A deep dive into minikube !

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About me:

Medya Ghazizadeh, Technical lead manager at Google.

Minikube maintainer since 2019

Other Works: Winnaker, K8Guard, Setup-Minikube , Gopogh,...

About me:

Sharif Elgamal, Software Engineer, Google

Container Tools since 2016, minikube maintainer since 2019.

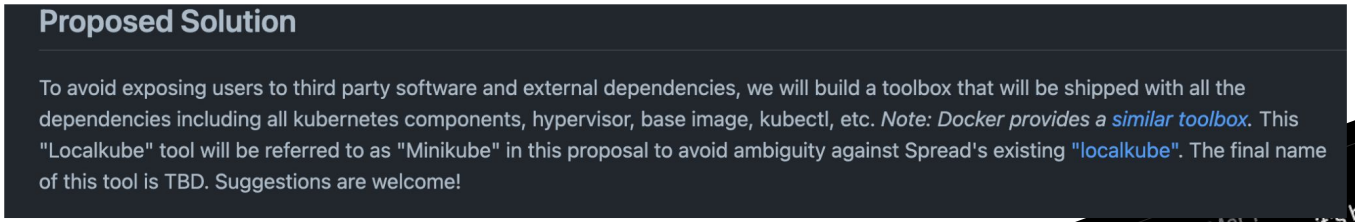
Twitter @sharfers

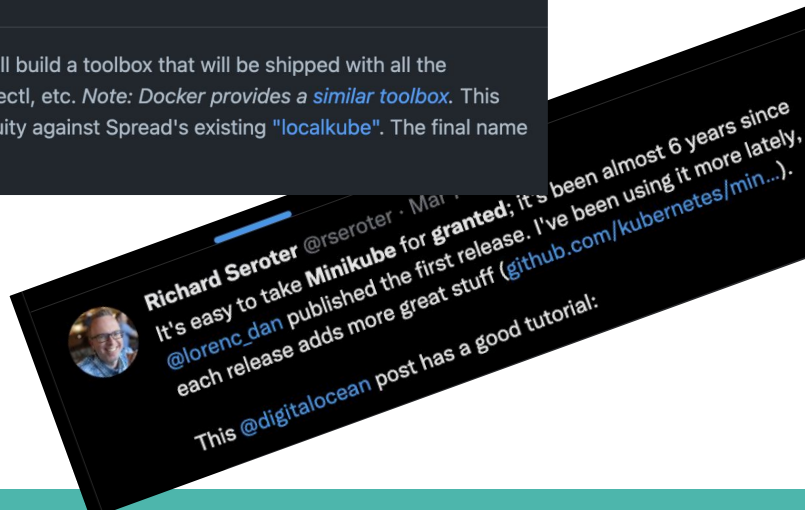
It all started in 2016

Minikube was created 6 years ago by Google to alleviate the difficulties that developers had when setting up a Kubernetes environment for local development.

The same team that also built Kaniko, Skaffold, Jib, kpt, Tekton,...

- Checkout the nostalgic Original Proposal





OK Google ... Assist the developers please !

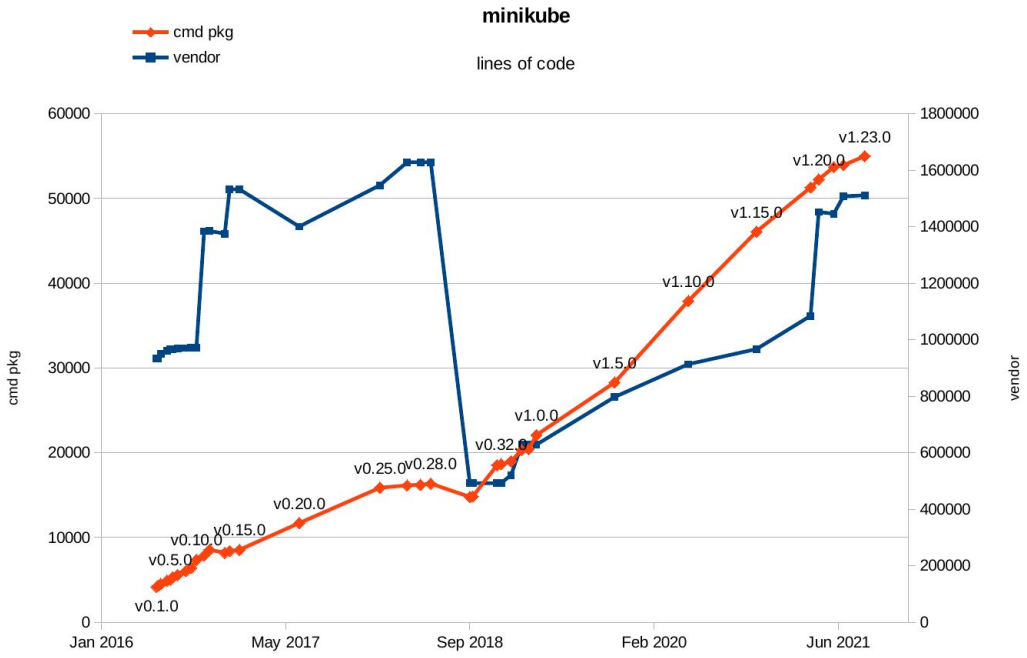
Google has continued to evolve the Minikube project to grow the Kubernetes ecosystem by making Kubernetes development more attractive and frictionless

- Google contributes to so many essential open source projects that even Kelsey can't keep up t list all of them.

