Cloud-Edge platforms made easy

"The middleware you always needed"

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September

2023

Free

Cloud-Edge systems are not easy to build.

Journalists, consultants, researchers 😜, cloud providers, others will tell you Industry 4.0 is easy (and coming).
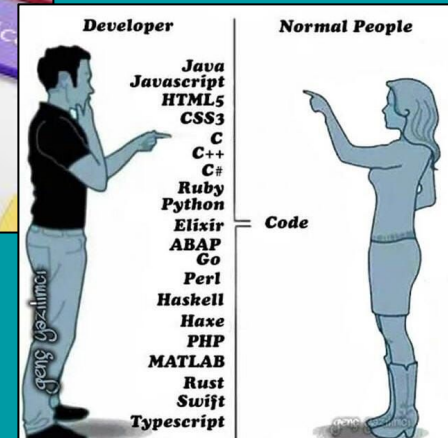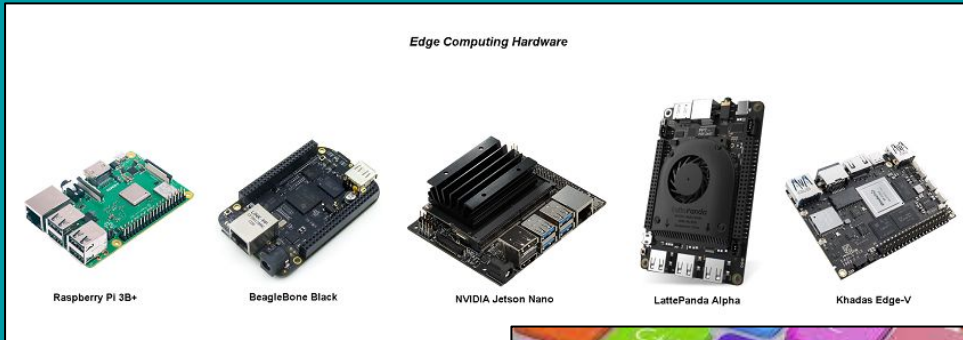
What's the problem?

(It's not you, it's me)

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Big mess, sorry heterogeneity…

Edge Computing Hardware

Raspberry Pi 3B+ — BeagleBone Black — NVIDIA Jetson Nano — LattePanda Alpha — Khadas Edge-V

https://www.dublinlive.ie/news/dublin-news/heartbreak-dublin-institution-close-doors-26800431 (Apr 2023) 106 years

Give me all the (other) bad stuff up front, please.

"Gärna"

The operator, chained networked ownership, latency, 4-5-(6)G,Wifi, 1-10GBe, TSN, CPS systems, ownership, code security, on-off-prem, power loss, polling, control, compiling code, legal issues, maintenance …

Another eye test

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Hang on.. you haven't mentioned the problem yet...

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The Blurb.

If, one can sort out the edge hardware, decide on a coding language, (find) the code, hire programmers, we still have a problem.
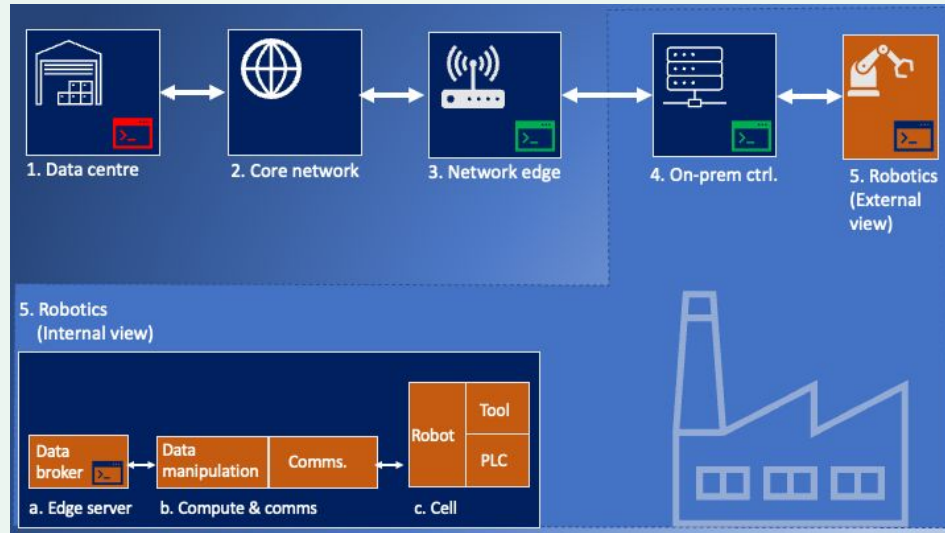
Where should the code run? Who takes ownership, updates, fixes and the whole shebang*, or DevOps cycles.

