Cloud Native 2023

Chris Aniszczyk (@cra)

CTO and Co-Founder, CNCF

https://cncf.io

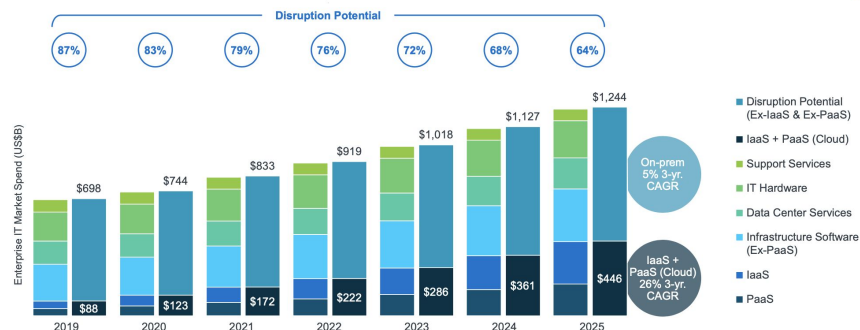**CLOUD NATIVE**
COMPUTING FOUNDATION

Cloud Native 2022… Open Source + Pandemic Growth!

- **Market shift in innovation — from legacy IT vendors to cloud providers and open source communities.**

- **Public cloud spend is only ~10% of the total $4T IT spend across the globe** and it varies across regions [Battery Ventures]

- "By 2025, nearly two-thirds of enterprises will be prolific software producers with code deployed daily, **over 90% of new apps cloud native**, **80% of code externally sourced, and 1.6 times more developers**" (see IDC FutureScape)

- *Pandemic helped accelerate cloud native… but we are still early days globally!*

We're in the early innings of cloud adoption

Disruption Potential

| 87% | 83% | 79% | 76% | 72% | 68% | 64% |

Legend:
- Disruption Potential (Ex-IaaS & Ex-PaaS)
- IaaS + PaaS (Cloud)
- Support Services
- IT Hardware
- Data Center Services
- Infrastructure Software (Ex-PaaS)
- IaaS
- PaaS

On-prem 5% 3-yr. CAGR
IaaS + PaaS (Cloud) 26% 3-yr. CAGR

Global maturity varies widely

In 2021, end users spent $396 billion on public cloud services

10%

Public cloud spend is only ~10% of total IT spend ($4T) across the globe

	North America	Europe	LATAM	APAC	MENA
% of Global GDP	27	27	6	36	4
% of Global Public Cloud Spending	55	26	2.6	15	1.2
% of IT spending on cloud	15	10	7.5	4.7	2.8

Cloud Native Today: CNCF (*7 year anniversary*)

The Cloud Native Computing Foundation (CNCF) is a non profit open source software foundation **dedicated to making cloud native computing ubiquitous and sustainable**!

CLOUD NATIVE COMPUTING FOUNDATION hosts **157 projects**

with over **180,000+ contributors**

representing **187 countries**

landscape.cncf.io

CNCF is *End User driven open source* with 800+ members!

Cloud Native 2022: Project Growth + Maturity

- **Accepted 35 [projects](#) in 2022**
- **New Major INCUBATING Projects:**
  - Knative
  - Istio
- **New GRADUATED Projects**
  - Argo
  - Flux
  - SPIFFE/SPIRE
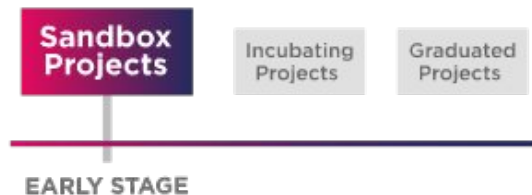
Projects accepted over time
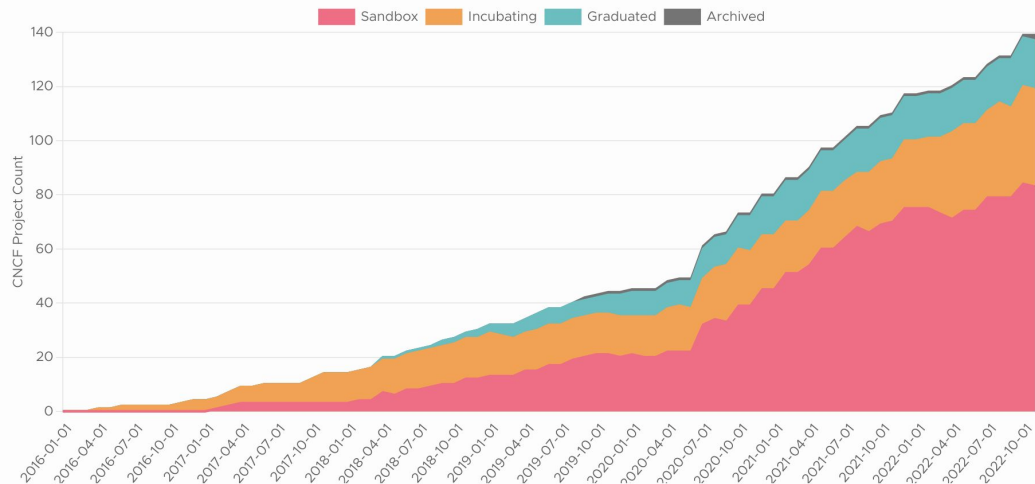
Cloud Native Project Velocity