Primary Goal

make it simple to run Kubernetes locally for learning and day-to-day development, testing & debugging workflows.

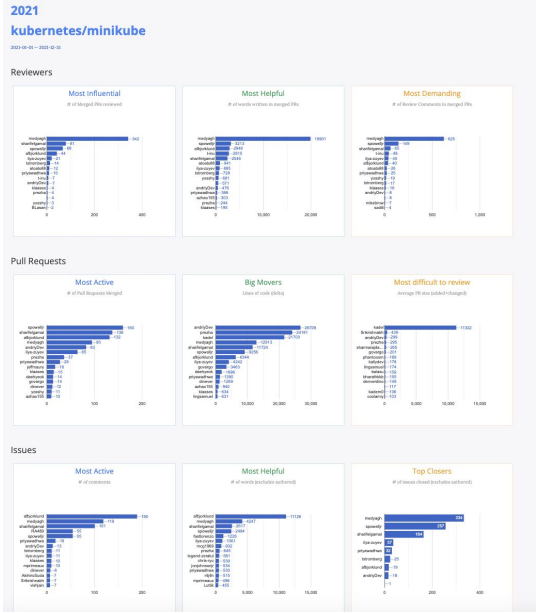
- 1. Inclusive
- 2. Community-driven
- 3. User-friendly
- 4. Support all Kubernetes features
- 5. Cross-platform
- 6. Reliable
- 7. High Performance
- 8. Developer Focused


minikube
lines of code
cmd pkg
vendor
60000
50000
40000
30000
20000
10000
0
1800000
1600000
1400000
1200000
1000000
800000
600000
400000
200000
0
Jan 2016
May 2017
Sep 2018
Feb 2020
Jun 2021
v0.1.0
v0.5.0
v0.10.0
v0.15.0
v0.20.0
v0.25.0
v0.28.0
v0.32.0
v1.0.0
v1.5.0
v1.10.0
v1.15.0
v1.20.0
v1.23.0

Behind Minikube Emojis

700+ contributors and counting

- Notable Non-Googler Maintainer/Contributors
- Every contribution counts.
  Even Triaging Issues
- We built a tool to visaulize contributions
- Checkout Yearly Leaderboard in our website
-



Testing minikube is ... Different!

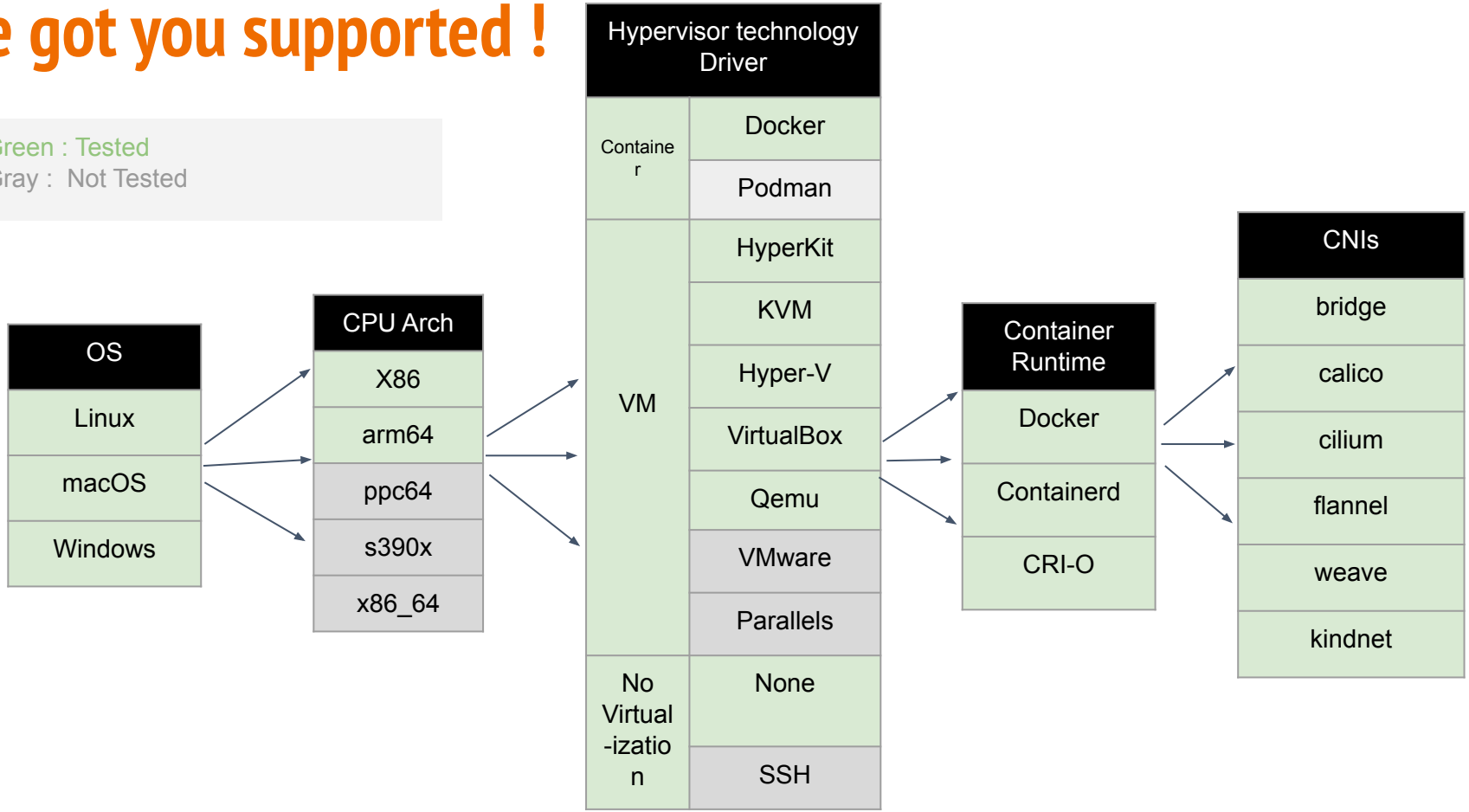
Our first Integration tests ran in the office! R.I.P*