Not a trivial problem.

*Everything

A Cyber-Physical System.

(in Germany)

So,

(get on with it, without using *all* the RISE Powerpoint template slides)

RISE

Cloud-Edge platforms made *easier*

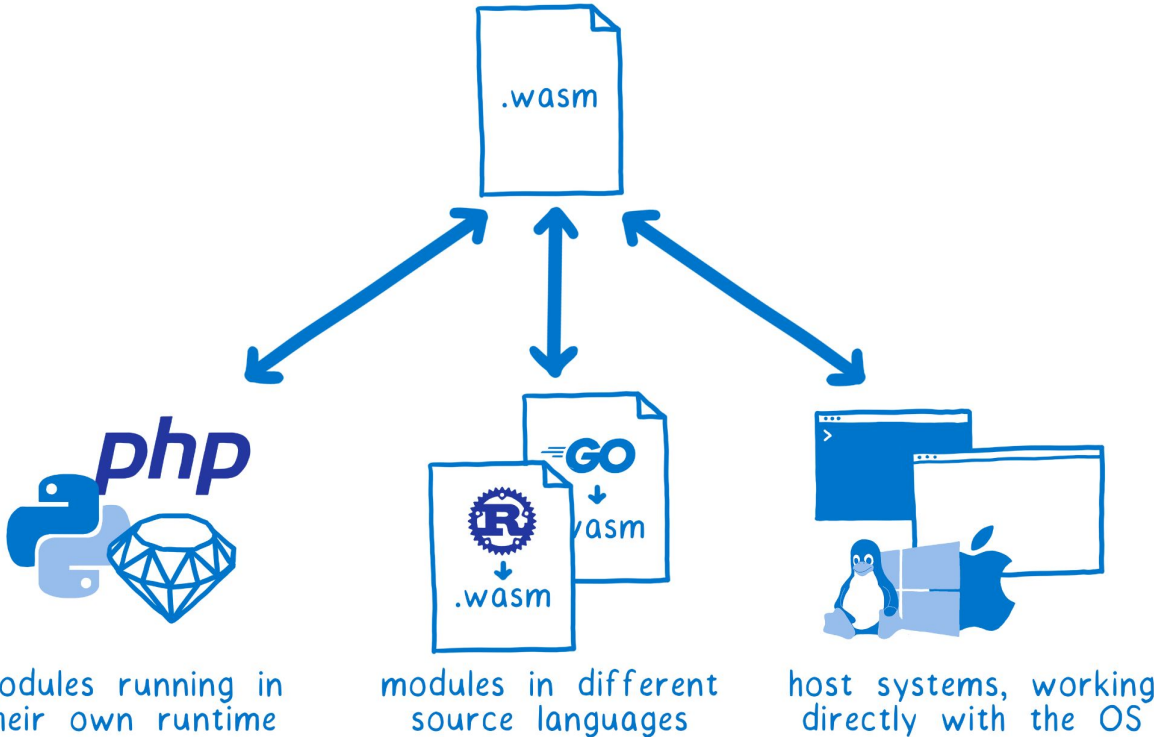## "The middleware RISE will show you"

Dodgy Researcher

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September

2023

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WebAssembly Interface Types
Interoperate with ALL THE THINGS!

Link

.wasm

php

GO
↓
R
↓
.wasm

modules running in their own runtime

modules in different source languages

host systems, working directly with the OS

"Write Once, Run everywhere"

Javascript "machine code"

Compiler support (AoT, JiT)

Open W3C standard

Safe, Sandboxed

Multi lang, multi hw

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"If WASM + WASI existed in 2008, we wouldn't have needed to create Docker. That's how important it is. WebAssembly on the server is the future of computing"