- Kubernetes continues to mature and have the **largest contributor base**

- OpenTelemetry continues to grow its contributor base and has become the second highest velocity project in the CNCF ecosystem

- **Backstage a year ago barely made this list and continues to accelerate,** solving an important pain point around cloud native developer experience

- GitOps continues to be an important technique in the cloud native ecosystem where projects like Argo and Flux continue to cultivate large communities

CNCF Projects 1/1/2022 - 1/1/2023
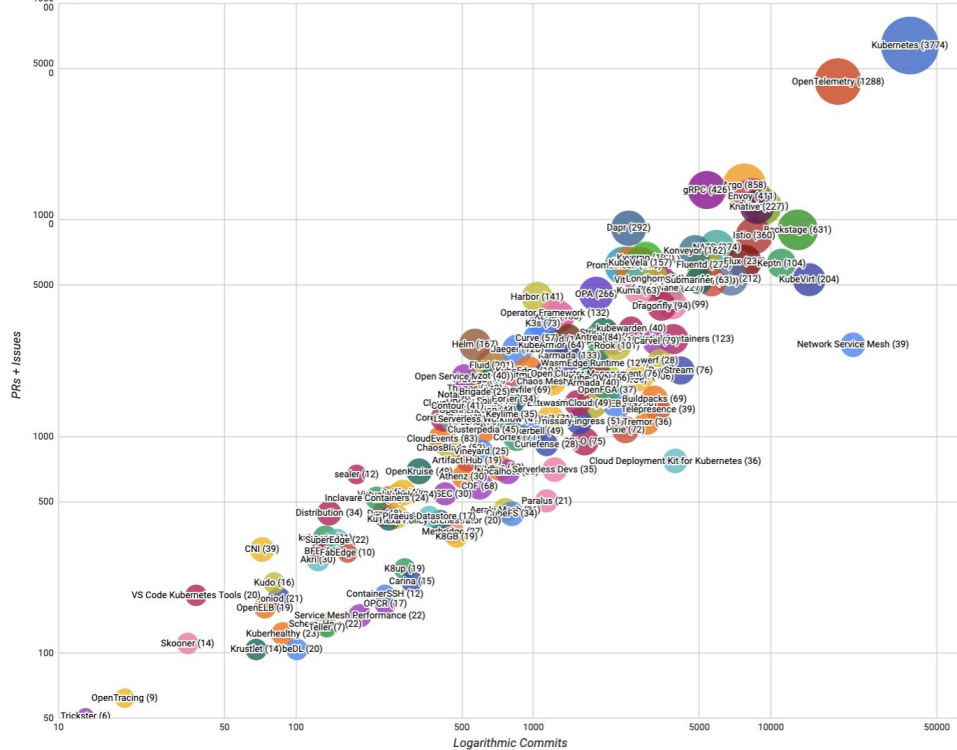
CNCF: Improving Open Source Security (2022)

- **CNCF has funded $1M+ in security audits and fuzzing work**

50
High or Medium Severity
Findings Fixed

196
Total Security
Improvements Made

73
Tools built or improved
to continually monitor projects
for security issues

ArtifactHub.io: Cloud Native Artifacts Everywhere!

- ~500K package views a month

- 10K+ packages available

- Supports multiple artifact types (helm, etc)
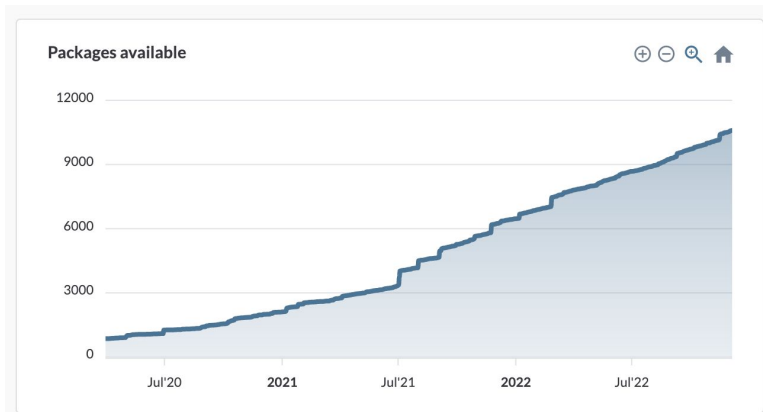
Artifact Hub is a web-based application that enables finding, installing, and publishing packages and configurations for CNCF projects. For example, this could include Helm charts and plugins, Falco configurations, Open Policy Agent (OPA) and Gatekeeper policies, OLM operators, Tinkerbell actions, kubectl plugins, Tekton tasks and pipelines, KEDA scalers, CoreDNS plugins, Keptn integrations, container images, and Kubewarden policies.