- Minikube’s VM drivers needed Baremetal servers with virtualization enabled.
- Nested Virtualization only available for certain Linux Distros

* Minikube’s first machine lab was decommissioned by covid pandemic in 2020
Currently being brought back to life by Steven Powell

We got you supported !

Green : Tested
Gray : Not Tested



It takes a village to test Minikube !

Minikube is the most tested local Kubernetes tool.

- 46 Self-hosted CI VMs in 5 different clouds (GCP, AWS, Equinix Metal, Azure, Macstadium) + Prow and Github Action
- 296 end to end tests in integration testing suite
- 100 unit tests
- Checkout detailed list of integration tests cases on website

Flake Rate System

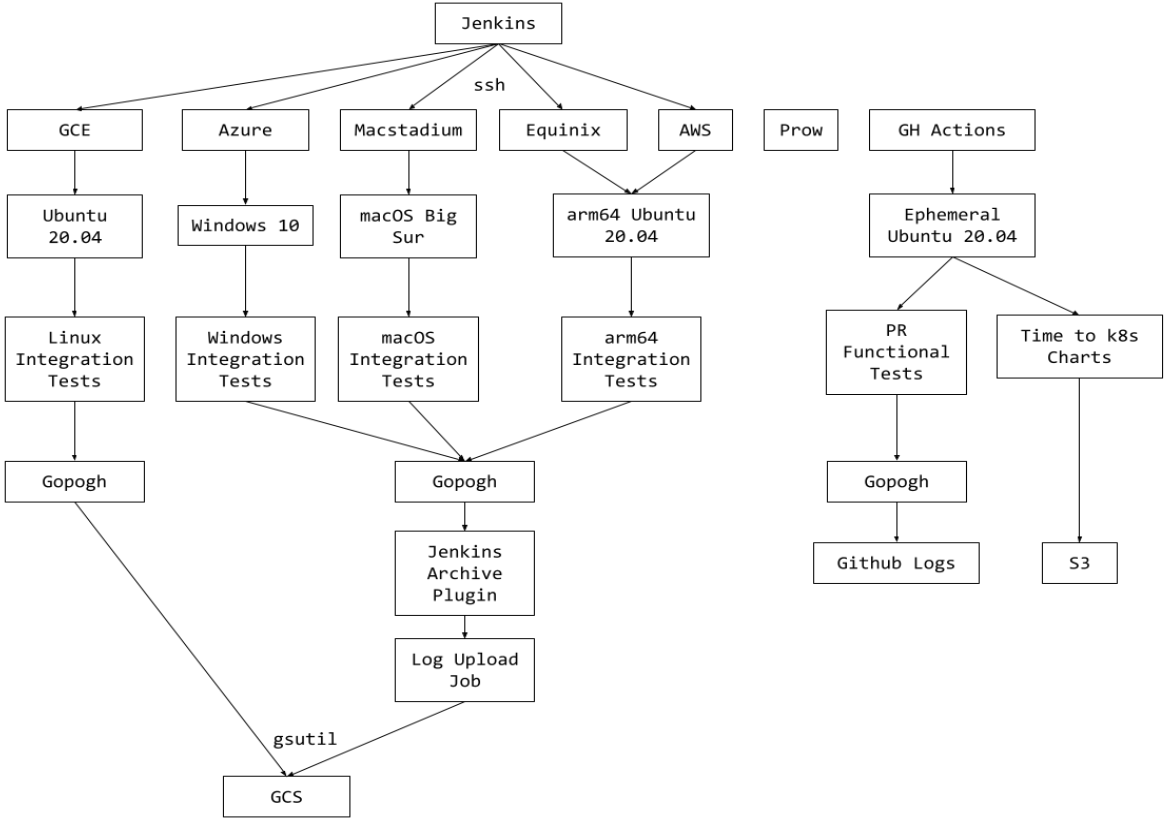
- Problem:
  - Running hundreds of test cases on dozen platforms, there are always some flaky test that fail 10-15% of the time on Master.
  - Reviewer had to have a lot of context to approve a PR with failed test.
- Solution:
  - Run tests on master regularly, generate failed rate on master.
  - On each PR comments how many of the Failed tests are a known Flake
  - Automatically create Github Issue for frequently failing test.
  - Generate Visaulized
- Minikube's Flake Rate System is built on top of Gopogh
- Checkout Flake Rate System Reports on website

What is Gopogh? -Reducing Squinting for go developers-

Problem: Failed minikube test logs come with thousands of lines of post mortem logs low-level system logs. (sometimes 10K lines) that makes it very hard to see what log is for what ! (lots of squinitng ...)