Solomon Hykes, co-founder of Docker, link

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Insights, please

Cyber Pysical Requirements

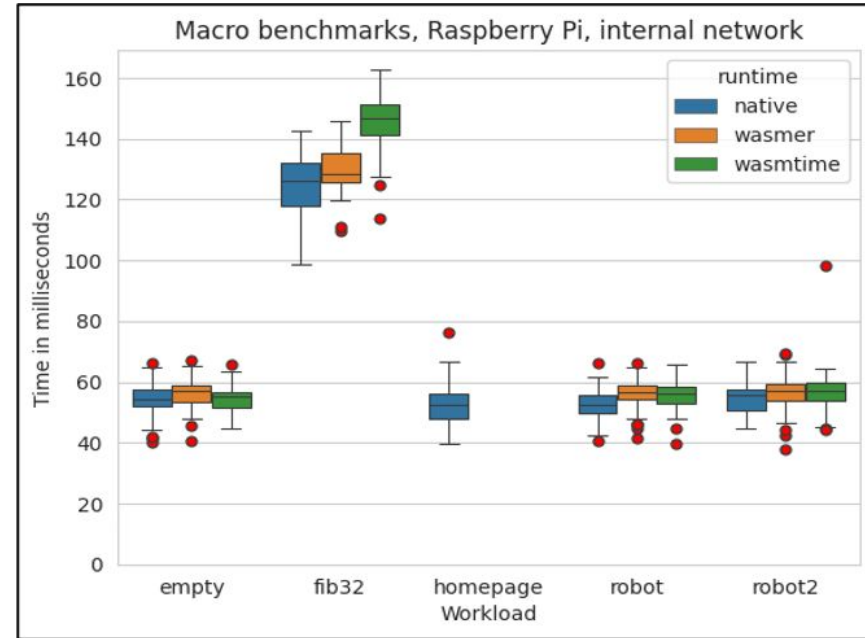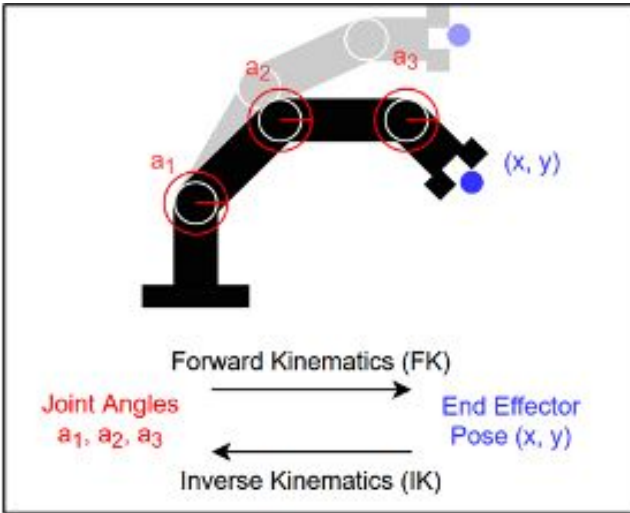| Sector	Latency	Source	Source / Notes
Industrial applications	5-500ms	Industrial consortium [4]	Industry 4.0 book.
Industrial Robotics[1]	50ms	HAL Robotics Ltd. *Arc Welding*	Interposition time along a robot's toolpath where new joint positions are calculated.
Industrial Robotics[2]	100ms	HAL Robotics Ltd. Electrical *signal polling.*	Frequency polled for an action i.e. to grab a part, move when a laser beam is broken etc.
6G	<1ms	Ericsson report [3]	"6G–connecting a cyber-physical world."
5G-Edge	1-10ms	ANIARA EU proposal [5]	Use case dependent: robotics, automotive.
5G	<10ms	3GPP Rel. 16/17	Quoted as 1ms, practically, 10's ms, see MONROE [6].
4G	<50ms	3GPP Rel. 8	OFDM, all IP, compression.

So, did you get anywhere?
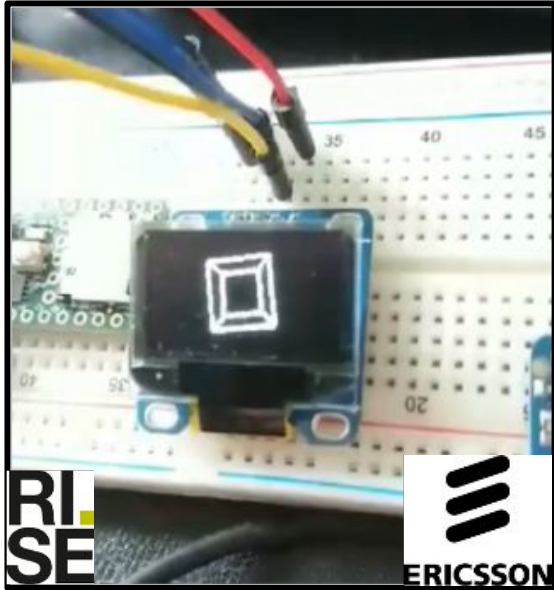
Yes: WebAssembly compared to native code!