Helm charts and plugins   Falco rules   OPA and Gatekeeper policies   OLM operators   Tinkerbell actions   Kubectl plugins

Tekton tasks and pipelines   KEDA scalers   CoreDNS plugins   Keptn integrations   Container images   Kubewarden policies

Packages available

GLOBAL Cloud Native Glossary (glossary.cncf.io)

| © 2020 Cloud Native Computing Foundation

History of Cloud Native... CNCF was born in 2015!

Over the years, we have evolved from a close single vendor stack to a multi vendor open source set of technologies.

Non-Virtualized Hardware	Virtualization	IaaS	PaaS	Open Source IaaS	Open Source PaaS	Containers	Cloud Native
2000	2001	2006	2009	2010	2011	2013	2015
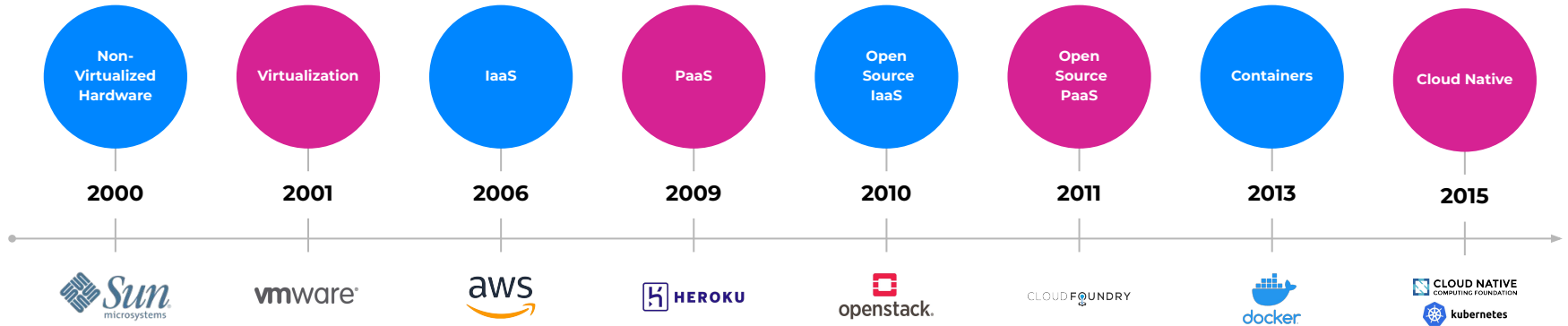
WebAssembly is Born (2017)

- [WebAssembly](#) (Wasm) was born in the browser to enable a secure sandbox
  - Security sandbox
  - Fast startup times, near-native speed

- WebAssembly v1.0 was released in 2017… and became an official W3C standard in 2019!

- CNCF projects like Envoy start experimenting with Wasm to replace its Lua filters with Wasm filters:
  - https://www.envoyproxy.io/docs/envoy/latest/configuration/http/http_filters/wasm_filter

Web Assembly (Wasm)

2017

WA
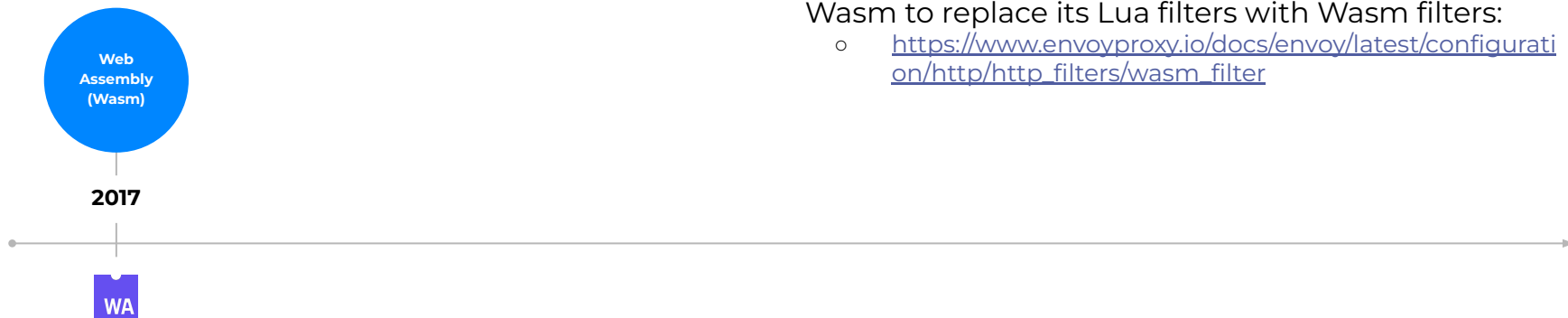
Open Serverless with Knative + MicroVMs (2018)