- Created in a hackathon with a funny name
- What is it short for ?
- Converts Raw Golang integration test results to HTML
  - Foldable/Sortable/Searchable
- Generate Summary table for test with durations
- Check out Gopogh
- Example Before/After

Minikube testing infrastructure



Minikube speaks your language

minikube speaks french:

```
LC ALL=fr out/minikube start
😄  minikube v1.9.2 sur Darwin 10.14.5
✨  Choix automatique du driver hyperkit. Autres choix:
docker
👍  Démarrage du noeud de plan de contrôle minikube dans le
cluster minikube
🔥  Création de VM hyperkit (CPUs=2, Mémoire=4000MB,
Disque=20000MB)...
🐳  Préparation de Kubernetes v1.18.0 sur Docker 19.03.8...
🌟  Installation des addons: default-storageclass,
storage-provisioner
🏄  Terminé ! kubectl est maintenant configuré pour utiliser
"minikube".
```

```
Easily add your language ( search in website for
“translation”)
```

English, German, Spanish, Chinese, French, Japanese, Korean, Polish, …

Checkout Minikube's Side Projects !

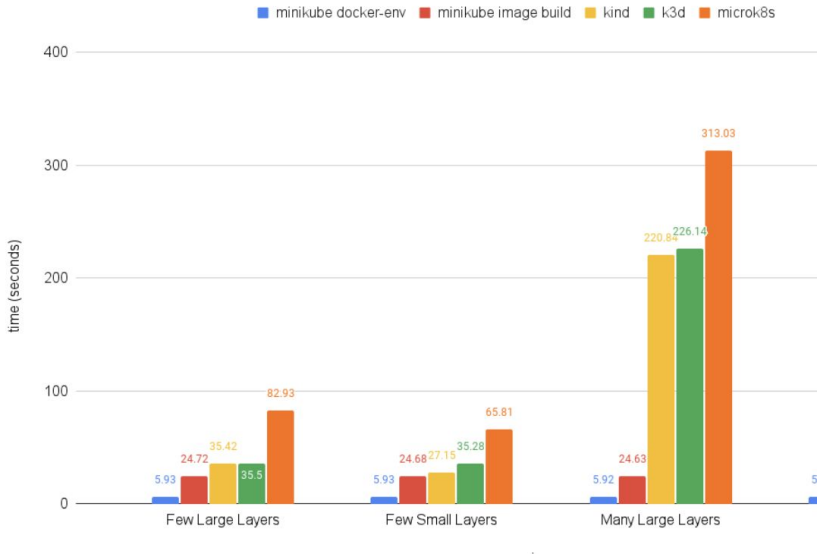
- Slowjam github.com/google/slowjam
- Triage Party github.com/google/triage-party
- Gopogh github.com/medyagh/gopogh
- Time To K8s github.com/tstromberg/time-to-k8s
- Minikube-CI github.com/minikube-ci/examples
- Pull Sheet github.com/google/pullsheet

The story of Kubernetes 1.24 ...

- Kubernetes removed the code for supporting docker runtime
  - Mirantis took over the code ! https://github.com/Mirantis/cri-dockerd/commit/49a64b2b11d88771fc62fae46dade204377ea6a5
- CNI ...
- Cgroup V2 ...

Minikube continues to support docker-env

- Users love “minikube docker-env” (building images directly on the cluster) and we can’t blame them, it is 36X time faster than Image load !



Global Warming

Data centers are projected to use 8% of the word’s electricity !

minikube roundtable

"Burning the legs off of developers since 2016"

minikube-darwin-amd64 causing too many CPU wakeups #3291

Closed parasyte opened this issue on Nov 1, 2018 · 4 comments

Minikube v0.23.0 100% CPU usage from kubernetes-dashboard v1.7.0 #2130

Closed bgehman opened this issue on Oct 28, 2017 · 4 comments

Docker run stuck and consuming 100% CPU #5991

Closed mvgijssel opened this issue on Nov 27, 2019 · 2 comments

Kube-apiserver Spamming the same log every second and takes up 10% more CPU than normal #5048