Macro-benchmark: how does WASM compare to native binaries that are compiled for a particular platform in an end-to-end setting.

We implemented 2 software robots to generate workloads (robot and robot2). Run on a Raspberry Pi4.

Forward Kinematics (FK)

Joint Angles
a_1, a_2, a_3

End Effector
Pose (x, y)

Inverse Kinematics (IK)

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Demos

WASM-based lightweight runtime

With Pontus Sköldström.

WASM-controlled Arduino robot runtime

With Remo Scolati

PDFs

The responsiveness and deployment of WebAssembly runtimes in Cyber-Physical Systems

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The placement and responsiveness of WebAssembly runtimes in Cyber-Physical systems

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Evolving 5G: ANIARA, an Edge-Cloud perspective

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KTH ROYAL INSTITUTE OF TECHNOLOGY

Degree Project in Computer Science and Engineering
Second cycle, 30 credits

Measuring the responsiveness of WebAssembly in edge network applications
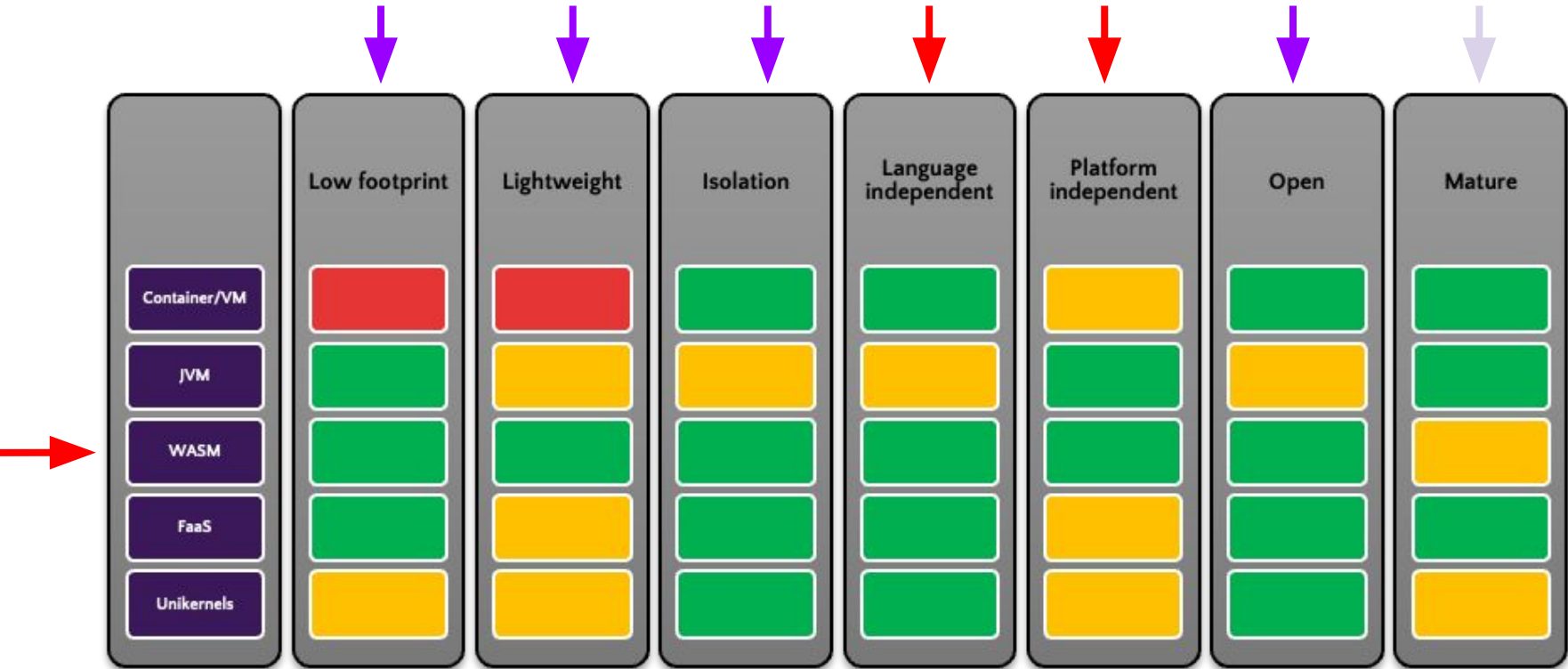
REMO SCOLATI