- [Knative](#) is open sourced to build open source enterprise level serverless and event driven applications
- Firecracker is [open sourced by AWS](#) as a way for lightweight virtualization (VMM) for serverless applications
- Serverless technology starts to **move from closed single vendor options to open source multi vendor** options

Web Assembly (Wasm)

Open Serverless: Knative MicroVMs

2017

2018

WA
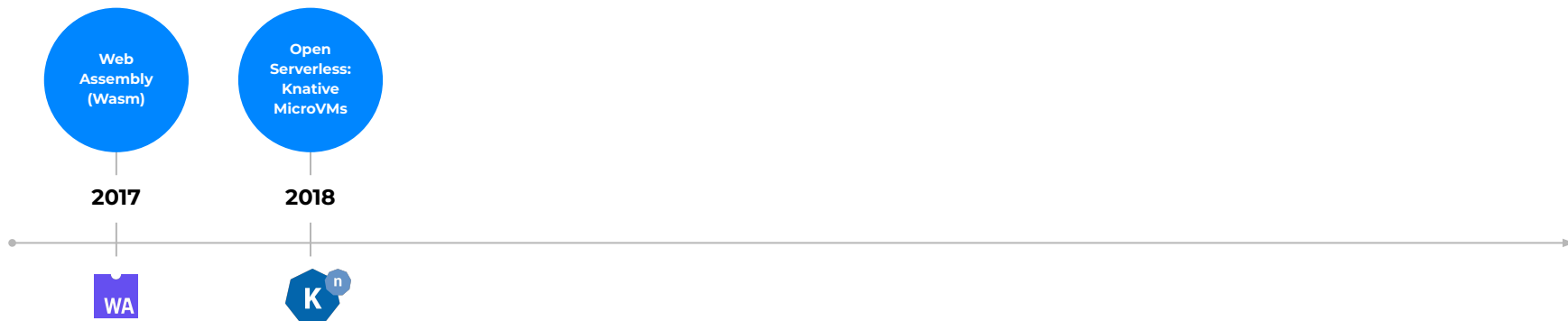
Lightweight Kubernetes starting with k3s (2019)

K3S

- Kubernetes starts to evolve with lightweight distributions like k3s and k0s that aim to simplify kubernetes for lightweight deployments.

- These distributions remove certain features and replace componetery like etcd for sqlite… but remain conformant!

- Enterprise Restaurant Compute: Chick-fil-a

- Kubernetes clusters in space!

Web Assembly (Wasm)

Open Serverless: Knative MicroVMs

k3s

2017

2018

2019

WA

K

n

K3S

eBPF Maturity + Tooling Explosion (2021)

- eBPF is a revolutionary technology with origins in the Linux kernel that can run sandboxed programs in a privileged context such as the operating system kernel. It is used to safely and **efficiently extend the capabilities of the kernel without requiring to change kernel source code or load kernel modules**
- eBPF Foundation: https://ebpf.foundation

Web Assembly (Wasm)	Open Serverless: Knative MicroVMs	k3s	eBPF Maturity
2017	2018	2019	2021

```
int syscall__ret_execve(struct pt_regs *ctx)
{
        struct comm_event event = {
                .pid = bpf_get_current_pid_tgid() >> 32,
                .type = TYPE_RETURN,
        };

        bpf_get_current_comm(&event.comm, sizeof(event.comm));
        comm_events.perf_submit(ctx, &event, sizeof(event));

        return 0;
}
```
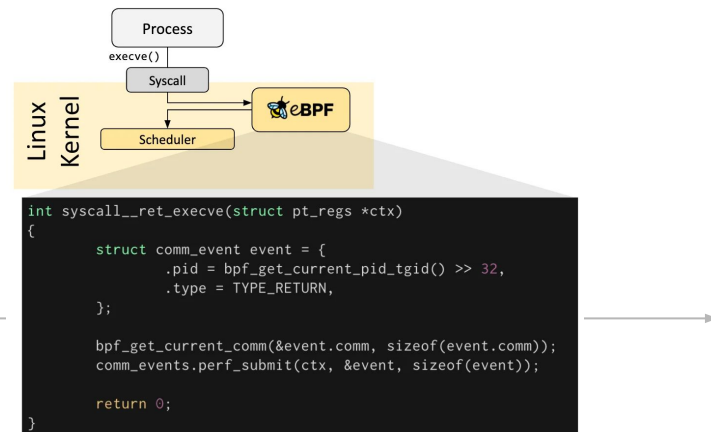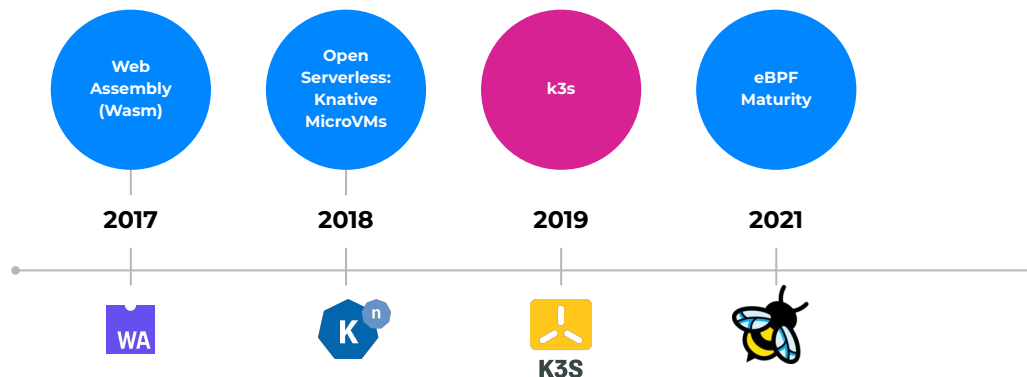
WASI Maturity + Wasmtime v1.0 (2022)