Closed cpu100 opened this issue on Aug 12, 2019 · 2 comments

VM has 50% resting CPU usage when idle #3207

Open samuela opened this issue on Oct 2, 2018 · 46 comments

samuela commented on Oct 2, 2018

38

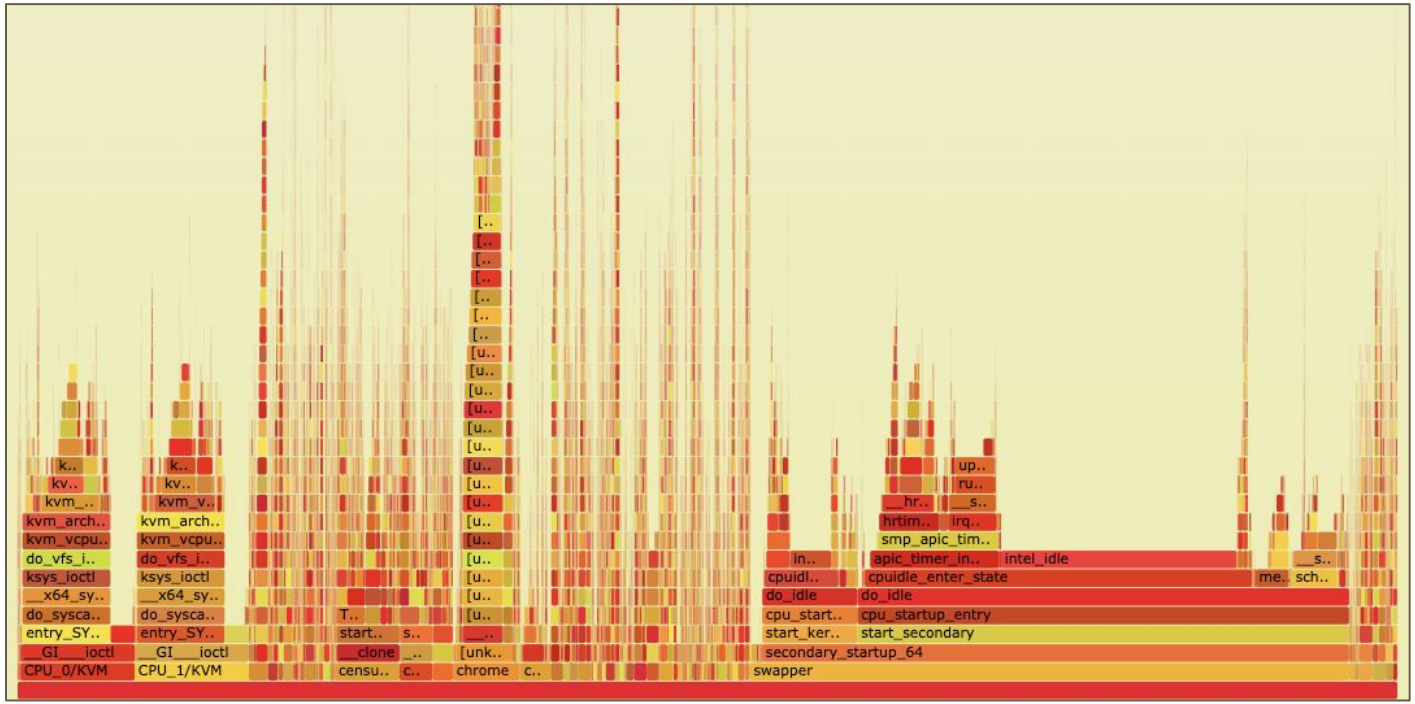
Reduce VM CPU overhead by 20% #5682

Open tstromberg opened this issue on Oct 21, 2019 · 5 comments

