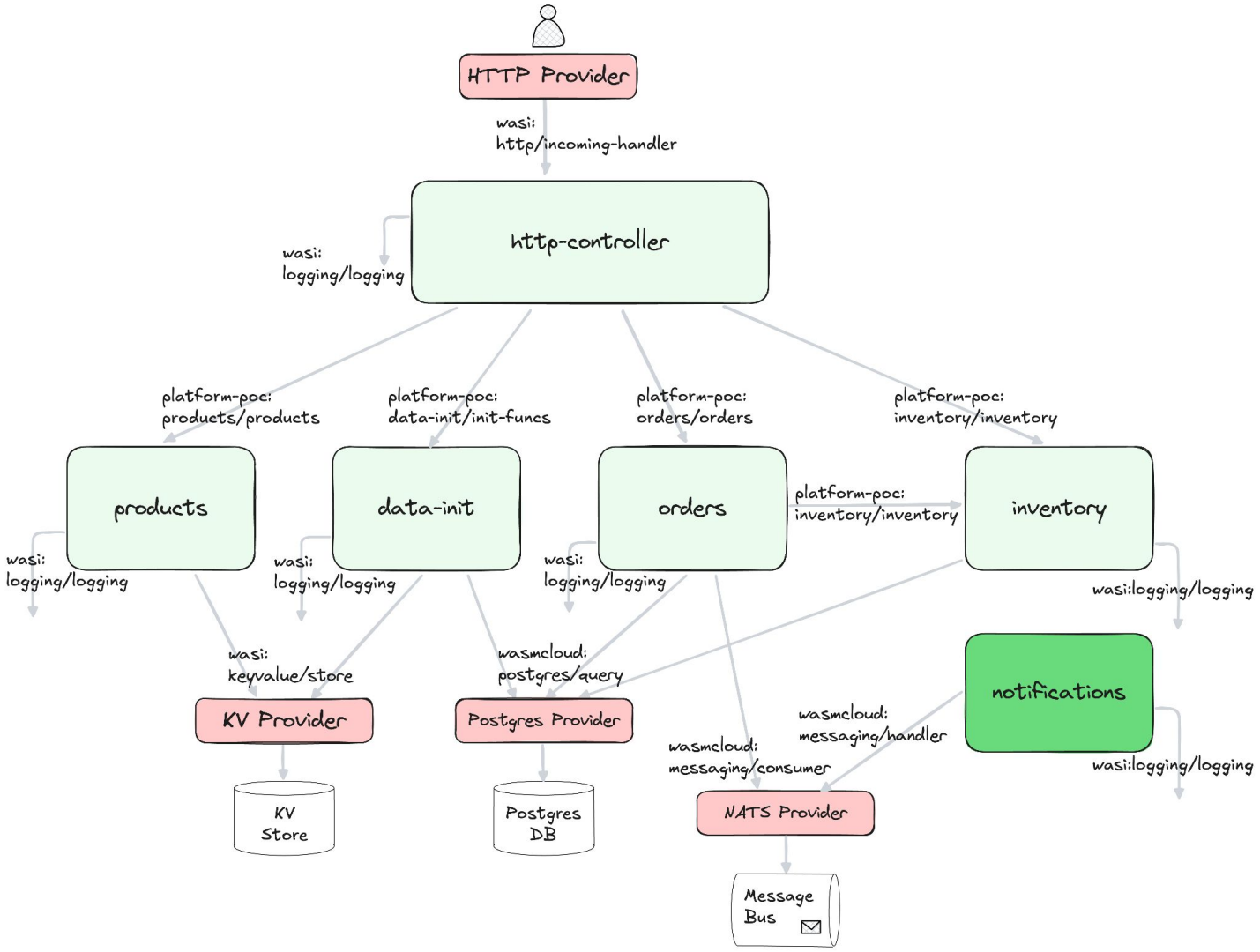
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Placing 10K orders

```
→ oha 'http://localhost:8080/orders' \
          -m POST \
          -d '[{"sku": "ENG-V8-500", "price": 1000, "quantity": 1}]' \
          -c 20 \
          -n 10000
Summary:
  Success rate: 100.00%
  Total:        4.3168 secs
  Slowest:      0.0484 secs
  Fastest:      0.0037 secs
  Average:      0.0086 secs
  Requests/sec: 2316.5356
```

Wasm binaries are small

About 1000 times smaller than their equivalent Java Spring Boot container image.

```
 92k data_init_s.wasm
543k http_controller_s.wasm
 70k inventory_service_s.wasm
 89k notification_service_s.wasm
105k orders_service_s.wasm
100k products_service_s.wasm
```

Fermyon.com on Spin

“A fresh page load of Fermyon.com may result in starting, executing, and shutting down 30+ concurrent WebAssembly processes. Yet the result is a page that loads so fast that it scores a 99% on Google’s page speed ranking.”