- WASI.dev matures + wastime v1 ships!
  - k8s + Wasm: https://github.com/containerd/runwasi

- Wasm enables cross lang/platform/arch, also:
  - Small binary sizes + secure sandbox!
  - Fast startup times, near-native speed

Web Assembly (Wasm)	Open Serverless: Knative MicroVMs	k3s	eBPF Maturity	WASI + Wasm Maturity
2017	**2018**	**2019**	**2021**	**2022**

Solomon Hykes / @shykes@hachyderm.io
@solomonstre · Follow

If WASM+WASI existed in 2008, we wouldn't have needed to created Docker. That's how important it is. Webassembly on the server is the future of computing. A standardized system interface was the missing link. Let's hope WASI is up to the task!

Lin Clark ✔ @linclark

WebAssembly running outside the web has a huge future. And that future gets one giant leap closer today with...

📢 Announcing WASI: A system interface for running WebAssembly outside the web (and inside it too)

hacks.mozilla.org/2019/03/standa...

3:39 PM · Mar 27, 2019

Read the full conversation on Twitter

♥ 2.2K   Reply   Copy link

Read 32 replies

Note: Web Assembly Growth

of 'Wasm' Events on Github
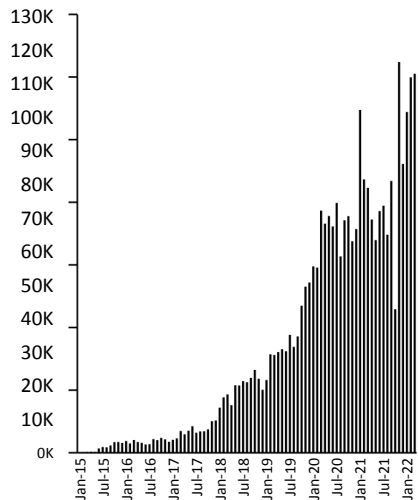
of 'Wasm' Posts
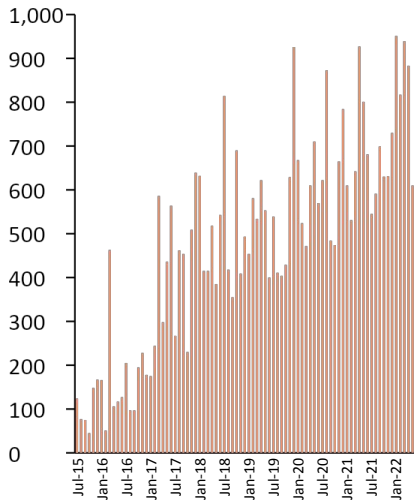
of 'Wasm' Questions
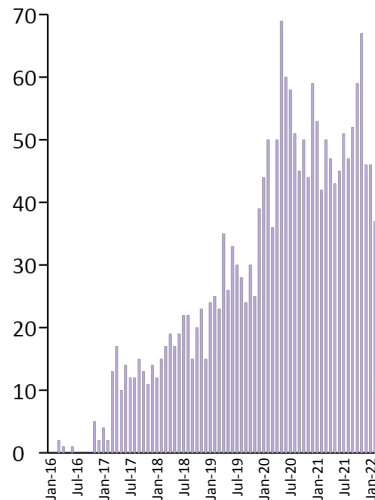
WebAssembly Search Trend (%)
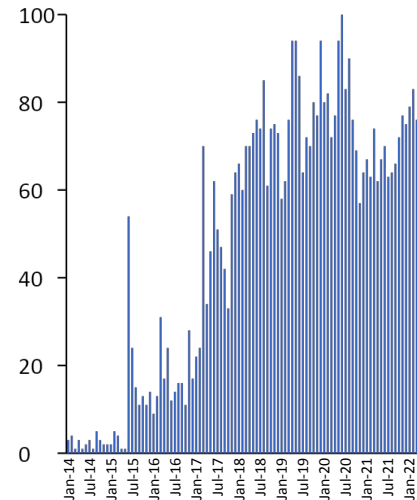
What's Next? OpenCost... GitOps... OpenTelemetry? (2023)
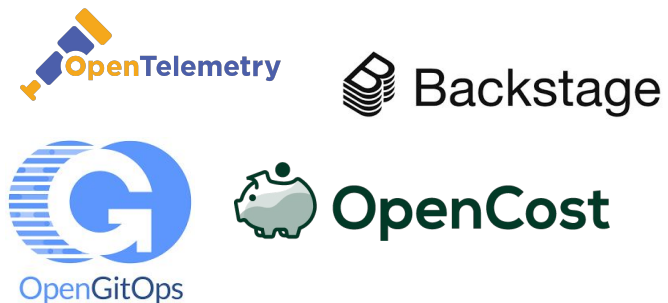
- **_MOST Innovation is happening up the stack!_**