github.com/kubernetes/minikube

Minkube and Sustainabilty

Minikube FlameGraph



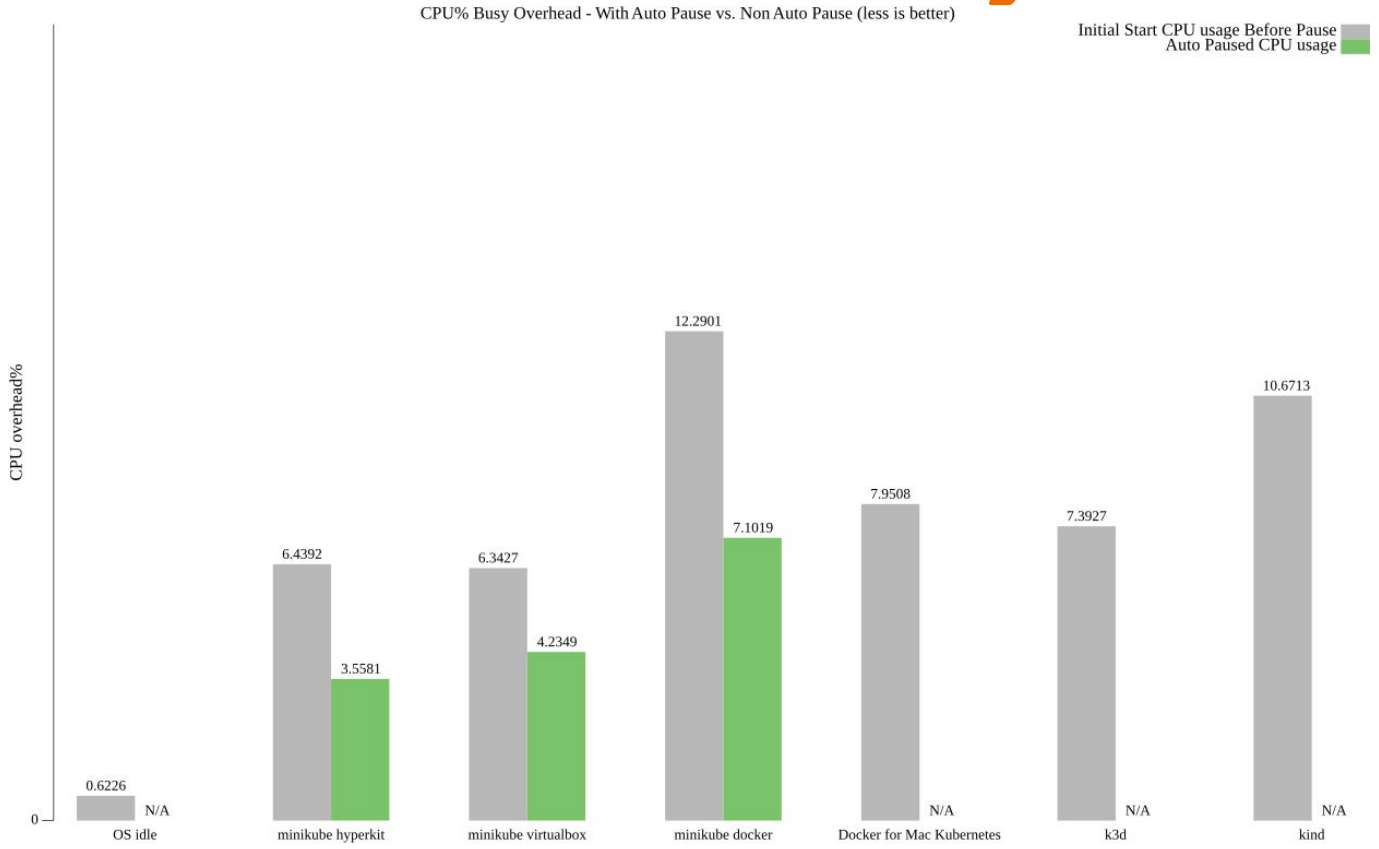
Minikube CPU usage over time

Save energy by using these Minikube features Features that can save energy

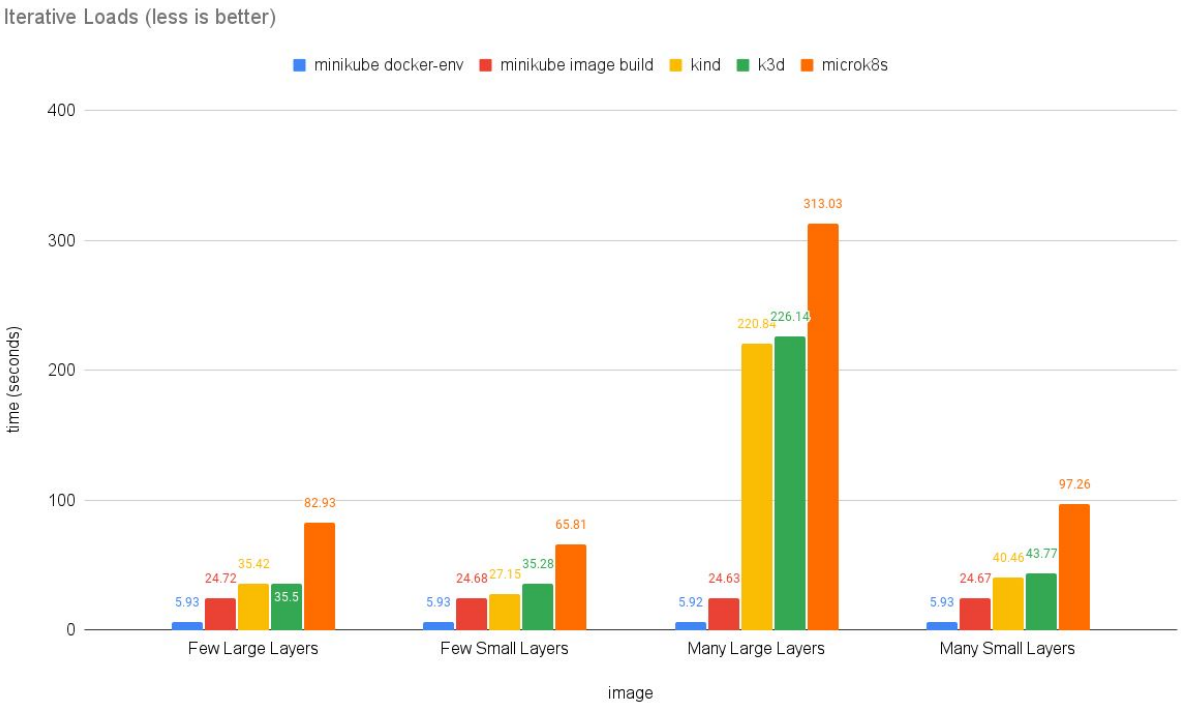
- try “minikube pause”
- Auto-Pause Addon