“Not long ago, we had a very busy day. Our traffic jumped to ten times its normal number of page requests. At a few moments, we were seeing over 2,500 requests coming in at a time (90 concurrent users each fetching around 30 resources). In our model, we run three workers, each on a small-sized VM with 3 CPUs and 300Mb of memory per worker.”

Rust

Safety *and* **speed**.

Increased productivity, really.

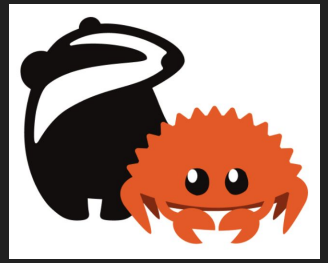
Shift left on quality.

Rust loves WebAssembly:

```
→ cargo build --target wasm32-wasip1
```

Build WebAssembly components on nightly:

```
→ cargo +nightly build --target wasm32-wasip2
```



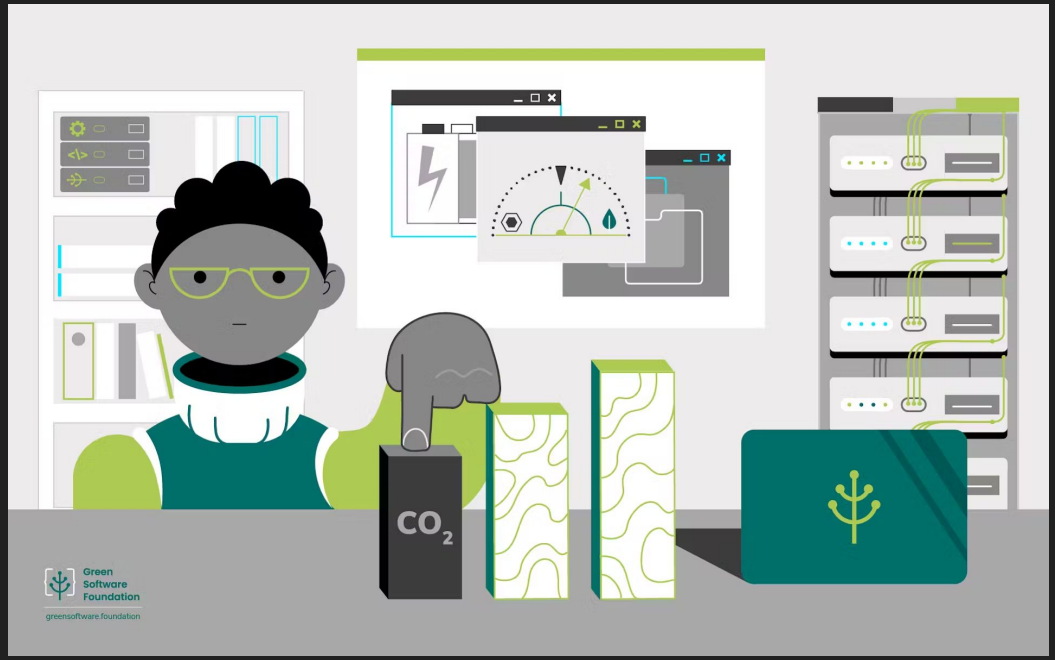
Roadmap

- ➔ Production ready — build greenfield scale-to-zero applications today
- ➔ Create a hybrid Kubernetes cluster using
  - ◆ wasmCloud Operator
  - ◆ SpinKube
- ➔ Gradually migrate, service by service, to new architecture
  - ◆ Remove all side effects, leaving just business logic

Let a decade of containers give way to a decade of WebAssembly components!

Let’s build eco-friendly enterprise applications

- ➔ The Green Software Foundation ref
- ➔ The Principles of Sustainable Software Engineering ref



Thank you! 🙏

slides

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stuart.harris@red-badger.com

https://github.com/redbadger/platform-poc

RED BADGER