    - OpenCost: open spec/tools for FinOps/CFM

    - GitOps (Argo/Flux): https://opengitops.dev

    - OpenTelemetry: Telemetry standards

    - Backstage: Open Source IdPs...

- Innovation at the bottom of the stack with wasm, containerd sandbox technology

2017	2018	2019	2021	2022	2023
Web Assembly (Wasm)	Open Serverless: Knative MicroVMs	k3s	eBPF Maturity	WASI + Wasm Maturity	?
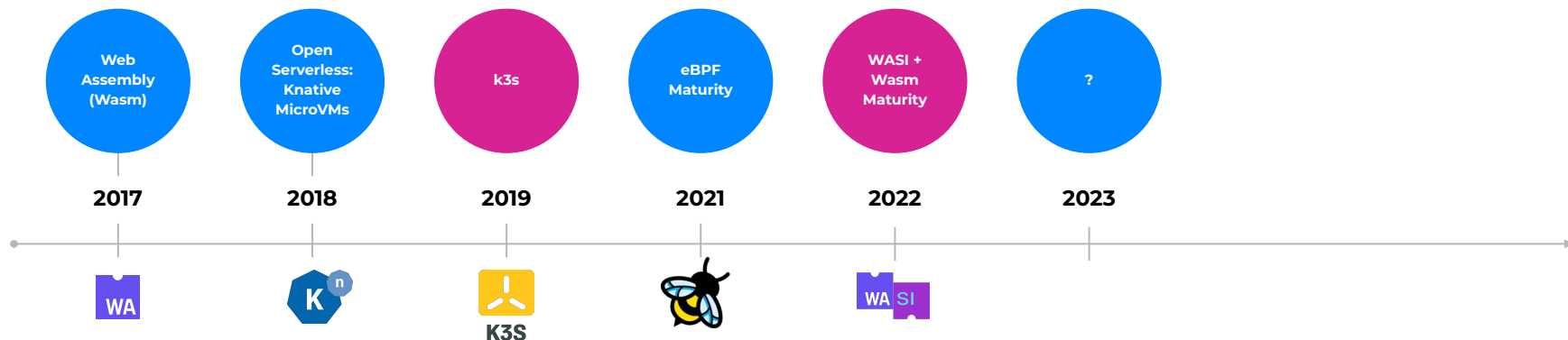
Cloud Native Future Trends

Kubernetes is Boring/Stable BUT Future is Exciting!

- Support for User Namespaces: supporting user namespaces in Kubernetes is to be able to run processes in pods with a different user and group IDs than in the host
- Sidecar containers: a way to actually designate a container as a sidecar so that it runs during the init phase and won't block pod lifecycle
- Better support for batch workloads:
  - Kueue, native "classic" batch style workload support
  - Jobs have had some improvements in the past year or so with adding indexes, etc but now additional features are being added like elastic index jobs which means jobs can be tied to autoscalers
- More advanced scheduling logic hooks for groups that want to build / integrate their own scheduler
- In place modification of pod resources - Essentially, let you modify a pods resources without having to restart the pod. This is big for stateful workloads like databases or game servers
- registry.k8s.io multi cloud migration!
- *Maybe 2 releases a year instead of 3 :)*

FinOps + Cloud Native + Kubernetes

- Cloud Financial Management (CFM) is a growing issue and concern
  - https://www.wsj.com/articles/cloud-bills-will-get-loftier-1518363001
  - Linux Foundation recently launched **FinOps Foundation**: finops.org