Minikube Loves Bechmarking

Minikube Website-> Benchmarks -> CPU Usage



Minikube Website-> Benchmarks -> Image Build

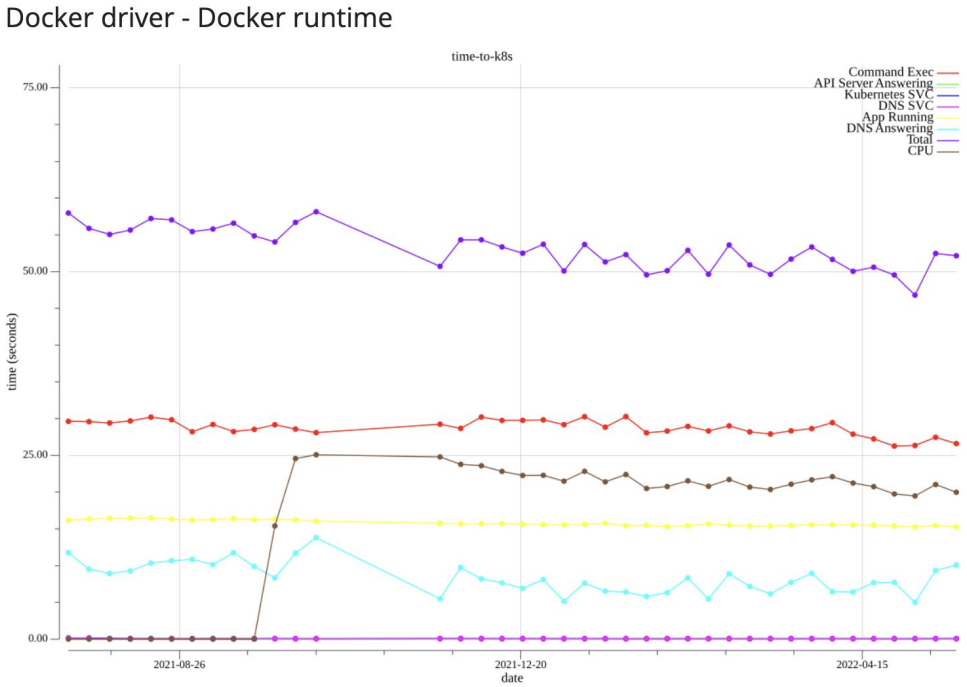


Minikube Website-> Benchmarks -> Time To K8s

- Measure Weekly/Daily

and per release

- Measure against similar tools



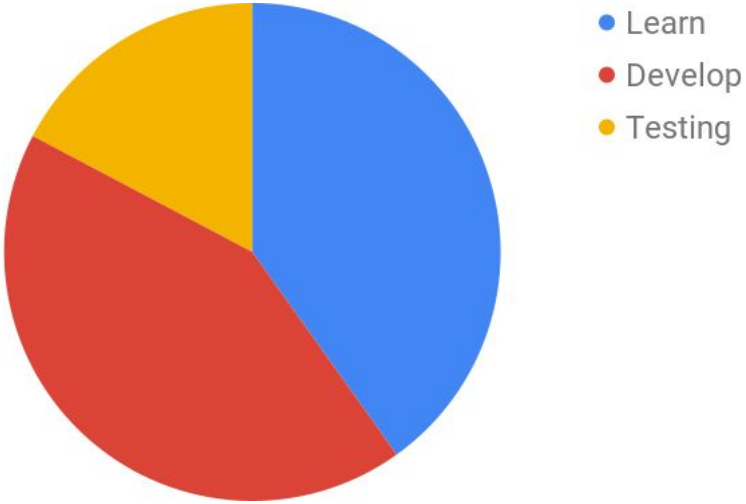
Minikube's Base Image

Did you know minikube maintains its own linux ?

- Hand Crafted - Just enough Linux for Kubernetes
- Small ISO - 280MB
- Based on CoreOS Buildroot
- Might Graduate out of Minikube to is own repo
- Advantages:
  - Granular control of enabled kernel modules and packages
  - Tailored for Kubernetes

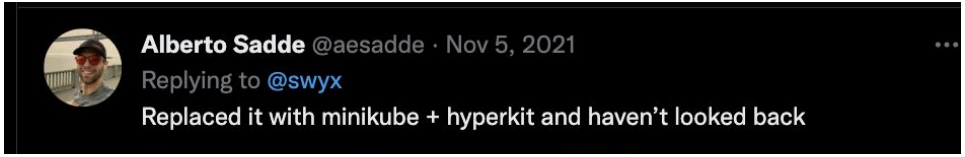
Types of Minikube users

- Learn Kubernetes
- Develope on Kubernetes
- Test/CI



New category of minikube users !

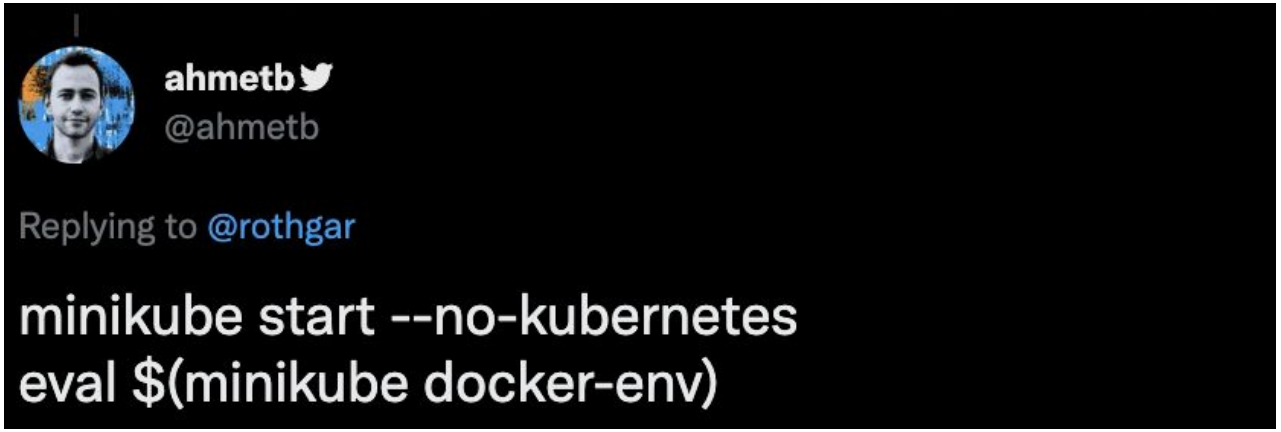
Tens of Blog posts, tweets and survey comments shows that a lot of new users are using minikube merely as a Docker Desktop Replacement.