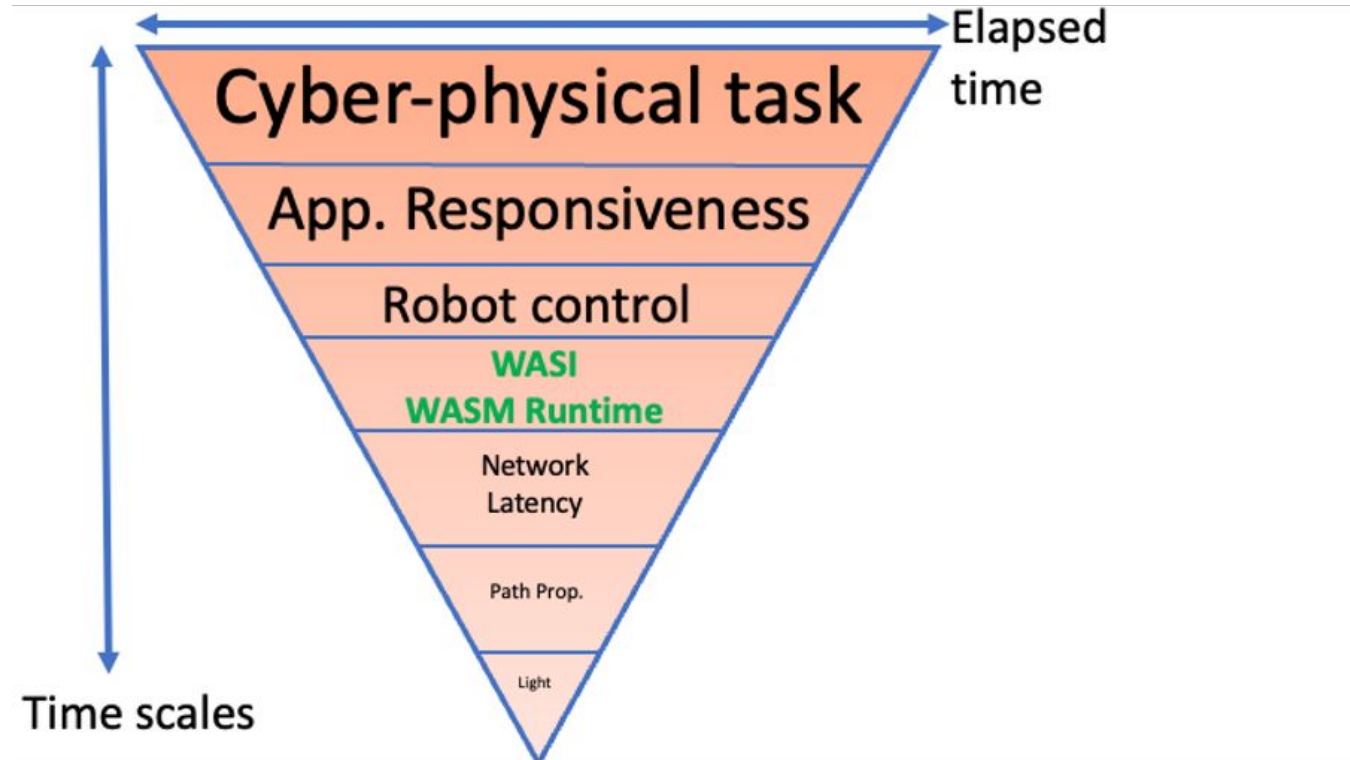Stockholm, Sweden, 2023

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Q & A.

Comparison: environment(s) + execution

	Low footprint	Lightweight	Isolation	Language independent	Platform independent	Open	Mature
Container/VM	🔴	🔴	🟢	🟢	🟡	🟢	🟢
JVM	🟢	🟡	🟡	🟡	🟢	🟡	🟢
WASM	🟢	🟢	🟢	🟢	🟢	🟢	🟡
FaaS	🟢	🟡	🟢	🟢	🟡	🟢	🟢
Unikernels	🟡	🟡	🟢	🟢	🟡	🟢	🟡

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Insight: Responsivness

Is WebAssembly all greatness and light?

- Confusing choice of runtimes (at least 30)
- WASM runs in a sandbox, operating system and network calls have to go through an API (called WASI)
- Windows 'system' slightly different (Blazor)
- Ahead of time (AoT) and Just In Time (JiT) compilation options have tradeoffs

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