- Lack of open source innovation and education around CFM
  - Chargeback and cost modeling isn't a solved problem in Kubernetes
  - OpenCost.io is a CNCF sandbox project that is aiming to help with standards
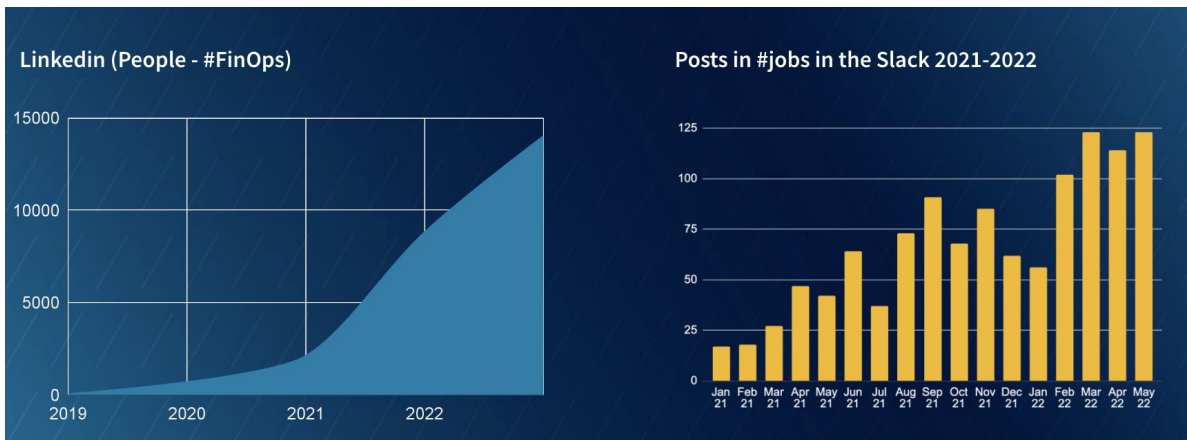
Third Wave of Computing: Web Assembly?

- Web Assembly is a growing but early days deployment target for cloud and edge computing
- https://sapphireventures.com/blog/whats-up-with-webassembly-computes-next-paradigm-shift
- https://www.docker.com/blog/docker-wasm-technical-preview/
- https://www.infoworld.com/article/3681853/azure-kubernetes-doubles-down-on-webassembly.html
- CNCF hosts WasmCloud, WasmEdge etc and planning to do more work!

PC
Apps | Apps | Apps
Libs
Libaries
Operating System
Computer

VM
Apps | Apps | Apps
Libs | Libs | Libs
OS | OS | OS
Hypervisor OS (CPU)
Computer

CONTAINER
Apps | Apps | Apps
Libs | Libs | Libs
Kernel (Docker)
Hypervisor OS (CPU)
Computer

WASM
Apps | Apps | Apps
Libs | Libs | Libs
Host (WebAssembly)
Libs (Libraries)
OS
Device

ACTORS
Apps | Apps | Apps
Cap | Cap | Cap
Host (wasmCloud)
Libs (Libraries)
OS
Device

DECLARATIVE

TIGHTLY COUPLED

FORMAT:	PC	CLOUD	CONTAINER	WEBASSEMBLY	WASMCLOUD
EXECUTION:	Image - Datacenter	VM - Public Cloud	Container - Kubernetes	Wasm - Intergrated	Wasm - Distributed
Developer	Full	OS, App, Lib	App, Lib	Wasm	Business Logic
Abstraction	-	CPU	Linux Kernel	Secure Sandbox	Sandbox + Capabilities
Compatability	All	Most	Most	Most	Most
Size	Large	Med	Small	Tiny	Minuscule
Portability	-	Low	Med (CPU, Linux)	High	Highest
Security	System	OS	Process Boundary	Capability	Actor
Where		Proprietary Cloud & Edge	Dev, Edge, Cloud, K8s	Dev, App, Edge, Cloud, K8s, Browser, Devices	Dev, App, Edge, Cloud, K8s, Browser, Devices

LEGEND: Developer Provided | Device / Computer

Next Generation IDE Experience: Cloud [Native] IDEs

- IDEs have stagnated and with the rise of cloud native, new forms of development are happening!
  - https://github.com/features/codespaces/
  - https://www.gitpod.io/cde
  - https://www.eclipse.org/che/
  - https://aws.amazon.com/codecatalyst/ (Beta)
- Try it TODAY! https://gitpod.io/#https://github.com/prometheus/prometheus

THE #1 PROGRAMMER EXCUSE FOR LEGITIMATELY SLACKING OFF:

"MY CODE'S COMPILING."

HEY! GET BACK TO WORK!

COMPILING!