20	4/7/2022 6:24:02	Devops dude recommended as replacement for Docker Desktop	Beautifully and robustly runs containers!
21	3/31/2022 13:59:56	Docker Desktop licensing issue at work. Once I switched at work, why not at home?	What I assume it was created for: let a developer work with k8s on their laptop.
22	3/28/2022 12:44:59	Replace docker-compose	Puts the k8s in the dev.
23	3/6/2022 9:36:20	Because of the changes to Docker Desktop licensing.	Keep it free to use!
24	3/1/2022 3:20:33	Local Kubernetes cluster, Docker Desktop replacement	Provide a complete solution and a nice usage experience
25	2/23/2022 1:55:11	Wanted a Docker for Desktop alternative that is free and fully featured.	Setup and usage is extremely easy. Performance is excellent. Minikube is excellent for local development use.
26	2/21/2022 21:49:35	Replacing docker desktop	User friendly
27	2/8/2022 5:55:42	Docker Desktop costs money now	Easy to use if you don't need to hit ports from outside the host OS
28	2/5/2022 4:31:46	Docker Desktop alternatives	
29	2/4/2022 12:32:09	Alternative to paid docker desktop	
30	1/31/2022 14:25:49	I can't use Docker Desktop at work anymore.	

Minikube surveys received hundreds of requests showing interest to run minikube as a container runtime engine

minikube start –no-kubernetes ?



Top differentiators Minikube vs similar tools

- Multiple container runtimes for Kubernetes
- Direct access to container runtime for faster image build
- Integration tests (most comprehensive)

Advantages of VM Drivers

- No need to have Docker Desktop License
- Less CPU usage
- You can hit the port directly (for example if you have a hotspot service running on port 80 you can curl $(minikube ip):80 on your machine vs Docker Driver that by design needs to be assigned a random port.

Two Pieces of Exciting News

Tens of Suvery Requests for VM driver on M1/Arm64

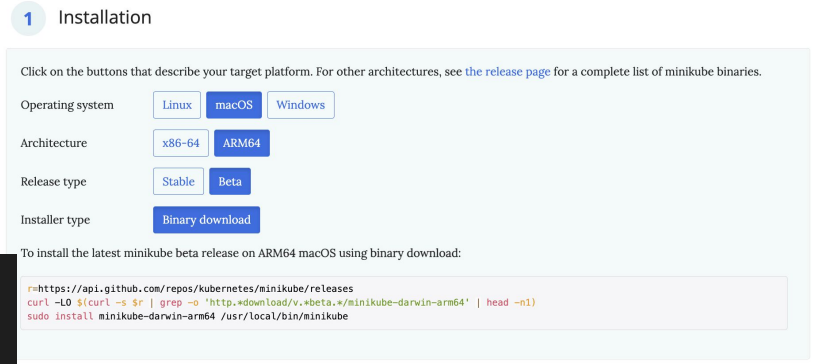
	If minikube could make any one improvement, what would it be?
4	Create a VM Driver for Mac M1 arm64 chips
4	Native Apple M1 support
4	Better support for MacOS. Another driver (e.g qemu) that can run natively on M1, while providing features like ingress that just works out of the box.
5	It's working really well on my M1, otherwise I'd say to save battery on Intel Macs. I know this is very Mac specific, and probably related to Docker and not Minikube itself.
3	Bolstering M1 ARM64 support!
5	M1 ARM app didn't work when downloaded directly the Docker.dmg file. Command prompt worked
5	More driver support on macOS, I want to upgrade to M1 macs but not sure what the implications are with minikube.
4	Apple M1 support
4	Native support for Mac M1 ingress

1: Try Qemu Driver on Apple M1

- Qemu driver is finally available for Arm64 and M1
- This means on Arm-based machines like Apple M1 you could have a Kubernetes experience without having to have Docker Desktop.

Try Qemu2 Driver Today in Beta Release

```
[$
11:30:35 medya
[$ brew install qemu
Warning: qemu 6.2.0_1 is already installed and up-to-date.
To reinstall 6.2.0_1, run:
  brew reinstall qemu
11:30:37 medya
[$ minikube version
minikube version: v1.26.0-beta.1
commit: f0a6d95bdb2f2b83c4f952383fe29de03c269eab
11:30:40 medya
[$ minikube start --driver=qemu2
😄  minikube v1.26.0-beta.1 on Darwin 12.3.1 (arm64)
✨  Using the qemu2 (experimental) driver based on existing profile
👍  Starting control plane node minikube in cluster minikube
🔄  Restarting existing qemu2 VM for "minikube" ...
❗  This VM is having trouble accessing https://k8s.gcr.io
💡  To pull new external images, you may need to configure a proxy: https://minikube.sigs.k8s.io/docs/reference/networking/proxy/
🐳  Preparing Kubernetes v1.23.6 on Docker 20.10.14 ...
🔎  Verifying Kubernetes components...
    ▪ Using image gcr.io/k8s-minikube/storage-provisioner:v5
🌟  Enabled addons: default-storageclass, storage-provisioner
🏄  Done! kubectl is now configured to use "minikube" cluster and "default" namespace by default
11:31:21 medya
$
```



Challenges of adding ARM64 ISO

- Slow iteration of testing
- BIOS/EFI
- AppArmor
- Lack of team familiarity with Buildroot

2: Try Early prototype of Minikube-GUI

- Go to minikube website
- Search for Minikube Gui

Things to try:

- Simplified View (one cluster)
- Advanced View (multi cluster)
- Right click tray icon

New Contributors Welcome!

- Consolidate Kubernetes docs around Minikube
- Organize Website for new users
- Checkout good first issues
- Checkout Office hours

Experts wanted! (hiring)

- Building Linux (Buildroot)
- Hypervisor Technologies (qemu, hyperv,...)
- GUI Skills (C++, QT,...)

- DM twitter @medya_dev