OH. CARRY ON.
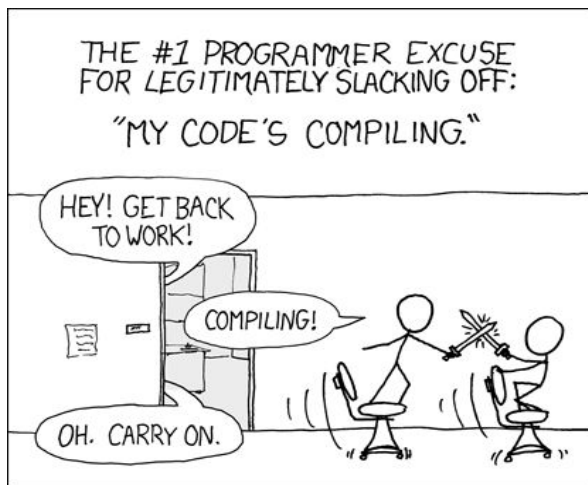
Principles of CDEs

Cloud Development Environments value the following principles:

01 Ephemeral over long lived
A fresh disposable development environment for every task.

05 Independent over tangled
Isolated and self-sufficient.

02 Reproducible over cobbled together
Consistently replicable without manual intervention.

06 Powerful over constrained
Supports the most expansive development activities.

03 Effortless over arduous
With minimal friction and difficulty.

07 Equitable over requiring specialized skills
Lowers the barrier to software development.

04 Abundant over scarce
Instantaneously obtainable, seemingly infinite.

08 Collaborative over solitary
Enables collaboration across time, space and practice.

Wrapping Up!

CONTRIBUTION is the Currency of Open Source!

- **CONTRIBUTION IS THE CURRENCY OF OPEN SOURCE! (Sweden is #13 across CNCF)**
- Harvard Study: "Data on firm contributions to open source software (OSS), an important crowdsourced public good, is used to test the theoretical predictions. Using matching and panel data methods to help address endogeneity concerns, **this study shows that contributing firms capture up to 100% more productive value from usage of OSS than their free-riding peers**"

All CNCF Committers countries stats (All)

	min	max	avg ∨	current
United States	4.21 K	5.82 K	5.11 K	5.82 K
Germany	928	1.40 K	1.18 K	1.40 K
China	766	1.38 K	1.08 K	1.38 K
India	613	1.27 K	942	1.27 K
United Kingdom	695	1.04 K	880	1.04 K
France	418	682	562	682
Japan	368	545	469	545
Canada	342	531	444	531
Australia	309	481	400	481
Netherlands	223	354	292	354
Spain	222	315	272	315
Poland	184	282	240	282
Sweden	168	295	237	295
Russian Federation	166	263	221	263
Brazil	143	239	193	239
Switzerland	137	209	177	209
Korea Republic of	104	178	145	178
Czech Republic	103	160	135	160
Italy	101	157	130	157

Cloud Native Training: Get Educated!

NEW in 2023

[Prometheus Certified Associate (PCA)](#)

[**NEW**] SkillCreds (mini certs):
[Developing Helm Charts (SC104)](#)
[Open Data Formats: YAML (SC101)](#)

Increased completion of all courses

- [Kubernetes Massively Open Online Course (MOOC)](#) hit **300,000 enrollments (25% increase from 2022)**.
- [Certified Kubernetes Administrator (CKA) exam](#) hit **~100,000+ enrollments (49% increase from 2022).**
- [Certified Kubernetes Application Developer (CKAD)](#) hit ~50,000 exam registrations (44% increase from 2022).
- [Certified Kubernetes Security Specialist (CKS)](#) exam hit **~20,000 registrations (113% increase from 2022)**.
- [Kubernetes and Cloud Native Associate (KCNA)](#) exam hit 4,000 registrations (brand new certification)

- [Kubernetes Training Partner (KTP)](#) program grew to 57 certified companies (14% increase from 2022).
- [Kubernetes Certified Service Provider (KCSP)](#) program grew to 254 companies (8.5% increase from 2021)

Code for free PCA/KCNA: StockholmCNDay2023

Join Cloud Native!

ALL ARE WELCOME!

Many ways to contribute, **not just code!**

- [Mentorship Programs](#) (stipends)
- [Cloud Native Community Groups](#)
  - Organize a meetup!
- [Kubernetes Community Days](#)
  - Organize a KCD!
- [KubeCon + CloudNativeCon](#)
  - Attend an event!
- [Chat with our Ambassadors](#)
- Kubernetes Shadow Programs

KubeCon | CloudNativeCon
Europe 2023
18 – 21 APRIL
RAI CONVENTION CENTRE
AMSTERDAM, THE NETHERLANDS

KubeCon | CloudNativeCon
North America 2023
SAVE THE DATE
NOVEMBER 6-9, 2023
CHICAGO, ILLINOIS
#KUBECON + #CLOUDNATIVECON

kubecon.io

Thank You!

Code: **StockholmCNDay2023**

https://twitter.com/cra

https://cncf.io

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